

Town of Ajax Urban Forest Management Plan: COMPREHENSIVE REPORT

2011 - 2015

DECEMBER 2010

Submitted to:
Town of Ajax

Prepared by:

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Acknowledgements

Internal Stakeholders

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External Stakeholders

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“[Urban forestry] is a planned and programmatic approach of the development and maintenance of the urban forest, including all elements of green infrastructure within the community, in an effort to optimize the resulting benefits in social, environmental, public health, economic, and aesthetic terms, especially when resulting from a community visioning and goal-setting process”.

From Planning the Urban Forest (Schwab 2009)

Executive Summary

This document is a strategic management plan for the Town of Ajax’s urban forest. The Plan lays out the steps necessary to realize the Town’s vision for a healthy and sustainable urban forest which supports a thriving and liveable community. Guided by this vision, a mission statement and six strategic objectives, the Plan provides 32 recommendations for implementation within the next five years, as well as future directions for implementation within a broader 20-year strategic framework.

The Plan has been developed in response to the growing number and complexity of challenges to urban forests and their management. Such challenges include, but are not limited to, climate change, invasive species, pests and pathogens, population growth, suburban development and urban intensification, and urban forest population dynamics (i.e., ageing tree resources). The first section of the Plan outlines these challenges, and describes the multitude of diverse benefits provided by the urban forest. Findings of the Town’s Urban Forest Study, published in 2009, are highlighted wherever applicable.

The first section also outlines the framework for implementation of this Plan, which includes a 20-year strategic framework, four five-year management plans, and twenty annual operating plans. The concept of active adaptive management is firmly embedded in this planning framework to permit flexibility by Town staff and other partners to respond to unforeseen changes in the environment, community, regulatory framework or direction of Town policy.

Sections 2 through 8 outline current practices in Ajax, best practices identified in other communities or scientific and technical literature, and opportunities for improvement in management with regard to a variety of important issues facing the Town’s urban forest. This plan includes a detailed discussion concerning tree habitat, maintenance and establishment, and builds on these critical parts of urban forest stewardship with descriptions of a plan for tree establishment, and strategies for proactive Town-wide pruning, tree protection, and Plant Health Care. Other recommended responses to the challenges facing Ajax’s urban forest include a woodland stewardship program and a tree risk management strategy. Key elements of a public education and private land stewardship program are also outlined in a discussion of public engagement and partnerships.

Topics addressed in the Plan include:

- Municipal Arboricultural Standards and Practices;
- Tree Establishment and Urban Forest Enhancement;
- Urban Forest Pest Management;
- The Planning and Development Process;
- A Private Tree By-law;
- Protecting and Enhancing Wooded Natural Areas, and;
- Awareness, Engagement and Partnerships.

Each section provides a comprehensive set of management solutions, a description of the tools and methods Ajax will require to implement them, and a detailed review of the rationale supporting these recommendations. The recommendations themselves are found in the first five-year management plan, following the Executive Summary. Many recommendations can be implemented within existing staff and budgetary resources, while others, such as the recommended street and park tree inventory, will require the commitment of additional resources.

The rationale for the Plan's recommendations ranges from increasing the efficiency and effectiveness of urban forest management operations, to building knowledge of the urban forest resource, to adopting novel approaches which will contribute to improved urban forest health and sustainability.

Selected recommendations include:

- Regularly undertaking Criteria and Indicators-based assessments of all aspects of Ajax's urban forest;
- Combining all technical standards, regulations and policies related to urban trees in Ajax within one 'Tree Technical Manual';
- Undertaking a complete street and park tree inventory;
- Implementing a number of initiatives to identify and improve tree habitat across the Town;
- Establishing two urban forest working groups;
- Allocating additional resources to improve tree maintenance and site plan compliance inspection;
- Undertaking a woodland stewardship program, and;
- Establishing relationships with local stewardship groups.

32 recommendations are provided in the first five-year management plan. Considerations for future management planning are outlined in Section 9 of the Comprehensive Report.

Five-Year Urban Forest Management Plan (2011 – 2015)

Conservation of trees in the urban environment can only be achieved effectively through the development and implementation of a strategic **urban forest** management plan (UFMP) that coordinates the policies and practices surrounding all management and planning activities related to trees. A plan that encompasses a long-term vision with short- to medium-term goals and realistic, implementable practices is necessary for the conservation and management of trees and the benefits they provide to the Town of Ajax. The following 32 recommendations identify specific actions needed for the Town of Ajax to realize its vision of a sustainable urban forest.

The recommendations provided here have evolved out of research on current practices within the Town and best practices and precedents from elsewhere, as well as consultations with Town staff and key stakeholders. The recommendations have also been developed with consideration for the results and recommendations of the Town’s recently completed Urban Forest Study (TRCA 2009a), as well as for what is realistic and feasible within the Town of Ajax, and what can be achieved over the next five years.

As stated in the Introduction (Section 1.3), the focus of this report is on providing direction for the first Five-Year Management Plan (2011 – 2015). However, this report is also intended to provide strategic guidance for three subsequent five year plans to be undertaken as part of a longer term 20-year strategy. This section provides the recommendations for the first Five-Year Management Plan. Considerations for the next three Five-Year Management Plans to be developed are provided, in brief, in Section 9.

Recommendations have been laid out according to the following template:

Recommendation # X – TITLE

Brief description of the recommendation and key elements.

Lead	<i>Determined in consultation with Town staff.</i>
Potential Partners	<i>Determined in consultation with Town staff; confirmation required with external parties.</i>
Cost	<i>Estimated; flagged as one time or ongoing</i>
Funding	<i>ANTICIPATED OR POTENTIAL SOURCE; Town source verified; other sources to be confirmed</i>
	<i>HIGH: to be started or undertaken over the next year (2011)</i>
Priority / Target Timing	<i>MEDIUM: to be started or undertaken between 2012 and 2015</i>
	<i>LOW: to be started or undertaken after 2015 - listed as future priorities in Section 9.</i>
Expected Outcomes	<i>As related to this Plan and the urban forest vision and goals.</i>

The following 32 recommendations have generally been organized according to the sections in this Plan where the related background, best practices and/or precedents, rationale and implementation guidance are provided.

- **1.1 – Recommendations: Municipal Arboriculture Standards and Practices (Section 2)**
- **1.2 – Recommendations: Tree Establishment and Urban Forest Enhancement (Section 3)**
- **1.3 – Recommendations: Urban Forest Pest Management (Section 4)**
- **1.4 – Recommendations: Development Process (Section 5)**
- **1.5 – Recommendations: Private Tree By-law (Section 6)**
- **1.6 – Recommendations: Protecting and Enhancing Wooded Natural Areas (Section 7)**
- **1.7 – Recommendations: Awareness, Engagement and Partnerships (Section 8)**

However, these recommendations have also been considered in relationship to each other, and in cases where the same recommendation arose out of more than one section, they are not duplicated but rather placed in the most logical section.

It is expected that many of the recommendations can be accommodated within existing work plans and staffing resources. However, achieving the Town’s vision for its urban forest will require some additional and ongoing commitments of resources. Furthermore, the ability of the Town to implement the Plan with the existing and recommended resources will need to be monitored and reviewed prior to development of the second Five-Year Plan.

It is also recognized that, depending on available funding, some medium priority and/or more costly items may need to be delayed until the next Five-Year Management Plan when it comes to the actual implementation of this Plan. Nonetheless, this first Five-Year Management Plan lays out actions that the Project Management Team feels are key to moving the Town of Ajax from reactive to proactive management, and towards better protection, enhancement and expansion of its urban forest.

The status of these various recommendations will be reviewed and assessed, in conjunction with consideration for any related outstanding items (e.g. those listed in Section 9) and potential new actions, as part of the development of the next Five-Year Management Plan, as discussed in Section 9.

1.1 Recommendations for Monitoring the Plan

Recommendation # 1 – Monitoring the Status of the Plan

Monitor the progress of this Plan and the state of Ajax’s urban forest by applying the Criteria and Indicators developed by Clark *et al.* (1997) and updated by Kenney *et al.* (in press) (as provided in Appendix A) on a regular basis (i.e., every five years) starting with a baseline assessment in 2010.

Lead	Operations and Environmental Services
Potential Partners	Urban Forest Working Group, TRCA
Cost	Existing staff resources (periodic)
Funding	Operating budget
Priority / Target Timing	HIGH / Once in 2010 (repeated in 2016, 2021, 2026)
Expected Outcomes	Provides a baseline and consistent approach for quantifiable and qualitative assessment of urban forest management plan implementation. Facilitates future target and goal setting.

1.2 Recommendations for Municipal Arboriculture Practices

Recommendation # 2 – Undertaking a Municipal Tree Inventory

Undertake a GIS-based street and park tree inventory that is compatible with the forthcoming corporate asset management system and with i-Tree benefit-cost analysis software.

- a. Integrate inventory data into the corporate asset-management system and establish a system to enable continuous updating and work order processing.
- b. Make basic inventory data and mapping available online for public use.
- c. Explore opportunities to integrate data from tree inventories for new developments, particularly for trees to be assumed by the Town, to be fully compatible with the Town’s asset management system.

Lead	Operations and Environmental Services
Potential Partners	Planning and Development Services
Cost	\$50,000 est. (for initial inventory); existing staff resources for maintenance
Funding	Capital budget for initial inventory; Operating budget for ongoing inventory maintenance
Priority / Target Timing	HIGH / Start 2011 and ongoing (data to be updated on an ongoing basis through day-to-day municipal operations)
Expected Outcomes	Collection and maintenance of critical data for the Town to effectively manage the trees it is responsible for along roads and in parks. This data will provide concrete data related to municipal tree diversity, age structure and health and will help direct operations related to pruning, maintaining appropriate levels of diversity, proactively managing trees presenting a greater risk to the community, and identifying areas in need of proactive care (such as underplanting or tree replacement).

Recommendation # 3 – Improving the Pruning Cycle

Improve the current grid pruning cycle to ensure it is consistent with best practices by:

- a. Integrating the pruning cycle with the forthcoming corporate asset management system to track individual tree work histories and other related information.
- b. Expanding the existing pruning cycle as new streets are assumed by the Town.
- c. Using the public tree inventory to direct the pruning cycle, with the objective of reducing the pruning interval from eight to five years by 2025.
- d. Using Town planting lists to undertake a program of regular young tree pruning, with a minimum of three pruning rounds within the first 10 years after planting.
- e. Investigating opportunities to undertake proactive young tree pruning on private lands that will be assumed by the Town as part of the development process prior to their formal assumption.

Lead	Operations and Environmental Services
Potential Partners	Contracted service providers; Planning and Development Services
Cost	Existing staff resources (ongoing)
Funding	Operating budget
Priority / Target Timing	HIGH / Start 2011 and ongoing (<i>2025 target for reducing pruning cycle to five years</i>)
Expected Outcomes	Early pruning of young trees is a relatively small up-front cost that will ensure good tree structure and development, and save the Town significant expenses related to pruning and risk tree care in the long term.

Recommendation # 4 – Additional Staffing Resources: Seasonal Plant Health Care Worker(s)

Retain one or two additional seasonal **Plant Health Care** technicians to conduct young tree pruning and maintenance (e.g., watering, mulching) of Town-owned trees. This person could also provide some technical guidance to residents and other local landowners on how to plant the right tree in the right place.

Lead	Operations and Environmental Services
Potential Partners	Local Colleges (i.e., internship programs)
Cost	\$15,000 - \$30,000 per year, est. (ongoing)
Funding	Operating budget
Priority / Target Timing	HIGH / Start in 2011 (four months per year)
Expected Outcomes	Making a relatively small investment into the health of newly planted trees will greatly reduce tree-related maintenance and risk in the long-term. Having summer students / interns undertake this work is a cost-effective means of undertaking proactive maintenance and allows the Town to allocate its arborists to work requiring greater skill such as risk management.

Recommendation # 5 – Developing a Risk Management Policy

Develop and implement a formal Urban Forest Risk Management Policy and procedure statement, and integrate related practices into the Town’s new asset management system.

Lead	Operations and Environmental Services
Potential Partners	Ajax Fire and Emergency Services, Legislative and Information Services
Cost	Existing staff resources (one time)
Funding	Operating budget (one-time development, ongoing implementation)
Priority / Target Timing	HIGH / 2011
Expected Outcomes	Reduced tree-related risk over time. Improved tree health. Reduced liability claims. Accelerated response following significant storm events, resulting in faster clean-up of debris and restoration of utility services.

Recommendation # 6 – Internal Coordination: Urban Forest Working Group (UFWG)

- a. Establish an Urban Forest Working Group (UFWG) that includes representatives from all Town departments involved in tree issues and from agencies (e.g., TRCA, CLOCA) and organizations contracting tree maintenance or other works which may affect trees (e.g., Veridian).
- b. Through the UFWG, strengthen the Site Plan review and compliance process with respect to tree preservation, tree habitat and establishment.

Priority activities include undertaking a “State of the Urban Forest” assessment through application of the criteria and indicators (provided in Appendix A of the Comprehensive Report). Priority areas for discussion include proactive care of trees to be assumed by the Town prior to their actual assumption, developing an appropriate valuation and replacement system for trees being removed, and specific mechanisms for ensuring **canopy cover** across the Town is gradually increased in the face of intensification.

Lead	Operations and Environmental Services / Planning and Development Services
Potential Partners	Ajax Fire and Emergency Services, Legislative and Information Services, Recreation and Culture, TRCA, CLOCA, local utility companies
Cost	Existing staff resources (ongoing)
Funding	Operating budget
Priority / Target Timing	HIGH / Start 2011
Expected Outcomes	Improved coordination and cooperation among Town departments, and between the Town and utility companies involved in tree pruning / removal. Increased compliance with site plan specifications. Improved tree protection on development sites.

Recommendation # 7 – Improved Tree Protection Standards and Specifications

Expand and update tree protection standards and specifications to be consistent with current best practices and leading examples from other municipalities (as outlined in the Comprehensive Report)

To be included in the Tree Technical Manual (as per Recommendation #11).

Lead	Operations and Environmental Services / Planning and Development Services
Potential Partners	-
Cost	Existing staff resources (one time)
Funding	Operating budget
Priority / Target Timing	HIGH / 2011
Expected Outcomes	Reduced number of tree removals. Increased survivorship of retained trees. Increased urban forest health and sustainability.

1.3 Recommendations for Tree Establishment and Urban Forest Enhancement

Recommendation # 8 – Improved Urban Forest Diversity and Species Selection

- a. Promote increased urban forest diversity by establishing a more diverse range of tree species in accordance with the '30-20-10' rule on a neighbourhood/street segment level, favouring native tree species wherever possible
- b. In accordance with Town engineering design criteria, require that no more than eight street trees with the same species shall be planted within a street (unless the groupings of trees are a sufficient distance apart).

To be included in the Tree Technical Manual (as per Recommendation #11).

Lead	Operations and Environmental Services
Potential Partners	Planning and Development Services
Cost	Existing staff resources (one time)
Funding	Operating budget
Priority / Target Timing	HIGH / 2011
Expected Outcomes	Increased urban forest diversity. Increased resilience to urban forest stressors.

Recommendation # 9 – Improved Tree Planting Lists

- a. Amend Schedule 'A' and 'B' planting lists to exclude Norway maple, weeping willow and other invasive and potentially-invasive species and to increase species diversity by including more tree species.
- b. Update Planning and Development Services' Department Design Criteria street tree planting list to include more detailed information in order to guide the stock selection process, and to include the same species as the Operations and Environmental Services Schedules 'A' and 'B'.

To be included in the Tree Technical Manual (as per Recommendation #11).

Lead	Operations and Environmental Services / Planning and Development Services
Potential Partners	Ajax Fire and Emergency Services, Legislative and Information Services, Recreation and Culture, local utility companies, TRCA
Cost	Existing staff resources (one time)
Funding	Operating budget
Priority / Target Timing	HIGH / 2011
Expected Outcomes	Improved coordination and cooperation among Town departments. Increased compliance with site plan specifications. Improved tree replacement on all types of projects.

Recommendation # 10 – Improved Tree Habitat Standards

Improve tree habitat by:

- a. Amending planting standards and specifications to conform to current best practices, including increased soil volumes and elimination of tree grates, tree guards and soil screening.
- b. Developing and implementing standards for soil type, with respect to basic nutrient levels and percent organic matter.
- c. Developing and implementing a municipal standard for required soil volumes for all plantings on public property and new developments (i.e., a minimum of two cubic feet of soil should be provided for every square foot of future crown area spread, and larger soil volumes should be encouraged where possible).
- d. Encouraging the installation of wide parking lot borders and islands with optimal soil volumes, bio-retention areas and permeable pavers wherever feasible.

To be included in the Tree Technical Manual (as per Recommendation #11).

Lead	Planning and Development Services
Potential Partners	Operations and Environmental Services
Cost	Existing staff resources (one time)
Funding	Operating budget
Priority / Target Timing	HIGH / 2011
Expected Outcomes	Improved tree health and urban forest sustainability. Increased rate of survival of newly-established trees. Reduced management costs over time.

Recommendation #11 – Development of a Tree Technical Manual

Develop a comprehensive ‘Tree Technical Manual’ that provides specific guidance related to tree protection, replacement, restoration, maintenance and care standards for use on all types of projects Town-wide. To involve compilation of updated standards, screening against current best practices, and development of standards and specifications where they are missing.

To include the guidelines, standards and specifications developed through Recommendations 7, 8, 9 and 10.

Lead	Operations and Environmental Services / Planning and Development Services
Potential Partners	TRCA
Cost	\$25,000 - \$35,000 est. (one-time)
Funding	Capital budget
Priority / Target Timing	MEDIUM / 2012 - 2013
Expected Outcomes	Improved urban forest health and sustainability. Consistent application of effective tree protection and habitat design methods across the Town. Tool for internal and external use on all types of tree establishment and urban forest enhancement projects in the Town. Increase tree canopy and leaf area over time.

Recommendation # 12 – Identification of Plantable Spots in the Urban Matrix

Undertake a detailed assessment of the potential “plantable spots” throughout the Town’s urban areas, and outside the Environmental Protection and Open Space lands (note: reforestation on these lands addressed through Recommendation 26) through an Urban Tree Cover (UTC) analysis. This would complement the identification of plantable spots through the municipal tree inventory (Recommendation #2), and focus on opportunities on lands not owned by the municipality (or conservation authorities) such as yards, school grounds, business park lawns, health unit grounds, etc.

Lead	Operations and Environmental Services
Potential Partners	TRCA, Planning and Development Services
Cost	\$40,000 (one time)
Funding	Capital budget
Priority / Target Timing	MEDIUM / Start 2013 - 2014
Expected Outcomes	Identification of all potential “plantable spots” outside of the Town’s open space and natural areas. This will provide useful data for determining the actual potential canopy cover in the Town (in conjunction with other sources), and will also provide direction for pursuing increased tree plantings.

Recommendation # 13 – Maximizing Tree Replacement in the Urban Areas on Municipal Lands

Maximize tree replacement on municipal lands by:

- Proactively underplanting trees and shrubs in areas currently dominated by mature trees in order to maintain urban forest canopy as older trees are removed.
- Focusing establishment of hardy trees with high contribution to air quality improvement in ‘hot spots’ and in proximity to local emission sources, as well as in public spaces where shade would be beneficial such as parks, along trails, near bus shelters, etc.
- Filling all “plantable spots” identified through the municipal tree inventory (Recommendation #2).

Lead	Operations and Environmental Services
Potential Partners	TRCA, CLOCA, others (with respect to item d)
Cost	Existing staff resources (ongoing)
Funding	Operating budget
Priority / Target Timing	MEDIUM / Start 2013 - 2014
Expected Outcomes	Maintained canopy cover in treed areas. Increased benefits (e.g., health, environmental, social) derived from individual trees. Reduced urban heat island effect. Increased urban forest canopy cover in established neighbourhoods and new developments.

Recommendation # 14 – Increasing Tree Planting on Private and Institutional Lands

Increase tree plantings / replacement on private and institutional lands by:

- improving awareness and on-line resources related to the benefits of trees in urban areas (as per Recommendation 27),
- providing technical support for planting “the right tree in the right place” on-line, through workshops, and through technical support and the Technical Tree Manual (see Recommendations 4, 11, 22 and 29),
- exploring the feasibility of providing subsidized or free trees (see Recommendation 31), and
- undertaking some targeted outreach through the Urban Forest Steering Committee partners (as per Recommendation 32)

All potential “plantable areas” identified through analysis (as per Recommendation 12) should be considered, but priority areas should include: known “hot spots” in the urban area, front yards, commercial or institutional areas with expanses of mown lawn, and school grounds.

Lead	Communications
Potential Partners	Operations and Environmental Services, Durham Catholic Board of Education, Durham Public Board of Education, and Durham Region Health Department, CLOCA and TRCA, and potentially Durham Land Stewardship Council
Cost	Existing staff resources (ongoing)
Potential Funding	Capital budget, Environment Canada, Evergreen, the Forest Gene Conservation Association (FGCA), LEAF, Ontario Trillium Foundation, Trees Canada and Trees Ontario (as specified in the Comprehensive Report, Section 8)
Priority / Target Timing	MEDIUM / Start 2013 - 2014
Expected Outcomes	Maintained canopy cover in treed areas. Increased rate of survival of newly-established trees. Increased benefits derived from individual trees. Increased urban forest canopy cover in established neighbourhoods and new developments.

Recommendation # 15 – Research New Approaches and Technologies

- Undertake planting trials with bare-root planting stock and underutilized **native species**.
- Investigate undertaking a long-term locally-sourced nursery seed stock growing and supply contract.
- Investigate enhanced rooting environment techniques in municipal projects for consideration as future standard specifications.

Lead	Operations and Environmental Services
Potential Partners	-
Cost	Research to draw on existing staff resources; implementation costs TBD
Funding	Operating or capital, depending on implementation
Priority / Target Timing	MEDIUM / Start 2013 (ongoing)
Expected Outcomes	Increased knowledge of applicability of innovative methods of urban forest management. Increase resilience to urban forest stressors.

1.4 Recommendations for Urban Forest Pest Management

Recommendation # 16 – Improved Pest Vulnerability Analysis

Utilize tree inventory data (as per Recommendation #2) to conduct a more detailed Pest Vulnerability Analysis for all catalogued street tree species.

Lead	Operations and Environmental Services
Potential Partners	-
Cost	Existing staff resources (one time)
Funding	Operating budget
Priority / Target Timing	MEDIUM / Start 2013 or 2014 (following completion of street and park tree inventory)
Expected Outcomes	Improved knowledge of urban forest resource. Increased efficiency and effectiveness in addressing urban forest pest and pathogen infestations. Increased urban forest health and sustainability.

Recommendation # 17 – New Emerald Ash Borer Strategy

- a. Develop and implement an Emerald Ash Borer Management Strategy with strategic components (as outlined in Section 4 of this Plan).
- b. Utilize the Emerald Ash Borer Management Strategy as a template for other specific pest management strategies, as and when required.

Lead	Operations and Environmental Services
Potential Partners	Nearby municipalities (e.g., Pickering, Whitby, Oshawa), Canadian Forest Service (CFS), Canadian Food Inspection Agency (CFIA).
Cost	\$10,000 est.(one time)
Funding	Capital budget
Priority / Target Timing	HIGH / 2010 - 2011
Expected Outcomes	Effective response to the impending threat of Emerald Ash Borer. Increased rate of survival and retention of urban ash trees. Improved understanding of costs and strategies to manage Emerald Ash Borer infestation.

Recommendation # 18 – Wood Waste Management

Identify suitable locations for infested or infected wood waste storage and processing within Town boundaries, and establish a protocol to appropriately process such wood waste to minimize risk of pest or disease dispersal.

Lead	Operations and Environmental Services
Potential Partners	Local utility companies
Cost	Existing staff resources (ongoing)
Funding	Operating budget
Priority / Target Timing	HIGH / 2010 - 2011
Expected Outcomes	Reduced incidence of urban forest pests and diseases.

1.5 Recommendations for Planning and Development Process

Recommendation # 19 – Progressive Engineering Guidelines

Consider modifying engineering guidelines for slopes and grading, on a case-by-case basis and in consultation with Town planning and engineering staff, to support preservation of retainable trees or treed areas, particularly for developments adjacent to protected natural areas.

Lead	Planning and Development Services
Potential Partners	Operations and Environmental Services, Engineering, Development Community
Cost	Existing staff resources (one time)
Funding	Operating budget
Priority / Target Timing	MEDIUM / 2013 - 2014
Expected Outcomes	Increased retention of trees during development, and greater post-construction longevity of protected trees.

Recommendation # 20 – Improved Site Plan Manual

- a. Amend the Site Plan Manual so that all healthy, non-invasive trees above a specified diameter (e.g., 90 mm) proposed for removal are valued using the Council of Tree Landscape Appraisers (CTLA) approaches.
- b. Ensure the Site Plan Manual direction related to tree protection and replacement is consistent with the updated guidelines, standards and specifications (as per Recommendations 7, 8, 9 and 10) and the Tree Technical Manual (as per Recommendation 11) once completed.

Lead	Planning and Development Services
Potential Partners	Operations and Environmental Services
Cost	Existing staff resources (one time)
Funding	Operating budget
Priority / Target Timing	MEDIUM / 2012 – 2014 (to be coordinated with related recommendations)
Expected Outcomes	Tree valuation to consider more than just their trunk diameter and identify an appropriate value. Improved Town-wide consistency in planting and protection standards.

Recommendation # 21 – Improved Tree Compensation

Investigate approaches to require compensation, financial or in the form of off-site planting, when a minimum of one tree per subdivision lot cannot be achieved.

Lead	Planning and Development Services
Potential Partners	Operations and Environmental Services, Legal Services
Cost	Existing staff resources (one time)
Funding	Operating budget
Priority / Target Timing	MEDIUM / 2012 – 2014
Expected Outcomes	Receive appropriate compensation to off-set incremental loss of tree cover through development, and to support an overall increase in canopy cover.

Recommendation # 22 – Additional Staffing Resources: Full-time Arborist / Site Inspector

Increase staffing resources so that a certified arborist inspector in Planning and Development or Operations and Environmental Services is able to:

- review draft and approved site plans
- conduct site inspections to ensure that tree protection, salvage and replacement plans are executed as specified, and
- provide technical assistance with respect to tree protection and planting to Town staff as well as members of the community (on a limited basis).

Lead	Planning and Development Services / Operations and Environmental Services
Potential Partners	
Cost	\$80,000 per year, est. (ongoing)
Funding	Operating budget
Priority / Target Timing	HIGH / 2011
Expected Outcomes	Improved ability to approve plans that provide appropriate tree protection and replacement, and enforce what is approved on paper by the Town. Increased rate of survival of both protected and newly-established trees.



1.6 Recommendations for Private Tree By-law

Recommendation # 23 – New Private Tree By-law Cost: Benefit Analysis

Undertake a cost-benefit analysis of the development, implementation and enforcement of a new private tree by-law focusing on individual trees of significance in the Town’s urban area outside of the Environmental Protection and Open Space Areas (where trees are already protected by an existing public and private tree by-law).

Lead	Planning and Development Services
Potential Partners	Operations and Environmental Services
Cost	\$20,000 est. (one time)
Funding	Capital budget
Priority / Target Timing	MEDIUM / 2013 - 2014
Expected Outcomes	Better understanding of the anticipated costs as compared to the anticipated number of trees saved through the implementation of an additional private tree by-law.

Recommendation # 24 – Heritage Tree Identification and Protection

Undertake, in collaboration with one or more community groups, a “Heritage Tree Hunt”.

Should a new private tree by-law be developed as per of the second Five-Year Management Plan, inclusion of trees identified during this initiative for specific protection should be considered.

Lead	Operations and Environmental Services
Potential Partners	Town Communication staff, Recreation and Culture, TRCA, local stewardship groups
Cost	\$2,500 est. for promotional materials, tour bus, etc.
Funding	Capital budget
Priority / Target Timing	MEDIUM / 2014 - 2015
Expected Outcomes	Identification of trees that are of great importance to the community, and publicity for these trees.

1.7 Recommendations for Protecting and Enhancing Wooded Natural Areas

Recommendation # 25 – Urban Woodland Inventory and Assessment

Undertake a Town-wide inventory, assessment and detailed mapping of woodlands. This would build on existing vegetation community mapping from the conservation authorities and be supplemented with scoped field studies focusing on woodlands in the urban area.

Lead	Operations and Environmental Services / Planning and Development
Potential Partners	TRCA, CLOCA
Cost	\$40,000 est. (one time)
Funding	Capital budget
T Priority / Target Timing	MEDIUM / 2014 - 2015
Expected Outcomes	Improved understanding of the remaining woodlands within the Town. Foundation for the development of a Town-wide woodland management plan and management plans for individual woodlots and woodlands.

Recommendation # 26 – Continued Parks and Open Space Restoration

In partnership with TRCA and CLOCA, conduct a more detailed assessment of the potential “plantable areas” to confirm where opportunities exist on Town or TRCA-owned or CLOCA-owned lands (excluding areas recently planted as part of the 2006-2010 Restoration Project) and include these in a 2011 – 2015 Ajax Parks and Open Space Restoration Project Plan.

Monitor the status of restoration works completed as part of the Parks and Open Space Restoration Project for 2006 – 2010 in a systematic way to identify potential improvements to restoration approaches, if needed.

Lead	Operations and Environmental Services
Potential Partners	TRCA, CLOCA
Cost	\$20,000 per year, est. (ongoing)
Funding	Capital budget
Priority / Target Timing	HIGH / Start 2011
Expected Outcomes	Increased urban forest canopy through plantings on available, public open spaces Increased knowledge to support future decision-making and restoration project planning.

1.8 Recommendations for Awareness, Engagement and Partnerships

Recommendation # 27 – Urban Forest Communications Program

Develop and implement an urban forestry communications program with goals and actions (as described in Section 8 of this Plan).

- a) Promotion of the Urban Forest Management Plan (short-term).
- b) Improvements to the Urban Forestry section on the Town’s website.
- c) Adopting a three staged marketing and outreach plan, as follows:
 - Stage 1: an identifier and consistent imaging;
 - Stage 2: development of promotional materials on key topics;
 - Stage 3: dissemination of materials.

Lead	Communications (under Office of the CAO)
Potential Partners	Operations and Environmental Services, Durham Health, TRCA, CLOCA
Cost	\$5,000 - \$10,000 for printed materials and dissemination (to utilize existing communications staff and arborists for support)
Potential Funding	Environment Canada EcoAction Program
Priority / Target Timing	HIGH / 2011 - 2012
Expected Outcomes	Improved public awareness and appreciation of the urban forest. Increased stewardship of existing trees on private lands, and more trees being planted.

Recommendation # 28 – Targeted Social Marketing Campaign

In addition to the development of more general urban forest resource information and materials, undertake some targeted social marketing in the community at times and locations when people are expected to be receptive (i.e., information booths at large nurseries and garden supply stores during spring). Engaging local businesses who have fairly large open spaces on their property should also be pursued.

Lead	Communications (under Office of the CAO)
Potential Partners	Operations and Environmental Services, , local nurseries and garden supply stores, local businesses
Cost	\$2,500 - \$5,000 for printed materials (to utilize existing communications staff and arborists for support)
Potential Funding	Environment Canada EcoAction Program
Timing	MEDIUM / 2013 - 2015
Expected Outcomes	Improved public awareness and appreciation of the urban forest. Increased urban forest health and sustainability.

Recommendation # 29 – Awareness and Stewardship Support

The Town’s Communications staff and recommended Arborist Inspector (see Recommendation 22) will cooperate to provide outreach and education to residents, neighbourhood groups, schools, businesses and other stakeholders in order to:

- a) Provide technical support on tree care issues;
- b) Undertake community outreach in the form of workshops, presentations, visits to schools, etc.,
- c) Coordinate community involvement in restoration / landscaping activities in public spaces, and;
- d) Liaise and coordinate with various volunteer groups involved in urban forest activities.

Lead	Communications (under Office of the CAO) / Operations and Environmental Services
Potential Partners	Durham Public Board of Education, Durham Catholic Board of Education, Durham Land Stewardship Council, Durham Health, TRCA, CLOCA, LEAF
Cost	\$2,500 - \$5,000 for printed materials (to utilize existing communications staff and arborists for support)
Funding	Operating budget
Priority / Target Timing	MEDIUM / 2013 – 2015 (and ongoing into the next management plans)
Expected Outcomes	Improved public awareness and appreciation of the urban forest. Increased urban forest health and sustainability. Increased urban forest canopy.

Recommendation # 30 – Expanded Partnerships for Urban Forest Stewardship

- a. Build on existing public sector partnerships (with the Durham Catholic Board of Education, Durham Public Board of Education, and Durham Region Health Department, Durham Land Stewardship Council, CLOCA and TRCA) and develop new partnerships with CLOCA, the Durham Land Stewardship Council on urban forest initiatives.
- b. Explore private sector partnerships regarding urban forest initiatives with Veridian, Ontario Power Generation (OPG), Ontario Realty Corporation (ORC), private schools, businesses/industries (through the Board of Trade, Durham Homebuilders Association), golf courses and cemeteries.

Lead	Operations and Environmental Services / Communications / Planning and Development Services
Potential Partners	As above
Cost	Existing staff resources (ongoing)
Potential Funding	(for specific projects and tree planting activities) Environment Canada, Evergreen, Ontario Trillium Foundation, Trees Canada and Trees Ontario
Priority / Target Timing	MEDIUM / 2013 – 2015 (to be pursued once communications plan and supporting materials are developed, and be ongoing into future management plans)
Expected Outcomes	Improved public awareness and appreciation of the urban forest. Increased private sector knowledge and compliance with tree preservation requirements. Better tree care and more tree plantings on private lands, as well as broader support for municipal urban forest initiatives.

Recommendation # 31 – Pursuit of Funding and Resource Sharing for Urban Forest Initiatives

Pursue funding opportunities and subsidies for urban forest initiatives, with public sector and non-profit partners where appropriate, available through Environment Canada, Evergreen, the Forest Gene Conservation Association (FGCA), LEAF, Ontario Trillium Foundation, Trees Canada and Trees Ontario.

Lead	Communications (under Office of the CAO) / Operations and Environmental Services / Urban Forest Steering Committee (see Recommendation 32)
Potential Partners	Durham Catholic Board of Education, Durham Public Board of Education, and Durham Region Health Department, CLOCA and TRCA
Cost	Existing staff resources (ongoing)
Funding	Environment Canada, Evergreen, the Forest Gene Conservation Association (FGCA), LEAF, Ontario Trillium Foundation, Trees Canada and Trees Ontario (as specified in the Comprehensive Report, Section 8)
Priority / Target Timing	MEDIUM / 2013 – 2015 (to be pursued once communications plan and supporting materials are developed, and be ongoing into future management plans)
Expected Outcomes	Support for tree planting and care activities on private lands throughout the Town.

Recommendation # 32 – External Co-ordination: Urban Forest Steering Committee (UFSC)

Establish an Urban Forest Steering Committee comprised of selected Town staff and external partners to pursue funding and resource sharing for partnership-based urban forestry projects, as well as overseeing implementation of these projects, and provide input related to ongoing Plan implementation.

Lead	Operations and Environmental Services / Communications
Potential Partners	Other Town departments and external groups such as MNR, TRCA, CLOCA, local stewardship groups, Trees Canada and Trees Ontario, etc.
Cost	In-house.
Funding	N/A
Priority / Target Timing	MEDIUM / 2013 – 2015 (to be pursued once communications plan and supporting materials are developed, and be ongoing into future management plans)
Expected Outcomes	Support for Town staff in terms of co-ordinating stewardship activities on private lands, and vehicle for pursuing funding with non-profit and/or non-governmental organizations.

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“Conservation of trees in the urban environment can only be achieved effectively through the development and implementation of a strategic urban forest management plan that standardizes policies and practices surrounding activities related to trees”.

Canadian Urban Forest Network Website (June 2010)

1. Introduction

The Town of Ajax has, for well over a decade, been working to better understand and manage its **urban forest** resources, while also looking for opportunities to enhance those resources through its own activities and through partnerships with various organizations and agencies. However, Town staff recognizes that to undertake this work effectively, there is a need for a strategic plan that summarizes current practices, identifies gaps and opportunities for improvement, and makes recommendations that are appropriate for Ajax. In the recently completed Urban Forest Study (based on the i-Tree UFORE/Eco model) prepared by the Toronto Region Conservation Authority (TRCA), the first recommendation is to develop a strategic urban forest management plan for public and private property in the Town. This document is that Plan.

The Town of Ajax is a municipality in the Region of Durham with a population of about 100,000 and an area of 67 km². It is situated on Lake Ontario, and bounded by the City of Pickering to the west and north, and the Town of Whitby to the east (as shown in Figure 1). The municipality’s land cover is predominantly residential and agricultural, but also includes natural cover and open space areas. The Town’s urban forest is a dynamic and diverse entity, comprised of trees and shrubs of various sizes and ages growing on public and private land across all land cover types.

Trees, particularly in urban areas, are increasingly recognized for the numerous valuable environmental services they provide, ranging from air pollution filtration to providing health benefits associated with cooling and shade (see Section 1.5 and Appendix B). Urban forest **canopy cover** across the Town of Ajax is currently estimated at 18.5% (TRCA 2009a). The Town recognizes that in order to remain both liveable and sustainable as it grows, it will need to make a concerted effort to both protect and enhance its existing cover, and pursue opportunities for expanding this cover in both open spaces and within the built up areas.



Figure 1: Map of the Town of Ajax and its adjacent municipalities in the Region of Durham.

The purpose of this Plan is to review and assess the current management of the Town’s urban forest, and to recommend strategies for increasing canopy cover and the effectiveness of urban forest management on both public and private lands.

The recommendations provided in this Plan have been developed based on a review of the Town’s resources and practices, consideration of best practices for key topic areas and precedents in other municipalities, and with input from Town staff and key stakeholders. The recommendations also consider the range of resources that might reasonably be available to the Town. Implementation of these recommendations, over time, is intended to enable the Town to transition from reactive to proactive urban forest management, thereby increasing operating effectiveness, improving tree health and diversity, reducing risk to the public, and maximizing the wide-ranging benefits provided by a healthy and sustainable urban forest.

This Plan focuses on strategic and specific actions to be undertaken in the first five years (2011 – 2015) and is also intended to provide the background and basis for a longer term 20 year plan that is reviewed and updated at five-year intervals (i.e., 2015, 2020, 2025) in order to achieve the Town’s urban forest vision and objectives.

1.1 Plan Vision, Mission and Goals

The following long-term (i.e., 20 year) vision, mission statement and strategic goals have been developed with consideration for the Town of Ajax’s unique environmental and land use context, as well as with consideration for the various stakeholders who already contribute or could contribute to urban forest sustainability. The vision statement reflects the desired outcomes of the successful implementation of this Plan, while the mission statement and strategic goals are intended to guide the implementation of this Plan over the next five years and through the subsequent three five-year management plans.

Vision Statement

The Town of Ajax will continue to demonstrate leadership in sustainable urban forest management by protecting and enhancing a thriving urban forest that is multi-aged, diverse, healthy and well-managed. The urban forest will support a healthy and liveable community by improving air and water quality, reducing energy consumption, providing habitat for wildlife, offering recreational opportunities, and beautifying the Town's neighbourhoods. The Town's residents will value the entire urban forest as an essential asset that positively contributes to environmental, economic and social well-being.

Mission Statement

The Town of Ajax will adaptively manage the trees on its lands, and encourage the planting and management of trees on private lands, in order to maximize their health and longevity. The Town will also strive to enhance the urban forest by improving and enforcing tree protection, expanding tree planting, and improving tree care. This will be achieved by optimizing internal resource use, improving public education and outreach, and working with the full range of current and future urban forest stakeholders to preserve and enhance the urban forest for the long-term.

Strategic Goals

The following six goals identify the key objectives that the Town of Ajax seeks to achieve through the implementation of this Plan. These goals are intended to provide direction for long term management (i.e., 20 years) through the first five year Plan and three subsequent five year plans that will be developed as part of future planning.

1. Improve knowledge of the Town’s urban forest by undertaking inventories, periodic urban forest studies, and ongoing data collection designed to support more effective adaptive management, particularly on municipal and conservation authority lands.
2. Draw on new data and best management practices to optimize urban forest health and cover, increase native biodiversity, and reduce the risks presented by trees on municipal lands.
3. Engage a broad range of stakeholders in the protection and care of existing trees, and the planting of new trees on public and private lands to promote expansion of the urban forest.
4. Work with all engaged stakeholders to ensure that tree protection is a priority consideration during development, and that the urban forest is enhanced and expanded by planting the right trees in the right places.
5. Ensure that urban forest management is recognized as an essential and ongoing activity that requires a long-term commitment of resources by integrating urban forest initiatives into operational and capital budgeting, and committing to a sustained urban forest awareness campaign.
6. Monitor and review the status of the urban forest using established criteria and indicators at regular intervals, and revise planning and practices as required.

The vision, goals, and specific recommendations are to be implemented so that they are consistent with the principles of **adaptive management** and with a **Plant Health Care (PHC)**-based approach, including the concept of **Integrated Pest Management (IPM)**.

1.2 Plan Contents

The Town of Ajax’s staff identified seven focus areas to be addressed in this Plan, as listed below. Information gaps and opportunities for improvement are identified for each of these topic areas based on an assessment of best practices, technical literature and municipal precedents. Town staff and stakeholders have been consulted, where appropriate.

- ***Municipal Arboriculture Standards and Practices (Section 2)***
- ***Tree Establishment and Urban Forest Enhancement (Section 3)***
- ***Urban Forest Pest Management (Section 4)***
- ***Development Process (Section 5)***
- ***Private Tree By-law (Section 6)***
- ***Protecting and Enhancing Wooded Natural Areas (Section 7)***
- ***Awareness, Engagement and Partnerships (Section 8)***

The gaps and opportunities identified in each of these sections form the basis for the recommendations identified in the **Five Year Management Plan** and also provide some direction for subsequent management plans, as outlined in **Section 9**.

1.3 Plan Framework and Monitoring

The focus of this report is on the first Five-Year Management Plan (2011 – 2015). However, trees are long-lived and require an extended time frame for strategic management. A 20 year timeline has been recommended and adopted in other municipalities (e.g., Town of Oakville, City of Guelph, City of Burlington) as a workable time in which to achieve tangible urban forest goals (as shown in Figure 2). Therefore, although only the first Five-Year Management Plan has been developed, this report is also intended to provide strategic guidance for three subsequent five year plans.



Figure 2: The temporal framework for the Town of Ajax’s long-term urban forest management planning.

Subsequent five-year plans will use the same vision, goals and guiding principles laid out in this Plan (Section 1.1), update the recommendations provided in Five-Year Management Plan #1, and incorporate new recommendations, if required, in response to new information and/or changing circumstances for Five-Year Management Plans #2 (2015 – 2020), #3 (2021 – 2025) and #4 (2026 – 2030).

In addition to the 20-year strategic framework and the four nested five-year management plans to direct activities, there should also be annual operating plans, as illustrated in Figure 2. These are typically developed by senior municipal staff responsible for coordinating budget and staffing requirements and link to daily planning, communications, or on-the-ground operations related to urban forest management activities. Each annual operating plan should include specific plans for operations (e.g., planting, pruning, removals, and inspections) as well as actions for planning, and engagement/stewardship.

Adaptive Management and Monitoring

Forested ecosystems are dynamic and complex entities, particularly with the addition of the human component. Urban forest managers cannot necessarily predict the changes and events (e.g., drought, severe weather, pest infestations) that will need to be accommodated. For this reason, the concept of **adaptive management** is directly linked to the idea of monitoring, and firmly embedded as a guiding principle of strategic planning and management.

The effects or results of the initial approach must be monitored in a systematic manner so that any required adjustments can be made based on the experience gained and new information.

In keeping with the principles of strategic planning and active adaptive management, the successes and shortcomings experienced during every five-year management planning period must be reviewed, and findings should be incorporated into the subsequent management plan. This review should be undertaken in the final year of each management planning cycle, ideally in consultation with a technical advisory committee and key stakeholders.

“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 project

Urban forest management plans are a relatively new tool that only a few municipalities have begun to implement, and there are no known implementation and results monitoring reports available to refer to. However, there has been recent work on developing a set of standard criteria and indicators for urban forest management (Kenney *et al.*, in press) provided in Appendix A. 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 treed resources, the municipal management approach, and the community and stakeholder engagement. The 25 criteria include measures that are typically used (e.g., such as **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 Ajax Urban Forest Study recently completed by TRCA for the Town organized its recommendations according to as many of the 24 criteria identified by Urban Forest Innovations and Kenney (2008) as possible, given the contents and findings of the study. These are essentially the same criteria (with some refinements and one addition) as in the more recent paper by Kenney *et al.* (in press). The integration of the Urban Forest Study’s recommendations with the additional recommendations identified through this study provide comprehensive direction for the Town’s urban forest planning that can be monitored using the criteria and indicators referenced above (and provided in Appendix A). The relationship between the recommendations found in the Ajax Urban Forest Study and in this plan is detailed in Appendix E.

1.4 An Overview of Ajax’s Urban Forest

Part of the Regional Municipality of Durham, Ajax covers approximately 67 km² within the Lake Erie – Lake Ontario **Ecoregion** (known as Ecoregion 6E) of the broader mixedwood plains **Ecozone**. Although the Town is dominated by residential areas of single-family detached homes, there are also some forested valley corridors, isolated upland woodlands, isolated groups of trees, and individual trees scattered throughout the Town’s **urban matrix**. These trees are all part of the Town’s **urban forest**, and are described briefly in this section.

Notably, the Town has completed a number of natural area studies and plans over the past few decades, but has not yet undertaken an inventory of the trees along its streets or in its parks. Therefore, more is known about the nature and extent of the Town's remaining natural areas than the trees along its boulevards and in its parks and other open spaces, although some information about other parts of the urban forest have been collected through the recent Urban Forest Study (TRCA 2009).

According to the Town's Urban Forest Study (TRCA 2009), Ajax's urban forest, including trees and shrubs across all land cover types, within and outside of natural areas, covers approximately 18.4% of the municipality, with tree cover accounting for 14.6%. This level of canopy cover is comparable to Toronto's, which is estimated at 17.5 – 20%, and greater than some other largely urban municipalities (e.g., Mississauga 14%, Brampton 8%) but lower than some others (e.g., Oakville 29%, Guelph 30%). Burlington's canopy cover has recently been estimated to be 23% City-wide, with 17% cover in its urban area and 28% in its rural area (TRCA 2009a; Urban Forest Innovations and Dougan & Associates 2007; City of Burlington 2010). It should be noted that these canopy cover estimates have been generated using several differing methodologies, and direct comparisons between communities may be of limited utility.

Ajax's estimated leaf area is 98 km², or 1.45 m² per 1 m² of the study area (TRCA 2009).

The nature of a jurisdiction's urban forest is determined by a number of factors including the local biophysical context (i.e., climate, landform, soils, etc.), the extent and species of local pre-settlement forests, current land cover types, and urban design. These are described briefly below.

In Ajax, the local climate, which is moderated by its proximity to Lake Ontario, is characterised by humid, warm summers and mild, snowy winters. This results in more than 160 frost free days and about 800 to 850 mm of precipitation annually, but highly variable rainfall (TRCA 2002a,b).

The Town of Ajax is almost entirely positioned on the Lake Iroquois Plain with the former Lake Iroquois shoreline undulating across the Town's northern border. The Iroquois Plain slopes gently towards Lake Ontario. Its soils are a mixture of clay, silt and deposits overlaying Halton Till.

The Town is largely captured by the Duffins Creek and the Carruthers Creek watersheds, with a small portion of the Lynde Creek watershed running along the Town's eastern border. It is thought that this area was almost entirely forested prior to European settlement, but was cleared for agriculture and is now largely urbanized with a strip of rural lands along its northern and eastern boundaries (TRCA 2002a,b; CLOCA 2008).

The municipality's land cover is predominantly residential and agricultural (approximately 33% and 21% respectively), but also encompasses commercial and industrial lands (11%), and blocks of natural cover and open space areas (14%) extending across the rural and urban areas. The highest proportion of tree and shrub cover is in the natural cover land use type (54.2%), while the open space land use is comprised of 12.9% trees and shrubs. Residential areas are comprised of about 17.3% tree and shrub cover, while trees and shrubs account for only 5.9% of commercial and industrial area cover (TRCA 2009a).

The forest vegetation in the natural areas consists of a mix of species from the Great Lakes – St. Lawrence and Deciduous forest types, and natural forested areas are concentrated along the reaches of Duffins Creek, Carruthers Creek, Urfe Creek, and the headwaters of Millers Creek in the Town. There are also a few isolated upland woodlots scattered throughout the urban area.

Overall, Ajax’s urban forest is comprised of about 1,365,000 trees, including about 32,000 street trees. Although details on the species composition of trees in natural areas and the urban areas is lacking, information collected through the recent Urban Forest Study (TRCA 2009a) and a more dated ecological assessment (Gregory *et al.* 1999) indicate overall species diversity of the urban forest is relatively low and with a high proportion of invasive trees and shrubs, particularly in the residential and commercial areas (i.e., in terms of percentage leaf area, the three dominant tree species are Sugar maple, Eastern White Cedar, Norway maple followed by common buckthorn, white ash, eastern hemlock, white pine, trembling aspen, green ash, Manitoba maple, white spruce, American elm, and hawthorn).

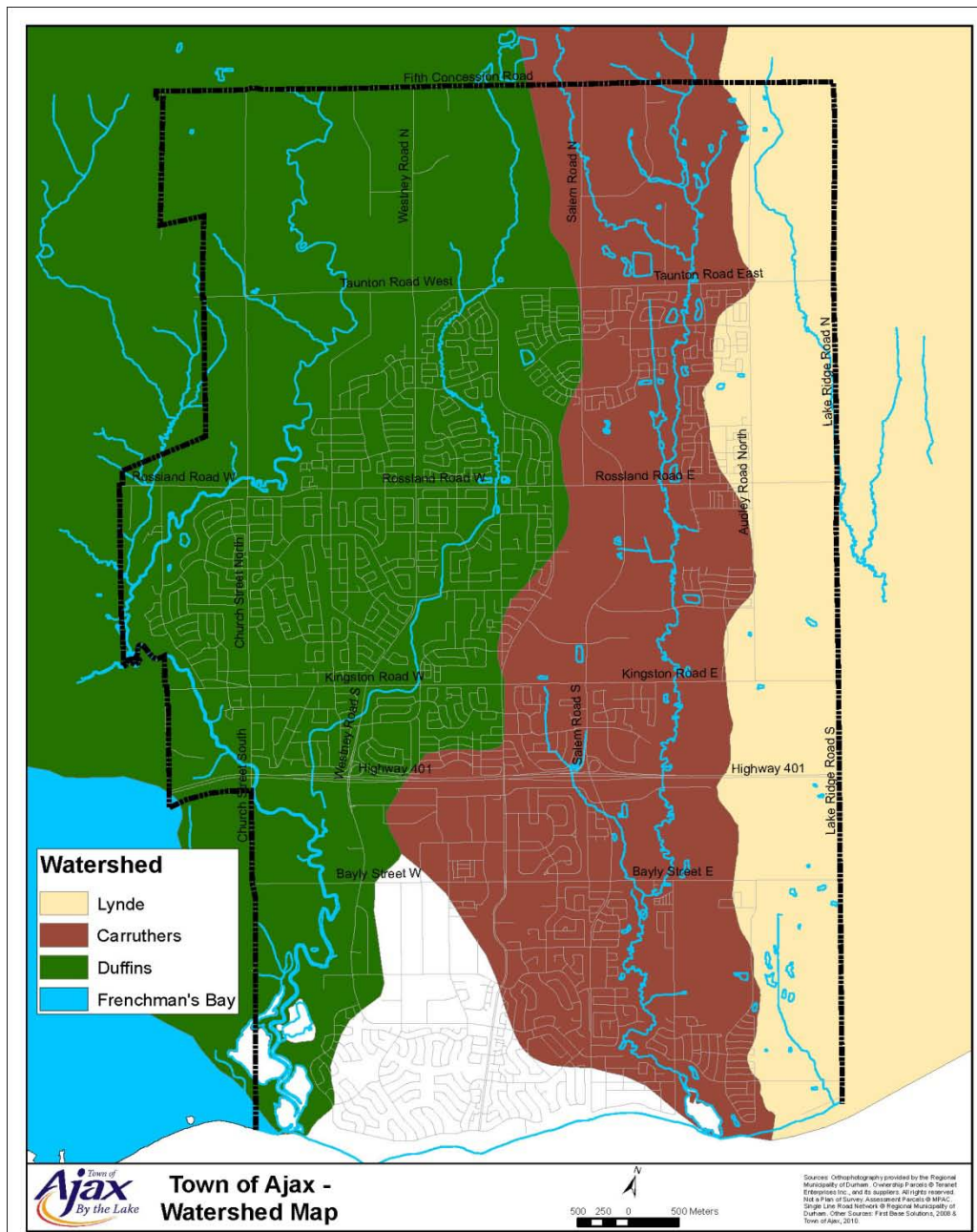


Figure 3: Map of the main watersheds in the Town of Ajax.

Ajax’s Urban Forest Study also found that the bulk of the Town’s trees are of small diameter (i.e., 86% less than 22.6 cm and less than 2% larger than 61 cm). The history of clearing and the fact that many trees in the urban area have been planted relatively recently, combined with the abundance of Eastern white cedar and buckthorn (which tend not to grow to great diameters even at maturity), helps explain the dominance of small trees.

Like many municipalities in southern Ontario, Ajax’s **urban forest** is a blend of natural remnants (primarily associated with major creek corridors), relatively small former farming or plantation areas now succeeding to forest cover, and a mix of remnant and planted trees located on a wide range of private and public lands in the Town. Such lands include boulevards, parks, residential yards, school grounds, agricultural lands (e.g., hedgerows) and commercial lands. Like many other municipalities, Ajax has a large proportion of smaller trees and **invasive species**. All of these factors, combined with climate change and other stressors (discussed in Section 1.5) make the urban forest vulnerable to threats to its health, and ultimately to decline.

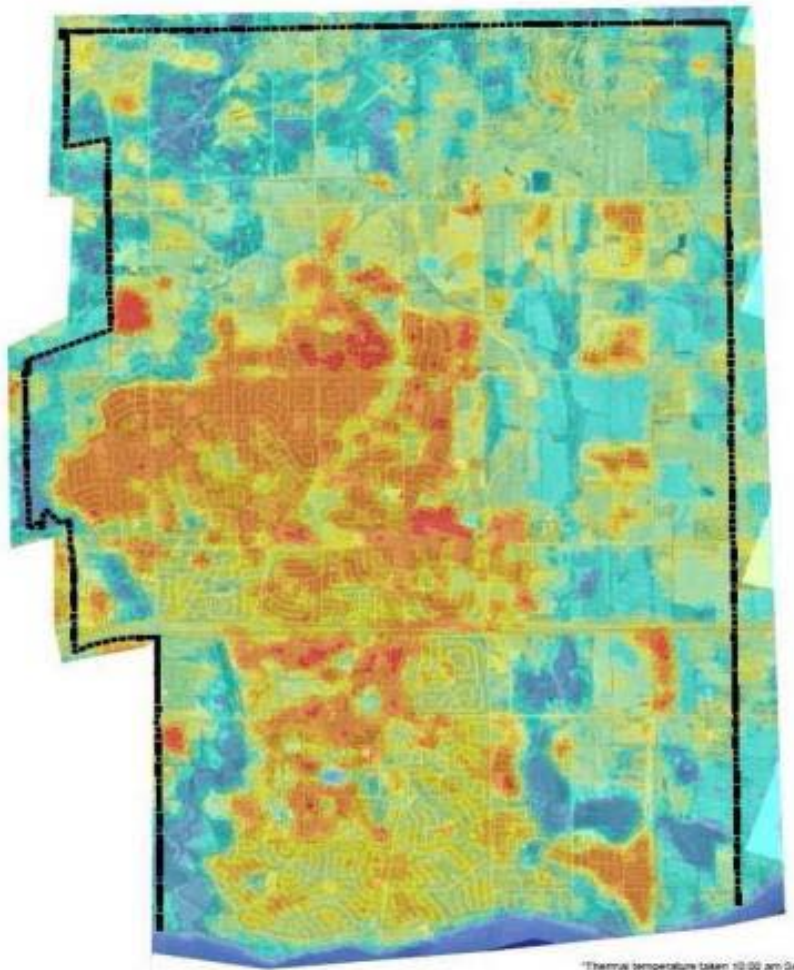


Figure 4: Thermal map of the Town of Ajax (from TRCA 2009a). Yellow-red areas indicate effective surface temperatures of 35-47°C, blue-green areas indicate effective surface temperatures of <25-34°C. Hottest areas are concentrated in residential, commercial and industrial lands with less tree forest canopy. Forested and natural areas are substantially cooler.

However, there are also substantial opportunities in Ajax to improve the urban forest’s resilience and health through a variety of readily implemented strategies (as outlined in the first five-year management plan). For example, the Urban Forest Study analysis found that about 26.5% of the Town is comprised of potential **plantable space**, primarily in residential areas. This part of Town is most susceptible to the **urban heat island effect**, particularly away from the lakeshore (see Figure 4). Working with residents and various partners to protect existing native trees, replenish plantable spaces with more native and non-native, non-invasive trees, and supporting natural **successional processes** that will lead to the re-establishment of local forested areas will ultimately create a healthy and sustainable urban forest in the Town.

1.5 Benefits of the Urban Forest and Management Challenges

1.5.1 Benefits of the Urban Forest

The benefits of trees in urban and urbanizing settings are well-documented, and Ajax’s urban forest provides real and important environmental, economic and social benefits to the Town. Trees (and shrubs) have the capacity to clean the air and water, moderate the local climate, reduce energy consumption in homes and buildings, sequester and store atmospheric carbon, provide shade and screening, help control storm water runoff, and provide habitat for wildlife. They also provide social and economic benefits ranging from contributing to mental and physical health to increasing the value of residential real estate. The shade from trees protects people from the damaging health effects of ultraviolet radiation (UVR). Exposure to UVR can lead to serious negative health effects for people of all ages.

Cumulatively, these benefits contribute significantly to making Ajax a more sustainable community. While some benefits cannot be easily measured or assigned a monetary value, recent research has developed standard methods for quantifying some environmental benefits in order to illustrate the relative value of trees in terms of the green infrastructure services they provide. The recent Urban Forest Study conducted by TRCA (2009a) estimated that Ajax’s 1.4 million trees provide well over \$1 million in environmental services annually in terms of air pollution filtration and residential energy savings alone. Other comparable studies completed by TRCA and the United States Department of Agriculture (USDA) Forest Service over the past five years have provided comparable data for a number of urban and urbanizing municipalities in southern Ontario and the north eastern United States.

A more detailed summary of the benefits provided by urban forests in general, and by Ajax’s urban forest specifically, is provided in Appendix B. Additional information can also be viewed on-line at the International Society Arboriculture’s *Trees Are Good* website (ISA 2009).

1.5.2 Climate Change and the Urban Forest

With climate change, which is already thought to have caused an average temperature increase of about 0.5°C in southern Ontario, there is concern that increasing temperatures will cause some periodic drought stress for trees and natural areas, and that a greater frequency of extreme weather events (e.g., ice storms, intense rain storms) will make urban forests more vulnerable to pests, invasive species and general decline (Colombo 2008; Hellman et al. 2008; Varrin et al. 2009). In municipalities that are largely urbanized, like Ajax, the effects of periods of high temperatures and extreme weather events are likely to be compounded by the extent of impervious and unvegetated surfaces.

The recently completed Urban Forest Study for the Town of Ajax (2009) quantified and valued the following benefits provided by the Town’s trees as follows:

- *61 metric tonnes of air pollution removed annually (\$671,000),*
- *Reduction in demand for heating and cooling of 1,220 Megawatt-hours (valued at more than \$400,000), and*
- *2,800 tonnes of carbon sequestered annually.*

This study also estimated the replacement cost of the Town’s urban forest (excluding ecological or social considerations) to be more than \$500 million.

Anticipated effects include periods of poor air quality during hot periods, intense urban heat island effects, and excessive levels of storm water runoff following severe rain storms (TRCA 2002b).

Although southern Ontario is generally expected to be less impacted by climate change than regions further north or south, noticeable changes will occur which will nonetheless require mitigation and adaptation (2degreesC 2007; EPCCO 2009).

Recommended strategies for helping the urban forest adapt to and mitigate the effects of climate change include many approaches that are consistent with and integral to good urban forest management planning. These include (adapted from Wieditz and Penney 2007, 2degreesC 2007, Galatowitsch *et al.* 2009):

- Reducing, where possible, non-climate stressors on urban woodlands and in wooded ravines (e.g., invasive plants) and managing for multi-species and multi-aged stands;
- Planting trees tolerant of warmer and drier summer conditions, particularly when planting in open areas such as along roadways or sidewalks, as well as **native species** that are currently at the northern limit of their ranges;
- Increasing levels of tree diversity (genetic, species, and age-class) and avoiding planting species known to be invasive or susceptible to life-threatening pests (such as Emerald Ash Borer) already documented or very likely to occur in Ajax;
- Reviewing and improving strategies for coping with pest invasions;
- Developing extreme weather response plans for managing damage to trees following storms;
- Protecting and creating connected greenways to facilitate species movement and adaptation in response to shifts in ecosystems;
- Monitoring the responses of different tree species to changing conditions and new pests in order to facilitate **adaptive management**; and
- Exploring research partnerships with local academic institutions and other organizations to evaluate the survival of certain tree and shrub species under controlled conditions to guide species selection

These recommendations have been integrated into this Plan, where appropriate, along with other considerations for gaps and needs identified out of the review and analysis of current and best practices.

Protection and enhancement of the urban forest presents a unique, practical and relatively inexpensive opportunity to both mitigate and adapt to these anticipated changes (Harris and Hobbs 2006; Turner *et al.* 2009). Trees provide a wide range of tangible environmental benefits, including carbon sequestration and storage (see Section 1.5 and Appendix B). Implementing Town-wide management practices designed to improve the native diversity, structure (e.g., range of tree sizes and ages), and connectivity of the urban forest will help make this entity more resilient to the stressors associated with climate change.



1.5.3 Urban Forest Management Challenges

The benefits described above provide a strong justification to support the expansion of tree cover in urban areas. However, in reality this can be very challenging to implement. Ajax is already a largely urbanized municipality whose population is expected to increase from its current 90,000 to at least 120,000 by 2021 (TRCA 2002b) without an expansion of its current urban boundary. Protection of existing trees and planting new trees in suitable locations, particularly in the urban area, will require careful planning and buy-in from all involved stakeholders. Furthermore, tree protection and planting should be balanced with, not at the expense of, urban intensification and infrastructure elements that are also intended to support community sustainability by reducing emissions of carbon dioxide and other pollutants (e.g., integration of bike lanes and expanded public transit).

Challenges to growing and maintaining a healthy urban forest in Ajax, as elsewhere, are numerous. Generous estimates suggest that the average lifespan of an average urban tree is 32 years and that many newly planted trees do not survive their first year (Moll and Ebenreck 1989). Other estimates cite much lower average life spans, ranging between 7 and 12 years. Key challenges to urban forest management and sustainability include:

- effective management of trees on municipal lands with limited resources, ensuring the right tree is planted in the right place;
- building resilience to urban forest pests and diseases,
- ongoing development pressures;
- improving planting and care of trees on private lands, and;
- managing wooded natural areas

Trees in urban areas frequently end up in conflicts with utilities and hard infrastructure, and in competition with other land uses both above and below ground. There are typically opportunities for integrating trees into well-planned communities, although sometimes creativity and innovation are required. Looking strategically at identifying and protecting areas where native trees can reach their **genetic potential** is an important approach within any jurisdiction-wide plan. It should also be recognized that trees complement traditional engineered ‘grey’ infrastructure in many important ways. For example, tree cover can greatly extend the service life of asphalt, reduce pressure on sewer systems by reducing peak stormwater flows, and extend the life of building heating and cooling systems.

Working towards urban forest sustainability is further confounded by the shifts in temperature and precipitation, and the increased incidence of extreme weather events that have been linked to climate change (described in Section 1.5.2). These can also increase tree susceptibility to pests.

Key solutions to urban forest management challenges recommended in this Plan include:

- identifying adequate space for trees early in the planning and development approval process;
- improving above and below-ground site conditions for trees, especially in built-up areas;
- implementing regulations for and actively protecting trees determined to be significant in the community;
- providing resources for policy and by-law enforcement related to urban forest sustainability;
- coordinating with partner agencies and others responsible for the local urban forest;
- promoting and providing incentives for tree replacement and planting in suitable locations;
- managing natural areas for **invasive species** and adjacent land use impacts;
- improving connectivity among forested areas;
- planting a diversity of native and non-invasive tree species;
- systematic monitoring for known tree pests and hazard trees, and;
- regular, proactive tree care on public and private lands.

Provided with regular maintenance and adequate growing space, urban trees will be more resilient to environmental extremes and to the rigours of urban life, and will therefore be better able to adapt to future challenges. They will also pose less risk of failure, need to be replaced less frequently and provide exponentially more benefits as they mature.



2. Municipal Arboriculture Standards and Practices

This section reviews existing **urban forest** management practices in the Town of Ajax, presents examples of best management practices from other jurisdictions and from the current scientific and technical literature, and provides several recommendations for improving urban forest management. Arboriculture standards for planting, pruning, managing and preserving the urban forest, as well as related policies and procedures, are discussed.

This section is organized into the following sub-sections:

- 2.1 - Current standards and practices in the Town of Ajax
- 2.2 - Best practices , lessons and precedents from other jurisdictions
- 2.3 - Opportunities for improvement in Ajax

The “opportunities for improvement” section includes recommendations intended to improve and optimize Ajax’s municipal practices related to urban forest sustainability. These recommendations are re-iterated in the Five-Year Management Plan as specific actions with anticipated outcomes, costs and suggested timing.

2.1 Current Standards and Practices in Ajax

2.1.1 Management and Administration

The municipally-owned and managed portions of Ajax’s urban forest are under the jurisdiction of the Town’s Operations and Environmental Services Department. Full-time urban forestry staff includes one supervisor and two arborists. Equipment includes a 58’ Altec aerial lift device on a 2000 International truck chassis, and a Vermeer BC1000 chipper. The urban forestry section is under the supervision of the Manager of Environmental Services. While staff reports that cooperation on urban forestry issues is very good among different Town departments, there is currently no formal interdepartmental urban forestry working group.

2.1.2 Tree Inventory

A detailed public tree inventory can include a wide range of individual tree data such as location, species, size (diameter, height, canopy), condition, and maintenance requirements, and can be a powerful tool to improve the effectiveness and efficiency of urban forest management on public lands (i.e., streets, parks and other municipal open spaces).

The Town of Ajax does not have or maintain an inventory of publicly-owned trees. A database of work orders and planting locations, some dating back to 1992, provides a record of individual tree locations. Other planting locations can be found in approved subdivision street tree planting plans and approved site plans. However, these are proposed tree locations that sometimes change as developers may plant or substitute different species subject to the Town’s Landscape Architect’s approval on a revised sketch or on site. More accurate information through as-built drawings is available once the Town assumes the subdivision, but the usefulness of these records for management operations is limited unless it is integrated into a Town-wide asset management system.

The Town’s Urban Forest Study was designed to provide a general municipal level picture of urban forest structure and function across all land uses, and provides some indication of urban forest species composition, structure and condition in Ajax. To complement this high-level analysis, a more detailed public tree inventory is needed to guide site level urban forest management activities.

A comprehensive public tree inventory would differentiate between intensively managed parts of the municipal forest and extensively managed woodlands – that is, areas where individual trees are managed under arboricultural techniques as opposed to areas that are managed en masse using techniques more closely related to silviculture (e.g., woodlot management). The Urban Forest Study results do not differentiate between such areas, providing only some indication of the tree species and size classes in natural areas as compared to trees within the Town’s **urban matrix**. The Urban Forest Study does, however, provide some very useful information related to “big picture” urban forest characterization in Ajax, and also establishes a monitoring framework and baseline for assessing changes to these “big picture” parameters.

As part of its grid pruning program, the Town has characterized some streets by predominant tree species and has counted the number of municipally-owned trees on these streets, based on past work records. While such lists are useful for grid pruning contract tendering, they are not replacements for a detailed public tree inventory.

2.1.3 Tree Maintenance

Maintenance of Ajax’s public trees involves watering, mulching, pest control, fertilization, stump and tree removal and, most commonly, tree pruning. The Town has implemented a tree maintenance program which includes but is not limited to the pruning of trees for public safety, road safety, vehicle clearance, street lighting clearance, tree health and structure, as well as preventative maintenance.

Service Delivery

Ajax’s urban forest management services are delivered under a combined service delivery model, whereby Town staff and outside contractors deliver urban forestry services. Contracted services account for approximately 30% of the Operations and Environmental Services annual forestry budget. Town staff fulfill customer service requests, undertake greening initiatives, and conduct some block and park tree pruning. Contractors carry out the bulk of the block pruning and all stumping, caliper tree supply and caliper planting services.

The Town and its contractors only conduct maintenance on publicly-owned trees. However, staff have, on occasion, conducted inspections of private trees and advised homeowners on appropriate action with respect to tree maintenance issues. The Town also assumes responsibility for maintaining shared trees when any portion of the tree trunk touches the boundary between private and municipal property. Staff report that this arrangement results in improved tree health and overall condition. Trees on Regional roadways located in the Town of Ajax are typically maintained by Town resources, including maintenance, removals and replanting. The Town currently does not receive compensation from the Region for these services.

The Town’s boulevard trees are pruned on an eight-year cycle, and approximately 1600 to 2000 trees are pruned per year (1350 through non-climbing methods, 250 through climbing in 2010). The current pruning program does not allow for all of the estimated 32,000 trees to be pruned during the eight year span; only approximately half of the Town’s trees are pruned during this time. Boulevard tree pruning work is

predominantly conducted by contractors; Town staff generally responds to customer (resident) requests and conduct block pruning only when all outstanding service requests from customers are completed.

As part of the Town’s commitment to high-quality customer service and in accordance with ISO-9001 standards, Town staff and contractors are required to attempt to make contact with residents in the vicinity of work being undertaken through pruning notices, at least 48 hours prior to commencement of the work. Staff and contractors also knock on each resident’s door immediately prior to commencing work. If residents express concerns about the work, staff and contractors are instructed not to perform the work, move to the next tree, and advise Town management. This practice exceeds industry standards, as municipally-contracted arborists are asked to make pre-emptive contact with residents.

The Town does not have a formalized tree maintenance and inspection program in any of its more than 78 parks, parkettes, open spaces and environmental protection areas. Available funds for parklands are typically directed towards tree planting. Park trees are generally maintained on a per-request or as-needed basis, or when Town arborists have completed outstanding customer service requests.

Tree Work Order and Inspection Requests

Ajax’s two full-time arborists are generally involved in responding to resident service requests. Typically, a work order begins when a customer (generally a resident or local business owner) submits a written or telephone request for tree maintenance or inspection based upon their own identification of an issue or concern. The service request is then turned into a work order, which is filed in the Active Work Order System folder. The Work Order is considered active until staff completes the work and the work order is ‘signed off’. The Work Order is then filed in the Work Orders Completed system folder and the record of completed work is maintained. Staff currently report that this system is effective and fairly efficient, but would benefit from being integrated with a corporate asset management system.

If a customer submits a request for tree maintenance or inspection of a tree in a subdivision that has not yet been assumed by the Town, staff in Operations and Environmental Services contact the Town’s Landscape Architect at Planning and Development Services, who conveys the request to the subdivision developer. It is the developer’s responsibility to address these requests. The work is inspected by Town staff prior to assumption of the subdivision.

Staff also report that backlogs in active Work Orders often preclude undertaking proactive maintenance such as grid pruning, pest management and monitoring, and site inspection. Given Ajax’s commitment to continually improving the level of customer service it provides, this issue can likely only be resolved by increasing the resources available (i.e., through internal staffing or contractors) for carrying out customer Work Order and inspection requests.

Young Tree Pruning

Pruning newly-planted trees at routine intervals represents one of the best investments in the future urban forest. Currently, there is no program in Ajax to routinely inspect and structurally prune young trees after planting. Most young trees are planted as part of a development (subdivision and site plans). Developers are responsible for the care (pruning) of newly planted trees until the Town assumes a subdivision. Residents are responsible for watering and taking care of the **street trees**. Other young tree maintenance is carried out as part of the Town’s **Plant Health Care** program (see below).

Plant Health Care

In 2002, the Town developed a long-term Plant Health Care (PHC) program. Recently, much of the Town’s PHC program was targeted towards reducing the use of chemical pesticides for turfgrass applications in parks and open space areas. With the recent passing of the provincial *Cosmetic Pesticides Ban Act, 2008*, even greater reliance has been placed upon cultural practices to promote plant health.

Several important urban forestry initiatives are included in the Town’s PHC program. Most importantly, two summer students are hired annually as Plant Healthcare Technicians and tasked with maintaining newly-planted trees through watering, mulching, planting stake removal, and general health assessment. However, this program does not include young tree structural pruning.

Utility Line Maintenance

Town forestry staff does not maintain trees or tree parts within ten feet (three metres) of energized conductors. All utility line clearing (i.e., pruning tree branches away from conductors) is undertaken by Veridian, the local utility company, which, in turn, contracts out this work. It is acknowledged that Veridian’s primary concern with respect to tree maintenance is to minimize or eliminate disruptions to utility services caused by branch or tree failures, and that maintaining tree health and proper structure is a secondary concern. Veridian does not undertake tree removal, stumping or tree establishment.

Ajax staff report that increased coordination with Veridian would improve the efficiency of urban forest management by reducing work duplication and backlogs. For example, Veridian may identify trees for removal and provide clearance for Ajax staff or contractors, who then remove the tree. Alternately, enabling Veridian to conduct such a removal would expedite the process and reduce workloads for Town staff. There may also be opportunities for tree planting along the edges of hydro corridors in Town if standard setbacks and acceptable tree species (i.e., small to medium-stature shrubs and trees) are clearly defined.

Risk Management

While Town certified arborists and contracted service providers are expected to be able to identify and mitigate a range of potentially high-risk conditions associated with publicly-owned trees, Ajax does not have a formalized process to assess and catalogue risk associated with publicly-owned trees. The Town does not have a tree risk management policy, nor is there a post-storm tree inspection protocol. This places the Town in a potentially vulnerable position when damage or safety issues arise related to trees under municipal ownership.

Tree risk issues are typically identified and mitigated during the course of block pruning, and through customer service requests. If Town arborists are made aware of potential risk issues, a standard point-based assessment can be undertaken and risk mitigation work can follow if required. In some cases (e.g., a large native specimen in a prominent location), expert risk assessment services may be desired or required. In addition, the Town does not currently cable or brace trees. These practices, if performed correctly and managed appropriately, can greatly reduce the risk presented by certain aging trees while maintaining the environmental services that such trees provide.

2.1.4 **Tree Protection**

Protection of existing trees during development and construction is among the most important activities which can be undertaken to promote the long-term sustainability of the urban forest, as canopy and leaf area lost during construction can take years to replace.

The Town’s recently approved Official Plan Amendment No. 38 (2010), requires a Tree Inventory and Preservation Plan for any development or site alteration where private or public trees/vegetation exist within the property and/or exist a minimum of three metres beyond the property line. OPA 38 also requires the plan to be prepared by a qualified Landscape Architect with a Certified Arborist, and detail *“tree health and size, existing trees proposed to be removed and the canopy replacement, existing trees proposed to be transplanted and their new locations (if tree spades are needed, indicate the spade size), existing trees proposed to be retained/protected and their monetary dollar value, and the dimensions and details of recommended tree protection and preservation measures for all trees to be retained”* (policy 5.3(u)).

Currently, municipally-owned trees and trees on select public and private lands are regulated under by-laws 137-2006 and 138-2006. For example, by-law 138-2006 states:

“No person shall cause or permit any new construction, or excavation on a street, or on public property or private property within:

- (i) a 2 metre radius of a tree less than 40 cm in diameter, and,*
- (ii) a 3 metre radius of a tree greater than 40 cm in diameter,*

without the prior written approval of the Manager [of Operations and Environmental Services].”

In addition to current tree protection by-laws, existing trees are also protected and/or replaced through different planning processes such as the Site Plan and Subdivision approval processes (refer to Sections 5.1.5, 5.1.6 and 5.1.7). Basic tree protection fencing specifications are available from the Town’s Planning and Development Services Department (Drawing No. DS204). Additionally, Planning and Development Services is currently developing a plywood tree hoarding standard detail. Plywood tree hoarding will apply to mature trees that are in close proximity to construction. Currently, the Town uses Detail TP-1, “Tree Protection Barriers” from the City of Toronto *Tree Protection Policy and Specifications for Construction near Trees*.

2.1.5 **Asset Management**

An asset management system is a software suite that facilitates the management of a variety of corporate assets, such as infrastructure, fleet vehicles and even trees. Digital asset management systems are typically shared across an entire enterprise (e.g., the Town of Ajax), and can assist with physical asset selection, inspection, maintenance and management requirements, as well as track work order history, costs and contract provisions. By managing assets across the Town using a shared system, Ajax could improve utilization and performance, reduce capital costs, reduce asset-related operating costs, extend asset life and subsequently improve returns on investment.

At the time of the development of this Plan, the Town of Ajax was in the process of selecting a corporate-wide asset management system. Staff noted that the selection process should be completed in the fall of 2010, and that tree asset management will be a component of the enterprise-wide asset management system.

2.2 Best Practices, Lessons and Precedents from Other Jurisdictions

2.2.1 Inventory

A number of municipalities have compiled public tree data in the form of street and/or park tree inventories. Attributes collected vary widely; some inventories include little more than basic species and size data, while others also provide detailed assessments of location, condition, risk and other attributes.

Five examples of state-of-the-art street tree inventories from the Town of New Tecumseth (Ontario), City of Kitchener (Ontario), City of London (Ontario), City of Vancouver (British Columbia) and City of Pittsburgh (Pennsylvania) are presented in Appendix C.

Benefits of a detailed public tree inventory include:

- **A broader understanding of urban forest structure:** The street tree inventory includes, among other attributes, tree species and diameter data. 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 and can guide future tree establishment, maintenance and monitoring decisions. A detailed inventory will also enable an assessment of the urban forest's **leaf area index**, which is a more accurate indicator of the provision of urban forest-derived benefits than **canopy cover**. It will also enable assessment of Relative Diameter at Breast Height (RDBH) for inventoried trees, which compares the actual diameter of urban trees to known maximum diameters, providing some indication of urban forest health and structure.
- **Improved engineering and infrastructure project planning:** A GIS-based urban forest inventory layer enables engineers, planners and urban forestry staff to locate individual trees in proximity to proposed road works or other infrastructure projects, identify potential conflicts with above and below-ground utilities, and plan effective tree protection measures for such projects.
- **Improved and more efficient urban forest management and maintenance:** Managers can use existing street tree inventory information to accomplish a variety of goals and objectives. By combining inventory data and spatial attributes, the mixture of native and non-native 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 similarly prioritized, and species-based pest management strategies can be developed. An inventory is also an essential risk reduction tool.

The inventory may also reveal other valuable assets such as rare or endangered species or candidate heritage trees that may otherwise be overlooked. An inventory is also useful for by-law enforcement as it provides a record of tree species, condition, and age in the event that a tree is illegally damaged or removed. This assists in identifying appropriate replanting requirements.



2.2.2 Tree Maintenance

Service Delivery

Urban forest management in Ontario, with few exceptions, is conducted using the model of joint municipal and contracted service provision. This model is applied in cities such as Windsor, Hamilton, Burlington, Oakville, Mississauga, London, Toronto, and Ajax. The key variable is the relative distribution of specific operations between contractors and staff. In most examples, municipal staff and contractors share the tasks of routine maintenance such as pruning and tree removals. Planting is often conducted as part of capital projects, with additional infill planting undertaken by the municipality or contractors by tender. Below are several case studies which highlight municipalities operating under both common service delivery models.

City of Brantford – Contracted Service Delivery

Brantford is one of few municipalities which contract out the entirety of their urban forest maintenance requirements. The City's staff is comprised of one urban forestry coordinator and one technician, who supervise the maintenance or inspection of approximately 60,000 trees on a relatively short five year pruning cycle, as well as the annual establishment of approximately 900 trees. The operating budget of Brantford's forestry division of Parks and Recreation (under the Engineering Department) is approximately \$600,000 annually.

Town of Oakville, ON – Combined Service Delivery

Oakville's urban forest is managed by the Town's Parks and Open Space Department, a division of the Community Services Commission. The municipally-owned urban forest includes street trees, woodlots, parks, natural ravines and valleys. The Forestry service section is comprised of various activities that include forestry administration, large tree care, municipal tree protection, forest stewardship and health, and cost-recovery activities that Forestry Services provides to external customers. Such services currently include utility line clearing for Oakville Hydro and street tree maintenance along Regional roads for Halton Region. The Forestry services section is comprised of 21.7 full-time equivalent staff, with a base budget of \$2.6 million for 2010.

The Town of Oakville implemented a 20-year Strategic Urban Forest Management Plan for south Oakville in 2008. As part of this Plan, the Town was divided into five 'preliminary urban forestry management units', which were created by combining the Town's 24 existing urban forest management zones with three tree age/size class zones. These management zones coincide with the planned five year street tree grid pruning cycle, which has not yet been fully implemented.

City of London, ON – Combined Service Delivery

London's forestry operations are managed by the Transportation and Roadside Operation Group of the Environmental and Engineering Services Department. The group manages over 170,000 street, park and woodlot trees. The majority of pruning and removal services are carried out by municipal staff, but approximately 25% of services, including maintenance and consulting, are carried out by contractors. Forestry operations are carried out by a staff of 26, with a projected combined operating (maintenance) and capital (planting) budget of \$4.2 million for 2010.

City of Mississauga, ON – Combined Service Delivery

Mississauga's urban forest is managed by the Forestry Operations Unit of the community services commission. The Unit consists of one supervisor, four maintenance inspectors, 14 full-time arborists and four temporary arborists. The 18 arborists are divided into seven crews: three aerial truck crews and four climbing crews.

Staff carries out routine maintenance, as well as emergency pruning and removals of City-owned trees. The City also relies on contractors to carry out proactive maintenance including block pruning and risk mitigation. Mississauga’s annual combined urban forestry budget is approximately \$9 million.

A number of municipalities permit residents, at their own expense, to hire contractors to conduct maintenance on city-owned trees. In the City of Toronto, for example, an “Agreement for Contractors to Perform Arboricultural Services on City Owned Street Trees” enables a property owner to contract standard tree maintenance work to a City approved tree service company. This option is made available in the event that the property owner wishes to expedite a request for standard tree maintenance and to avoid waiting for City Forestry crews to conduct the required work. Similar programs exist in cities such as Winnipeg, MB and New York, NY, among others. Typically, this is regulated through a basic permitting process, and contractors must meet specific criteria in order to obtain approval to conduct works.

Block 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; some municipalities distribute annual pruning activities across the whole land area, pruning a portion of every neighbourhood each year (e.g., Vancouver), while others maintain trees in one or two areas of their jurisdiction in a given year and move elsewhere in the next phase of the cycle (e.g., Modesto, CA).

The main benefit associated with the former approach is a reduced perception of tree maintenance crew presence in a given section of the municipality at any point in the pruning cycle. For example, if a given neighbourhood has one-fifth of its trees pruned in one year of a five-year pruning cycle, the crew will be present in that neighbourhood for less time than if all of that neighbourhood’s trees were pruned at once. This approach also enables staff and contractors to cover more of the land area and enables better inspection of the urban forest as a whole. However, that crew will return to the same general area every year, whereas utilizing the latter approach, they would not return again until a new cycle begins five years later. Ajax’s current pruning grid more closely resembles the former approach, whereby grid pruning is distributed throughout the Town.

Generally, trees are visually inspected during the course of cyclical pruning for signs of declining health and risk. Some municipalities have effective means of electronically tracking the results of such inspections, while for others this remains a shortfall.

Table 1 provides a comparison of the frequency of pruning and/or inspection cycles in several cities in North America and abroad.

City of Vancouver, BC

Vancouver’s urban forestry staff inspect and maintain street trees on a seven year cycle. Crews systematically prune at least one-seventh of all trees in each of the City’s 22 neighbourhoods annually. During maintenance of each street tree, staff update information regarding trunk diameter, height and tree condition using the *VanTree* urban forest management system. Prior to entering a scheduled neighbourhood, staff inspect every tree and prioritize the work that needs to be performed. Throughout the year tree inspectors respond to service requests from the public, designate specific blocks for pruning, and prioritize street tree maintenance.

Table 1: Comparison of municipal scheduled grid pruning cycles. Hydro pruning cycles not included.

Municipality	Pruning / Inspection Cycle	Approximate Number of Street Trees	Population
Whitehorse, Australia	2 years	75,000	155,725
Southwark, UK	3 years	12,500	274,400
San Francisco, CA, USA (Dept. of Public Works)	2-5 years (by species)	40,000	808,977 (city-county)
Brantford, ON	4-5 years	60,000	90,192
Whitby, ON	5 years (subdivisions)	50,000	111,184
Oakville, ON	5 years (proposed)	Unknown	165,613
Modesto, CA, USA	6 years	200,000	211,156
Burlington, ON	7 years	51,868	164,415
Vancouver, BC	7 years	134,000	578,041 (city)
Edmonton, AB	7 years (4 years for elm)	294,400	730,372 (city)
Calgary, AB	8 years (3 visits in first 10 years)	360,000	988,193 (city)
<i>Ajax, ON</i>	8 years	32,000	97,167
Los Angeles, CA, USA	9 years (variable)	700,000	3,833,995 (city)
Aurora, CO, USA	10 years	Unknown	319,057
Hamilton, ON	10 years	Unknown	504,559 (city)
Urbana, IL, USA	9-13 years (sources vary)	12,000	39,484
Pickering, ON	No grid pruning cycle	Unknown	100,273

City of Hamilton, ON

The City of Hamilton prunes street trees in a ten year grid cycle for the area which was formerly the City of Hamilton, and on a request only basis for the former outlying areas. The portion of the new City under this grid program is divided into 118 areas, 77 of which are located below the Escarpment and 44 which are located above.

San Francisco, California, USA

The City of San Francisco maintains one of the most unique approaches to street tree maintenance of any municipality. In many parts of the City, property owners are required to maintain street trees adjacent to the subject property; they are allowed to prune trees themselves but are encouraged to seek arboriculture advice or hire a certified arborist. In other areas, responsibility is mixed – the Department of Public Works (DPW) maintains select trees (typically the larger individuals), while homeowners are required to maintain smaller trees. The city maintains a list of streets where the DPW is responsible for tree maintenance and makes this list available online.

Young Tree Pruning

Periodic structural pruning of newly-planted and young trees is among the best investments that can be made in a municipality’s urban forest. Providing young trees with proper structure by eliminating co-dominant

unions, establishing a central leader and strong scaffold branches, and making small cuts which minimize decay reduces the need for future pruning, the likelihood of branch and tree failure, conflicts with utilities and overall management costs. Young tree pruning can be easily and quickly conducted from the ground using secateurs and pruning poles, and a large number of trees can be pruned per unit time by staff or qualified volunteers without extensive arboricultural training or experience.

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 and block pruning as there is no need for arborists equipped with aerial lift equipment and wood chippers to attend to small trees reachable from the ground.

Few municipalities undertake periodic young tree pruning, but two examples of successful programs are provided below:

City of Calgary, AB

Calgary maintains its 340,000 street trees on an eight year pruning cycle, which may vary depending on age class, species and other factors. However, newly-planted trees receive three pruning visits within the first ten years, ensuring they develop proper structure over the long term and thereby reducing the need for frequent pruning later in life.

Cities of Ithaca and New York, USA

Through their respective parks departments, both Ithaca and New York City have organized Citizen Pruner programs, through which volunteers are trained and engaged in proper tree planting, mulching, watering and young tree pruning techniques.

In New York, participants receive 12 hours of classroom and field training, and take an exam that certifies them to legally work on trees owned by the city. This includes street trees and most park trees, excluding parks that have their own conservancies, such as Central Park. Certificates are issued by Trees New York and the New York City Department of Parks and Recreation. In New York City, where there is limited money for tree maintenance but significant need, this provides a tremendous benefit. Certification must be renewed every five years.

In Ithaca, the training course is sponsored by the City of Ithaca and Cornell Cooperative Extension, and certifies the citizens to work on public trees, shrubs, and other beautification projects undertaken by the City. Volunteers receive work assignments from the City Forester and are encouraged to suggest projects as they identify areas needing attention. Urban forest management work conducted by Citizen Pruners includes:

- removal of suckers at base of trees;
- weeding and/or mulching around base of trees;
- pruning damaged, dead, diseased limbs within reach of the ground;
- removal of low branches on young trees;
- pruning to shape young trees to ensure proper canopy structure;
- monitoring and reporting tree problems and suggesting sites for new trees, and;
- planting bare root trees as instructed.

Citizen Pruners attend meetings with the City Forester and Cooperative Extension staff to review tasks and receive instruction and training as necessary. They also assist in educating the public about trees at special events and workshops.

Plant Health Care

The urban environment is often hostile to the long-term health of the urban forest. Environmental stressors both above and below-ground can leave plants prone to insect and disease infestations. Intensification of land use reduces the quality and quantity of tree habitat, often below thresholds necessary to support healthy trees.

Dedicated programs to identify and manage plant health issues, including pests, can help reduce urban forest stressors. This approach is often referred to as **Plant Health Care (PHC)**. PHC is an industry-recognized term that reflects an ecological approach to plant management, including preventative care and cultural practices, monitoring and early detection of problems, and implementation of a holistic and integrated approach to providing long-term solutions to plant health issues. Key aspects of PHC include:

- Proper tree selection: “the right tree in the right place”;
- Early pruning of young trees to establish strong structure for long-term stability;
- Fertilization and watering according to the soil conditions and the species requirements;
- Using an array of cultural practices and biological controls to reduce the use of pesticides, and;
- Structural support systems such as cabling and bracing.

Several of these aspects are discussed in other sections of this Plan.

PHC is closely linked with **Integrated Pest Management (IPM)**, which is an approach that takes a more holistic approach to pest management (e.g., use of manual or cultural practices, or biological controls) with the objective of minimizing pesticide use. Some leading municipalities have implemented programs to control vegetation pests such as noxious weeds and **invasive species** in natural areas, but generally in localized areas (e.g., specific natural area management plans in the City of Toronto) or targeted at specific pests (e.g., gypsy moth) and not jurisdiction-wide. For example, Winnipeg’s comprehensive IPM program applies non-pesticide approaches, such as sticky banding and monitoring, in combination with the targeted application of chemicals. In southern Ontario, several municipalities including Burlington and Oakville, among others, currently undertake annual gypsy moth and Emerald Ash Borer surveys.

Other cultural practices conducted by some municipalities include programs to mulch trees, create and expand **mulch beds** shared by multiple trees, and use watering bags for new plantings (e.g., City of Toronto, Town of Markham). Others have begun tree hardiness trials to assess the suitability of diverse and underutilized tree species for establishment in urban areas.

Utility Line Maintenance

In most municipalities, utility line maintenance is the responsibility of local utility companies, who often contract all or some of this work out. The Town of Oakville is one of few examples where the Town is contracted to conduct line clearing for the regional utility.

Given the unique role of utility companies in urban forest management, a lack of coordination between utility companies and municipal forestry staff can result in inefficiencies and make it more difficult to achieve a common vision of a healthy, sustainable and safe urban forest. Several municipalities, such as Mississauga, maintain membership in a Public Utilities Coordination Committee (PUCC) or similar working group to bring members of different stakeholder groups, including local utilities, together to discuss urban forestry issues.

In Mississauga, the PUCC Inspector is the liaison with public utilities, the Region of Peel and the Transportation and Works Department on road reconstruction projects and driveway widening requests. The Inspector is responsible for monitoring these agencies and their contractors to ensure they are complying with Urban Forestry guidelines regarding the protection of street trees. The Inspector is also responsible for recommending and overseeing any preventative maintenance practices that should be completed on City trees prior to and during construction works. A similar group, the Utilities Coordinating Committee, exists in Oakville.

Risk Management

In light of increasing liability and a growing body of legal precedents establishing a Duty of Care for tree owners to maintain their trees in reasonably safe condition, municipalities are beginning to recognize the importance of tree risk assessment and proactive risk management. While resource constraints invariably restrict the ability of any municipality to ensure the safety of all trees (a fact that is recognized by the courts), the development and implementation of a realistic risk management strategy is becoming increasingly recognized as a necessity. Several municipalities that have established processes for managing risk associated with publicly-owned trees are described below.

Town of New Tecumseth, ON

Prior to undertaking its complete street tree inventory, the Town of New Tecumseth commissioned a priority tree risk assessment, which involved a basic visual risk inspection of areas with a large number of mature street trees. The Town continues to respond to resident requests with formalized and documented risk assessments. The Town's inventory also includes overall condition ratings; trees with higher ratings are considered at increased levels of risk. Risk management recommendations are included for all inventoried street trees as required, and are supported by priority ratings. The Town also undertakes occasional risk mitigation measures such as tree cabling and bracing.

City of Burlington, ON

Burlington occasionally undertakes risk mitigation measures such as tree cabling and bracing, and cabled trees are inspected on an annual basis. Staff also conducts annual basic visual inspections of trees within striking distance of formal trails in City-owned woodlots and carry out maintenance and management as required. Areas with a high proportion of mature street trees are visually inspected for obvious signs of risk every two years and more closely during the seven year pruning cycle. Through its recently adopted urban forest management plan, Burlington will develop formal risk management policies and procedures, and will begin to integrate the results of risk assessments into the corporate asset management system.

European jurisdictions have the most stringent risk management policies of those studied. For example, some districts mandate tree inspection frequencies between one and four years. Trees in close proximity to roadways, buildings or other intensively-used areas are inspected on a more frequent basis, as are certain tree species known to be more prone to structural defects.

Several municipalities in southern Ontario have begun to provide formalized risk assessment training for urban forestry staff, either through internal education or outside course providers and certifying organizations such as the International Society of Arboriculture.

2.2.3 *Tree Protection*

Many municipalities have developed comprehensive tree protection specifications for implementation during construction near trees. Leading examples include:

- City of Burlington, ON – *Spec No. SS12 – Tree Protection and Preservation*
- City of Palo Alto, CA – *Tree Technical Manual*
- City of Toronto, ON – *Tree Protection Policy and Specifications for Construction near Trees*
- 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, York Region and Palo Alto have compiled wide-ranging ‘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.

2.2.4 *Asset Management Systems*

A few municipalities have integrated, or are beginning to integrate, urban forest management into digitized, enterprise-wide physical asset management systems. Two examples are reviewed below:

City of Burlington, ON

Burlington currently operates *Avantis* Enterprise Asset Management (EAM) as its corporate physical asset management system. Currently, *Avantis* enables several departments and business units to more effectively manage physical infrastructure such as sewers and roads, as well as fleet vehicles. The City’s urban forest management plan recommends that Burlington integrate its existing 52,000+ tree inventory, risk assessment and cyclical pruning programs into the *Avantis* EAM.

Town of Oakville, ON

Oakville currently operates Azteca Systems, Inc. *CityWorks*, an ESRI GIS-compatible digital asset management system which includes basic information regarding the Town’s trees. The Town’s urban forest management plan recommended that basic GIS information concerning Town’s trees be made available online for public use, and that the system be configured to track tree survivorship, which will aid in future tree species selection for establishment on municipally-owned property. The plan also recommended that the system be configured to provide an annual summary of all risk trees to be inspected.

Other municipalities, such as Ann Arbor, MI and New York City, have also implemented *CityWorks* and integrated their GIS-based inventories with this asset management system. The Town of New Tecumseth is also in the process of implementing a *CityWorks* system.

A large number of tree inventory and asset management systems are available for commercial use or in the public domain. A comprehensive review of several of these systems is provided in Andreu *et al.* (2009).

2.3 Opportunities for Improvement in Ajax and Related Recommendations

Opportunities for improvement identified for the Town of Ajax related to the various aspects of municipal arboriculture are described below. Associated recommendations related to these opportunities are highlighted in **bold**, and presented more succinctly in the Five-Year Management Plan (along with anticipated outcomes, costs and suggested timing).

2.3.1 Management and Administration

While there is generally good cooperation among Town departments on many urban forestry issues, staff report that a lack of coordination on certain projects or initiatives occasionally results in damage to trees, establishment of poor planting stock, and other issues which can adversely affect the sustainability of the urban forest. Currently, Planning and Development Services circulates Site Plan applications to the Director of Operations and Environmental Services for comment. Operations and Environmental Services staff are an integral component of the Site Plan Review Team and are regularly invited to attend Site Plan Design/Pre-consultation Team meetings (held every Tuesday morning at Town Hall). However, **additional resources are required to ensure that Operations and Environmental Services staff are involved in all site plan reviews where trees may be affected, and to provide follow-up site inspections to ensure compliance with tree preservation plans.**

This process could also be strengthened through improved interdepartmental communication. It is therefore **recommended that the Town establish an Urban Forestry Working Group (UFWG)**. This group will consist of staff from appropriate Town departments including Operations and Environmental Services, Legislative and Information Services, and Planning and Development Services. Given the nature of urban forestry operations, representatives from local utility companies (e.g., Veridian) should also be invited to participate in meetings of the UFWG when appropriate. The group should also meet and maintain contact with appropriate staff from Durham Region and Ministry of Transportation for issues related to tree protection, maintenance and planting along regional and provincial roads, as well as TRCA and CLOCA for collaborative tree planting/naturalization efforts on Town and conservation authority lands. The group will meet on a regular basis (e.g., bi-monthly) and work collaboratively to coordinate efforts for tree protection, maintenance and replanting on public lands, as well as ensuring that consistent standards and best practices are applied to tree protection and replacement on private lands. The group will also work with existing working groups such as the Site Plan/Pre-consultation Team, Subdivision Team and Parks Design Team for information sharing purposes.

2.3.2 Tree Inventory

The importance of undertaking a tree inventory to inform the Town's management decisions cannot be emphasized enough. The data collected through such an inventory can be used for a wide range of purposes ranging from identification of plantable spaces and areas of mature trees in need of **underplanting**, to assessment of the percentage of municipal trees vulnerable to a given pest. The Town should undertake a GIS-based public tree inventory that is compatible with the forthcoming corporate asset management system and with **i-Tree** benefit-cost analysis software. The inventory should first be conducted for publicly-owned street

trees and should, over time, extend to Town parks. The Town should ensure that inventory data can be fully integrated into the corporate asset-management system and should establish a system to enable continuous data updating and work order processing. Basic inventory data and mapping should be made available online for public use.

The Town should also explore opportunities for a more comprehensive tree inventory, also to be fully compatible with the corporate asset management system that includes trees to be assumed by the Town on lands identified for development.

2.3.3 Tree Maintenance

Service Delivery

The urban forest management service delivery model implemented in Ajax is consistent with that of many municipalities, and seems to work well. The main strengths of the joint service delivery model are efficiency and cost effectiveness. There are limitations to this method of service delivery; for example, tree pruning quality and worker safety may be harder to quantify. These limitations can be overcome by contracting work out to reputable firms according to carefully considered terms and conditions, combined with periodic inspections to ensure compliance.

Block Pruning

The Town's eight year block pruning cycle is consistent with practices in many other municipalities and trees should continue to be pruned in accordance with the ANSI A-300 pruning standards by ISA-certified arborists only, as per current practices. There are, however, several opportunities to improve the Town's block pruning program.

Firstly, economic analyses suggest that scheduling tree maintenance by species, age class and location is the optimal way to structure a grid pruning program. While the Town has a list of streets characterized by dominant tree species, scheduling pruning by such attributes will not be feasible until a street tree inventory (at minimum) is conducted. Furthermore, such pruning is generally not feasible due to time and resource constraints. Therefore, it has been found that a four to five year pruning cycle generally provides the optimum balance between operating costs and maintained tree value (Miller and Sylvester 1981). Various municipalities, however, successfully implement a wide range of schedules and practices which can enable longer pruning cycles to work effectively.

Secondly, the Town's **pruning and inspection cycle should be integrated with the forthcoming corporate asset management system**. This will enable the Town to effectively track the work histories of individual trees and enable simultaneous inventory updating. Over time, grid pruning can be prioritized by actual work requirements and varied cycles can be set up for different parts of the Town.

Young Tree Pruning

Currently, the Town does not prune newly-established trees more often than during the course of the grid pruning cycle, potentially leaving young trees to irreversibly develop poor structure that can contribute to future health problems and increased risk and maintenance costs.

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.

The Town should provide young tree pruning training to all urban forestry staff, as well as to seasonal **Plant Health Care** technicians. Annual planting lists should be used to direct the pruning, which should take place in the third, sixth and ninth years after planting. While the number of trees planted in Ajax varies annually, the Town plants up to 800 trees per year as part of operations and capital expenditures, and an additional 1,500 are planted through development. Pruning these trees according to the above-described **schedule will likely require an additional seasonal Plant Health Care technician**, preferably hired in the spring, fall or winter to minimise stress on pruned trees. Doing so will realize substantial short and long-term cost savings and risk prevention by excluding these trees from the regular grid pruning cycle as well as through reducing long-term future maintenance requirements.

In the short term, this new approach to young tree pruning should apply to lands currently owned by the Town of Ajax and trees located on the Regional Road allowance. However, Town staff should, through the Urban Forest Working Group (see Section 2.3.1), investigate opportunities to expand this program to trees on lands that are to be assumed by the Town as part of the development process. This will require the Town to work with developers to determine if young tree pruning on lands to be assumed by the Town can be initiated following Site Plan Approval, but prior to actual assumption of the developed lands by the Town.

Plant Health Care

Ajax has recognized the importance of a holistic, ecologically-sound approach to managing plant health issues through the implementation of a number of PHC initiatives such as site-specific tree selection, watering and mulching, stake removal, and general health assessment. Strategies and recommendations to address other PHC-related issues, such as young tree pruning, pest and disease management and tree establishment, are addressed in other sections of this Plan.

Utility Line Maintenance

There are **several opportunities to improve the management of Town trees with respect to utility line clearing**. These include, but are not limited to:

- Ensuring that tree health and structure are maintained and promoted during utility line clearing;
- Better coordinating grid pruning and utility line clearing to minimize work duplication and increase efficiency;
- Improving public awareness about the role and responsibilities of the Town as compared to those of utility arboriculture staff and contractors;
- Coordinating with utility contractors (i.e., Veridian) to enable tree removals and possibly stump removal, and;
- Sharing Town objectives and standards with utility contractors and encouraging compliance with them.

These challenges can most effectively be addressed through the establishment of an Urban Forestry Working Group that includes Town staff from all relevant departments. It is recommended that representatives of **Veridian and other local utility and telecommunications companies are invited to participate in the meetings of the Urban Forestry Working Group**, either as regular members or through occasional sessions.

Risk Management

The Town does not currently have a formalized tree risk inspection or reporting process, and generally relies on customer service requests or grid pruning inspection and maintenance to identify and mitigate potential tree risk. The key to effective risk management lies in an operational policy that coordinates inspection, mitigation and proactive planning in order to improve safety and reduce risk, uncertainty and liability.

Key components of an effective risk management policy or strategy include:

- Policy statement, framing the scope of the policy and assigning responsibility, goals and standard of care statement;
- Determination of acceptable risk;
- Minimum training and qualifications of risk assessors;
- Frequency of assessment;
- Management options;
- Record-keeping protocols;
- Strategy funding and/or partnerships, and;
- Program assessment and reporting.

It is therefore **recommended that a formal urban forest risk management policy be developed** to confirm successful inspection and pruning practices currently in place and further develop these programs to enhance risk management. A dedicated policy will set minimum standards for risk inspection and documentation, resulting in consistency of assessment and sustained resources for inspection over the long term.

It is also **recommended that all Town arboriculture staff obtain formal risk assessment training**, and that this level of competency be set as a requirement in the standard of care statement in the Town's tree risk management policy. As opportunities for risk assessment certification become available, Town staff should also obtain such accreditation.

2.3.4 Tree Protection

Absent from Ajax's tree protection specifications, but included in the policies and standards of several other municipalities, are specifications regarding trunk diameter-based Tree Protection Zones (TPZ), root protection (including root pruning outside of TPZs), arborist reports, protection hoarding material and improved installation techniques, and soil conservation.

It is recommended that the Town update its tree protection specifications to be consistent with leading examples from other municipalities. It is further recommended that the Town compile a 'tree technical manual' which outlines all of the relevant policies and practices with respect to tree protection and establishment on all public and private property, as applicable during the site plan approval process.

A key opportunity for improvement will be to implement a consistent standard for **Tree Protection Zone (TPZ)** radius, to be applicable wherever TPZs are required. For instance, existing by-laws specify a 2metre TPZ radius for a tree less than 40centimetre in diameter, and a 3metre TPZ radius for a tree greater than 40centimetre in diameter. While it is assumed that TPZ radius is measured from the base of the tree, existing by-laws do not specify from where (tree centre, tree trunk or drip line) the radius is measured. Conversely, some staff specify a 1 metre TPZ radius from the dripline, regardless of the tree size. These standards need to be made

consistent, and it is recommended that TPZ zones are set according to the subject tree’s DBH (diameter at breast height).

2.3.5 Asset Management Systems

The Town is in the process of selecting an asset management system to be implemented across the corporate structure. While it is beyond the scope of this Plan to evaluate potential systems from an **urban forest** management perspective, it is recommended that the selected system be optimized to manage tree inventory and work order tracking information, and be fully GIS-compatible and sufficiently customisable to enable collection of specific attributes and compatibility with i-Tree benefit-cost analysis software.



“[T]he Town should remain committed to its role as a leader in environmental responsibility and continue to design parks that incorporate natural, indigenous vegetation features in order to foster an appreciation for such areas and maintain crucial ecological functions”.

Town of Ajax Recreation, Parks and Culture Master Plan (2008)

3. Tree Establishment and Urban Forest Enhancement

Poor growing environments and lack of suitable tree habitat are central problems in current **urban forest** management. In most urban environments, soil volume, quality and drainage are insufficient to promote tree longevity and growth. Furthermore, urban soils are often disturbed for infrastructure projects, as are the tree roots growing within them. Above ground, utility wires, buildings, and people compete for the same space as branches, leaves and trunks. As a result, trees are rarely able to attain their full **genetic potential**, thereby providing fewer benefits and increasing management and maintenance costs. Improving above- and below-ground conditions for trees, especially in intensively-managed areas where people, trees and other municipal infrastructure interact, will be increasingly important as global climate change brings likely increases in temperatures, drought frequency and duration, and damaging winds.

Urban trees with adequate growing space will be more resilient to such environmental extremes and the rigours of daily existence. Strategies and mechanisms for growing and managing a high quality urban forest which provides the greatest benefits possible are presented in this section. Key considerations include **species diversity** and planting stock selection, location-specific issues and key planting locations. This information is presented in the following sub-sections:

- 3.1 – Tree establishment context
- 3.2 – Current practices in Ajax
- 3.3 - Best practices and opportunities for improvement

The “opportunities for improvement” section includes recommendations intended to improve and optimize Ajax’s tree establishment and urban forest enhancement practices. These recommendations are consolidated and re-iterated in the Five-Year Management Plan as specific actions with anticipated outcomes, costs and suggested timing.

3.1 Tree Establishment Context

3.1.1 *State of Ajax’s Urban Forest*

Ajax’s urban forest is estimated to comprise of 1,365,760 trees ($\pm 228,063$). About 32,000 of these are **street trees** on municipal rights-of-way. The most common tree across the Town is Eastern white-cedar (*Thuja occidentalis*), as it is a very common hedge species. Sugar maple (*Acer saccharum*) comprises the most leaf area (22.6%) and second-most individual stems (11.4%), and Norway maple is the most common tree in residential areas, comprising roughly 8.8% of total urban forest leaf area. The invasive common buckthorn (*Rhamnus cathartica*) is also found throughout Ajax (TRCA 2009a, Gregory et al. 1999).

Given the history of clearing and the fact that many trees in the urban area have been planted relatively recently, it is not surprising that approximately 44% of all trees fall within the smallest diameter class (i.e., less than 7.6 cm diameter) while about 86% of trees are less than 22.6 cm diameter and less than 2% are more than 61 cm diameter at breast height (DBH). The relative “youth” of Ajax’s urban forest, combined with the abundance of Eastern white cedar and buckthorn, which tend not to grow to great diameters even at maturity, contributes to this unevenness in size classes.

3.2 Current Practices in Ajax

3.2.1 Management, Administration and Planting Stock Selection

The Town plants trees as part of capital projects (approximately 250/year) and through operations (approximately 500/year). Additionally, up to 1,500 trees are planted annually in new development areas as part of the site development process. The latter trees are not planted by the Town, which assumes responsibility for them when it assumes responsibility for the rest of the services in a given subdivision.

The Town contracts the supply and delivery of trees for a term of three years through a competitive bidding process. The Town provides bidders with Schedule 'A' and 'B' tree species lists. Trees in Schedule 'A' are considered preferable and are typically of a higher cost than Schedule 'B'.

In total, 50 species are included in the planting schedules. Of these, 21 are native, 39 are non-native, and 6 are invasive or potentially invasive (Norway maple including 'Crimson King', Amur cork-tree, Amur maple, Tatarian maple and weeping willow). Ash trees (*genus Fraxinus*) are notably absent from the approved species list, due to the impending threat of Emerald Ash Borer.

The planting list for spring 2010 includes 14 species:

- Black walnut – *Juglans nigra*
- Colorado blue spruce – *Picea pungens*
- English oak – *Quercus robur*
- Freeman maple – *Acer x freemanii*
- Japanese Tree Lilac – *Syringa reticulata*
- Linden – *Tilia* sp.
- London planetree – *Platanus occidentalis*
- Pear – *Pyrus* sp.
- Red maple – *Acer rubrum*
- Red oak – *Quercus rubra*
- Silver maple – *Acer saccharinum*
- Sugar maple 'Green Mountain' – *Acer saccharum*
- Tulip-tree – *Liriodendron tulipifera*
- White pine – *Pinus strobus*

There is no preference for local or native seed sources in the contract tenders. Unless otherwise specified, all trees for operations and capital projects must be 50 mm caliper or 200 cm tall (for coniferous trees) wire basket stock, as outlined in the tender documents. Planning and Development Services Department Design Criteria (for subdivision street trees) require 70 mm caliper trees, while Site Plan Application Guidelines require a minimum 60 mm caliper for deciduous trees and 180 cm height for conifers. Conifers are not planted as street trees. It is not always clear when each guideline is to be applied, and why the range in minimum acceptable stock sizes exists.

All trees are expected to be nursery grown in accordance with the *Canadian Standards for Nursery Stock* as published by the Canadian Nursery Landscape Association.

3.2.2 **Tree Habitat and Planting Specifications**

Operations and Capital Projects

Like supply and delivery, tree planting is contracted by tender for a term of three years. Specifications for planting are outlined in the tender documents, and include conditions such as hand digging of holes, minimum standards for soil quality and watering, among others.

Street trees

For new planting areas along Town streets, the Planning and Development Services Department has developed specifications for deciduous street tree planting (DS201). For urban settings, the tree pit, grate and guard detail (DS205) can also be used as a planting standard. Coniferous tree planting (DS202) and shrub planting (DS203) are not allowed as street trees. Standards for coniferous and shrub plantings are only for public park areas and private site plan areas.

Deciduous trees planted in a row are to be centered 5 to 7 m apart for small flowering trees, and 7 to 12 m apart for shade trees; evergreen trees are to be spaced 4 to 8 m apart.

Parking Lots and other Large Asphalt Areas

Trees planted on the edges and within parking lots provide immense benefits by reducing air conditioning use, cooling air and surface temperatures, and prolonging asphalt lifespan. However, trees often suffer in these environments due to lack of water, heavy salt use, inadequate rooting space, reflected heat and physical damage from vehicles.

As outlined in the Town's *Site Plan Review Manual, 2009*, landscape strips adjacent to parking areas are required to provide large growing deciduous shade trees on 7 to 9 m centres and must also include appropriate ground covers. Mulched shrub beds are typically required in front of parking areas to help screen parked cars. Large asphalt areas are also typically framed by curbed planting islands a minimum of 3.0 m width (preferably 4.5 m) and shall include drought-resistant trees and/or shrubs. Plantings shall not obscure a driver's sight lines (i.e., shrub planting not exceeding 60 cm in height).

While most Town specifications are consistent with best practices, several opportunities for improvement are available, as discussed in Section 3.3. The Town may, however, retain securities for plant survival for up to five years at its discretion.

3.2.3 **Planting Locations**

Currently, trees planted in Ajax are typically established to replace removed trees, fill available boulevard planting spaces and complement existing street tree plantings. The absence of a street tree inventory makes planting to achieve specific diversity, size class and other objectives difficult.

Trees in new developments are planted in accordance with Design Criteria guidelines, which address considerations including **species diversity**, spacing, offset from utilities, stocking density and aesthetics. One objective of these guidelines is to provide for sufficient mature tree canopy in new developments. Currently, conflicts with utilities and infrastructure, design considerations and space issues may result in less than one tree being established per new development lot.

Trees are also established as part of capital projects. For example, extensive tree planting began in the Pickering Beach area in Spring 2010. This area was identified as a priority for tree establishment because infill development and intensification in the 1980s and 1990s resulted in significant **canopy cover** loss. Site plan application surcharges collected at that time are now to be used to plant trees in this location and increase **urban forest** canopy in this area.

Other capital projects through which trees will be planted over the next five years include:

- Greenwood Conservation Area trailhead improvement
- Hermitage Park upgrades
- Waterfront Park East and ‘gateway’ upgrades
- Lynde Marsh Acquisition Area – Community Communications Property
- Paradise Park Improvements, and
- Cedar, Devonside, Miles and Duffins Park playground replacement programs.

3.2.4 **Monitoring, Site Supervision and Inspections**

Because the supply/delivery and planting services are governed by two separate contracts and trees are delivered directly to the Operations Centre, trees are generally inspected prior to planting, thereby ensuring that fairly high quality planting stock is established. Trees are inspected again after planting.

Recently-planted trees are monitored by seasonal **Plant Health Care** technicians. Currently, neither the tree supply and delivery nor tree planting contracts carry a warranty period. However, staff report fairly high planting success, due in part to the rigorous specifications outlined in the contract tenders and the pre- and post-planting inspections.

Trees planted in new developments are not regularly inspected by Town staff prior to or immediately after planting. However, staff in Planning and Development Services perform an initial street tree inspection prior to the subdivision entering the ‘above-ground maintenance period’ and provide the developer with a deficiency list if necessary (which the developer then has to rectify). Staff then perform a final street tree inspection prior to the assumption of the subdivision and, if needed, generate another deficiency list that the developer has to address prior the subdivision being assumed by the Town. Once the subdivision is assumed, Operations and Environmental Services staff takes on the responsibility for monitoring and maintenance of the street trees.

3.3 **Best Practices, Opportunities for Improvement and Related Recommendations**

Best practices and opportunities for improvement identified for the Town of Ajax related to the various aspects of tree establishment and urban forest enhancement are described below. Associated recommendations related to these opportunities are highlighted in **bold**, and presented in a more consolidated manner in the Five-Year Management Plan (along with anticipated outcomes, costs and suggested timing).

All of the following best practice considerations should be formalized and consolidated in a Town-wide ‘Tree Technical Manual’ that builds on a number of the Town’s existing guidelines, criteria and specifications related to tree establishment, as discussed in Section 2. Such a manual should include specifications and discussion regarding:

- guidelines for tree habitat including adequate soil volumes, soil depths, and basic soil quality requirements;
- specifications for typical right-of-way cross-sections (e.g., arterial, collector, local, etc.), new subdivisions, parklands and open space that integrate appropriate tree rooting environments;
- a list of recommended trees and shrubs with indications of suitability for different conditions and that account for urban forest diversity targets, and;
- requirements for an arborist to review and supervise proper implementation of plans, and follow-up both immediately and two years post-construction to assess survival

Specific guidance related to these topics is provided below, along with recommendations related to further research required regarding suitability trials.

3.3.1 **Management, Administration and Planting Stock Selection**

Site-specific Tree Selection

A key component of urban forest sustainability and **Plant Health Care** is appropriate, site-specific tree species selection, or planting “the right tree in the right place”. Currently, the Town maintains a list of acceptable species through the Planning and Development Services Department Design Criteria. While the list is fairly comprehensive and diverse, there is no indication of the suitability of different species to specific soil types, planting locations, and maintenance requirements. Furthermore, the list differs from the Operations and Environmental Services species schedules.

It is recommended that the Town’s Planning and Development Services Design Criteria list be modified to provide consistent Town-wide standards, and to include greater detail, including size at maturity, soil pH, texture and volume requirements, tolerances and common characteristics, in order to enable selection of more appropriate tree species for planting along Town streets and in other public areas. Both the Design Criteria list and Town schedules ‘A’ and ‘B’ should be updated to include the same species, in order to ensure the application of consistent standards and practices and increased urban forest diversity. Notably, all schedules should exclude trees considered to be moderately to highly invasive such as Norway maple (including ‘Crimson King’ and other cultivars), Amur cork-tree, Amur maple, Tatarian maple and weeping willow.

In response to anticipated climate changes, **planting trees tolerant of warmer and drier summer conditions, particularly when planting in open areas such as along roadways or sidewalks, as well as native species that are currently at the northern limit of their ranges**, should also be undertaken. These plantings should be regularly monitored as a form of species suitability trial; results can then be used to inform future planting decisions.

Local Seed

Given the increased resilience of locally-sourced planting stock to biotic and abiotic stressors, in comparison to non-native seed stock of the same species, **the Town should investigate undertaking longer-term growing**

relationships with nursery stock providers to include growing stock from locally-sourced seed. This may require developing a program to collect native seed, as well as longer-term stock growing and supply contracts. The Forest Gene Conservation Association is a good resource for information concerning local seed collection, storage and propagation.

Species and Structural Diversity

Tree species selection should ultimately be informed by the findings of a tree inventory. Areas with an abundance of mature trees should be targeted for proactive **underplanting** of trees and shrubs, while areas with low **species diversity** should be considered as candidate areas for the establishment of underused species. Overly-abundant species (such as Norway maple) and species susceptible to potentially catastrophic pest or disease infestations should also be avoided. Ideally, **in the urban matrix neighbourhood-level tree species diversity should conform to the 30-20-10 rule of acceptable diversity** 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.

Upon completion of a public tree inventory, Town planting initiatives can also be informed by the Relative Diameter at Breast Height (RDBH) criterion, with the ultimate objective of an even distribution of trees among four general age/size classes.

The Town should also undertake street tree species suitability trials, whereby individual trees planted in a variety of sites will be regularly monitored and reported on with the purpose of developing a species profile to guide future tree establishment decisions and species selection. Species selection should always avoid tree species known to be invasive, and include as great a diversity of native or indigenous species as possible, recognizing that under harsh urban site conditions sometimes non-invasive, non-natives can have greater growth and longevity.

These species diversity and size class guidelines are not intended for application in natural areas, woodlots or similar lands, where natural stand dynamics, species composition and **successional processes** should be encouraged.

3.3.2 Tree Habitat and Planting Specifications

Soil Volume

Town tree pit specifications require approximately 2.2 m³ of soil volume which, while insufficient to enable the growth of large-stature trees, exceed the minimum volumes required by some municipalities. Urban (1992) discusses minimum recommended soil volumes for street tree plantings, by mature tree size. Research **indicates that *minimum soil volume for optimal tree growth is 2 cu. ft. (0.06 m³) for every square foot (0.1 m²) of future crown projection area***, and greater soil volumes should be encouraged wherever possible. The Town should amend the Site Grading Notes (Section 3.4.10) in its *Site Plan Review Manual, 2009*, to require the same minimum soil volume noted above for tree planting in new developments, where possible.

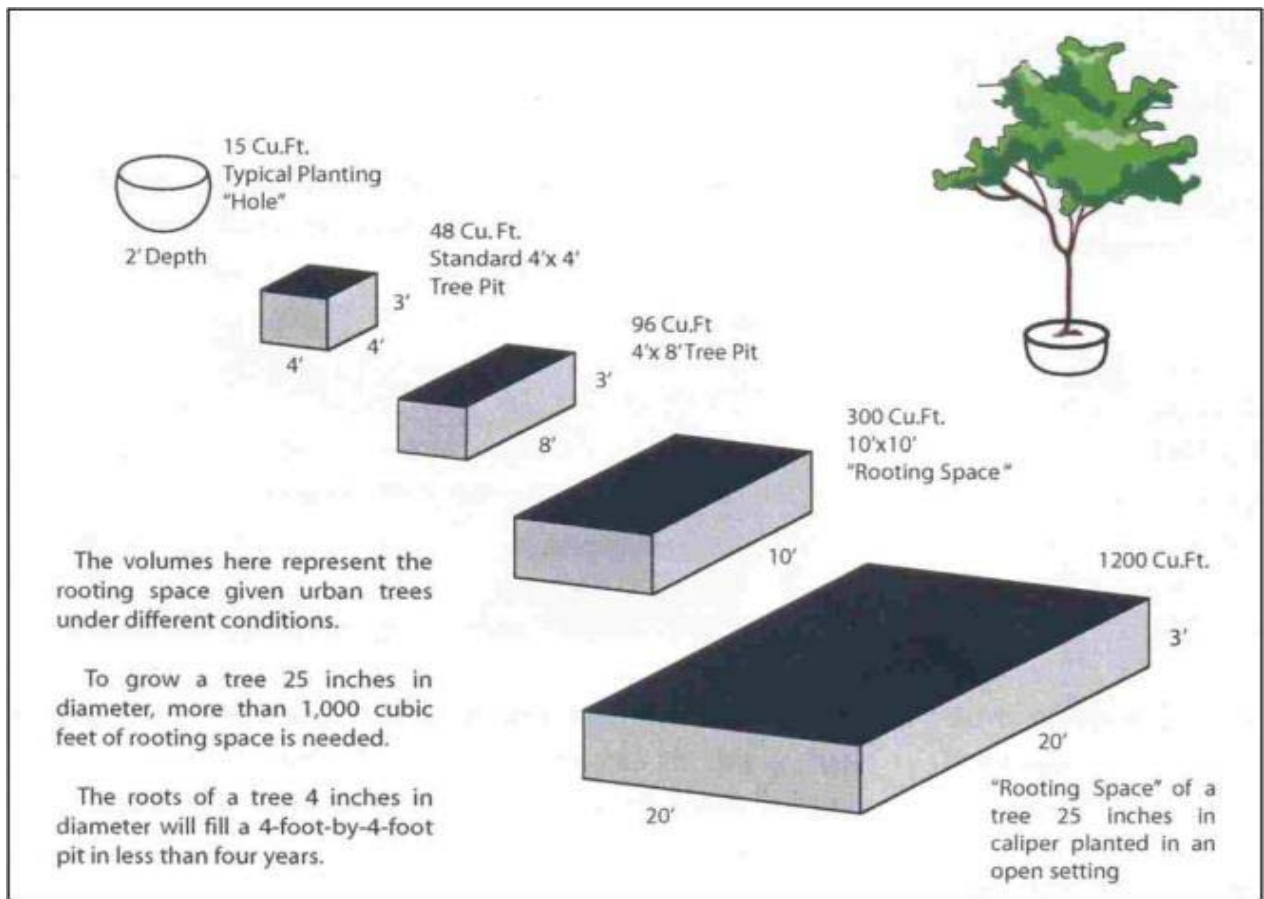


Figure 5: Rooting space required for growing trees in urban settings.

For parking lots and other large asphalt areas, the Town's minimum size requirements for tree islands and borders are consistent with or exceed practices in other communities; for example, minimum widths in Burlington are 2.5 m, and 3 m in Toronto. However, Toronto typically requires a minimum soil depth of 900 mm or soil volume of 30m³ for most parking lot row islands. The effectiveness of the latter requirement in promoting optimal tree growth depends upon many factors, including species selection, watering and drainage, and surrounding landscape design.

The Town should, whenever possible, require optimal soil volumes as well as the widest possible row islands and borders if high-quality shade trees are to be included as a long-term feature in parking lots or other large asphalt areas. The incorporation of bio-retention areas and permeable surfaces should also be encouraged, provided salt use is relatively low.

Minimum soil requirements being put forward by municipalities are highly variable, but provide some guidance in terms of current minimum and maximum standards being adopted. The City of Toronto's *Design Guidelines for 'Greening' Surface Parking Lots, 2007*, provide an excellent resource for tree-amenable parking lot design. The City of Nanaimo, BC requires a minimum of 4 m³ of soil for street tree plantings for trees

planted in hard surfaces. Trees in Calgary, AB are provided a minimum of 14 m³ of soil volume in sidewalk plantings. The Town of Oakville, ON, developed the “Tree Habitat Design Guidelines for Oakville” based on the work of Lindsey and Bassuk (1991). It was determined that large-stature trees require 98 m³ of soil volume, medium trees require 44 m³, and small trees require 16 m³. Both the Oakville and North Oakville UFMPs recommend that these be adopted as minimum engineering guidelines.

Soil volume guidelines can be difficult to implement or enforce following completion of development plans and designs, and should not be an afterthought in the planning process. Rather, adequate space for desired future trees should be identified early on in the process and implemented by requiring a minimum soil depth in combination with minimum tree pit dimensions, specified in construction drawings. If required, staff may also take soil core samples to confirm soil depth and assess volume.

Soil Quality

Ajax’s current soil quality specifications do not conform to best practices. Contrary to current specifications, **planting soils should not be screened** (in order to maintain their structure), **and soil organic content should not exceed approximately 5%** (contrary to the 10% specified) in order to avoid drainage and soil pH problems.

Tree Pit Design and Below-ground Tree Habitat

Ajax specifications also require the installation of metal grates and tree protectors. Unless carefully designed and implemented, neither is considered a good practice for tree establishment. Both types of installations may girdle or otherwise damage trees if not properly maintained. The cost increases for these methods should be redirected towards improving soils and planting locations. **Regular inspection and maintenance are required if installation of metal grates and tree guards is to continue in Ajax.**

It has now been recognized that standard tree pits generally do not enable trees to reach their full **genetic potential**, often leading to early mortality and increased maintenance requirements. **The Town should therefore investigate the implementation of advanced rooting environment techniques**, particularly sub-soil structural cells (often known as ‘Silva Cells’). This investigation should include several real-world feasibility and proof-of-concept studies, which would involve selecting appropriate locations, soil mixes and tree species for regularly-monitored street tree planting trials.

Implementing advanced rooting environment techniques and technologies may increase the up-front cost of some projects, but cost savings can be realized by directing a larger share of funds for nursery stock towards lower-density, higher-quality plantings which will have a much greater likelihood of attaining large size at maturity. Additional savings come from reduced costs of future tree maintenance, storm water management, energy use, and even health care, as larger, healthier trees provide far more benefits than small trees which require more frequent replacement.

Planting Stock Type and Size

Given the low costs and potentially high quality of bare-root planting stock (Trowbridge and Bassuk 2004), the **Town should also undertake planting trials with bare-root planting stock**, particularly in conjunction with enhanced rooting environment techniques.

The Town should consider streamlining all standards and specifications to require 50 mm **caliper** stock in new developments and street tree plantings, as larger stock is more difficult to establish in the poorer soils typically found in many new developments (Trowbridge and Bassuk 2004). **Planning and Development and Operations and Environmental Services staff should collaborate in the development of a harmonized standard for planting stock size.**

Watering

Given the importance of adequate watering to ensure successful tree establishment, **the Town should ensure that newly-planted trees are adequately watered for a minimum of two years after planting, especially during periods of drought.** This can be achieved through the existing **Plant Health Care** program in conjunction with improved public outreach and education about the importance of proper watering for young trees. The **Plant Health Care** process should be discussed with the Urban Forest Working Group, and Planning and Development Services, to ensure that critical aspects are implemented as soon as trees are planted.

Fertilization

Fertilization of urban trees should be applied on an as needed, case-by-case basis. Newly-planted trees should not be fertilized, as over-fertilization may result in damage to critical fine roots. Trees stressed during construction may be considered on an individual basis for fertilization with slow-release fertilizer. Trees in actively-managed turf areas should generally not be fertilized above and beyond the fertilization provided to surrounding grass in order to avoid root damage from over-fertilization.

3.3.3 Planting Locations

The Town's 2009 Urban Forest Study put forward several general recommendations to guide the location of future tree plantings on the basis of maximizing the ecological benefits provided by future urban forest canopy. Specifically, the study recommends that areas of the Town where the highest daytime heat signatures were recorded should be targeted for increased planting. Their study found that **downtown core areas and low/medium-density residential areas** are substantially warmer than surrounding land uses (see Figure 4).

Native and non-invasive trees should also be planted in **areas of poor air quality** (e.g., arterial roads) and near local emission sources. Hardy trees with a high contribution to air quality improvement should be used in these areas. Some examples are:

- Tulip-tree – *Liriodendron tulipifera*
- Basswood – *Tilia americana*
- Horschestnut – *Aesculus hippocastanum*
- Common hackberry – *Celtis occidentalis*
- Red and Freeman maple – *Acer rubrum* and *A. x Freemanii*
- Kentucky coffee-tree – *Gymnocladus dioicus*

Additionally, tree establishment should be directed to areas where trees will provide shade to residents and visitors who may be exposed to ultraviolet radiation, such as: **bus loops, walkways, trails, cycling paths, parks and other places where people gather for social / cultural activities.**

Strategies for incorporating **green infrastructure** into urban lands, particularly where intensification will take place, include, among others:

- Reducing, where possible, non-climate stressors on urban woodlands and in wooded ravines (e.g., invasive plants) and managing for multi-species and multi-aged stands;
- Reviewing and improving strategies for coping with pest invasions;
- Developing extreme weather response plans for managing damage to trees following storms;
- Protecting and creating connected greenways to facilitate species movement;
- Exploring research partnerships with local academic institutions and other organizations to evaluate the survival of certain tree and shrub species under controlled conditions to guide species selection;
- Embracing **Low Impact Development** measures such as integrating trees, shrubs and herbaceous plants into stormwater management areas designed to promote infiltration (e.g., naturalized stormwater management ponds, bio-swales beside roads, naturalized creek edges, etc.);
- Ensuring a specified minimum percentage of tree cover in parks, parking lots and other commercial and institutional open spaces to maximize the shading and cooling potential of trees. Use of tools such as improved tree pits, continuous soil trenches and structural cells can maximize the extent and suitability of below-ground rooting areas without sacrificing above-ground space for parking, sidewalks and other urban amenities;
- Providing incentives for, and improving awareness of, proper tree planting and care on private lands such as front and rear yards. Trees planted in yards generally exhibit significantly improved growth and survival compared to those planted in boulevards or in tree pits. Increasing public awareness about the importance of front and rear yard planting will play an important role in establishing more trees in high-quality habitat and promoting a healthy urban forest; and
- Recognizing other opportunities for urban forest replenishment on lands not owned by the Town, including school grounds, conservation authority lands, industrial areas and business parks, institutional lands, golf courses and cemeteries.

3.3.4 **Site Supervision and Inspections**

The current inspection protocol is sufficiently robust to enable the assessment of nursery stock condition immediately prior to and after planting, as well as the condition of trees one or more years after (through **Plant Health Care** inspections). This process exceeds the standard found in many municipalities, where nursery stock is often not inspected or only random sample inspections take place. Nevertheless, staff reports that resources are not always available to enable such inspections, leading at times to the establishment of poor stock or even incorrect tree species. Furthermore, the successful implementation of several of the recommendations provided in this section (e.g., regarding soil volume, stock selection, tree habitat design, etc.) will require additional follow-up and monitoring by Town staff. Therefore, **effective monitoring of new plantings, particularly according to updated standards, will require additional capital and human resources.**

“Insect and diseases that attack the vegetation should be considered a natural process, and will not be controlled, except in the instance where they threaten the integrity of the vegetation community. Where control of infestations is required, it will be directed narrowly to the specific problem. Biological, rather than chemical control should be used wherever feasible”.

Greenwood Conservation Area Management Plan (2004)

4. Urban Forest Pest Management

Among the most serious threats to **urban forest** health and sustainability are alien and **invasive species**. Alien species are defined as “species of plants, animals and micro-organisms introduced outside their natural past or present distribution. Alien species become invasive when they establish and spread in a new environment, and threaten the **native species**, the environment, the economy, or some aspect of society” (Environment Canada, 2009). Urban forest pests and pathogens may cause rapid and widespread tree decline and mortality, or may change forest structure and population dynamics over time. Either way, proactive monitoring, identification and management of urban forest pests are critical to the long-term sustainability of the urban forest.

As international trade and the movement of goods have accelerated, the number of introduced and invasive plants and animals has dramatically increased. Eastern North America has a long history of significant damage to trees in urban forests and woodlands caused by invasive pests. The most notable examples are the loss of virtually all American chestnut (*Castanea dentata*) trees due to chestnut blight and the death of the vast majority of white elm (*Ulmus americana*) trees from urban and rural areas due to Dutch Elm Disease.

Today, a number of pests and pathogens continue to threaten trees and forests in southern Ontario. This section of the Plan reviews the greatest threats to urban forest health in Ajax, including invasive insect pest, pathogen and plant species. Recommendations for monitoring, mitigating and preventing future invasions and outbreaks are also presented.

This section is organized according to the following sub-sections:

- 4.1 – Urban forest pests, pathogens and plants of concern in Ajax (including a pest vulnerability matrix)
- 4.2 – Current pest management practices in Ajax
- 4.3 – Opportunities for improvement
- 4.4 – Pest-specific management strategies

The “opportunities for improvement” section includes recommendations intended to improve and optimize Ajax’s pest management practices. These recommendations are consolidated and re-iterated in the Five-Year Management Plan as specific actions with anticipated outcomes, costs and suggested timing. A sample strategy for dealing with a current pest of significant threat is also provided for Emerald Ash Borer (EAB).

4.1 Urban Forest Pests, Pathogens and Plants of Concern in Ajax

In the past eight years, two highly-destructive forest pests have been discovered in Ontario: the Asian Longhorned Beetle and the Emerald Ash Borer. The Asian Longhorned Beetle (*Anoplophora glabripennis*) was discovered in an industrial park between the cities of Vaughan and Toronto in September, 2003. The Emerald Ash Borer (*Agrilus planipennis*) was first discovered in Windsor, Ontario in 2002. Both of these pests have the potential to cause extensive damage to the urban and natural forests of Ontario.

At present, the Asian Longhorned Beetle infestation appears to be fully contained, with only a small area of northern Toronto and Vaughan regulated under Ministerial Orders through the Canadian Food Inspection Agency (CFIA). At the current time, it is unlikely that Asian Longhorned Beetle will pose a serious threat to Ajax's urban forest. However, 64% of Ajax's urban forest is potentially susceptible to various levels of infestation by this beetle.

A pest of more immediate concern is Emerald Ash Borer (EAB) (*Agrilus planipennis* Fairmaire), an introduced insect which kills ash trees (**genus** *Fraxinus*). EAB is considered to be one of the worst invasive forest pests ever to be introduced to North America, and threatens to decimate ash populations across the continent. EAB affects ash trees in urban, suburban and natural forests alike, as larval feeding produces serpentine galleries that disrupt nutrient flow in the affected tree's phloem, usually resulting in tree death within 2-3 years after initial attack.

Increased awareness of EAB and ongoing survey efforts have led to the detection of numerous infestations in the United States and Canada. By the summer of 2009, EAB was found as far north as Sault Ste. Marie, Ontario and as far east as Montreal, Québec. The latest Ontario infestations were found in Ottawa and Brantford. The beetle continues to spread rapidly, leading to massive mortality of ash-dominated forest stands and urban ash trees. EAB has killed or infested an estimated 70 million ash trees since its detection in 2002, and an estimated 10 billion ash trees in Canada and the US are at risk of infestation and death.

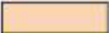



The rapid spread of EAB has been hastened by the inadvertent human transport of beetle-contaminated firewood and other infested ash materials, in addition to the adult beetle's ability to move over 10 km on the wing. Both Canada and the US are dedicated to slowing its spread in order to protect ash resources. Quarantine regulations have been set wherever the pest has been detected but new populations continue to be found at various locations in both countries. The CFIA, under the authority of the *Plant Protection Act, 1990*, has since put regulatory measures in place to restrict the movement of any ash tree materials from infested areas. In addition, the Canadian Forest Service (CFS) has helped develop new international standards for the treatment of wood packing material so that any unwanted pests are destroyed before they are inadvertently transported to another continent. Additionally, the CFIA and CFS have developed sampling protocols to improve the early detection of EAB in urban areas.

Based on the experiences of municipalities already affected by EAB, it appears the infestation cycle may last about 15 years. Following initial contact, noticeable ash mortality appears within about 5 years. Tree mortality rates then peak after another 5 years, followed by 5 years of declining mortality.

Currently, it is not known if Emerald Ash Borer is present in Ajax. However, it is very likely that if an infestation is not already ongoing, the beetle may soon begin attacking ash trees in the Town. According to the 2009 Urban Forest Study, approximately 8% of the urban forest, or 150,000 trees, are vulnerable to infestation by EAB. The entirety of Durham Region is regulated by the CFIA to prevent the movement of potentially-infested wood and wood products.

Table 2: Pest vulnerability matrix of Ajax’s dominant urban forest tree species.

Tree Species/Pest	Borers	ALB ²	DED	Gypsy Moth ³	Anthracnose	Rusts	Aphids/ Scales/ Weevils	Defoliating Caterpillars ⁵	Leafminers/ skeletonizers	Other	% Ajax leaf area ⁶	% Ajax trees ⁶
E. white cedar											5	20.2
Sugar maple										Decline, <i>Verticillium</i> , scorch, leaf stalk borer, gall mites,	22.6	11.4
Buckthorn											3	9.2
White ash	EAB ¹							Webworm		Galls, <i>Verticillium</i> , leaf spot, canker, ash ring spot virus	4.5	9
Eastern hemlock						Needle rust	Woolly adelgid ⁴			Bagworm, mites, sapsucker	5.7	5.5
White pine	Bark beetle, Sirex woodwasp					W.P. blister rust	White pine weevil, adelgid	Sawfly	Needle miner	Bark beetles, mites, decline	2.5	5
Trembling aspen								Tent caterpillar, tortrix		Crown gall, canker	2	4
Green ash	EAB ¹									<i>See white ash</i>	4	3
Manitoba maple										Leaf stalk borer, mites, boxelder bug,	5	3
White spruce							Gall adelgid	Sawfly	Needle miner	Mites	2	3
American elm										Phloem necrosis, leaf spot, cankers	2.5	3
Hawthorn									Sawfly	Lace bugs, fire blight, scab, powdery mildew	2	2.5
Norway maple										Tar spot, <i>Verticillium</i> , girdling roots, scorch, leaf stalk borer	8.6	2

-  - Potential host, damage unlikely to be significant to individual trees.
-  - Occasional-to-common host, damage possible to individual trees *but* unlikely to be significant to individual trees or populations.
-  - Common host, *and/or* damage unlikely to be significant to populations, damage to individuals varies.
-  - Common host, *and/or* damage may be significant to entire populations.

1 – Native ash borers may occur but are unlikely to affect entire populations.
 2 – Other hosts may include *Aesculus*, *Salix*, *Betula*, *Platanus*, *Celtis*, *Sorbus*, *Malus*, *Morus*, *Prunus*, *Pyrus*, *Quercus*, *Robinia* and *Tilia* genera.
 3 – Most common hosts include *Quercus* genus (oaks).
 4 – Not currently observed in S. Ontario.
 5 – Not including gypsy moth.
 6 – Figures in *italics* are estimated.

4.1.1 Pest Vulnerability Analysis

In the absence of a detailed inventory of Ajax’s urban forest, it is difficult to accurately assess the vulnerability of the Town’s trees to specific urban forest pests. However, a pest vulnerability analysis based on the findings of the 2009 Urban Forest Study is presented in Table 2 and addresses the known susceptibility of the Town’s 13 dominant tree species, by leaf area and stem count, to forest pests and pathogens. This approach to pest vulnerability analysis is informed by the work of Lacan and McBride (2008).

Trees which do not make up a dominant part of the Town’s urban forest should not be overlooked with regard to pest vulnerability. Important urban trees include, among others:

- Beech (**genus** *Fagus*) – aphids, borers, scale including beech bark disease, bleeding canker;
- Birch (genus *Betula*) – leafminers, skeletonizer, bronze birch borer, caterpillars;
- Black walnut (*Juglans nigra*) – fall webworm, scales, mites, blight, leaf spot, powdery mildew, canker diseases;
- Catalpa (genus *Catalpa*) – mealybugs, leafspot, *Verticillium*;
- Crabapple (genus *Malus*) – skeletonizers, tent caterpillar, apple scab;
- Honeylocust (*Gleditsia triacanthos*) – pod gall, aphids (Honeylocust plant bug);
- Linden (genus *Tilia*) – cankerworms, June beetles, loopers, aphids.
- Oaks (genus *Quercus*) – susceptible to: gypsy moth and other defoliators, sudden oak death (*Phytophthora*), galls, aphids, twig pruners, lacebugs, leafminers, anthracnose, canker, *Armillaria* root rot, oak wilt, chlorosis on poor sites;
- Sycamore/London planetree – aphids, lace bugs, anthracnose, scorch, canker stain (London planetree).

Plant Pests

Alien insects and pathogens may have the most dramatic effects upon urban tree health, often resulting in rapid, widespread and easily-observable tree decline or mortality. However, invasive plant species are also a major stressor upon urban forest sustainability, particularly in natural areas.

Invasive plant species can typically be described as species that are fast growing, prolific seeding and aggressively competitive with native species. Often these species are also non-native. The issue of invasive tree species is a concern for Ajax’s natural and open space areas and woodlots. Species such as Norway maple (*Acer platanoides*), Manitoba maple (*A. negundo*) and Siberian elm (*Ulmus pumila*), occasionally still planted by Town residents, can and have invaded many of these areas and are outcompeting native tree species on some sites. Invasive plant species are also a concern in the understorey of woodlands and natural areas, where plants such as garlic mustard (*Alliaria petiolata*), European buckthorn (*Rhamnus cathartica*) and dog-strangling vine (*Cynanchum* or *Vincetoxicum rossicum*) can rapidly displace native ground flora and lead to significant reductions in biodiversity. Once established in a natural area these species are often difficult to manage and can permanently alter ecosystem composition and function.

Management and reduction of invasive plant species populations requires specific strategies including education, partnerships, identification and monitoring, and cultural controls. Strategies for addressing invasive plants in natural areas and woodlots are presented in Section 7.

4.2 Current Pest Management Practices in Ajax

Currently, there is no formalized **urban forest** pest management program in the Town. Tree pests are typically identified on an ad-hoc basis by staff, residents or contractors during grid pruning, and management to date has been minimal. Biological or cultural controls are favoured over chemical controls, particularly since the implementation of the provincial *Cosmetic Pesticides Ban Act, 2008*.

The Greenwood Conservation Area Management Plan (p. 35) states:

“Insect and diseases that attack the vegetation should be considered a natural process, and will not be controlled, except in the instance where they threaten the integrity of the vegetation community. Where control of infestations is required, it will be directed narrowly to the specific problem. Biological, rather than chemical control should be used wherever feasible. A bacterial spray program may be considered to control gypsy moth in climax forest communities, but only where vegetation is threatened over the long term.”

The Operations and Environmental Services department does not have a written policy outlining the above statement, although it is consistent with current pest management practices in the Town. Integrated Pest Management is also incorporated in the Town’s Plant Health Care (PHC) program, which is targeted towards reducing the use of chemical pesticides for turfgrass applications in parks and open space areas. With the recent passing of the provincial *Cosmetic Pesticides Ban Act, 2008*, even greater reliance has been placed upon cultural practices to promote plant health. Plant Health Care Technicians are also tasked with identifying pest infestations, if present.

4.3 Opportunities for Improvement and Related Recommendations

Opportunities for improvement identified for the Town of Ajax related to the various aspects of pest management are outlined below. Associated recommendations are highlighted in **bold**, and presented as part of the Five-Year Management Plan (along with anticipated outcomes, costs and suggested timing).

Reducing the vulnerability of the Town’s urban forest to pest and pathogen stressors will require the implementation of a wide range of urban forest practices, including:

- **Plant Health Care: site-appropriate tree species selection, young tree pruning, watering, mulching**
- **Improving tree habitat: increasing soil volumes, improving soil quality, reducing above- and below-ground competition for space and resources to increase resiliency to pest and pathogen stressors**
- **Diversifying the urban forest: establishing underutilized and new native and non-invasive tree and shrub species**
- **Improving knowledge and understanding of the urban forest: conducting a public tree inventory and improved species-based pest vulnerability analysis, increasing monitoring, species and stock suitability trials, and**
- **Pest-specific management: Development and implementation of targeted strategies to mitigate the effects of specific insect pests or pathogens.**

Strategies to improve Plant Health Care, tree habitat, diversity and knowledge and understanding of the urban forest have been addressed in other sections of this Plan.

4.4 Pest-Specific Management Strategies: Emerald Ash Borer (EAB) Example

This section provides a strategic approach to manage insect pests and pathogens using Emerald Ash Borer as an example, and can be used as a template for other pests of concern.

The development and implementation of targeted strategies to address specific pest problems may be required from time to time, particularly if regional pest dynamics change to increase the vulnerability of certain components of the urban forest.

Because of the increasingly severe threat of Emerald Ash Borer (EAB), several Ontario municipalities, including Burlington, Oakville and Kitchener, have developed or are currently developing strategies to manage EAB infestations. Given the high likelihood of an EAB infestation in the Town of Ajax within the next few years, it is recommended that the Town develop a targeted strategy to manage this pest. Key components of this strategy are outlined in detail below. These components include:

- Ash Tree Inventory
- Survey Methodologies
- Survey and Management Areas
- Management Strategies
- Communication and Public Education
- Cost Analysis

Similar strategic components can be used to develop management strategies for other pest and pathogen infestations such as Dutch Elm Disease, sugar maple decline, gypsy moth or hemlock woolly adelgid.

Ash Tree Inventory

Knowledge of the location, size and condition of ash trees is crucial to the effective management of an EAB infestation. Such an inventory will enable the Town to prioritize survey and management activities depending on the distribution, condition, and potential risk associated with ash trees, which typically die within 2 to 3 years of infestation. Any ash tree inventory should be GIS-based and linked to the Town's asset management system.

Hyperspectral imaging technology, which combines high-resolution aerial photography with LIDAR (Light Detection and Ranging) and GIS analysis, enables mapping of the location and quantity of EAB host trees across the municipality. This technology and the information that it provides would be highly useful for future planning, budgeting, education and management of this pest. The greatest benefit associated with hyperspectral imaging is the ability to easily identify ash trees across all land uses and property ownership types; ash trees in streets, parks, natural areas and private yards can be identified by measuring the distinct light signature of ash tree foliage.

Aerial photography collected as part of the **hyperspectral analysis** can also be used to undertake a detailed tree **canopy cover** assessment, including an analysis of **potential canopy cover**. Perhaps the most promising aspect of hyperspectral analysis is the possibility of identifying stressed ash trees or ash trees in decline, which may provide 'front-line' identification of EAB infestation. The cost of hyperspectral analysis may range between \$70,000-\$150,000, depending on the level of analysis and canopy assessment undertaken.

Survey Methodologies

A number of survey methodologies can be implemented individually or in combination to facilitate the identification and delimitation of EAB infestation. The most commonly-applied and successful of these include the installation of baited traps (Oakville has installed 125 traps) and the CFS-developed grid-based branch sampling technique.

Using the latter technique, which is recommended for implementation in Ajax, a one km grid is overlaid on a map of the municipality. A radius of 250 m is drawn around each grid intersection point to create sample plots. All ash trees in the inventory are displayed on the map, if available.

A field crew is then dispatched to each plot to collect branch samples. Tree information such as species, DBH, and height are recorded along with any visual signs of EAB. Ten or more ash trees are selected, starting from the center of each plot. Sample trees can be selected at random, or based on criteria such as condition or size. Two branches are removed from each tree using a pole pruner (mid to lower crown, south aspect). Branches should be a minimum of 5-7 cm diameter and at least 50 cm long. Branch samples are labelled on the cut ends. It is estimated that 25 mid-sized trees (50 branches) can be sampled per day by a two-person crew.

Branch samples are then taken to a lab or other facility where the bark is removed to expose the phloem. Branch samples are typically secured in a table vise and the bark is removed using a draw knife. Once the bark is removed, thin slices of phloem are shaved off to expose larvae/galleries. All signs of EAB are recorded, including the number of larvae, number of galleries (old and new), number of eggs, etc. The inspected branches are then collected into two categories; infested and not infested.

If branches are inspected in the fall, the shavings of phloem should be very thin (1mm), to ensure that no larvae or galleries are missed. Thicker shavings are possible in the spring when larvae have matured. Experience suggests that more larvae/galleries have been found on the top of branches, and that visual and hidden evidence of infestation can typically be found more often on the south and west facing sides of infested ash trees.

Other methodologies including visual assessment, tree climbing, destructive sampling, and detection trees are also possible, but are less suited to Town-wide implementation as part of a targeted EAB management strategy. Visual assessment or canopy inspection through climbing are better suited to implementation during routine grid pruning and tree maintenance.

Survey and Management Areas

Due to resource constraints, the Town will need to prioritize areas for more intensive surveying and implementation of management strategies upon identification of an EAB infestation.

Priority areas for surveying may include ‘ash hotspots’ (commercial and shipping areas, recreation areas, nurseries, etc.) or areas with high concentrations of ash trees. Additionally, the Town should conduct delimitation surveys to establish an idea of the extent of infestation once the first infested trees are found. Grid-based branch sampling should be conducted across the Town.

Should infestation be confirmed and the Town decides to implement management strategies, resource constraints will require that specific areas, or ash trees with certain attributes, be prioritized for management.

A number of factors, such as local tree diversity, community perception of individual trees or trees of certain size/age, risk potential, and others, will determine priority areas or trees for priority management.

Management Strategies

It must be recognized that no management strategy will result in the elimination of an EAB infestation. However, several management strategies are available to slow the spread of EAB, manage cost and risk, and save important ash trees. The range of potential management options includes:

- The 'Do Nothing' Approach;
- Visual Inspection and removal of dead/diseased trees only;
- Proactive removal and replacement of ash trees;
- Tree injection (widely variable depending on sizes/numbers of trees injected).

The cost of implementing these approaches will vary widely depending upon the number of trees affected, the intensity of management, and other factors.

As part of EAB management, removed trees should be replaced with native, non-ash tree species. The objective of tree replacements should be to establish native trees with low pest susceptibility.

All removed infested and non-infested ash trees should be processed and disposed of in a manner that eliminates host suitability for all EAB life stages. Removed trees should be finely chipped and chips should be composted. No wood materials will be allowed to leave the regulated area of Durham Region, and should not leave Ajax for disposal. As such, appropriate wood waste storage facilities should be found locally, even prior to the development and implementation of an EAB management strategy. Wood infested with other insect pests or infected with pathogenic diseases can also be stored in such facilities, provided appropriate measures (e.g., bark stripping, burning or chipping) are undertaken. The expected influx and surplus of woodchips from dead ash trees can complement the Town's supplies for its **Plant Health Care** programs, and can even be given away to residents for use in gardens once it is well composted (2+ years composting time). Dispensing mulch is a common practice in many municipalities, and is often a key component of community environment days and other similar activities.

Communications and Public Education

Effective management of EAB in Ajax will require the timely communication of:

- Identification of ash trees and EAB signs and symptoms;
- the threat of the Emerald Ash Borer;
- the status of the infestation;
- planned and proposed management activities, including pesticide application;
- reporting procedures for suspected EAB infestation;
- the responsibilities of residents to monitor their own trees and manage pests;
- the rights of the Town to inspect and require removal of hazardous or infested private trees, and;
- external resources including identification guides, management strategies, agencies and scientific publications.

Good communication may help encourage cooperation such as abiding by tree quarantine guidelines and reporting possible infestations, and may calm potential anxieties regarding the threat of EAB or possible pesticide usage. Conversely, poor communication may erode support for the EAB management program, increase losses of trees and their associated benefits, and lead to a general misunderstanding or mistrust of the agencies involved.

A combination of communication and outreach tools will be necessary to reach the largest possible number of potentially affected individuals, businesses and organizations in Ajax. Tools should include the internet (an improved web presence), media and paid advertising, public information sessions, printed materials (leaflets and door hangers), and door-to-door outreach.

Cost Analysis

A detailed cost analysis, which should include the costs of surveying and monitoring, potential long-term management strategies and the potential loss of tree benefits, will enable decision-makers to select an appropriate management strategy and plan future resource allocations. An accurate cost analysis will require a more detailed understanding of the size, number and distribution of publicly-owned ash trees, which can only be informed by a tree inventory or **hyperspectral analysis**.



Ash trees in the United States in decline due to EAB infestation.

“The Town recognizes the value of tree cover in improving air quality and lowering air temperature during summer months. Expanding and providing a more robust tree cover creates bird and wildlife habitat, reduces the urban heat island effect, improves air quality, and connects open spaces and other natural areas”.

Town of Ajax Official Plan Amendment 38 (2010)

5. Planning and Development Process

The Town of Ajax is a largely built up municipality that will, like many nearby municipalities, continue to experience intense growth pressures over the next few decades. The current population of approximately 100,000 is expected to increase to nearly 138,000 by 2031, and an estimated 17,000 new residential units are planned to accommodate this growth, including significant development in existing **greenfield** areas (Town of Ajax OPA 141). Strong development pressure within the cores and on the peripheries of urbanized areas, combined with steady population growth, poses a primary challenge to sustaining urban forests and the benefits they provide (Pauleit *et al.* 2005; Nowak *et al.* 2005).

This section provides an overview of existing policies, legislation and by-laws related to tree protection and replacement in the Town, particularly on private lands, and identifies opportunities for strengthening these planning tools at the local level in support of better tree protection, replacement and overall **urban forest** sustainability. It is organized into the following sub-sections:

- 5.1 – Existing policies, legislation and by-laws
- 5.2 – Current practices in Ajax
- 5.3 – Opportunities for improvement

The “opportunities for improvement” section includes recommendations related to the Town’s planning and development process. These recommendations are consolidated and re-iterated in the Five-Year Management Plan as specific actions with anticipated outcomes, costs and suggested timing.

5.1 Existing Policies, Legislation, and By-laws

5.1.1 *Provincial Species at Risk Act*

Ontario's original *Endangered Species Act*(ESA) was written back in 1971, but has been updated and was passed in 2007. The updated ESA 2007 provides broader protection for provincially designated species at risk and their habitats; greater support for volunteer stewardship efforts of private landowners, resource users, and conservation organizations; a stronger commitment to recovery of species; greater flexibility in act implementation; increased fines, more effective enforcement, and greater accountability, including government reporting requirements.

The four categories, or classes, of "at risk" are:

- **EXTIRPATED** - a **native species** that no longer exists in the wild in Ontario, but still exists elsewhere;
- **ENDANGERED** - a native species facing extinction or extirpation;
- **THREATENED** - a native species at risk of becoming endangered;
- **SPECIAL CONCERN** - a native species that is sensitive to human activities or natural events which may cause it to become endangered or threatened.

Currently, the only tree species designated by the Province whose range overlaps with Ajax is Butternut (*Juglans cinerea*), which is designated as Endangered both provincially and federally, although the Central Lake Ontario Conservation Authority (CLOCA) also lists Cherry or Sweet Birch (*Betula lenta*) and Common Hoptree (*Ptelea trifoliata*) as additional tree species at risk that could be expected to occur in the Lynde Creek watershed (which overlaps with the easternmost Ajax) (CLOCA 2008). Notably, the status of species at risk is updated once or twice every year and needs to be verified on a regular basis.

Properties where damage to or removal of one or more Butternut tree is being contemplated must notify the local Ontario Ministry of Natural Resources (OMNR), have a certified Butternut Assessor evaluate the trees in question, and submit these evaluations to the OMNR. Protocols for addressing other tree species at risk have yet to be developed, but consultation with OMNR is still required.

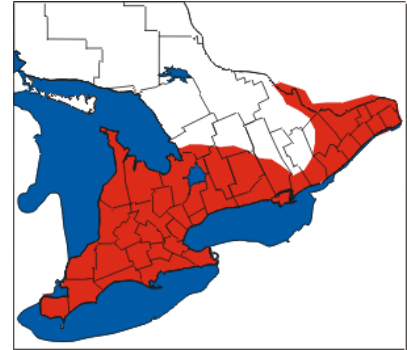


Figure 6: Range for Butternut tree (an endangered species) in Ontario (from the Royal Ontario Museum).

5.1.2 Provincial Greenbelt Act

The *Greenbelt Act* is provincial legislation that took effect December 16, 2004 with the general intent of setting limits to urbanization in the Greater Golden Horseshoe Area, and providing permanent protection to the agricultural land base and the ecological features and functions occurring in the most populated portion of Ontario. It builds on and incorporates the Niagara Escarpment Plan lands, under provincial protection since the 1970's, and the Oak Ridges Moraine Conservation Plan, in place since 2003, and incorporates additional adjacent lands based on their agricultural and natural heritage values. The Greenbelt Plan (MMAH 2005a) provides policy direction and mapping in support of the *Greenbelt Act*.

The Town of Ajax is south of the Oak Ridges Moraine, however the Greenbelt captures all of Ajax's rural area under its Protected Countryside designation (see Figure 7). This includes the band of land between Audley Road and Lake Ridge Road to the Town's east, and north of Taunton Road. The north-south band forms one of the few Greenbelt linkages all the way down to Lake Ontario, while the lands north of Taunton Road include Greenwood Conservation Area, and the headwaters of Miller's Creek, and the upper reaches of Duffins Creek, Carruthers Creek and Lynde Creek.

Within the Greenbelt there are Rural Area and Natural Heritage System policies that apply in Ajax (policies 3.1.4 and 3.2.2 respectively). The Rural Area policies support existing and new agricultural operations but do not permit new residential developments. The Greenbelt Natural Heritage System policies also permit existing agricultural activities but any new development requires that the proposal can demonstrate it will have no negative effects on any "key natural heritage features" (including **significant woodlands** as well as other potentially wooded features such as significant habitat of endangered, threatened and special concern species, wetlands and life science Areas of Natural and Scientific Interest (ANSIs) or "key hydrologic features", or their functions, and that connectivity among these features will not be lost. In addition, key natural heritage and hydrologic features require a "vegetation protection zone" whose width is determined when new development or site alteration is proposed within 120 m of the feature. These are identified within the Greenbelt Natural Heritage System shown in Figure 7.

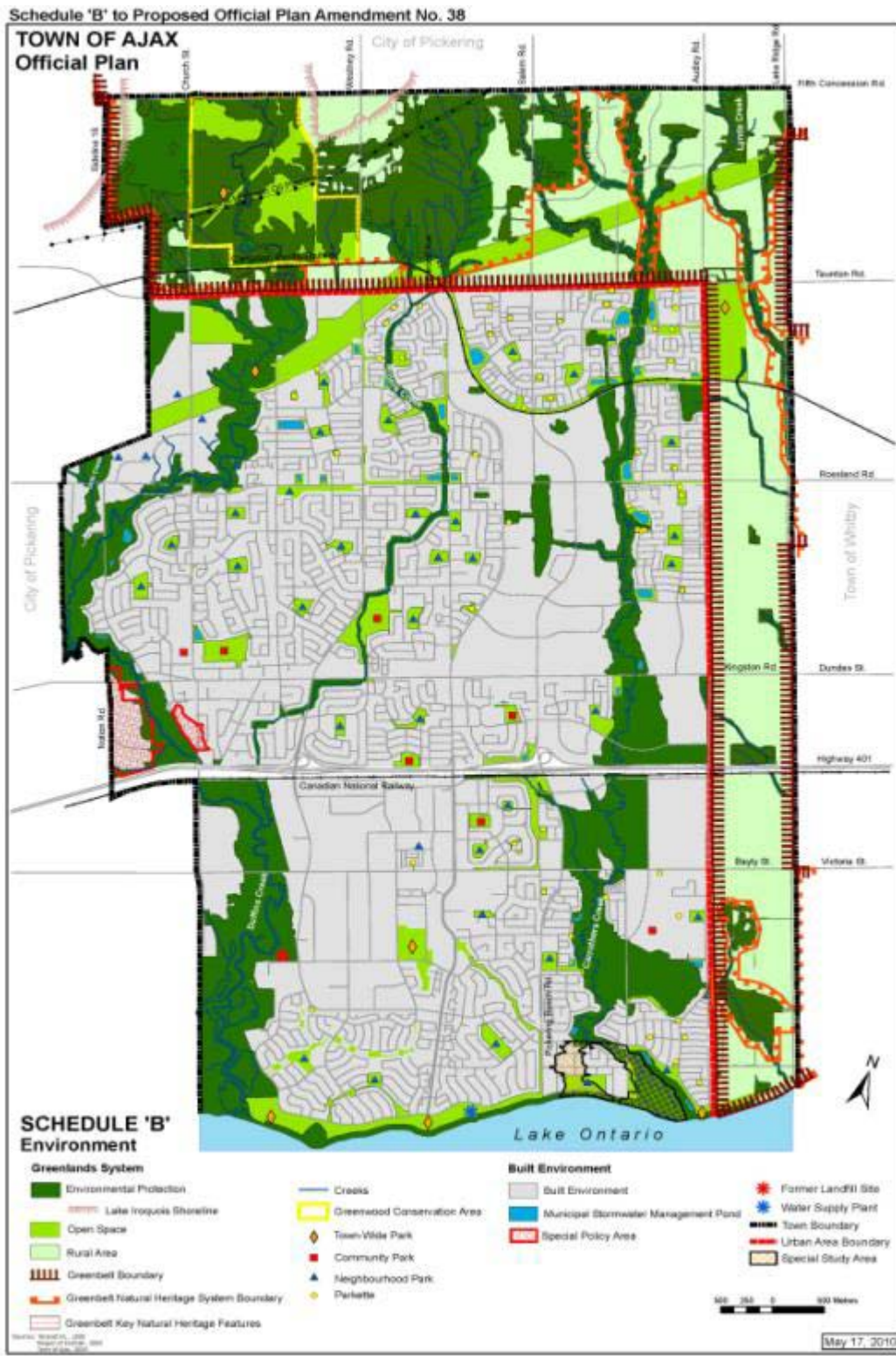


Figure 7: Town of Ajax’s Greenlands System, including the Greenbelt boundary and Greenbelt Natural Heritage System, as well as Town designated Environmental Protection and Open Space lands (from the Town’s Official Plan Amendment 38, passed by Council June 2010).

Furthermore, the Greenbelt Plan includes policies that support publicly accessible and connected trail systems (policy 3.3.2), as well as a requirement for a 30 m **vegetation protection zone** along the shoreline and the need to integrate landscaping and habitat restoration into any infill, redevelopment or new development along the shoreline “to enhance the ability of native plants and animals to use the shoreline” (policy 4.1.3).

In the most current Draft Technical Paper in support of the **significant woodlands** policy for the Greenbelt (OMNR 2008), significant woodlands south of the Oak Ridges Moraine within the Greenbelt Natural Heritage System can be between 0.5 and 4 ha depending on their species composition, age, linkage value, and proximity to other significant features. In addition, a minimum 30 m buffer (or vegetation protection zone) is required from the boundary of the significant woodland. Notably, actively managed plantations are exempt from this designation.

These policies have recently been integrated into the Town’s Official Plan through the Official Plan Amendment No. 38 (Town of Ajax 2010) and provide strong support for protection of woodlands within the Greenbelt Natural Heritage System, as well as for integration of other natural wooded features, particularly along the lakeshore.

5.1.3 **Region of Durham**

As a lower tier or “area” municipality within the Region of Durham, Ajax’s policies must be consistent with the Region’s, although they may be more specific and restrictive if the Town feels it is appropriate. Notably, Durham is a fairly large (2537 km²) and very agricultural region that contains seven other area municipalities that are larger than Ajax, and so Ajax’s specific needs are not necessarily reflected in the regional planning documents.

At the broadest level, the Region of Durham’s Strategic Plan includes a theme that addresses environmental protection and stewardship, and includes a specific goal (2.3) to “*enhance ecological health with a continuous natural heritage and Greenland system*” (Durham Region 2009b).

The Regional Official Plan, and the recent Official Plan Amendment No. 38, also includes general policies that address natural heritage protection, including protection for **significant woodlands** on and off of the Oak Ridges Moraine, and a few policies that address **urban forest** management. Policies provide support for a connected and functional natural systems (policy 2.3.2); native tree plantings along provincial highways (policy 2.3.5), regional road allowances (policy 2.3.18), Highway 407 (policy 11.3.9); and tree planting for “*the purposes of improving air quality, health and reducing energy use through shading and sheltering*” (policy 2.3.4.6). Policy 2.3.18 also commits the Region to identify significant woodlands, expand sustainable woodlands, establish a tree planting program on Regional road allowances that encourages the use of indigenous species, encourage landowners to take advantage of woodlot management programs, have a target of 30% woodland cover, and encourage area municipalities to prepare Urban Tree Strategies (Durham Region 2008, 2009a).

Durham Region also recently passed a by-law (27-2008) that regulates all woodlands of at least 1 ha throughout the Region. This by-law requires permit approval for any tree injury or destruction in a regulated woodland, but does exclude fruit and nut orchards, actively managed plantations, tree nurseries, hedgerows, former agricultural lands overgrown with young (i.e., less than 15 years old) trees.

Additional exemptions of note include:

- trees on lands where a building permit has been approved within 15 m of the edge of the approved building, or that must be removed to accommodate utilities or servicing for that building;
- **invasive species** (such as buckthorn, Norway maple, English hawthorn, white mulberry, tree-of-heaven and Siberian elm); and
- removal of trees for normal farm practices that retains woodland existing cover (i.e., not clear cutting).

Permits can be sought for implementation of good forestry practices or for clear cutting, and approved permits may be tied to conditions regarding the proposed removal.

5.1.4 **Town of Ajax Strategic Plan, Official Plan and Zoning By-laws**

Provincial and regional policies related to tree protection focus on natural areas; however, the Town’s local policies, through Official Plan Amendment No. 38 (OPA 38), provide a stronger and more comprehensive planning framework with regard to the protection of trees outside natural areas, as well as enhancement of the **urban forest** as a whole. OPA 38 was adopted by Town Council in June 2010 and is with the Region of Durham for approval. Subsequent to OPA 38 being approved by the Region, the Town’s Zoning By-law will be amended to be brought in alignment with these policies.

The Town of Ajax’s Strategic Plan (2007-2010) includes a guiding principle of “Environmental Awareness” and four supporting goals that can be tied to urban forest management. These goals target protection of natural features and open space (4.1), securement of lands for public uses (4.2), enhancement of the waterfront (4.3), and preservation of special areas (4.4). Specific actions identified under goal 4.1 related to the urban forest include: increasing tree cover in the Duffins and Carruthers Creek watersheds, promoting new native tree and shrub plantings throughout the Town, supporting wildlife corridors, and restoring riparian areas, woodlots and open spaces.

Town of Ajax Strategic Plan Guiding Principle – Environmental Awareness

Corporate Goals

4.1 Protect and integrate our natural features and open space systems

4.2 Secure Environmental Lands for Public Interest (Economic Development Office; Planning and Development)

4.3 Maintain and enhance a “jewel” of a waterfront

4.4 Preserve our natural landscapes and special community places (e.g., Greenwood)

The Town’s Official Plan supports natural heritage protection, enhancement and connectivity, and specifically supports:

- the integration of trees, particularly mature specimens, in the downtown area (including parking bays) as well as the Village Central area
- integration of tree cover into all new developments, including retention and incorporation of existing remnant natural features (e.g., hedgerows);
- use of native or indigenous plant material;
- compensation for mature trees removed in the form of on-site replacement; and
- land securement.

The recent Official Plan Amendment 38 (OPA 38) (Town of Ajax 2010) further strengthens these policies by incorporating **significant woodlands**, significant valley lands, the Lake Ontario shoreline, and **potential natural cover** identified by TRCA into the Environmental Protection Area designation, and adding a number of policies that explicitly support protection and enhancement of the urban forest outside of natural areas. The updated policies also provide repeated support for native and non-native, non-invasive plantings, and the use of trees to mitigate climate change and **urban heat island effects**. The explicit link between the protection and enhancement of tree cover, and the ability of these trees to both help mitigate climate change (e.g. support for species that provide “high levels of carbon sequestration”), and help communities adapt to it (e.g., provision of shade and cooling) is notable, and not found in many other municipal official plans.

With policy 2.1.4, “Tree Canopy”, the Town becomes one of the first lower tier municipalities to provide specific direction related to urban forest management. In addition to direction for developing an urban forest management plan, the policies also direct: consideration of a Town-wide tree cutting by-law, watering for newly planted trees, compensation for healthy trees removed through development, support for increased awareness about the benefits of trees and tree care, and expansion of local tree canopy (including plantings in extensive parking areas).

OPA 38 policies also reinforce the direction from the former Official Plan and other Town plans for land securement by directing development of a proactive Greenlands System Securement Strategy (policy 2.2.2(c)).

Town of Ajax
Official Plan Amendment 38

2.5.2 Urban Design

“The Town intends to enhance the connectivity, sustainability and aesthetics of streetscapes and landscaping throughout the Built Environment, and strengthen connectivity to the Greenlands System by ensuring proper attention to detail is provided in the design and implementation of streetscapes and landscaping”.

“Accordingly, the Town shall:

a) Require all new public and private sector development to incorporate high-quality landscaping, including native or non-native, non-invasive trees...;

b) Require new development to appropriately address arterial roads through the provision of sidewalks, and the use of tree cover...;

d) Require all development subject to Site Plan Control to be subject to review and approval of sustainable design elements Sustainable design elements include but are not limited to:

i) native or non-native non-invasive trees, shrubs, hedges, plantings...

iv) landscaping for winter wind protection and snow drift, and summer solar protection;

g) Parking lots... designed to accommodate tree islands.”

Additional policies in OPA 38 that are supportive of local urban forest sustainability include:

- support for naturalization in portions of the Greenlands System;
- requirements for 30 m vegetation protection zones to significant natural features in the Greenbelt (i.e., rural area) and at least 10 m buffers to woodlots in the urban area, and 30 m buffers for creeks and wetlands;
- requirements for Tree Inventory and Preservation Plan anywhere trees or vegetation exist within the property proposed for development and/or within three metres of the property line;
- plans to be prepared by a qualified Landscape Architect and Certified Arborist, and specifications for their content;
- integration of small woodlots and hedgerows in Neighbourhood Parks, and of natural heritage in Community Parks.

Collectively, these policies provide direction for the Town to not only protect its existing urban forest and natural areas, but also to expand the urban forest and undertake innovative approaches to better integrate trees into Ajax’s communities.

5.1.5 **Town By-laws Regulating Trees**

In addition to the regional by-law (described in Section 5.1.3) regulating woodlands of at least 1 ha that applies to the Town, there are also a number of Town by-laws that, directly or indirectly, relate to tree management.

Parks By-Law 32-2008

Prohibits the planting, pruning, removal or damaging of any plant (including trees and shrubs) on municipally owned or managed park lands.

Property Standards By-Law 70-2003

Requires all trees on private property to be maintained in a manner that will “eliminate a condition which is a source of danger” or remove trees where “the dangerous condition cannot be eliminated by maintenance practices”. The by-law also requires all landscaping (including trees and shrubs) required as part of a development or redevelopment to be undertaken and maintained in compliance with the Town’s requirements.

Town of Ajax

Official Plan Amendment 38

2.1.4 Tree Canopy

“The Town recognizes the value of tree cover in improving air quality and lowering air temperature during summer months. Expanding and providing a more robust tree cover creates bird and wildlife habitat, reduces the urban heat island effect, improves air quality, and connects open spaces and other natural areas”.

“To maintain, protect, and enhance the existing tree canopy, the Town shall:

a) Develop and implement an Urban Forest Management Plan;

b) Encourage the planting of native or non-native non-invasive tree species ...;

c) Consider enacting a Town-wide tree-cutting by-law ...;

d) Encourage the use of water-conserving irrigation systems and the provision of adequate permeable surfaces around newly planted trees ...;

e) Require reimbursement, in the form of new trees or financial compensation, for all healthy trees proposed to be removed ...;

f) Encourage tree planting by local residents and organizations; and,

g) Implement measures to protect, enhance, and expand the tree canopy”.

Sediment and Erosion Control By-law 53-2006

Prohibits the placement or dumping of fill, or grading, on public or private lands except in accordance with this by-law. Notably, the placing or dumping of fill, removal of topsoil or alteration of the grade of land as a condition to the approval of a site plan, a plan of subdivision or a consent is exempt from the permitting process except within 30 m of a waterbody.

Permit applications must include a Tree Preservation Plan and Arborist Report, if required. This Plan must include:

- The location and type of existing vegetative cover, including the species and size in **caliper** of all trees, and the location of all shrubs.
- An assessment of the existing vegetative cover to determine the preservation value.
- A description of the vegetative measures, tree protection and tree preservation to be used, including, but not limited to, mulches, types of seeds and fertilizers and their application rates; and
- the type, location and extent of pre-existing and undisturbed vegetation types, and a schedule for maintenance and upkeep.

Tree Protection By-law 137-2006



Figure 8: Schedules from Town of Ajax’s Tree Protection By-law (137-2006) showing areas regulated by the by-law.

Tree Protection By-law 137-2006 regulates all trees in the Town's Greenbelt / rural area as well as trees on lands designated as Environmental Protection, Open Space, Town-Wide Park, Community Park, or Neighbourhood Park in the Town's Official Plan and areas zoned as Private Open Space in the Town's Zoning By-laws (as shown in Figure 8). This by-law covers trees on municipal / public and private lands in the specified regulated areas, and as such is different from many other municipal tree by-laws that either focus on trees or woodlands under municipal or private ownership.

Noteworthy exemptions include activities undertaken in a woodlot pursuant to the Durham Region Tree Conservation By-law, the injury or destruction of up to five trees each calendar year by a farmer as an integral component of an active farm operation, and one or more trees located on a lot of less than 1.2 hectares with a single dwelling on it (with the exception of land zoned Private Open Space in the Town).

The by-law also allows the Director to, where replacement planting is not physically possible on the property where the tree is located, (a) require replacement trees planted at another location; or (b) accept cash in lieu payment for the planting of trees at another location. Where a property is not subject to site plan approval, the Director may also obtain a written commitment to ensure that the replacement planting is carried out and, where substantial replanting is required or where the applicant has previously violated conditions to a Permit under this section, the Director may require an applicant to post a letter of credit in an amount equal to 120% of the total cost of replanting and maintaining the trees for a period of two years.

This by-law, and gaps and opportunities related to it, are discussed further in Section 6.

5.1.6 *Town of Ajax Site Plan Application Process*

The provincial government, through the *Planning Act* (1990), gives municipalities the authority, through site plan control (part 41) to specify trees to be protected and/ or replaced (including hedges, trees and shrubs). It also allows them to require, as a condition of development, a parkland dedication (2% of the subject lands for commercial or industrial land uses; 5% of the subject lands for all other land uses) or accept "cash-in-lieu".

Like many municipalities, Ajax has a Site Plan Manual (last revised in 2009) to guide the site plan development process. In addition to providing application guidelines, it also outlines responsible departments and the role of the Site Plan Review Committee. Guidelines relevant to tree preservation and replacement are summarized below. It should be noted that landscape plans are required with all site plan applications.

Engineering Requirements

- Landscaped areas must have slopes of 2-8%; driveways 1-5%, municipal boulevards 1-5%, etc.
- All disturbed areas to be top soiled to at least 150 mm depth and sodded.

Landscape Design

- Landscape strips adjacent to parking areas are required to provide large growing deciduous shade trees on 7 to 9 m centres and must also include appropriate ground cover. Mulched shrub beds are typically required in front of parking areas to help screen parked cars.
- Large asphalt areas are also typically framed by curbed planting islands a minimum of 3.0 m in width (preferably 4.5 m) and shall include drought-resistant trees and/or shrubs that do not obscure a driver's sight lines (i.e., 60 cm in height).
- Landscape plans must take feature buffer requirements into account.

Landscape Standards

These standards specify minimum height, caliper and/or spread for planted trees and shrubs as well as spacing for small to medium deciduous trees (5 to 7 m apart), shade trees (7 to 12 m) and evergreen trees (4 to 8 m). Mulch depth (70 mm) and type (shredded bark) is also specified. However, the manual allows for trees and/or shrubs to be planted at closer intervals, with higher diameters and in greater quantities if a specific purpose is identified by the Town (e.g., restoration works). Notably, these standards are not consistent with the Town's drawing standards DS201 and DS202 (which specify 100 mm depth and allow shredded pine bark mulch or approved equal), and need to be reviewed as part of the development of a consolidated Town-wide Tree Technical Manual, as recommended in Sections 2 and 3 of this Plan.

Tree Preservation Plan

Plans with existing trees / vegetation must comply with existing tree by-laws (i.e., Durham Regional Tree Conservation By-law No. 27-2008 and Town of Ajax Tree Protection By-law No. 137-2006) and proponents are advised that all trees/vegetation shall remain undisturbed until such time as site plan approval has been given and the Tree Preservation Plan has been agreed to by the Town.

Plans are to include a survey of all trees of at least 60 mm **caliper** and vegetation masses (including boulevard trees and those within three metres of the property line), indicate if material is to be saved, removed or re-located, and specify protection to be implemented for trees to be preserved.

Tree Replacement Program

The Town may, at its discretion, require replacement for deciduous trees (with a minimum caliper of 150 mm) or coniferous trees (with a minimum height of 4.5 m), which are to be removed or intended to be protected and expire within five years of completion of construction of the development. The manual specifies the "aggregate caliper formula" to be the basis of replacement (i.e., if one 250 mm caliper tree is to be removed, the replacement shall be 5-50 mm caliper trees, 2-125 mm caliper trees or 1-250 mm caliper tree). However, discussions with the Town's Landscape Architect (P. Yeung, June 2010) indicated that in some cases where the tree proposed for removal is considered significant due to its size and species that a Town arborist has done a valuation according to the 9th Edition of the Council of Tree and Landscape Appraisers (CTLA) guide, and that accommodating preservation or a fair replacement has been negotiated on this basis.

Town staff have also indicated that they do not have a confirmed approach for requiring compensation where at least one tree per lot cannot be achieved in a given subdivision, and that funds allocated for this purpose could be targeted towards tree planting and maintenance in parts of the Town where trees, and particularly large stature trees that will contribute to overall canopy cover the most, can be accommodated.

Municipal boulevards must also be planted across the full frontage of the subject property to the satisfaction of the Town.

Securities

For all plant material, the Town holds back 25% of the landscaping securities for a period of one year and reserves the right to retain \$1,000.00 per tree for a period of 5 years for trees being protected or re-located.

Like the Town’s Official Plan policies, the Site Plan Manual Guidelines are quite comprehensive with respect to tree protection and replacement guidelines, but based on discussions with Town staff there are insufficient staff resources for inspection following site plan approval to ensure that tree protection and replacement measures specified are implemented.

5.1.7 *Town of Ajax Tree Protection Guidelines and Specifications*

As indicated in Section 2.2.3, basic tree protection fencing specifications are available from the Town’s Planning and Development Services Department (Drawing No. DS204). There are also Town standards for tree protection during development or construction on private lands through the Site Plan process, which requires plywood tree hoarding for mature trees close to any construction works.



5.2 Opportunities for Improvement and Related Recommendations

A few opportunities for improvement identified for the Town of Ajax related to the planning and development are outlined below. Associated recommendations are highlighted in **bold**, and presented as part of the Five-Year Management Plan, along with anticipated outcomes, costs and suggested timing.

The Town's recently approved OPA 38 policies provide comprehensive and specific direction that addresses both the Town's natural wooded areas and opportunities for tree preservation and planting outside the natural areas. With respect to natural wooded features, these are well protected by the Town's Official Plan policies which are supported generally by the Region's policies and specifically by the Region's woodland by-law. Natural wooded areas in the Town's rural lands are also protected by provincial Greenbelt policies. Although there is a shift in planning in southern Ontario to better recognize and integrate urban forestry goals and policies, most municipalities have yet to adopt policies as comprehensive as Ajax's with respect to the **urban forest**, and no real gaps or opportunities for improvement were identified at the Official Plan level.

Ajax's site plan guidelines are also quite comprehensive and progressive with respect to urban forest management. However, several opportunities for improvement have been identified, as follows:

- **The Town should consider relaxing its engineering guidelines for slopes and grading, on a case by case basis and in consultation with Town engineers, to support preservation of retainable trees or treed areas, particularly for development adjacent to protected natural areas.**
- **Minimum soil depth requirements should be increased in any location where trees may be planted in the future, and specifications about soil type should also be provided** (and be consistent with specifications provided in the Town's consolidated Tree Technical Manual to be developed).
- **The feasibility of a Town-wide private tree by-law that protects all trees above a certain diameter should be explored**(see Section 6).
- **The Site Plan Manual should be amended to allow for a Council of Tree and Landscape Appraisers (CTLA) valuation of certain trees proposed for removal** (ideally these should be defined as being healthy, indigenous trees of at least 90 mm diameter) to ensure a sustainable **replacement value** is assigned to them.
- **Town staff should explore approaches for ensuring that in developments when at least one tree per lot is not feasible (e.g., due to lot size), that compensation is provided for tree planting elsewhere in the Town where trees can be accommodated.**
- **Staff resources need to be increased so that a certified arborist in Planning and Development or Environmental Services is able to review draft and approved site plans, and conduct periodic post-construction site inspections to ensure that the tree protection, salvage and replacement plans are executed as specified.**

“The Private Tree By-law was adopted to preserve significant trees on private property in the City of Toronto, to assist in sustaining the urban forest in the City and to educate individuals with respect to tree protection measures and alternatives to tree injury and destruction”.

City of Toronto website, Urban Forestry section (accessed August 2010)

6. Private Tree By-law

In Ajax, as elsewhere in southern Ontario, much of the **urban forest** is privately-owned. Often, the condition and composition of the privately-owned component of the urban forest is unknown, and pest management, risk mitigation and tree removal and establishment decisions are outside the direct control of municipal urban forest managers. Tree by-laws regulating injury to and destruction of trees on private property is one tool that municipalities in Ontario have at their disposal to try and ensure that trees considered significant in a municipality are not removed without good reason or due process. However, such by-laws can evoke strong resentment among some segments of the community who feel that their private property rights are being infringed upon. Private tree by-laws are also tools that require dedicated resources to be administered and enforced, and as such should be carefully thought out and crafted with consideration for the local context and resource availability.

This section reviews the issue of a private tree protection by-law for the Town of Ajax, including a review of relevant tree by-laws from other jurisdictions. Considerations related to the resource requirements of implementing such a by-law are also discussed. It is organized according into the following sub-sections:

- 6.1 – Private tree by-laws in Ontario: An overview
- 6.2 – Town of Ajax Context
- 6.3 – Private tree by-law precedents in southern Ontario
- 6.4 – Opportunities for improvement

The “opportunities for improvement” section includes recommendations related to private tree by-law in the Town. These recommendations are consolidated and re-iterated in the Five-Year Management Plan as specific actions with anticipated outcomes, costs and suggested timing.

6.1 Private Tree by-laws in Ontario: An Overview

6.1.1 *A Brief History of Private Tree Legislation in Ontario*

Regulation of trees on private land in Ontario is not new. The first *Trees Conservation Act* was implemented in 1946 and allowed larger (i.e., upper tier) municipalities to pass by-laws regulating the cutting of trees in woodlands. Since that time there has been the *Trees Act* (1950) which was amended by the *Forestry Act* (1990) which were both essentially updates to the first act.

The *Forestry Act* continues to be an important and relevant piece of legislation because it (a) provides the standard legal definition for what constitutes a woodland (i.e., 1000 trees of any size per ha; 750 trees over 5 cm DBH per ha; 500 trees measuring over 12 cm DBH per ha or 250 trees measuring over 20 cm DBH per ha), and (b) makes it an offense for someone to injure or remove a tree whose trunk extends onto the neighbour’s property line (i.e., a boundary tree) without their formal consent.

The first piece of legislation allowing lower-tier municipalities (with populations greater than 10,000) to enact tree by-laws was the former *Municipal Act* (1990). This act was updated in 2001, came into effect in 2003, and is currently the principal piece of legislation that governs private tree by-laws in Ontario.

6.1.2 *The Municipal Act*

The *Municipal Act* (2001) allows municipalities of any size to enact tree by-laws, provides effective tools for protecting trees, and enables harmonization with area municipalities. Key elements to this new legislation are found in the Natural Environment sections (Ch. 25, Sections 135 to 147) of the act, and include: by-law administration through a permitting process, the ability to hand out stop work orders in cases of infractions, appeal procedures, higher ceilings on fines, and different fines for individuals versus corporations. Specific clauses in this section of the act give a lower tier municipality the authority to, through a private tree by-law:

- require permits and impose conditions to a permit;
- share powers with an upper-tier municipality;
- order discontinuation of activity;
- set fines for convictions of up to \$10,000 for persons and \$50,000 for corporations for a first time offense, and up to \$25,000 for persons and \$100,000 for corporations for a subsequent offense; and
- order an offender to replant trees in addition to the above fines.

Under the *Municipal Act* (2001), a property owner also has the right to appeal to the Ontario Municipal Board if their permit application is rejected by the Town and they do not accept the terms of that rejection.

There are a number of exemptions included in the *Municipal Act* (2001) which apply to any private tree by law. These include tree cutting activities undertaken by the municipality as well as tree cutting undertaken for approved surveying activities, or as part of the development or expansion of an approved pit or quarry. In addition, private tree by-laws only apply when the *Planning Act* is not applicable (i.e., prior to site plan approval and after the construction is completed), although many municipalities with private tree by-laws require Tree Preservation Plans as part of site plan approval to comply with requirements laid out in their private tree by-laws (e.g., Town of Oakville, Town of Richmond Hill, City of Guelph, City of Toronto).

In addition to the *Municipal Act*, a lower tier private tree by-law should have consideration for the:

- provincial *Endangered Species Act* (2007) and federal *Special at Risk Act* (2002);
- applicable provincial legislation (such as the *Greenbelt Act* (2004));
- upper tier woodland by-laws; and
- other local by-laws that regulate trees.

HISTORY OF REGULATION OF TREES ON PRIVATE PROPERTY IN ONTARIO

Trees Conservation Act (1946): allowed larger (i.e., upper tier) municipalities to pass by-laws regulating woodland tree cutting.

Trees Act (1950) and Forestry Act (1990): updates to the first act; Forestry Act provides a legal definition of “woodland” and regulates boundary trees.

Municipal Act (1990): allowed lower-tier municipalities (with populations +10,000) to enact private tree by-laws.

Municipal Act (2001) (now in force): allows municipalities of any size to enact private tree by-laws

6.1.3 *The Ontario Heritage Act*

The *Ontario Heritage Act* (1990) is primarily intended to be used for the designation of heritage buildings and landscapes, but can also be used for specific types of tree protection. Under Part IV s. 29 and 37, specific heritage trees can be protected by municipal by-law, but must be associated with a cultural heritage landscape having provincial significance. The process is quite onerous but does allow for protection through a voluntary conservation easement agreement or by designation. This tool is infrequently used for the purposes of tree preservation.

More relevant is perhaps Part IV s. 27 (1.2, 1.3), which allows municipalities to maintain a list of properties considered to have cultural value or interest (which could include trees). These properties are not designated under the *Ontario Heritage Act*, but may be described and can be listed on a municipal registry without the property owner's consent. Although it does not confer any power on the municipality to prevent damage to or removal of the tree, the local Municipal Heritage Committee, if it exists, must be consulted and the property owners must give 60 days notice to the municipality of an intention to damage or destroy the tree.

Most municipalities do not use this as a legislative tool to regulate tree protection because it is fairly limited and cumbersome. However, it does provide the basis for development and maintenance of a local heritage tree list, which is an excellent tool for increasing awareness and engagement in the community. It also provides an opportunity to educate the landowner who decides to remove a tree on their property, and perhaps consider alternatives.

6.1.4 *Other Important Considerations*

Other important considerations include establishing a permitting process that is workable and effective, and setting appropriate permitting fees. These items are not legislated and must be tailored to each municipality.

Implementation of private tree by-laws can be a challenge for municipalities. Although a growing number of municipalities have private tree by-laws, most lower tier by-laws have been in place for five years or less, and no comprehensive analyses of resource requirements across jurisdictions have been done to date.

It is also important to recognize that a private tree by-law is only one potential component of effective urban forest management, and that it must be tailored to the needs and context of the given municipality.

6.2 Town of Ajax Context

All by-laws that regulate activities related to trees on public or private lands in the Town of Ajax have been reviewed in Sections 2.1.4 and 5.1.5. Currently:

- Woodlots of at least 1 ha throughout the Town are regulated by the Durham Region by-law 27-2008.
- Trees in Ajax’s designated rural areas, natural areas and parks, as well as open space lands are regulated by the Town’s Tree Protection By-law 137-2006, but lots smaller than 1.2 ha with single dwellings on them are exempt (except for those within Private Open Space zoned lands).

Therefore, the main gap in tree regulation is on private lands within the Town’s residential, mixed use and employment areas within the urban area. As indicated in Section 5, Town staff feels that given Ajax’s current and anticipated growth, and its desire to remain a sustainable and green community, it will be important to regulate trees on these lands where the pressures for intensification will be greatest.

6.3 Private Tree By-law Precedents in southern Ontario

As of June 2010, 24 of 36 upper tier municipalities in southern and eastern Ontario had a forest conservation by-law, and 28 lower (or single) tier municipalities had tree by-laws. While the number of upper tier or regional municipalities with by-laws has not changed since 2001, the number of lower and single tier municipalities with by-laws for trees on private lands more than doubled (from 13 to 28) over the same period.

For the purposes of this review, 22 of the 28 lower or single-tier by-laws were reviewed. By-laws excluded from this review include those that were developed prior to the adoption of the current *Municipal Act* (2001) that have not been updated since (e.g., Municipality of Clarington), as well as a few from mainly rural municipalities whose application strictly focuses on woodlot protection (e.g., Town of Caledon, City of Barrie).

6.3.1 Types of Private Tree By-laws

No two private tree by-laws are identical as each one has been tailored to address different municipal needs and concerns. Private tree by-laws, more so than other types of by-laws, can become somewhat complex and technical, but can be divided into three basic approaches: (1) “woodland” by-laws – that focus on woodland/forest protection, (2) “arboricultural” by-laws – that focus on protection of individual trees, and (3) “sensitive areas” or “designated areas” by-laws – that protect all trees in identified areas or areas defined by their environmentally sensitive nature (e.g., valleys/floodplains). While many municipalities have adopted one of these approaches, some have integrated two or all of them into their by-laws. To further complicate matters, some municipalities have incorporated regulation for trees on public lands in their “private” tree by-laws (e.g., Town of Ajax). However, generally upper tier municipalities take responsibility for woodland, or at least “large” woodland, protection, while smaller woodlots and individual tree protection typically falls to lower tier municipalities. Obviously single-tier municipalities are able to regulate both woodlands and individual trees to whatever level they determine to be appropriate.

Under the *Municipal Act* (2001), upper tier municipalities can only have jurisdiction over woodlands that are at least 1.0 ha, and so all the newer upper tier by-laws conform to this size cut-off. However, the *Municipal Act* (2001) also stipulates that a lower tier municipality can delegate authority for protection of smaller woodlots (e.g., 0.2 or 0.5 to 1.0 ha to the upper tier). This has been done in municipalities like the Town of Markham and

Town of Milton. However, many lower tier municipalities have opted to implement their own “woodland” by-laws because their regional municipality does not have one, or because they prefer to retain direct control over by-law implementation (e.g., Town of Caledon, City of Brampton, Town of Oakville).

In Ajax, the combination of the Region’s and the Town’s existing tree by-laws provides fairly comprehensive coverage for wooded natural areas, as well as open grown trees in parks and open spaces, and so additional by-law protection of woodlots, even small ones, is not recommended.

The by-laws closely reviewed for this study are primarily lower and single tier municipalities have adopted a strictly “arboricultural” or “sensitive areas” approach on private lands. The Town’s current Tree Protection By-law could be categorized as the “sensitive areas” by-law approach (although it also includes open grown trees in parks and open spaces), while a more “arboricultural” type by-law is what the Town needs to consider.

“Sensitive areas” or “designated areas” tree by-laws typically focus on the preservation of all trees in areas known to be erosion prone (e.g., valleys and/or floodplains), but may also include upland treed areas with other valued ecological functions (e.g., headwater protection). These by-laws tend to have a strong environmental intent, usually related to municipal water quality and quantity management. Other municipalities with by-laws focussing on regulating trees in environmentally sensitive areas include the City of Brantford, Town of Wasaga Beach, and Ajax’s neighbouring municipalities the City of Pickering and Town of Whitby.

The “arboricultural” approach addresses the protection of individual trees in specified locations or trees in specified categories (e.g., above a certain minimum diameter). The intent of these by-laws is generally to protect all trees that are considered significant within a municipality in recognition of the environmental, aesthetic and heritage value that they provide in an urban or urbanizing setting. This type of by-law generally focuses on protection of mature or maturing trees, but what is regulated varies significantly among municipalities.

6.3.2 “Arboricultural” or “Individual” Private Tree By-laws

Of the lower and single-tier municipalities in Ontario that regulate individual trees, minimum size classes regulated range from 15 cm DBH to 76 cm DBH, although the bulk of the municipalities regulate trees of at least 20 to 40 cm DBH. Outside of Ontario, selected by-laws from British Columbia and California (i.e., Victoria, Vancouver, Palo Alto) regulate between 7.5 and 30 cm DBH.

A number of municipalities also specifically include heritage trees in their by-laws, but define them differently. In some municipalities, heritage trees are simply equated to large diameter trees (e.g., Town of Oakville provides a higher level of protection for trees of 76 cm DBH and more, in the former Town of Ancaster the size threshold is 45 cm DBH), while in other municipalities a special designation is applied to certain trees because of their species, size, location, etc. (e.g., Town of Fort Erie regulates “Significant Community Trees” while the City of Kingston calls them “Distinctive Trees”).

Given the scarcity of mature, native trees in Ajax, the Town might consider specifically designating heritage trees with the highest possible level of protection.

There are also a number of common exemptions included in private tree by-laws in Ontario for safety and/or practical reasons. Common examples include exemptions for:

- trees that are imminent hazards
- tree pruning for health of tree and for branches interfering with utility conductors or structures
- tree removal for emergency work (e.g., clean up of damage related to ice storms or wind storms)
- removal of highly **invasive species**
- trees on rooftops, interior courtyards or solariums, and
- trees in orchards, nurseries or actively managed plantations.

Beyond the required permit exemptions (described in Section 6.1) and typical permit exemptions (listed above), a number of these by-laws have also included additional exception or exemptions. Examples of notable exceptions included by some are:

- trees in golf courses and cemeteries
- ornamental trees,
- trees within a specified distance from an occupied building (e.g., ranging from 3 m to 7.5 m) or trees within residential lots below a specified size (e.g., 1 ha in Wasaga Beach, 2 ha in Whitby), and
- the first few trees removed every calendar year (e.g., up to four trees above 15 cm DBH in Mississauga; up to four trees between 20 and 76 cm DBH in Oakville; up to four trees above 20 cm DBH in Aurora).

While the first three exemptions make sense and should be considered in Ajax, the last exemption provides a large potential loophole and is not recommended. Already, in Ajax’s current Tree Protection By-law, staff has seen how a permit exemption for up to five trees per year on agricultural lands can cumulatively result in the loss of significant tree canopy over time.

Private Tree By-laws and Residential Land Uses

Given the Town’s interest in a by-law focussing on its urban area which is largely residential, this discussion also takes a specific look at by-laws that have addressed residential issues:

- In the City of Kingston all trees above 15 cm DBH are regulated along with all “distinctive trees” and trees in Environmental Protection and Open Space areas, however all trees on residential lots are exempt.
- In the City of Ottawa’s recently passed “Urban Tree Protection By-law”, they have taken a two tiered approach to provide residential lots with a bit more flexibility. In Ottawa, all trees on lots greater than 1 ha in the urban area are regulated (i.e., presumably this captures most potential development or re-development sites), while on lots less than 1 ha only trees of 50 cm DBH or more are regulated.
- Similarly in the City of Guelph’s recently updated by-law, on lots greater than 0.2 ha in the City trees of at least 10 cm DBH are regulated, while on all other lots (i.e., most residential lots fall below 0.2 ha) trees are not regulated.
- The City of Clarence-Rockland regulates trees on front yards of at least 15 cm DBH but exempts side and rear lots, perhaps in recognition of the fact that more construction tends to happen on the sides and rears of residential properties (e.g., pools, decks, additions) than front yards.
- The former Town of Ancaster (now Hamilton), City of Brampton, and draft City of Hamilton by-laws for individual trees exempt trees within 7.5 m, 5 m and 3 m (respectively) from an occupied building, such

as a residential home. This exemption recognizes the fact that in many cases a large tree close to a home or otherwise occupied building can constitute a hazard and cause damage to load bearing structures such as foundations, and so would likely receive permit approval.

These permit exemptions typically reflect the ways in which different municipalities have tried to balance tree protection and practical realities in urban areas, as well as balance preservation with private property rights. Some municipalities also include exemptions in recognition of the fact that they do not have the resources to regulate every tree removal in their jurisdiction and must “pick their battles” so as to make the administration of the by-law more manageable and less resource intensive for Town staff.

However, there are also a number of municipalities that regulate all trees on virtually all lots of at least 20 or 30 cm DBH and do not provide any exceptions or exemptions like the ones listed above for residential lots. These include the City of Toronto, Town of Markham, Town of Richmond Hill and City of Vaughan. This means that, assuming their by-laws are respected and enforced, residences who wish to remove one or more trees above the given size threshold that does not fall into one of the established permit exemption categories (e.g., dead or hazard tree, highly **invasive species**, located on a rooftop or in a solarium) must seek a permit from the municipality.

6.3.3 **Permitting Process, Conditions and Permitting Fees**

Although the tree by-law permitting process does require arboricultural and administrative resources from the municipality (either from in-house or contracted staff), there are some real potential benefits to this process. Requiring a permit for proposed tree removals on private property increases a municipality’s control over which trees may or may not be removed, and also provides an opportunity for residents and other local landowners to be educated about the benefits that trees provide.

Under the *Municipal Act*, a permit can also be tied to conditions. Examples of conditions on permits that allow tree removal that support protection and enhancement of the urban forest include:

- Requirements for proper protection of other trees on site to be retained (e.g., the City of Kingston requires identification of Tree Protection Zones);
- Requirements about the timing of tree removal (i.e., to avoid breeding bird season);
- Sign-off by a Certified Arborist on the condition of the tree to be removed (e.g., to confirm it is dead and/or a hazard);
- Requirements for replacement of trees to be removed.

Furthermore, many municipalities state in their by-laws that permits which have the potential to impact designated natural areas will be denied.

The question of what amount to set permit fees at is a frequent question asked by municipalities developing tree by-laws. Permit fees set by other municipalities with “arboricultural” or “significant area” private tree by-laws in southern Ontario range from no cost to up to \$500 per tree, but are generally in the order of \$50 to \$100.

While it is unlikely that permit fees alone will cover the full costs of a private tree by-law, they can offset some of them. For example, between 2002 and 2005 the City of Mississauga collected a little over \$20,000 in permit fees annually (except for one year where they collected close to \$30,000), but bore the cost of one full-time tree by-law officer dedicated to the enforcement of their by-law as well as the cost of related administrative support and expenses (e.g., mileage and vehicle costs for site visits) which amounted to well over \$100,000.

A key issue to consider when setting permit fees is setting them at a level that allows for some cost recovery, but not so high that land owners are discouraged from obtaining permits in the first place. If the municipality has an in-house arborist dedicated to conducting the site inspections as part of tree by-law enforcement and able to make calls on site, then a somewhat higher permit fee may be justified. Some municipalities rationalize their permit fees by charging only for the removal of healthy trees, while others have different fee levels depending on the number of trees being proposed for removal.

6.3.4 *Private Tree By-laws as Educational Tools*

Using a private tree by-law as more of an educational opportunity than a punitive measure seems to be the practice of many municipalities with by-laws in place. Research and interviews on this topic have found that:

- It is not uncommon to get by-law infractions (due to ignorance of the by-law or outright negligence), but once the land owner is informed about the by-law and sees it is being enforced they typically comply.
- Education about how the by-law works and the fact that the municipality is actually enforcing it is the most effective approach (i.e., the best enforcement is to have an officer in the field who can educate, make on-site decisions and negotiate).
- In addition to educating landowners, it is important to educate the consultants/tree companies the municipality deals with on how to fulfill the requirements of the by-law.
- Site visits are typically required prior to permit application to confirm boundaries, issues, etc. and this provides a unique opportunity for increasing awareness, and sometimes even exploring alternatives to the proposed tree removal.

Should a private tree by-law be developed in Ajax, how it is applied, administered and enforced (and why) should be included in the Town's urban forest communication strategy, as discussed in Section 8.

6.3.5 *Compensation and Letters of Credit*

Another benefit of having a municipal private tree by-law, is that it can provide a legislative basis for requiring compensation for trees removed. While it is common practice under the *Planning Act* to require landscaping through the site plan (or development) process, replacement of trees beyond what can be accommodated on site is usually not pursued. Under the *Municipal Act* it is possible to require compensation, where it cannot be accommodated on-site, with off-site plantings or cash-in-lieu.

How a reasonable compensation for trees removed is calculated varies among municipalities. A number use the **caliper** method (as does Ajax) whereby a single, healthy 50 cm DBH tree would need to be replaced with ten 50 mm diameter trees. Others use arboriculture tree appraisal methods, particularly for larger specimens (e.g., **Council of Tree and Landscape Appraisers (CTLA) Trunk Formula Method**), which is efficient in

determining financial compensation and is supposed to be applied to all trees of at least 90 mm. However, it only indirectly accounts for the impact of the tree removal on environmental and ecological benefits.

While there is no perfect method for valuing different trees, implementing the practices of compensation conveys the idea that removing a tree means reducing urban tree **canopy cover**, and that replacing that canopy cover, and the multiple benefits it provides, is important and not to be minimized. Municipalities who currently specify the ability to require compensation for trees removed in the form of replanting or cash in lieu in their private tree by-laws include the Town of Collingwood, City of Guelph, Town of Oakville, Town of Richmond Hill, and City of Toronto.

Another tool at a municipality's disposal is requiring a letter of credit equivalent to the cost of replacing and maintaining trees planted to ensure that the proponent establishes and maintains the trees as required. In the case of trees identified for protection, letters of credit can also be required to ensure the trees are protected as specified in the permit. Ajax already stipulates this as a condition in its current tree by-law (137-2006), as does the Town of Fort Erie, City of Guelph, City of Kingston, and City of Mississauga.

6.3.6 Resource Requirements

The issue of the anticipated costs of a new by-law to the municipality is obviously an important practical consideration. However, every municipality is different in terms of its internal organizational structure and staffing, population, as well as the nature and extent of tree resources. Difficulties in comparing different municipalities' costs for administering and enforcing their private tree by-laws is compounded by the fact that no two private tree by-laws are identical, and that not all municipalities track their by-law costs in the same way. Despite these challenges, an objective analysis of the costs incurred by various municipalities for implementing their private tree by-laws as compared to the estimated number of trees saved and/or replanted because of this legislation would be timely and interesting given the number of by-laws now in place in southern Ontario.

In general, the costs of administering and enforcing a by-law are related to the scope of the by-law, the nature of the permit exemptions and, for an individual private tree by-law (as is being considered in Ajax), the population base. While it is impossible to determine what Ajax's needs would be without knowing specifically what the proposed by-law would cover, it can be safely assumed that administration and enforcement of a private tree by-law in the urban area would require at least one half to full-time arborist, as well as some administrative support. The arborist should have both professional arboricultural qualifications, and good communication skills.

6.4 Opportunities for Improvement and Related Recommendations

Opportunities for improvement identified for the Town of Ajax related to private tree by-law are outlined below along with some discussion. Associated recommendations are highlighted in **bold**, and presented as part of the Five-Year Management Plan along with anticipated outcomes, costs and suggested timing.

While the trees in Ajax's rural areas, Environmental Protection Areas and Open Space lands are fairly well protected, at least from a legislative perspective, by the Region's woodlands by-law (regulating all woodlands of at least 1 ha) and the Town's existing Tree Protection By-law (137-2006), there is no specific legislative protection for trees in the Town's built up residential, mixed use and employment areas not engaged in the

Site Plan process. Given that these lands cover the majority of the Town, and that the Town is expected to continue to be subject to growth pressures and associated intensification, it will be important to try and protect the trees, particularly the larger native trees, in those areas.

A private tree by-law developed under the *Municipal Act* is a good tool that is available to municipalities in Ontario and one that should be seriously considered by the Town of Ajax to fill this gap.

However, in a context of limited resources whereby the Town is attempting to prioritize urban forestry initiatives that will provide the greatest “on the ground” benefits in relation to the required human resource and financial investment required, an additional private tree by-law comes up as a moderate to low priority for the time being. While a formal study on the actual effectiveness of by-laws focussing on individual trees in other municipalities has yet to be conducted, it is known that these by-laws tend to be very contentious issues in every community where they are contemplated and fairly labour intensive if properly enforced. It is also known that they cannot be effective unless accompanied by committed staff resources to educate residents and enforce the by-law. An additional consideration is the fact that the Region appears to leave enforcement of its woodland by-law to the lower tier municipalities, putting further strain on already stretched urban forest management resources in the Town.

While Town staff are generally supportive of more stringent protection for trees in the Town, **the Project Management Team agreed that it is more important for the Town to “get its’ own house in order first”** (i.e., ensure its practices on municipal lands are in line with best practices, and that the Town has the resources to enforce its current policies) **and focus on enhancing the urban forest through positive outreach and stewardship activities as part of the first Five-Year Management Plan.**

In the interim, a cost-benefit analysis of private tree by-laws focussing on individual trees in urban centres where they have been implemented is being recommended. Depending on the outcome of this analysis, and the progress the Town has made with respect to its other urban forest initiatives, a private tree by-law focussing on individual trees in the Town’s residential and commercial areas can be considered as part of the second Five-Year Management Plan.

As part of the first Five-Year Management Plan, the Town should also consider conducting, perhaps in partnership with one or more local groups, a “Heritage Tree Hunt” (see the Ontario Heritage Tree Alliance Toolkit) to developing a working list of heritage trees in the Town. This will serve primarily as an educational tool, but could also be considered for inclusion in the Town’s private tree by-law should it be pursued as part of the next Five-Year Management Plan.

“The maintenance and restoration of natural habitats are among the cheapest, safest and easiest solutions that could aid the effort to reduce greenhouse-gas emissions and promote adaptation to unavoidable climate change”.

From A force to fight global warming (Turner et al. 2009)

7. Protecting and Enhancing Wooded Natural Areas

Like most urban and urbanizing municipalities in southern Ontario, Ajax’s wooded natural areas are predominantly associated with its creek systems, and also include a few isolated upland woodlots and some scattered hedgerow features. This reflects the land use history of the area which went from being almost entirely forested to predominantly agricultural to the current largely urban land uses.

Protecting and enhancing the remaining wooded natural areas in the Town has been, and will continue to be a challenge. Landscape scale stresses of ongoing urbanization and intensification, habitat fragmentation and climate change continue to impact wooded natural areas in urbanizing settings making them more susceptible to extreme weather, and destructive pests and pathogens. In addition, natural areas adjacent to urban areas are subject to localized disturbances of encroachment (e.g., mowing, informal trail creation, etc.), free roaming pets, noise, lighting and dumping of garbage.

The Town has already recognized these issues and has been working with the TRCA, and others, to improve the sustainability of its wooded natural areas to the various stressors. This section provides an overview of Ajax’s wooded natural heritage and work done to date, and identifies further opportunities for maintaining and enhancing existing woodlots and hedgerows through management and restoration as the Town grows.

Planning and legislative measures already in place for protecting these areas are described in Section 5. This section covers the following topics:

- 7.1 – Overview of existing wooded natural heritage
- 7.2 – Best practices from local studies and plans
- 7.3 – Data gaps and opportunities for improvement

The “opportunities for improvement” section includes recommendations intended to improve and optimize Ajax’s woodlot protection and enhancement. These recommendations are consolidated and re-iterated in the Five-Year Management Plan as specific actions with anticipated outcomes, costs and suggested timing.

7.1 Overview of Existing Wooded Natural Heritage

Ajax lies within the Lake Erie – Lake Ontario **Ecoregion** (known as **Ecoregion 6E**) of the broader mixedwood plains **Ecozone** along Lake Ontario. The Town’s current **canopy cover** is estimated at 18.4% (14.6% tree cover and 3.8% shrub cover), and is primarily concentrated within the Town’s remaining natural areas (TRCA 2009a).

The forest vegetation in the natural areas consists of a mix of species from the Great Lakes – St. Lawrence and Deciduous forest types. Common native tree species found in the local natural systems include maple (mainly sugar and silver), beech, oak, hickory, black walnut, eastern cottonwood and ash (TRCA 2009a). Natural forested areas are concentrated along the reaches of Duffins Creek, Carruthers Creek, Urfe Creek, and the headwaters of Millers Creek in the Town. There are also a few isolated upland woodlots scattered throughout the urban area and woody vegetation associated with Lynde Creek running along the Town’s eastern border.

The current wooded connectivity in the Town is mostly along these valley and stream corridors. These connections support more biodiversity by allowing for dispersal of seeds and movement of low mobility fauna (e.g., amphibians), and also provide important stop over habitat for migratory birds after or before their Lake Ontario crossing.

Duffins Creek watershed, which is a large watershed that covers nearly half of Ajax (as well as large portions of Pickering and the Township of Uxbridge, as shown in Figure 3), is estimated to have about 37% natural cover, with about 25% of that being forest. This watershed has the most forested of all the watersheds that overlap with Ajax, and has most of its forest cover in its headwaters on the Oak Ridges Moraine, and not on its south slope (TRCA 2002b; TRCA 2003).

Carruthers Creek Watershed, which is much smaller but covers most of the remaining Town of Ajax, has about 25% natural cover but less than 4% of that is forested. This includes a few isolated patches of forest cover associated with the Rossland Road Wetland Complex north of Highway 401 in Ajax, but is mainly associated with the provincially significant deciduous and mixed swamp complex south of the 401 in Town that extends down to the lakeshore (i.e., Carruthers Creek Wetland Complex). Natural connectivity is limited to narrow belts along riparian corridors that tend to be of poor quality and dominated by species such as cracked willow and Manitoba maple (TRCA 2002a; TRCA 2003).

Lynde Creek Watershed runs parallel to Carruthers along Ajax's eastern boundary and is well documented in the Lynde Creek Existing Conditions Report (CLOCA 2008). Forest cover in this watershed is estimated at 17%, although much of this appears to be outside the Town of Ajax boundaries. As with Duffins and Carruthers, vegetation community (i.e., Ecological Land Classification) mapping is available for the entire watershed and can be used to help identify potential opportunities for reforestation.

Information collected through the recent Urban Forest Study (TRCA 2009a) and a more dated ecological assessment (Gregory et al. 1999) indicate overall **species diversity** of the Town's natural areas is relatively low (i.e., the three dominant tree species by leaf area are Sugar maple, Eastern White Cedar, Norway maple followed common buckthorn, white ash, eastern hemlock, white pine, trembling aspen, green ash, Manitoba maple, white spruce, American elm, and hawthorn), however there is not enough site-specific data that has been collected Town-wide to provide any definitive numbers to support this impression. Certainly within the built up portions of the Town there is a high proportion of invasive trees and shrubs, particularly in the residential and commercial areas, which presents an ongoing threat to the health of the nearby natural systems. The highly invasive Dog-strangling Vine (DSV) is known to be an issue in Greenwood Management Area (GCAMPAC *et al.* 2004), and therefore would be expected in other wooded natural areas in the Town.

Similarly, while the Urban Forest Study (TRCA 2009a) determined that overall the Town's trees have a very uneven diameter size class ratio with a heavy dominance of smaller diameter trees, information on the structure of the Town's wooded areas is lacking.



Figure 9: Remaining forested (and other natural areas) in Carruthers Creek watershed, as of 1999 (from TRCA 2002a).

7.2 Best Practices from Relevant Studies and Plans

7.2.1 Watershed Scale Approaches and Targets

Best practices related to watershed scale planning, as presented in the Duffins and Carruthers Watershed Plan (TRCA 2003), means adopting an approach natural area net gain, environment first planning, balancing various land uses, having consideration for human health and safety, recognizing that everyone counts, and committing to ownership and follow through.

As in the Town’s Official Plan, the commitment to strategic acquisition of natural heritage areas (i.e., from private to public ownership) as opportunities and resources permit comes across strongly in the local watershed plans (TRCA 2002a, b, 2003). This is one effective way of ensuring that these lands can be managed and developed in a way that is consistent with the approaches listed above.

A target suggested by Environment Canada (2004) and adopted by the Duffins and Carruthers Watershed Plan include aiming for 75% riparian cover of all creek corridors’ length with woody riparian vegetation. The same Environment Canada report suggests that a healthy watershed should have at least 30% overall forest cover. The Duffins and Carruthers Watershed Plan sets targets of 49% and 30% respectively for overall natural area cover, but does not specify a target for forested areas specifically. CLOCA has also set a target of 30% natural cover for its watersheds. Notably, these are all minimum targets and do not include trees outside natural areas, which also contribute to overall **canopy cover** and the related environmental services trees in the **urban matrix** provide. Targets for urban forest canopy cover (that include natural areas as well as trees in the urban matrix) are recommended by American Forests to be closer to 40%, but tailored to a given municipality’s context and treed resources.

Despite Ajax being predominantly urban, and perhaps because of, striving to improve the quantity and quality of riparian woody cover in the Town should still be a high priority, as should protection and enhancement of the local woodland cover. However, targets need to be reasonable based on Ajax’s land use context and should reflect what is possible if all truly plantable areas were restored to woodland and forest.

In the future, targets for natural area reforestation could be developed by consolidating the Ecological Land Classification mapping completed by TRCA and CLOCA for their respective watershed areas in the Town, along with conservation authority mapping for existing and potential forest cover, screened against the Town’s internal identification of plantable areas which considers land use planning opportunities and constraints associated with Environmental Protection and Open Space areas (currently being undertaken by the Town).

A comprehensive map identifying all potential plantable locations in the Town (i.e., including those within the urban matrix) will require further input from a street and park tree inventory, as well as a more detailed examination of smaller scale opportunities along roads and in open spaces associated with residential, institutional and commercial areas (e.g. as per **i-Tree Streets**). As with the natural areas mapping, this will also require careful consideration of municipal land use plans and consultation with all affected stakeholders.

7.2.2 Connectivity

Natural area connectivity is a central theme running through all natural heritage planning policies and studies in southern Ontario, and elsewhere. Although connectivity between natural areas can have some undesirable ecological consequences (e.g., facilitating spread of **invasive species**), the scientific literature continues to report that in fragmented landscapes the benefits far outweigh the risks (e.g., Damschen *et al.* 2006; Gilbert-Norton *et al.* 2009). The importance of habitat connectivity and enhancement is stressed even more under conditions of climate change, because these elements allow even low mobility populations to potentially respond, at least over time, via migration (e.g., Spring *et al.* 2010; Beier and Brost 2009).

In an urban area like Ajax, much of the existing connectivity is along the creek corridors, opportunities for east-west connectivity along the lakeshore, and in the rural (now Greenbelt) areas to the north of Town have also been identified through other plans (e.g., GCAMPAC and Town of Ajax 2004; Envision and Suzanne Barrett 2005). Furthermore, CLOCA and the Town have both recognized the opportunity to connect Cranberry / Lynde Shores to the Ajax waterfront via Warbler Swamp and Carruthers Creek Wetland Complex (OPA 38). There are also opportunities for smaller scale connectivity through protection and enhancement of remnant hedgerows, as well as through reforestation of former agricultural lands (as discussed in Section 7.2.3).

With all the competing land uses in urban areas, one approach adopted by municipalities is to combine their plans for connected trail networks with plans for natural area connectivity. In Ajax, the Town's recently completed Recreation, Parks and Culture Master Plan (2008) commits to the provision of parkland and trails to meet the needs of existing and new residents while ensuring ecological sustainability, integration of north-south greenways with the waterfront trail system, and protection of the Town's waterways and shorelines. This is an effective approach for trying to balance access and natural area protection, but one that requires some ongoing management and monitoring, as well as awareness building, to ensure that natural areas and their functions are not being degraded.



7.2.3 Restoration

Both active and passive restoration are identified as an integral management action in the Duffins and Carruthers Watershed Plan (TRCA 2003), and restoration opportunities are supported and currently being identified by CLOCA within the Lynde Creek watershed (K. Luttrell, pers. comm. August 2010). Although many of the opportunities for large-scale reforestation in these watersheds are in the rural areas outside the Town of Ajax (e.g., in the headwaters located on the Oak Ridges Moraine), there are still some opportunities within the Town of Ajax, particularly along the creek corridors.

Important concepts in natural area restoration, as espoused by the conservation authorities in their watershed reports, include prioritizing areas adjacent to existing natural areas, and/or that support greater connectivity between isolated patches. Landowner support and consent is also, obviously, critical, and there should also be consideration for anticipated land uses.

Areas identified for restoration in the various watershed and management plans include:

- Miller’s Creek corridor (Duffins and Carruthers Creek Watershed Plan, TRCA 2003)
- Areas in open space along the waterfront (identified in the Town’s Waterfront Management Plan 2005):
 - west of Duffins Creek, around Duffins Marsh
 - backdrop of naturalizing woodland at Lions’ Point
 - tree planting around Water Supply Plant, including the terrace gardens
 - Pickering Beach Road Terminus – landscaping to mark gateway to park
 - Lands adjacent to Carruthers Marsh
 - Habitat plantings in Lakeside Neighborhood Park to complement marsh
- Additional opportunities for reforestation and treed landscaping on the waterfront (identified in the Town’s Waterfront Management Plan 2005):
 - areas adjacent to Regional water supply plant graded for storm water management and, in part, originally intended for establishment of woodland areas
 - land west of Carruthers Marsh targeted for acquisition as an environmental buffer
 - parkland in the Lakeside Neighborhood Park Expansion (landscaping NOT naturalization), and

Restoration Best Practices

“Aquatic communities depend on stream bank vegetation cover to reduce warming of the water, slow down erosion and stream flow, add organic material to the food chain, and provide needed cover for fish and other wildlife species. In the rural areas, the creek ecosystem is most directly affected by loss of woody vegetation from the riparian zone (the area next to the watercourse). In many areas, particularly the headwaters of the Carruthers Creek and the mid reaches of Duffins Creek, woody vegetation has been removed and the land is cropped very close to the stream bank. Over the past 40 years however, improvements have been made to the riparian zone, and today, there is more woody riparian vegetation in the watershed than what existed in 1958. While these improvements are encouraging there is still much room for improvement”.

- *Duffins and Carruthers Creek Watershed Plan (2003)*

- East End – naturalize following acquisition (Note: Between Audley Road and Lakeridge Road there are substantial lands that have been identified for conservation purposes as ecological linkages between Carruthers Marsh, Cranberry/Lynde Marsh, and the Warbler Swamp Complex as part of the Provincial Land Acquisition Area).

With respect to the lakeshore restoration / landscaping areas, there must also be consideration for maintaining views of the lake while improving the lakeshore’s environmental value, as per the opinions expressed through the consultations undertaken for the Lakeshore Management Plan.

Specific restoration practices, as outlined in the Town’s Parks and Open Space Restoration Project (2006 – 2010), include the use of phased **successional plantings** to support the gradual evolution of an open area to woodland, and ultimately a forested community. These phases basically involve: (1) introduction of sun tolerant pioneer species (years 1 to 4), (2) introduction of more shade tolerant saplings (years 4 to 6), (3) selective removal of pioneer species (years 7 to fifteen), and (4) additional planting of shade tolerant species and monitoring.

Specific areas targeted for restoration through this project include:

- Millers Creek Corridor
- Duffins Creek – Paulynn Park
- Ajax Waterfront Park, west side of water supply plant
- Lakeside Park – woodlot regeneration
- Lakeside Park – east of Carruthers Marsh
- Anglers Parking Lot “leash free area”
- Greenwood Conservation Area
- Ajax Waterfront Park – west of Duffins Creek
- Carruthers Creek Corridor – from Callander Court to Shoal Point Road

Notably a comparison of areas identified and areas restored should be completed to feed into a new restoration plan for 2011 – 2015.



Meadows versus Woodlands

In some parts of southern Ontario, and elsewhere, meadow habitats are identified along with wetlands and forested areas as a target habitat type for restoration areas. Indeed, although most of southern Ontario once was forested, much of this forest has been cleared for well over a century, and some abandoned farm lands provide habitat for what are known as “grassland” bird species, as well as other wildlife.

However, the Duffins and Carruthers Creeks watershed studies make a good case for virtually all target restoration communities to be woodland and forest based on the fact that, left to their own devices, they would eventually become reforested, and that the relative scarcity of forest cover in these watersheds and the multiple benefits that forested areas provide makes reforestation a top priority (TRCA 2002a, b).

This position is supported by modeling that illustrates reforestation upstream reduces peak flows downstream (TRCA 2003). Indeed, achieving an enhanced natural heritage system (as modeled) is identified as a primary action needed to help achieve water balance, baseflow and storm water management objectives, groundwater quantity and quality objectives, and surface water quantity and quality in the local watersheds. In addition, localized naturalization of riparian areas (and protection of forested stream/creek corridors) - particularly with woody vegetation – is identified as a management action for protecting and improving surface water quality as well as aquatic habitat (TRCA 2003). Therefore, restoration of available areas to woodland and forest communities should be a top priority in Ajax.

Restoration Best Practices

“Since old-field habitats are the result of past agricultural use, it can be argued that, unless they are supporting species of concern, their greatest value in the TRCA region may be their restoration potential. Left alone these areas would naturally go through the process of succession, eventually reverting to forest, since the watershed lies within a forest bioregion. The ecological result would be an overall increase in forest cover and connectivity between forest patches.”

- *Duffins Creek State of the Watershed Study (2002)*

7.2.4 Woodlot Management in Urban Areas

The goal of good forest management is generally to protect and expand **native species diversity** so that the area is as intrinsically resilient to natural and anthropogenic stressors as possible. Mechanisms for protection include controlling the types and extent of access and preventing the spread of invasive plant species. Mechanisms for restoring native biodiversity include control and removal of invasive plants and replacement with site-appropriate **native species** grown from locally collected seed, as well as allowing for natural regeneration where there is a healthy proportion of **native species** already.

The importance of ongoing management in these types of areas cannot be overemphasized. Natural areas in urban and urbanized settings cannot simply be protected and left because there are too many impacts and stressors that can impact their sustainability. Management of publicly accessible natural areas is an ongoing exercise, and striking an appropriate balance between supporting access and protecting the local natural features and their functions is an ongoing challenge.

Development of an ecologically-sensitive trail system is one key component of good management. Trails should be designed to avoid highly sensitive areas, but provide enough access to discourage informal trail creation. In addition to the location of the trail system, there should be consideration for trail widths and surfacing. Boardwalks, bridges and platforms should also be integrated over wet areas to minimize soil compaction and habitat degradation related to trail use.

Additional site-specific strategies for balancing access with protection of ecological systems include: planting **native species** as a buffer between natural areas and public uses, formalizing trails to discourage informal trail creation, closing informal trails with large logs and/or prickly shrubs (e.g., raspberry), signs that indicate what types of activities are permitted and which are not (e.g., hiking versus off-road cycling).

Safety is another important consideration in any public space, and natural areas are no different. Clear and consistent directional signs should be provided, hazard tree assessments (particularly along formal trails) should be undertaken on a regular (i.e., at least annual) basis, and facilities such as washrooms and parking areas should be designed to be fully accessible.

Publicly accessible natural areas provide excellent opportunities for in situ demonstrations and education, and use of well-designed educational signs in key locations is also recommended.

Considerations for the level of facilities required for a given area (e.g., parking, washrooms), as well as both trail and natural area connectivity to other nearby natural systems are also very important considerations.

Greenwood Conservation Area Management Plan

The Greenwood Conservation Area Management Plan (GCAMP) (2004) is for the Town's largest publicly accessible natural area, and was developed collaboratively by the Greenwood Conservation Area Management Plan Advisory Committee, TRCA and the Town. This plan is fairly current and very comprehensive, and provides an excellent template for other woodlot / natural area management plans.

Key components include:

- description and evaluation of the property in the context of on relevant plans (e.g., watershed plans) and policies (e.g., *Planning Act*, *Lakes and Rivers Improvement Act*, *Ontario Water Resources Act*, *Migratory Birds Convention Act*)
- an assessment of existing natural resources and environmental conditions, including site limitations and opportunities
- identification of specific management zones (i.e., eight zones including nature reserve, restoration, public use and operational) based on different levels of ecological sensitivity, and direction on the types and levels of appropriate activities for each, and
- recommendations for future initiatives, including the protection of natural features and habitat regeneration based on an ecosystem approach to planning and management.

The GCAMP plan also provides a good template and process for developing such a plan, including development of an advisory committee and undertaking public consultations. Best practices for natural area management emphasized in the GCAMP plan include the importance of:

- partnerships (existing and new), education and outreach programs
- proactive prevention of impacts to natural systems instead of remediation following impacts
- balanced land use (i.e., sustaining natural resources while encouraging appropriate recreational activities)
- recognizing and promoting linkages to other natural features, and Duffins Creek watershed outside the boundaries of the area
- protecting existing native diversity (both in terms of community and species composition) and restoration of native diversity to degraded areas
- expansion of public ownership
- safety and accessibility
- pest control management only in circumstances where insects and diseases threaten the integrity of the vegetation community, and in a manner consistent with TRCA policies and with the Town of Ajax’s existing **Plant Health Care** Program, and
- a formal monitoring and reporting system for evaluating the effectiveness of management approaches.

The Greenwood Conservation Area Management Plan provides specific locations for access points, signs, trail types / design standards, permitted uses, links to adjacent trail systems, and a phased implementation strategy. It also provides mitigation approaches for common impacts (such as trail overuse and expansion, creation of unplanned trails, soil erosion, litter, vandalism) and invasive plant species management, as well as monitoring plan direction. Safety and security, as well as facility (i.e., parking and washroom needs) are also addressed.

Forest Management Best Practices

“Maintain the natural diversity of flora and fauna in the forest and restore biodiversity within the natural range of variation that is characteristic of the region.”

- Greenwood Conservation Area Management Plan (2004)



7.3 Opportunities for Improvement and Related Recommendations

Opportunities for improvement identified for the Town of Ajax related to the protection and enhancement of forested areas are outlined below. Associated recommendations are highlighted in **bold**, and presented as part of the Five-Year Management Plan along with anticipated outcomes, costs and suggested timing.

The planning policies and legislation that relate to woodlands in Ajax is discussed in detail in Section 5. No significant gaps were identified in the current policies or legislation; however Town staff has indicated that currently there are insufficient resources to enforce the existing Town tree and regional woodland by-laws. The Region uses contracted services to enforce its Woodlot By-law.

Increasing awareness and involvement through stewardship are also identified as critical to urban woodland protection and enhancement in all of the Town’s management plans. For example, the Town’s Parks and Open Space Restoration Project (2006 – 2010) includes its own communication plan that specifies use of the Town’s and TRCA’s websites, development and circulation of a joint Town-TRCA brochure, advertising in the local newspaper and community guides, and development and installation of interpretive signs at restoration sites. Strategies for improving awareness building and engagement, and building partnerships (as well as identifying tree planting subsidies and funding sources) are provided in Section 8.

The discussion and related recommendations for this section will focus on the operational aspects of wooded area management and restoration.

Relatively low levels of forest cover and diversity, combined with the presence of **invasive species**, climate change and other stressors associated with being in an urban environment make forested areas vulnerable to decline. However, in Ajax there are also substantial opportunities for improving the resilience and health of natural forested areas through ongoing management and restoration. Ajax’s Urban Forest Study (TRCA 2009a) found that about 26.5% of the Town is comprised of potential “**plantable space**”, primarily in the residential areas, but also within some of the Town’s the Environmental Protection and Open Space areas. Notably, this analysis is a rough first cut and represents an overestimate that still needs to be scrutinized more closely by staff in the Town’s Planning and Development Services to ensure conformity with approved land use plans, and will also require consultation with other stakeholders as well. **Ultimately this information should be consolidated to develop “plantable areas” mapping in terms of woodland restoration or reforestation, as well as opportunities for individual tree plantings within landscaped areas.** Notably, the Town is currently working on developing some draft “potential plantable areas” mapping based on existing information that will be released in conjunction with this study.

Assessment and Protection of Existing Wooded Features

The Town, working with various partners, should continue to protect existing native biodiversity by implementing and enforcing the sound policies and legislation already in place (outlined in Section 5) and managing its protected natural areas (i.e., for human use, **invasive species**, wildlife habitat). However, this would be most effectively undertaken with more baseline information about the local wooded areas, particularly those in the urban area where development pressure is greatest, and outside the Town’s Provincially Significant Wetlands which are already well-protected. This work would build on and update Ajax’s Integrated Ecological Study (Gregory *et al.* 1999), and would focus on woodlands under public ownership but should also include privately owned woodlots to some extent.

Protection of existing publicly-owned wooded natural areas, ideally following completion of a Town-wide woodland inventory, should be pursued within the framework of a Town-wide Woodland Management Plan that lays out principles and best practices (as per the Greenwood Area Conservation Plan) for all woodlands with respect to key issues like public use, **invasive species** management, mitigation of impacts, etc.. In some cases, larger publicly accessible areas may need stand alone management or master plans specifically guiding their development and level of use (such as the Waterfront Management Plan). This Plan could also identify priority woodlands for acquisition based on their ecological value.

Restoration Opportunities

The Town has already undertaken a number of restoration projects with TRCA through their Parks and Open Space Restoration Project (2006 - 2010). **Ongoing restoration works should be pursued within the framework of a new Parks and Open Space Restoration Project (i.e., 2011 – 2015) that draws on information provided through this study to identify and prioritize the next Town and TRCA lands in need of active (or primary) restoration.**

Further review by the Town / TRCA will be required to (a) verify if portions of any of the sites restored in 2006 – 2010 still require restoration or follow-up work, and (b) where the outstanding opportunities on Town-TRCA lands exist, and how they should be prioritized.

“The enhanced natural heritage system builds upon the existing patches of natural cover and enhances those patches with consideration for improvements in patch distribution, size, shape, and connectivity coupled with potential feasibility and landowner willingness.”

- *Duffins and Carruthers Creek Watershed Plan (2003)*



“There needs to be a strong communication component associated with any strategic plan and it needs to be ‘outside the box’ ”.

Ajax Urban Forest Study, Consultations Report (TRCA 2009b)

8. Awareness, Engagement and Partnerships

As in all municipalities in southern Ontario, much of the Town’s **urban forest** is located on lands that are not under municipal ownership or control. Furthermore, the resources that the Town is able to allocate to urban forest management on its own lands are limited and typically do not allow for implementation of the full range of desired activities, at least not within the desired timelines. Consequently, the importance of improving people’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 Ajax’s urban forest.

Recent social marketing research conducted in the City of Toronto, and elsewhere in the GTA, has found that one fundamental barrier to fostering stewardship is the growing detachment most people have from nature in our society (TRCA Stewardship, pers. comm. September 2010). The key challenge, then, is how to break and get beyond this barrier.

This section presents and describes the different components needed for a comprehensive urban forest communications program; reviews existing communication tools and current partnerships already in place in Ajax; presents some unique and progressive examples from other jurisdictions that could be adopted in Ajax; and identifies opportunities (organized by component) for expanding urban forest education, engagement and partnerships in the Town, including potential funding sources. This section is organized according to the following sub-sections:

- 8.1 – Communications program components
- 8.2 – Existing promotion and partnerships
- 8.3 – Examples from other jurisdictions
- 8.4 – Opportunities for improvement

The “opportunities for improvement” section includes recommendations intended to improve and optimize Ajax’s communications and outreach practices related to **urban forest** sustainability. These recommendations are consolidated and re-iterated in the Five-Year Management Plan as specific actions with anticipated outcomes, costs and suggested timing.



8.1 Communications Program Components

8.1.1 Increasing Awareness

Education is a vital part of **urban forest** management planning. In many jurisdictions, the urban forest is an ‘unknown’ entity that many in the community fail to recognize as important. However, in order for it to be valued, it must be recognized as important.

The goals of this program should be to:

1. increase residents’ and businesses’ awareness and knowledge concerning the Ajax’s urban forest;
2. foster the interest of residents and businesses regarding the protection and enhancement of Ajax’s urban forest, including trees on private land; and
3. involve residents and businesses in caring for Ajax’s urban forest, including trees on their own properties.

Increasing awareness can be achieved through printed and digital media, workshops / seminars / presentation, conducting open houses, and a targeted marketing campaign.

Educational materials should be circulated throughout the community, and a diversity of educational tools and venues should be utilized. Points to keep in mind are:

- Schools are often an effective starting point as children are very impressionable and will bring their new found knowledge home to their parents.
- Flyers containing specific information can be mailed in conjunction with other municipal mail-outs as a cost-savings measure.
- The Town’s most public and accessible tool is its website; it provides a cost effective means of providing a wide range of information regarding urban forestry, including links to resources developed by others.
- Hands-on presentations, workshops and urban forest tours by City staff involved in forestry are also valuable outreach mechanisms.
- Homeowners who garden tend to spend most of their “garden dollars” in the spring at larger nurseries and big box stores, and so forging partnerships with these retailers can have a significant impact.

A cornerstone of increasing community awareness lies in providing:

- Information on the benefits of trees and the urban forest, such as those provided in the Ajax Urban Forest Study (TRCA 2009a), and emphasizing links to documented health, social and financial benefits;
- Information on what their municipality is doing to care for trees on its lands and protect and enhance the local urban forest;
- Information on current activities related to urban forestry in the municipality; and
- Resources to landowners (e.g., information, technical support) for planting and properly maintaining trees on their own property.

Information can be shared via:

- the municipal website, as well as related on-line information sharing and networking tools such as e-newsletters, Facebook, Twitter and blogs;
- more conventional means such as press releases in the local paper(s), radio announcements and interviews, as well as occasional spots on local television;
- pamphlets at local libraries and municipal arenas / facilities, as well as disseminated to schools;
- advertising at local nurseries and chain stores selling garden supplies; and
- periodic open houses or public information centres.

Public Information Centres (PICs) provide an opportunity for individuals who are interested in the Urban Forest Management Plan, and potentially providing feedback, but not willing or able to commit beyond that. They are also an excellent opportunity to educate the community in person about what the Town is doing to better manage its **urban forest**, and about what they can do to improve the Town's urban forest by planting and/or caring for trees on their own property. However, effort should be made to either highlight a particular topic or area of interest that will draw people to it or to combine the event with some other related activity or project to garner sufficient interest. Such events can be held in the spring, when gardeners are out and thinking about planting, and in locations where people are going to purchase trees and/or garden supplies.

There are also many options for and examples of hands-on activities that increase awareness (as well as engage people). Outreach events that could be considered include:

- A community heritage tree hunt in the urban area;
- Expert-led site tours (e.g., walks in natural areas led by local arborists or conservation authority biologists);
- Restoration events in local parks, schools or other lands (e.g., open spaces in business parks) with landowner consent;
- Workshops on urban forestry issues relevant to Ajax targeted to (a) residents and (b) local businesses;
- Presentations, community meetings and open houses;
- Hosting local, national or international conferences about tree care (e.g., International Society of Arboriculture).

Effective public education should be treated like any other advertising or marketing campaign. Messages should be eye-catching and/or thought provoking, consistent, simple (but not simplistic) and repeated through a variety of media but with a consistent look and/or logo so that people connect the messages with the Town's UFMP. The key is to convey the message so that people become familiar with the Plan's key ideas and values and are moved to action, and to convey these ideas at a time and place when people are likely to be receptive to them.

8.1.2 *Fostering Engagement*

Fostering engagement in care of the urban forest can take many forms and should be targeted to a range of groups and sectors.

Strategies for achieving local level engagement in urban forest activities include:

- Recognition of current volunteers and attraction of more volunteers for stewardship activities (e.g. awards, commemorative plaques);
- Recognition of urban forestry initiatives undertaken by local businesses, and provision of technical support for implementing such initiatives;
- Organization of community events with environmental themes geared for volunteer participation (e.g., tree plantings, boardwalk building);
- Facilitation of public participation in the planning, design, and maintenance of the urban forest (e.g., through workshops, open houses, supervised tree plantings); and
- Support for external organizations designed to get the right tree planted in the right place on private lands (e.g., Local Enhancement & Appreciation of Forests (LEAF), Tree Canada).

There is a continued need to teach local residents, businesses and other institutions such as schools about proper care for the trees on their lands, and how best to take advantage of opportunities for tree planting on them. This can be achieved through partnerships with various groups, as well as by having a person on staff to provide this type of technical support and coordinate various volunteer activities related to the urban forest. The value to the municipality is that in exchange for providing this service, they increase the municipality's **canopy cover**, receive volunteer assistance and demonstrate a visible commitment to greening the municipality. Such a staff person can also match private landowners (e.g., industries) or schools looking to plant trees with willing and able volunteers.

While active engagement in urban forest activities is critical, it is also important to have clear guidelines and policies about volunteer activities so that volunteers are clear on their role, and the Town provides support but does not assume liability. Although there should be a process, it is also important to keep it simple and accessible because, if the process itself becomes too onerous, community groups and interested volunteers may lose interest or become frustrated. For restoration activities, it is also 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 the site on which they planted trees years before 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 at least appreciate efforts to have them properly transplanted.

8.1.3 *Building Partnerships and Pursuing Funding*

Urban forests thrive when knowledgeable people are involved in their care and planning. Collaborations between elected officials, the Town, its citizens, private and non-profit sectors offer long-term sustainability for the **urban forest**. These relationships foster a collective consciousness of forest values and stewardship, but can only occur when various parties are engaged.

This component involves building relationships with local agencies and organizations, as well as local businesses, on urban forest initiatives. Many non-governmental organizations already have volunteer programs and experience in fundraising that can be drawn upon. Schools are often keen to get involved, particularly if activities can be fit within and support their existing curricula. Businesses can be interested in these partnerships as well, particularly if they are given recognition for their activities, and can accomplish goals that support the vision they have for their company.

There are also a number of opportunities for funding support for urban forest activities through various programs (described in Section 8.4.3), many of which can benefit municipalities but require leadership from an external non-profit organization or school. Taking advantage of these opportunities requires partnerships.

In addition to building on existing and creating new partnerships, the creation of an Urban Forest Steering Committee (UFSC) comprised of representatives from active local organizations is a good way to maintain communications between the Town and its external partners, and also a source of input for Urban Forest Management Plan (UFMP) review and updates. Such a group can also be used to:

- Provide input and guidance related to ongoing UFMP implementation;
- Coordinate funding applications that require leadership by a non-profit organization outside the municipality, but still require municipal support;
- Advertise and promote various urban forest activities and updates in the Town;
- Direct and help undertake various urban forest activities on Town / conservation authority-owned lands;
- Support various urban forest activities on private lands; and
- Help monitor the status of the Plan.

8.2 Existing Promotion and Partnerships

8.2.1 *Increasing Awareness*

The Town has, over the past few years, become more active in promoting some aspects of local **urban forest** management, and currently has limited exposure through the Town's website, as well as through the occasional press release or news item published through items such as "Ajax Today" or the local paper.

Limited urban forestry-related information on the Town's website is found under the "Operations and Environmental Services" section. The four relevant pages currently posted (as of June 17, 2010) are: a page on tree care, a fairly comprehensive page on Emerald Ash Borer, a page on Ajax's Urban Forestry Study conducted by TRCA over 2008, and an announcement for the urban forest workshop held in April of 2009.

8.2.2 *Fostering Engagement*

As with the Town website, there has been some effort over the past few years to foster more interest and engagement in local **urban forest** issues.

Recent activities include:

- Key Stakeholder Charette (March 26, 2009)
- Public Workshop: “You & the Urban Forest in Ajax” (April 23, 2009)
- Key Stakeholder Workshop Day related to the Urban Forest Management Plan (April 7, 2010)

A more concerted effort to increase these activities would benefit the Town’s urban forest management planning.

8.2.3 Building Partnerships and Pursuing Funding

The Town has already been working with several organizations to help gather information on the local **urban forest**, increase awareness about the value of the urban forest (including linkages to human health) and encourage stewardship on public lands. These include:

- Central Lake Ontario Conservation Authority (CLOCA)
- Durham Catholic Board of Education
- Durham Public Board of Education
- Durham Region
- Durham Region Health Department
- TRCA (Toronto Region Conservation Authority)

The Town and TRCA have developed an especially good partnership by working together to complete the Urban Forest Study (TRCA 2009a) and associated consultations.

Although the Town is aware that some opportunities for urban forest activity funding may be available directly to the municipality or through partnerships, they have not had an opportunity to investigate these to date.

8.3 Examples from Other Jurisdictions

A number of municipalities in southern Ontario, and elsewhere, offer a range of resources to foster engagement and support stewardship of their **urban forest** resources. Typically, larger cities with larger urban forestry departments offer the broadest range of information and services, but some smaller to mid-sized municipalities are finding creative ways to engage their communities. Some examples are described below.

The Canadian Urban Forest Network’s Compendium of Best Management Practices states: “Any urban forestry program has to integrate people as part of the program itself”, and identifies maintaining an urban forestry section on the municipal website as a key component of municipal outreach along with engagement through events such as field tours and open houses. A number of municipalities in southern and eastern Ontario who have active urban staff and/or departments have followed this advice.

City of Toronto

The City of Toronto has a very comprehensive urban forestry website that includes information on the City’s: tree by-laws and policies, forest health care program (including fact sheets on common tree pests and sources of stress), operations in different wards, and community volunteer event opportunities. Additional documents

available for downloading include lists of native tree and shrub species, information on invasive plants and tree pests, and how to deal with tree roots.

In terms of more hands-on stewardship, the City also coordinates a number of community events annually, some with the TRCA. In 2010, in addition to tree plantings in various parks, they are holding a tree festival on Toronto Islands that will include performances, educational displays and interactive industry demos.

Town of Richmond Hill

The Town of Richmond Hill has a number of pages on various urban forestry topics on its website. In addition to information on the City's tree by-laws, the site provides pages on topics such as where the City's scheduled pruning is for that year, dealing with branches touching hydro wires, when and how to water trees, and preventing tree damage from powered grass trimmers and edgers. The Town also provides downloadable pamphlets on its private tree by-law and with lists of locally appropriate **native species** for plantings.

In terms of more hands-on engagement and stewardship, Richmond Hill has a number of programs supporting urban forest management. These include an Arbor Week Program (in elementary schools), Schoolyard Naturalization Program, and Healthy Yards Program. The Healthy Yards Program offers residents the option of purchasing subsidized plant kits and rain barrels. Notably, Richmond Hill's Healthy Yards Program was initially based on Toronto's model and funded through TD's Green Streets Canada (see Appendix D), but is now a very successful program run and funded by the Town.

Town of Markham

The Town of Markham, has a dedicated urban forestry page on its website that provides information on the Town's Trees for Tomorrow Program (committing to planting 75,000 trees between 2005 and 2010), tree by-laws, boulevard tree care and invasive tree pests. The site also has a downloadable copy of the City's comprehensive Treescape Guidelines.

Community stewardship initiatives coordinated by the Town include workshops and a backyard tree planting program led by Local Enhancement and Appreciation of Forests (LEAF). The Town also offers funding for local tree planting projects through its Trees for Tomorrow Fund.

Town of Oakville

The Town of Oakville's urban forest web page provides information on and links to a wide range of urban forest initiatives. These include the City's tree by-laws and policies, tree protection guidelines and basic tree care information guidance, major tree pest threats in the City, woodlot management approaches, and the City's Urban Forest Management Plans and studies. A unique stewardship / engagement initiative being undertaken in partnership with Oakville Green in 2010 is an urban forest arts contest.

City of Guelph

The City of Guelph, a largely urbanized area with a population of about 130,000 (comparable to Ajax's) and a current **canopy cover** of about 30%, has a number of interesting initiatives underway. On its website, there is a "Trees" section with information on their Healthy Landscapes Program (with information on tree/shrub watering), tree registry, the City's Strategic Urban Forest Management Framework, Private Tree by-law, planned urban forestry / horticulture activities, how to water trees, and common tree problems.

In terms of initiatives aimed at achieving more engagement, Guelph has an on-line Tree Registry, free workshops and free landscape consultations through their "Healthy Landscapes" program and free mulch delivered on request on a first come first served basis.

City of Ottawa

The City of Ottawa has a very active urban forestry department and is one of the few municipalities that provide a number of stewardship programs in addition to comprehensive information on their website. Ottawa's "Urban Tree Conservation" section on its website includes information on: the City's Tree Conservation By-law, how to measure tree diameter, FAQs, how to get a "distinctive tree" permit, tree conservation guidelines, EAB (removal and disposal of ash trees, treatment options, reporting outbreaks) information for woodlot owners, and descriptions of available tree species.

Specific programs they offer related to urban forestry include:

- EAB Awareness Week (last held May 17 - 23, 2010)
- "Trees in Trust Program - City provides and plants trees at no cost for City-owned frontage where resident requests a tree, has space, and no conflicts with overhead utilities.
- Alternative Snow Fencing Program - Targeted at rural landowners with corn cropping systems, the City encourages planting of trees as windbreaks along roads ~ 20 m from the right-of-way property line. The City will compensate landowners for the market value per tonne of unharvested corn for the 6 to 12 rows used for alternative snow fencing.
- Community Tree Planting Program (2007-2010) - A municipal grant program offering \$5K to \$10K to support tree planting in schoolyards, parks and other community greenspaces.
- Commemorative Tree Program - City assists in planting a tree in memory of a lost loved one. A \$400 cost includes the planting of a tree (50 mm **caliper**) in an agreed location and 3 years of maintenance, and installation of a small plaque if desired.

Other Notable Municipal Initiatives

A number of municipalities in southern Ontario actively pursuing urban forest community initiatives have recognized the need for a staff or student co-op position to provide (a) technical support to residents regarding "healthy" tree planting / landscaping practices, and (b) coordinate and facilitate activities and events with the community, school groups, and other targeted stakeholders (e.g., City of Guelph, City of Burlington, City of Kitchener). This emphasizes a more cooperative approach to working with the community, rather than the municipality being in the position of enforcing tree by-laws and other policies and regulations which are perceived as more punitive.

The TRCA has, and continues to, make significant contributions to various stewardship initiatives in the municipalities in its jurisdiction (e.g. Town of Markham, Town of Richmond Hill). Examples include workshops, Neighbourhood Surveys, guided hikes, nature interpretation kits focussing on trees, and other urban forest resources. Many of these could be readily adopted for use in Ajax.

8.4 Opportunities for Improvement and Related Recommendations

As stated in Section 8.1, the goals of a comprehensive urban forestry communications program should be to:

1. increase residents' awareness and knowledge concerning the Ajax's urban forest by communicating the value of the urban forest as essential natural infrastructure;
2. foster the interest of residents regarding the protection and enhancement of Ajax's urban forest, including trees on private land; and
3. involve residents in caring for Ajax's urban forest, including trees on their own properties.

The following sections highlight a number of potential mechanisms for pursuing these goals. These opportunities for improvement are outlined below with associated recommendations highlighted in **bold**. These recommendations are also presented as part of the Five-Year Management Plan along with anticipated outcomes, costs and suggested timing.

8.4.1 Increasing Awareness

UFMP Plan Promotion

In the short-term, activities should be undertaken to promote the existence of this Plan to key stakeholders and the broader community. This should involve posting the final Plan (and any related supporting materials) on the Town's website, placing advertisements in the local paper and community publications, and potentially hosting an Open House in 2011 to announce its release. Periodic news releases related to implementation of this Plan should also be put out over the next five years to maintain awareness.

Town Website

With respect to the Town's website, there is a tremendous opportunity to increase awareness by posting information about the Town's urban forest, proper tree care practices, and current urban forest activities.

Urban forestry resources should include information about:

- the value of the urban forest and associated health, ecological, economic and social benefits;
- the Town's urban forest management practices (e.g., care of existing and planting of new **street trees**, links to City tree-related policies / standards / by-laws);
- key areas of interest or concern (e.g., **invasive species** identification and management, good tree care practices, lists of **native species** suitable for yards, hazard trees);
- opportunities for residents to support urban forest sustainability (e.g., water new Town trees in their boulevards, plant and maintain trees on their property); and
- and Town-sponsored or endorsed events (past and upcoming) related to urban forestry.

Examples of information that could be posted are listed below:

Current Publications / Resources

- Ajax’s Urban Forest Study Parts A and B
- this Plan, and/or sections from it (e.g., text from the benefits section provided in Appendix A, the summary of recommendations provided in the first five-year management plan)
- Tree Protection By-laws and Policies (information on and links to)
- Town’s Public Tree By-law
- Town’s Tree Protection By-law
- Durham’s Woodland By-law
- Links to relevant Town policies in its Official Plan, as well as local plans for the waterfront, Greenwood Conservation Area, Duffins and Carruthers Creeks Watersheds, Lynde Watershed, etc.
- “Made for Shade – A guide for creating shade at home”. This booklet was developed by the Made for Shade partnership and is found on the Durham Region Health Department website (www.durham.ca) or by calling Durham Health Connection Line at 1-800-841-2729.

Tree Care and Tree Planting

- What the Town does and is responsible for
- What local landowners can do on their property (E.g., watering, mulching)
- Woodlot management
- Tree Pests of Concern
- Integrate existing EAB page
- Link to Ontario Invasive Plant Council website
- Links to **native species** lists (Evergreen, Richmond Hill)

Current Activities and Events

- 2011 planned inspection and pruning
- Veridian activities related to hydro corridor clearing
- Any open houses, public meetings, workshops and/or presentations on urban forest topics
- Arbor Day activities and other public tree planting events
- Planned restoration events

Additional on-line urban forestry resources that could support this programming include:

- Trees Canada Grow Clean Air Program (information on how to become carbon neutral through tree planting)
http://www.treecanada.ca/site/?page=programs_gca&lang=en
- Evergreen Native Plant Database
<http://nativeplants.evergreen.ca/>
- Evergreen Invasive Species Fact Sheets
<http://www.evergreen.ca/en/resources/native-plants/fact-sheets.sn>
- Ontario Invasive Plant Council - various on-line publications about **invasive species**
<http://www.ontarioinvasiveplants.ca/>
- Clean Air Partnership - Urban Heat Island - various on-line publications related to heat island mitigation and adaptation
http://www.cleanairpartnership.org/UHI_resources

- ISA (International Society of Arboriculture) Trees Are Good Website - excellent and comprehensive information source
<http://www.treesaregood.org>
- Ontario Nature pamphlet: Urban Forests – An Important Part of Our Natural Heritage
<http://www.ontarionature.org/>
- Compendium of Best Management Practices for Canadian Urban Forests.
http://www.treecanada.ca/programs/urbanforestry/cufn/resources_bmp.html#_top
- Canadian Urban Forest Network
<http://www.treecanada.ca/programs/urbanforestry/cufn/cufn.html>
- Durham Health Department Sun Safety
http://www.durham.ca/health.asp?nr=/departments/health/health_protection/sun_safety/
- Land Owner Resource Centre (via the Rideau Valley Conservation Authority)
<http://www.lrconline.com/lrc/products/index.htm>

This list is not exhaustive, and should be updated with new information and links periodically.

Links could also be established between the Town of Ajax’s website and its urban forestry partners’ websites (e.g., TRCA, CLOCA, Durham Land Stewardship Council).

Targeted Social Marketing

The Town should also consider undertaking **some targeted social marketing**. For example it is known that most residents who garden spend most of their garden dollars at large nurseries and big box stores that sell garden supplies. Therefore setting up an attended booth with some urban forestry pamphlets and a knowledgeable staff person at such a venue for a few hours on a sunny spring day would likely be an effective marketing approach.

The local business community should also be targeted through organizations such as the Board of Trade and the Durham Homebuilders Association to (a) improve tree care and expand tree planting on their properties in the Town, and (b) support tree care and planting initiatives on other private and institutional lands in the Town. Discussions should be held with representatives from the business community and representatives from the Town to explore opportunities for collaborating to enhance and expand Ajax’s urban forest.

The Town may also want to explore some different strategies for getting the community’s attention. For example, some municipalities (e.g., Windsor, Oakville) have had booths and/or Open Houses or Public Meetings in somewhat unconventional locations, such as in the main halls of shopping malls, to grab the interest of people who might not otherwise go out of their way to attend such an event.

Other Marketing and Outreach

A three stage process to be led by Corporate Communications for undertaking urban forest marketing and outreach is outlined below.

STAGE 1: The Town’s Communications staff should **develop an identifier** and consistent formatting / imaging related to urban forest information and activities. All publications – whether on-line, or hardcopy – and presentations done under the “urban forestry” banner in Ajax could then be given a consistent look and feel to connect the messages with the Town’s UFMP.

STAGE 2: This should be followed by **development of some promotional / educational materials** focussing on key topics specific to Ajax’s urban forest. These could include colour pamphlets and/or posters designed to be available as on-line and in hardcopy, as well as stock presentations for use at schools and other community venues. Key topics should include a summary of the benefits of Ajax’s urban forest, an overview of past and current initiatives, current policies and by-laws that apply to tree protection, and forest pests and **invasive species**.

STAGE 3: These **materials should be disseminated** to promote the value and sustainable management of the urban forest through:

- the Town’s website;
- pamphlets and posters on key topics in public spaces (such as the City’s libraries, community centres, parks and natural areas);
- public workshops, seminars, presentations, site walks, and demonstrations;
- an annual Open House event; and
- the local media (e.g., newspapers, radio) and other local organizations willing to promote this material.

Announcements related to ongoing urban forest activities should also be posted on the Town’s e-news bulletins at least three of four times per year, and inserted into local community guides, and higher profile activities should also be made into press releases.

8.4.2 Fostering Engagement

The Town should engage more residents, neighbourhood groups, schools, businesses and other stakeholders in the stewardship of trees on their lands by providing, either independently, or in partnership with other groups:

- **educational public workshops, seminars, and presentations;**
- **visits to schools;**
- **a recognition program for urban forestry initiatives, and**
- **site walks and demonstrations several times per year at selected restoration sites.**

Workshops specifically targeted to (a) residents and (b) businesses with extensive lawns or landscaped areas should be developed and promoted. These activities overlap with and complement those identified under Stage 3 of the marketing and outreach listed above.

Table 3: Summary of partnership and funding opportunities identified in Ajax (details provided in Appendix D).

Organization	Program Name	Partnership / Resource Sharing	Subsidy/Funding Opportunity
CLOCA	Clean Water Stewardship: Tree and Shrub Program	X	X
Durham Land Stewardship Council (DLSC)	Various programs and partners throughout the Region	X	
Durham Public Board of Education	ECO School Program; Greening of School Yards; Landscape Art	X	
Durham Region Health Department	Made for Shade	X	
Environment Canada	EcoAction Community Funding Program		X
Evergreen	Toyota Learning School Grounds Greening		X
Evergreen	Common Grounds		X
Forest Gene Conservation Association (FGCA)	"Ontario's Natural Selections" Seed Source Certification Program (with Trees Ontario and OMNR)	X	
LEAF	1. Residential Planting Consultations (Toronto, s. York Region) 2. On-line Workshop and Tree Pick-up (Trial - North York Region) 3. Tree Planting Guides and In-Store Rebates (Trial - Kitchener-Waterloo/Guelph/Cambridge)	X	
Ontario Trillium Foundation	Community Program or Province-Wide Program		X
TRCA	i-Trees Eco	X	
TRCA	Stewardship Program	X	
Trees Canada	TD Green Streets Program		X
Trees Canada	Greening Canada's School Grounds		X
Trees Canada	Focus on Forests	X	
Trees Canada	Corporate Greening for Carbon Credits	X	
Trees Ontario	Tree Planting Subsidy: 1. Full Service Incentive Program (50 Cent Program)	X	X
Trees Ontario	Tree Planting Subsidy: 2. Landowner Tree Planting Program (10 Cent Program)	X	X
Trees Ontario	Tree Planting Subsidy: 3. 50 Million Tree Program	X	X

8.4.3 *Building Partnerships and Pursuing Funding*

Opportunities for building existing partnerships and seeking out new partnerships should also be explored, along with related opportunities for provision of services in kind and seeking financial subsidies and support. The Town has already been developing partnerships on urban forest issues with the Durham Catholic Board of Education, Durham Public Board of Education, and Durham Region Health Department, and has an excellent and long-standing partnership with TRCA. These partnerships should continue to be developed and expanded. In addition, the Town should build on existing partnerships with TRCA and pursue partnerships on urban forestry issues with CLOCA, the Durham Land Stewardship Council (DLSC), Durham Region, and the Ministry of Transportation.

Sources of potential subsidies, provision of in-kind resources and direct funding have also been identified with Environment Canada, Evergreen, the Forest Gene Conservation Association (FGCA), LEAF, Ontario Trillium Foundation, Trees Canada and Trees Ontario. The nature of the support from these various organizations is summarized in Table 3. A comprehensive summary of the nature of the programs and how they could support the Town's urban forest sustainability is provided in Appendix D. In addition to these partnerships with public agencies and organizations, as well as non-profits, Ajax should also explore partnerships with the private sector. Some prime examples include: Veridian (utilities), Ontario Power Generation (OPG), Ontario Realty Corporation (ORC), private schools, businesses/industries (e.g., Durham Board of Trade), golf courses and cemeteries.

8.4.4 *Communications Coordination and Staffing*

Urban Forest Steering Committee (UFSC)

In addition to building on existing and creating new partnerships, creation of an **Urban Forest Steering Committee (UFSC) comprised of representatives from active local organizations** is a good way to maintain communications between the Town and its external partners, and also a source of input for Urban Forest Management Plan (UFMP) review and updates. Such a group would include community environmental organizations, Durham Health, conservation authority representatives from stewardship branches (TRCA and CLOCA), Durham Land Stewardship Council (DLSC), and local school boards.

The UFSC could focus on pursuing funding and resource sharing for partnership-based urban forestry projects, as well as overseeing implementation of these projects. It could also provide input related to ongoing UFMP implementation, and advertise and promote various urban forest activities through its networks.

Additional Staffing Considerations

Although a number of partnerships are identified, as are funding opportunities, to pursue all the priority items identified will require a significant time commitment from several Town staff. Corporate Communications staff have indicated that they would be willing to take the lead on a number of these items, and Operations and Environmental Services are also committed to allocating some of their arborists' time to support these initiatives. As a result, **no additional staffing needs have been identified at this time to augment existing communications, coordination and outreach programs**. However, the addition of one or two seasonal Plant Health Care Technicians is recommended to augment the Town's PHC program. However, the staffing situation should be monitored over the next five years to determine if additional staffing should be considered as part of the next Five-Year Management Plan.

“The Town should continually develop innovative and engaging initiatives, in partnership with local conservation authorities and other experts in environmental management, which encourage environmental stewardship and the role of individuals in maintaining and enhancing ecological systems in Ajax”.

Town of Ajax Recreation, Parks and Culture Master Plan (2008)

9. Considerations for Future Management Plans

Although the focus of this report is on providing direction for the first Five-Year Management Plan (2011 – 2015), it is also intended to provide strategic guidance for three subsequent five year plans to be undertaken as part of a longer term 20 year strategy.

Strategic direction is to be provided through the vision, mission and strategic objectives (presented in Section 1.1). More specific direction for the first five years is presented in the first five-year management plan. Additional direction for future management plans is provided in this section.

The general recommendations, summarized in Table 4 below, consist of the following:

- a. **Recommendations** identified for the first Five-Year Management Plan that are expected to be ongoing beyond 2015;
- b. **Opportunities** for improvement that were identified through the development of this Plan but require other recommendations to be completed first, and were therefore deferred to the second Five-Year Management Plan, and;
- c. **Opportunities** for improvement that were identified through the development of this Plan but determined to be of lesser priority at this time, and therefore deferred to a later Five-Year Management Plan.

These action items are listed below with their anticipated timing. However, these will all need to be reviewed, in conjunction with the status of first Five-Year Plan’s 32 recommendations, as part of the development of the second Five-Year Plan.

As part of subsequent Five-Year Management Plan development, consideration will need to be given to any new developments related to Ajax’s urban forest over the 2011 – 2015 period, and if any new recommendations are required. Consideration will also need to be given to whether or not staffing resources are able to pursue the various urban forest initiatives identified at a satisfactory pace to realize the Town’s vision.

Table 4: General recommendations for future urban forest management plans (i.e., 2016 – 2030).

General Recommendation for Future Management Plans	Projected Timing	Comments
MONITORING		
Monitoring the status of the Plan using the established Criteria and Indicators	once in 2016, 2021, 2026	
Monitoring the Status of the Urban Forest (i.e., a full i-Tree Eco study)	once in 2018	Est. \$35,000 one time cost
MUNICIPAL PRACTICES		
Municipal Tree Inventory	2016 - 2030	Ongoing updates and maintenance required
Improving the Pruning Cycle	2016 - 2025	Target of reducing the grid pruning interval from eight to five years by 2025
TREE ESTABLISHMENT		
Improved Urban Forest Species Diversity	2016 - 2030	Target of overall diversity of municipal street and park trees to meet “30-20-10” rule over time.
Maximizing Tree Replacement	2016 - 2030	Ongoing underplanting in areas of mature trees, planting in available spaces on municipal lands throughout the Town, and providing support for tree plantings on private lands
PEST MANAGEMENT		
Development of Pest-Specific Management Strategies	2016 - 2030	As needed
PRIVATE TREE BY-LAW		
Development of a diameter based private tree by-law for the urban areas	2016	Pending the results of the cost:benefit analysis, and consultations with key stakeholders.
By-law Education and Enforcement Resources	2017 - 2018	If an additional private tree by-law is approved, additional staffing resources will also be required
WOODLAND RESOURCES		
Urban Woodland Management Plan	2016	Building on the results of the urban woodland assessment study to be completed by 2015
Continued Parks and Open Space Restoration	2016 - 2020	Development of a new restoration plan that monitors works done and identifies new areas
COMMUNICATIONS AND PARTNERSHIPS		
Communications Program	2016 - 2030	Ongoing updates and initiatives required. Influenced by successes and failures of previous efforts, and available resources and staff time
Awareness and Stewardship Support	2016 - 2030	Continued support provided for tree care and planting on private and institutional lands
Expanded Partnerships for Urban Forest Stewardship	2016 - 2030	Continued development of public and private sector partnerships
Pursuit of Funding and Resource Sharing	2016 - 2030	Continued pursuit of funding and need for new research into new or different opportunities once every five years or so

10. Glossary of Key Terms

Key terms defined below are highlighted in the text the first time they appear in each section of the report in bold and grey.

“30-20-10” Rule: A rule-of-thumb, proposed by Santamour (1990), to guide the establishment of the urban forest. The rule states that no tree family exceeds 30%, no tree genus exceeds 20%, and no tree species exceeds 10% of the total urban forest inventory. The objective of this guideline is to promote urban forest diversity and resilience to pests, pathogens and other stressors.

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 (CO₂) suspended in Earth’s atmosphere. A greenhouse gas, atmospheric carbon dioxide is known to be a primary contributor to climate change.

Caliper: The diameter of a young tree, typically measured at 15 cm above ground for trees up to and including 100 mm cal., or 10 cm above the bud union where applicable. From 125 mm and up, measurements are taken at 30 cm above the ground.

Canopy cover: A measurement of the areal extent of vegetation foliage, typically measured in percentage of total land area. For example, the City of Toronto’s canopy cover is estimated at 17% of the total land area of the city.

Co-dominant: With respect to tree stems, where two or more of similar diameter are emerging from the same location on the trunk. Co-dominant unions are typically weak and face a higher risk of failure than normal unions. Commonly found on improperly maintained trees, and more common among certain tree species.

Council of Tree and Landscape Appraisers (CTLA) Trunk Formula Method: A commonly-accepted method used to appraise the monetary value of trees considered too large to be replaced with nursery or field-grown stock. Determination of the value of a tree is based on the cost of the largest commonly available transplantable tree and its cost of installation, plus the increase in value due to the larger size of the tree being appraised. These values are adjusted according to the species of the tree and its physical condition and landscape location.

Diversity (species): Variation in the family, genus and species composition of trees in the urban forest. Species diversity encourages resilience to physiological stressors by reducing the number of pest or pathogen hosts or spreading them across a wider area at lower densities.

Diversity (structural): Variation in the age, size, structure, location and other physical characteristics of urban forest trees. Structural diversity encourages a continuous urban forest canopy as larger and older trees are removed.

Ecozone: (or biome) The largest scale biogeographic division of the Earth's land surfaces, based on the historic and evolutionary distribution patterns of terrestrial plants and animals. Ecozones represent large areas where plants and animals developed in relative isolation over long periods of time, and are separated from one another by geologic or climactic conditions that formed barriers to plant and animal migration. Canada has 15 terrestrial Ecozones (adapted from Wikipedia accessed September 2010).

Ecoregion: (or bioregion) An ecologically and geographically defined area that is smaller than an ecozone and larger than an ecosystem. Ecoregions cover relatively large areas of land or water, and contain characteristic, geographically distinct assemblages of natural communities and species. The biodiversity of flora, fauna and ecosystems that characterise an ecoregion tends to be distinct from that of other ecoregions (adapted from Wikipedia accessed September 2010).

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: 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 *Acer saccharum*, while Black maple is *Acer nigrum*).

Greenfield areas / development: The creation of planned communities on previously undeveloped land. This land may be rural, agricultural or unused areas on the outskirts of urban areas. Greenfield development aims to provide practical, affordable and sustainable living spaces for growing urban populations.

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

Hyperspectral analysis: The collection and processing of information from across the electromagnetic spectrum, enabling identification of similar but unique materials (e.g., different tree species.) In the urban forest, imaging flights conducted by specially-equipped aircraft, combined with ground-based data collection, can enable accurate mapping of the spatial distribution of different tree species.

Integrated Pest Management (IPM): An integrated approach to managing pest populations that reduces or eliminates the use of pesticides. Key components of IPM may include setting thresholds, population monitoring, trapping, cultural practices (e.g. tree species selection), mechanical or biological controls and chemical pesticide application.

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.

i-Tree: A publicly-available software suite that provides urban and community forestry analysis and benefits assessment tools to communities of all sizes as well as state forestry agencies, municipal foresters, non-profit organizations, commercial arborists, environmental consultants, planners, and others interested in their community forests.

i-Tree Eco: A computer model used by managers and researchers to quantify urban forest structure and function. Using field and meteorological data, Eco calculates forest attributes (species composition and diversity, diameter distribution, tree health, etc.) as well as forest functions and values related to tree effects on air pollution, greenhouse gases and global warming, pollen, and building energy use. Formerly known as UFORE (Urban Forest Effects model).

i-Tree Streets: A street tree management and analysis tool for urban forest managers that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO₂ reduction, stormwater control, and property value increase. Formerly known as STRATUM (Street Tree Resource Analysis for Urban Forest Managers).

Low Impact Development (LID): A land planning and engineering design approach to managing and reducing stormwater runoff. This approach implements engineered small-scale hydrologic controls to replicate the pre-development hydrologic regime of watersheds through infiltrating, filtering, storing, evaporating, and detaining runoff close to its source.

Leaf area index: The ratio of total upper leaf surface of vegetation divided by the surface area of the land on which the vegetation grows. LAI is a dimensionless value, typically ranging from 0 for bare ground to 6 for a dense forest.

Mulch beds: Continuous expanses of wood chips or other mulch spread at the base of trees and tree groupings. Mulch beds promote tree health by regulating soil moisture and temperature, reducing competition from weeds and reducing soil compaction.

Native (or Indigenous) 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.

Plantable space: Land cover that is suitable for tree planting (i.e., plantable soil that is not filled with tree canopies or other overhead restriction), where planting/establishment would not be prohibited due to land use. Planting underneath utility wires is permitted (Ajax's Urban Forest Study TRCA 2009a).

Plant Health Care (PHC): A holistic approach to improving the health and quality of landscape vegetation, especially trees, through a wide range of practices, including proper species selection and planting, mulching, watering, fertilization, protection, pruning and risk mitigation. Particular attention is paid to the rooting environment, as a majority of plant health issues originate as a result of below-ground stressors.

Potential canopy cover: A refined measurement of urban forest canopy which accounts for the subject area's carrying capacity for tree cover. Relative canopy cover provides a useful baseline for assessment and enables more informed target and goal setting.

Potential natural cover: Lands which have the potential to provide for the restoration of *natural self-sustaining vegetation* over the long term in order to protect and restore native biodiversity (Town of Ajax OPA 38).

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

Significant woodlands: An area which is ecologically important in terms of features, such as species composition, age of trees and stand history; functionally important due to its contribution to the broader landscape because of its location, size, or due to the amount of forest cover in the planning area; or economically important due to site quality, species composition, or past management history. Criteria for determining significant *woodlands* are recommended by the Ministry of Natural Resources, but an approach developed by the Town that achieves or exceeds the same objective may also be used. While some significant resources may already be identified and inventoried, the significance of others can only be determined after evaluation. Any such evaluation will examine wildlife usage and enhance connectivity to the broader ecosystem (Town of Ajax OPA 38, June 2010).

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

Successional plantings / processes: With respect to forested areas, succession is the term used to describe the natural and gradual evolution of an open area to a forest. Although many aspects of this model continue to be debated, in general a meadow habitat will naturally evolve into a woodland and then a forest as long as there is input of seed from nearby sources, and no major disturbance that interrupts this progression takes place. Successional plantings are intended to speed up this process and typically involve the introduction of sun-tolerant so-called pioneer species, followed by the gradual introduction of more shade-tolerant species as a canopy cover is formed, followed by eventual removal (or loss) of the pioneer species.

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

Underplanting: The establishment of young trees in areas dominated by mature trees. Underplanting ensures continuity in the tree canopy as older individuals are removed over time by enabling young trees to fill in such gaps.

Urban Forest: Generally refers to all trees and associated woody vegetation (e.g. shrubs), on both private and public lands, within a given jurisdiction with a significant urbanized component or one that is entirely urbanized. This includes trees in natural areas as well as trees in more manicured settings such as parks, yards and boulevards.

Urban heat island effect: Increased surface temperatures during summer months in urbanized areas resulting from paved surfaces, such as asphalt, and dark building rooftops which absorb and release more heat from the sun during the day and night-time than the natural landscape, thereby increasing the ambient temperature and prolonging periods of higher air temperature (Town of Ajax OPA 38, June 2010).

Urban matrix: The portion of a developed landscape that is built up with residential, commercial, institutional and sometimes industrial uses. It is typically compared to the rural matrix which is dominated by agricultural land uses.

Vegetation protection zone (VPZ): A vegetated buffer area surrounding a *natural heritage feature and areas, hydrologic feature or hazardous lands* within which only those land uses permitted within the feature or *hazardous land* itself are permitted. A vegetation protection zone is intended to be restored with native, self-sustaining vegetation and be of sufficient width to protect the feature and its functions from effects of the proposed change and associated activities before, during, and after, construction, and where possible, restore and enhance the feature and/or its function. In the case of *hazardous lands*, the vegetation protection zone is intended to protect people and property from naturally occurring hazards over the long-term (Town of Ajax OPA 38, June 2010).



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Appendix A

Recommended 25 Criteria and Indicators for Urban Forest Sustainability from Kenney *et al.* (in press)

Table A-1. Expanded criteria and performance indicators for the Vegetation Resource. (Adapted from Clark et al. 1997).

Vegetation Resource					
Criteria	Performance indicators				Key Objectives
	Low	Moderate	Good	Optimal	
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
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.	No species represents more than 10% of the entire tree population at the neighbourhood level.	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 recognized.	The use of native species is <i>encouraged</i> on a project-appropriate basis in both intensively and extensively managed areas; invasive species are recognized and their use is discouraged.	The use of native species is <i>required</i> on a project-appropriate basis in both intensively and extensively managed areas; invasive species are recognized and prohibited.	Preservation and enhancement of local natural biodiversity

Table A-2. Expanded criteria and performance indicators for the Community Framework. (Adapted from Clark et al. 1997).

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.

Table A-3. Expanded criteria and performance indicators for the Resource Management Approach. (Adapted from Clark et al. 1997).

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 <i>existing</i> 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 <i>ad hoc</i>	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

Resource Management Approach					
Criteria	Performance Indicators				Key Objective
	Low	Moderate	Good	Optimal	
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.
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

Overview of Urban Forest Benefits: An Ajax Perspective

ENVIRONMENTAL BENEFITS

The various green infrastructure elements of an urban forest provide a range of environmental benefits, also known as ecological or ecosystem services. Such services include, but are not limited to:

- Improving air quality by reducing air pollution;
- Cooling the ‘urban heat island’ through shading and evapotranspiration;
- Treating and reducing the volume of stormwater runoff;
- Storing and sequestering atmospheric carbon; and,
- Providing habitat for urban and migratory wildlife.

In 2009, the Toronto and Region Conservation Authority (TRCA), in cooperation with the Town, completed the *Town of Ajax Urban Forest Study*. This study analysed local field-sampled environmental data using the United States Department of Agriculture (USDA) Forest Service Urban Forest Effects (UFORE) model, thereby quantifying the value and amount of a range of benefits provided by Ajax’ urban forest (TRCA 2009). Selected results of this analysis, as well as a general discussion of urban forest benefits, are provided in this section.

Improving Air Quality

Air quality is a serious concern in the Greater Toronto Area, particularly when local sources of pollution combine with air pollutants from industrial centres in the American Midwest to form smog. As a result, the Greater Toronto Area often experiences Air Quality Index values of over 50 (very poor) between early May and late September, on hot, windless sunny days.

Trees are among the most effective and efficient air-cleaning mechanisms available in urban centres to reduce the harmful effects of air pollutants such as nitrogen dioxide (NO₂), sulphur dioxide (SO₂), ozone (O₃), carbon monoxide (CO), and particulate matter of ten microns or less (PM₁₀) (McPherson et al. 1999; Nowak 1992; Rowntree et al. 1991).

In Ajax, the urban forest filters out 61 metric tonnes of criteria pollutants, providing approximately \$671,400 worth of these services annually. Trees account for 85.2% of this pollution removal. Research in 55 U.S. cities demonstrates that urban forests invariably provide millions of dollars worth of ‘free’ air pollutant removal – trees simply need places to grow and can care of the rest.

Cooling the ‘urban heat island’

Average daytime summer temperatures in urban areas can be over 5°C higher than in surrounding regions, and such high temperatures can last for several weeks during mid-summer. This phenomenon is termed the *urban heat island effect*, and occurs when grey infrastructure in city centres absorbs sunlight and reradiates it as heat.

Trees provide substantial cooling benefits in urban centres through direct and indirect cooling, particularly when planted in groups and situated with consideration of shading patterns and air flow. They absorb sunlight, thus providing shade and preventing light from reaching absorbing surfaces. By

shading buildings, they can reduce the amount of energy used to operate air conditioners, reducing greenhouse gas emissions and improving air quality. Similarly, properly-selected and placed trees reduce the cooling effect of winter winds, reducing reliance on heat generation. Trees also release water vapour as part of their respiratory processes through openings on the undersides of their leaves, called stomata. This process, known as evapotranspiration, absorbs heat directly from the ambient air and cools it (McPherson 1994; Pouyat and McDonnell 1991; Nowak 1994; Simpson 1998).

The Ajax UFORE study found a direct correlation between lower canopy cover and higher surface temperatures in Ajax, with highest temperatures in new residential developments in the northwest section of the Town, as well as in core commercial areas. Conversely, areas with higher vegetation cover recorded significantly lower temperatures.

Stormwater Runoff

During severe weather events, the hard surfaces found in urban areas channel oil and pollutant-contaminated stormwater into storm sewers, which flow directly into local water bodies. Ajax has 50 stormwater ponds that address water quality, but some of the older areas in the Town do not have stormwater quality controls. Ultimately all of the Town's stormwater is channelled into Lake Ontario, the source of much of the GTA's drinking water. The nonpoint pollution and increased water temperatures associated with storm water runoff have adverse effects upon fish and aquatic invertebrates, and contributes to increase algal blooms and nutrient imbalances in the receiving water bodies. The Town has participated in various studies related to water quality and has initiated a Stormwater Retrofit Environmental Assessment to look at ways of improving the quality of stormwater runoff in the areas of the Town not served by stormwater ponds. All new development in the Town is required to implement best management practices for stormwater management.

In the urban forest, trees and soils function together to reduce the volume and temperature, and increase the quality, of stormwater runoff. Trees reduce stormwater flow by intercepting rainwater on leaves, branches and trunks, enabling some of it to evaporate back into the atmosphere. More water directly infiltrates the ground, further reducing runoff and pollutant loading, and regenerating groundwater. As trees intercept stormwater, erosion is reduced, further contributing to stream and lake water quality and promoting slope and bank stability (Floyd 2002; Harris 1992; Peck and Callaghan 1999; Bernatzky 1983; Xiao et al. 1998).

Carbon storage and sequestration

Through their natural respiratory processes, trees are able to absorb atmospheric carbon, a known greenhouse gas which contributes to climate change and global warming. Carbon is stored in a tree's woody biomass and not released into the atmosphere until the tree decays, or is burned. The rate at which carbon is stored is termed sequestration, and is typically measured as volume per unit land area (Kollin and Schwab 2009). Although large, old trees provide exponentially more benefits with respect to air quality, shade and local habitat, from a carbon sequestration perspective, trees, on average, seem to gradually increase their capacity until they reach about 100 cm diameter at breast height, after which point their ability to uptake more atmospheric carbon than they release levels off (McNeil and Vava 2006). Nonetheless, the carbon storage of these large trees is significant and proportional to their size.

Ajax' urban forest sequesters an estimated 2,784 tonnes of carbon annually (net). Another 105,000 tonnes are already stored in standing trees in Ajax. Carbon storage and sequestration rates increase as tree size increases, thus highlighting the importance of maintaining large-stature trees for the long term. The increasing concern over global climate change may soon make carbon sequestration a viable economic incentive for sustainable urban forest management, particularly through increased tree establishment and long-term maintenance.

Wildlife habitat

Both street trees and trees in forested urban areas provide habitat and food sources for a diverse range of wildlife, including birds, invertebrates, reptiles, amphibians, and small mammals, while trees within riparian corridors help cool watercourses and provide the refuges needed by spawning fish (Friesen et al 1995; Tilghman 1987). When aligned in a linear orientation, contiguous forested areas, or even nearby fragments, provide important corridors for migratory birds and invertebrates such as butterflies. This habitat provision has important intrinsic value, and furthermore enables urban dwellers to more closely interact with nature, more regularly, contributing to psychological well-being and safer, more liveable communities.

Social Benefits

Urban forests provide important social benefits such as physical and psychological health, reduction in crime, and creating an atmosphere conducive to community participation.

Through many of the environmental benefits discussed above, trees and urban forests contribute to the improved physical and psychological health of urban residents. By filtering air pollution, trees have been shown to reduce the rates of asthma in cities, and one forested acre can remove as much carbon dioxide from the air as is produced by a car driven over 40,000 km annually. Forested areas in cities also promote physical activity such as walking, cycling and running by making safe and appealing refuges for such activities available closer to a greater number of residents. Street trees help to focus vehicle drivers' field of vision, leading to reduced traffic speeds and improved pedestrian safety.

Trees also contribute to psychological health; a landmark study found that some surgery patients situated in rooms overlooking treed areas recovered significantly sooner and used less pain medication than those without a similar view. Human stress levels, as measured by muscle tension, blood pressure level and electrical brain activity, have been found to be consistently lower within minutes of exposure to a green environment. Research from Chicago shows that green spaces, especially trees, may help facilitate positive social interaction among neighbourhood members and reduce feelings of social isolation and incidences of depression (Sorte 1995; Dwyer et al 1992; Ebenreck 1989; Grahn and Stigsdotter 2003; Heisler, Grant and Gao 2002; Kuo 2003; Kweon et al. 1998; Ulrich et al. 1991; Ulrich and Parsons 1993).

Health Benefits (Shading)

The natural shade provided by urban forests and residential trees, shrubs and climbing plants is one of the best defences against ultraviolet radiation (UVR) from the sun and an important part of sun safety practices. Shade alone can reduce the overall exposure to the sun's UVR by 75%. (www.sunsmart.com.au).

Exposure to UVR can result in health concerns such as damage to the eyes and skin, leading to cataracts and skin cancer, immunosuppression and premature aging of the skin. The higher the UV index reading, the greater potential for damage and the less time it takes for harm to occur.

UVR exposure, particularly during childhood and adolescence contributes significantly to the lifetime risk of developing skin cancer. The International Agency for Research on Cancer (an agency of the World Health Organization) has recently upgraded UVR to its highest cancer risk category. This brings sun safety and UVR exposure to the forefront of cancer prevention activity on a global level.

Canadian Statistics:

- Skin cancer is the most common cancer diagnosed in Canada. (Canadian Cancer Society, 2009)
- According to the Canadian Cancer Society, more than 75,100 Canadians will be diagnosed with non-melanoma skin cancer and approximately 5,000 Canadians will be diagnosed melanoma skin cancer in 2009. (Canadian Cancer Society, 2009)

Durham Region Statistics:

- 59% of residents report that they do not always or often avoid the sun between 11 am and 4 pm (Rapid Risk Factor Surveillance System (RRFSS) Jan-Dec. 2008)
- 54% of residents do not wear protective clothing when in the sun (RRFSS Jan-Dec. 2008)
- 40% of residents reported having a sunburn in the past 12 months. (RRFSS Jan-Dec. 2008)
- 93% of residents support the idea of shade (RRFSS Jan – Aug 2004)

Reducing the level of exposure to UVR decreases the burden of skin cancer on any community. Accumulated sun exposure and sunburns increase the chances of developing skin cancer. Shade is an underutilized strategy to reduce ultraviolet radiation. It is one of the best defenses against the sun's UVR and an important part of sun safety practices.

Economic Benefits

While urban forest management may be costly, many urban residents do not realize the significant economic benefits provided by trees. Research has shown that shoppers in well-treed commercial districts are willing to pay more for parking and will generally stay longer in shops than those in similar but more sparsely-treed areas. On average, shoppers on tree-lined streets believe the quality of merchandise sold there is higher, and are willing to pay up to 12 percent more for goods and services purchased in such areas. Even commercial property values can be up to 6 percent higher on such streets. Trees can also contribute to higher residential dwelling resale values, and homes with treed lots or street trees often stay on the market for a shorter time than those without. A survey of real estate brokers in American urban centres found that 85% believe trees positively contribute to a home's appeal to prospective buyers (Anderson and Cordell 1987; Canada Mortgage and Housing Corporation 1996; Laverne and Wilson-Geideman 2003; Wolf 2003).

The urban forest also reduces costs for energy usage. In Ajax, trees reduce demand for energy use by an estimated 35,570 million British Thermal Units (MBtu) and 1,220 Megawatt-hours (MWH), for a total annual savings of \$403,430. This results in avoided carbon emissions of 118 tonnes annually (TRCA 2009).

Appendix C

Municipal Tree Inventory: Selected Examples

Town of New Tecumseth, ON

The Town of New Tecumseth, a predominantly rural municipality north of Toronto, undertook a complete street tree inventory project in the summer of 2009 within its three urbanized communities (Alliston, Tottenham and Beeton). This inventory of over 5,000 street trees is GIS-based and includes basic size and species attributes; highly-detailed condition assessments; and code-based work recommendations with priority ratings, which can be queried to generate individual and street-based work orders. Unlike in most municipalities, all street trees are tagged to facilitate field identification.

City of Kitchener, ON

Kitchener maintains an inventory of over 47,000 street trees. The inventory is fully GIS-based, and was developed to be fully compatible with the USDA Forest Service i-Tree Streets street tree benefit-cost analysis software suite. A variety of condition and work order attributes are included, using standardized comments to facilitate analysis. The inventory will be used to generate a cost-benefit analysis of the city's urban forest, and was a key component of the development of the city's Emerald Ash Borer management strategy. It will also be integrated into the city's work order management system.

City of London, ON

London undertook an inventory of 123,359 street and 32,101 park trees in 2002, and regularly updates the system to reflect spring and fall plantings as well as the removal of hazardous and dead trees. Findings suggest that 33% of London's trees are maples. The inventory assists the City's Forestry Group in its year-round maintenance program as well as tree establishment planning. The City's street tree map is also available online through the *CityMap* application (see Figure A), enabling residents to view basic data about street and park trees, including species and diameter.

City of Vancouver, BC

Vancouver maintains an inventory of some 134,000 street trees and planting sites through a computerized system called *VanTree*. *VanTree* records each street tree's vital statistics, including species, height, diameter, condition, etc. The location of each tree is inventoried by street name and hundred block, with exact location indicated by a "cell" number showing its position relative to a building or residence address. *VanTree* also records service requests, and tracks the work history of each tree. This includes planting, watering, stake removal, systematic pruning, emergency calls, and finally, removal, stump grinding, and re-planting of a replacement tree. Removed trees are retained in the program memory for historical reference. *VanTree* is among the most comprehensive and successful municipal street tree inventory systems, due largely in part to its work history and work order tracking capabilities.

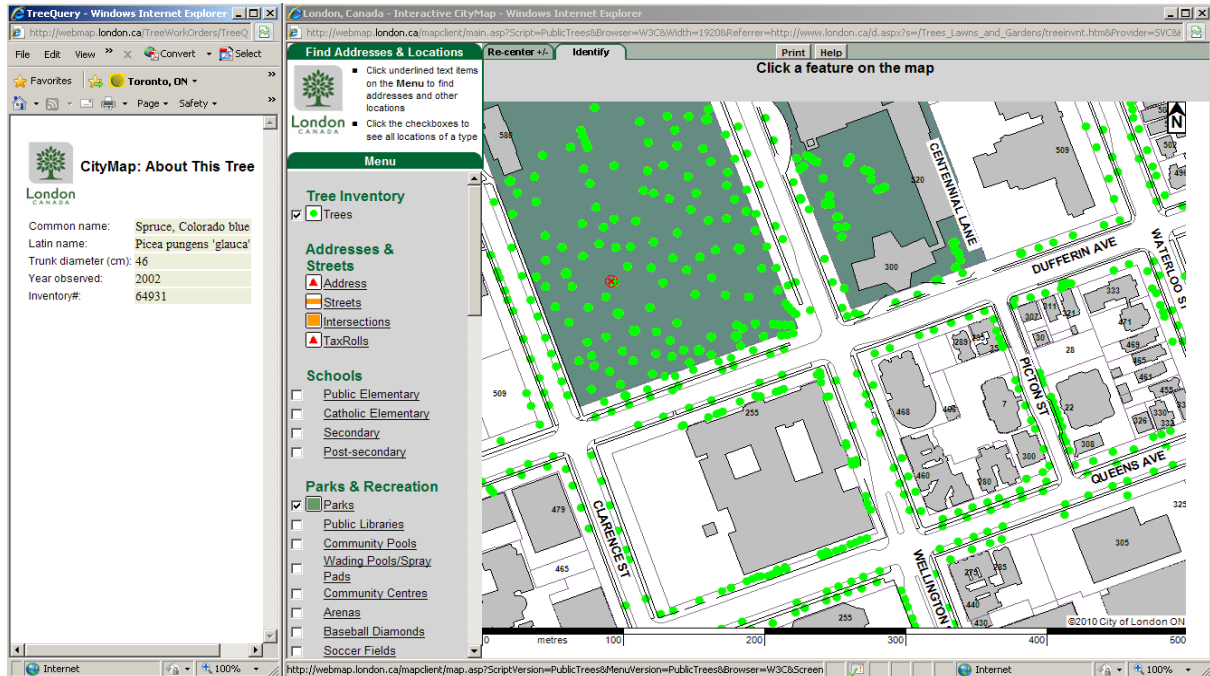


Figure A-1. Screenshot of the City of London's CityMap application, enabling users to view basic information about more than 120,000 publicly-owned trees. ©2010 City of London, ON.

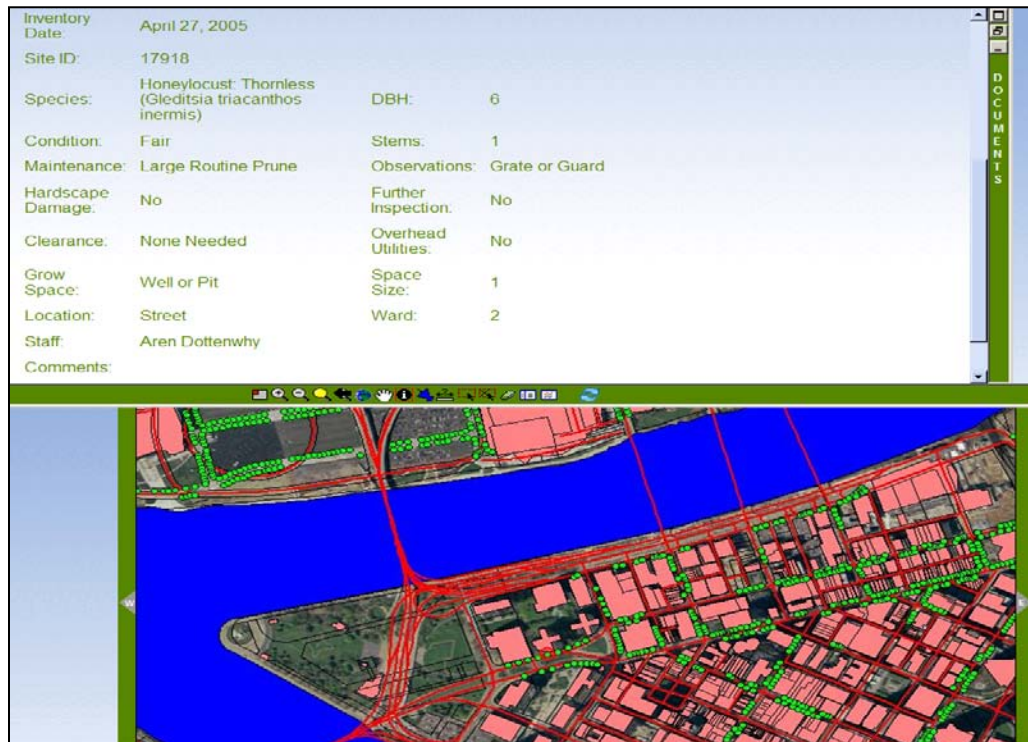


Figure A-2: Screenshot of the City of Pittsburgh's web-based street tree inventory program.

Table A-4: Examples of minimum required attributes for different levels of public tree inventories.

	Basic	Intermediate	Optimal
Tree ID tag	-	-	✓
Location	Municipal Address or Block	Points through airphoto interpretation	GIS
Location Type Description	-	✓	✓
Species	✓	✓	✓
Diameter (DBH)	✓	✓	✓
Crown Diameter (approx.)	-	-	✓
Crown Height (approx.)	-	-	✓
Tree Height (approx.)	-	-	✓
Tree Age Class	-	✓	✓
Condition	Scale-based	Scale- or point-based	Point-based, by tree component part
Pest/Pathogen ID	-	-	✓
Work Recommendations	-	✓	✓
Work Priority	-	✓	✓
Risk Assessment	-	✓	Using ISA method
Infrastructure Conflict	Yes/No	Descriptive	Code-based
Plantable Spaces	-	✓	GIS
Comments	✓	✓	✓
Database Management	Computerized	Computerised	GIS and Asset Management System
Data Collection Method	Paper or handheld device	Handheld device	Handheld device with GPS capability
Tree Types Inventoried	Street trees	Street/park trees	Street/park trees and woodland stand characteristics

City of Pittsburgh, Pennsylvania, USA

The City of Pittsburgh collected an inventory of 31,524 street trees, open space trees and stumps in 2005, comprising of 134 species and 60 genera. The stated objectives of the street tree inventory project were to identify hazardous conditions, provide accurate data for the City’s operational and capital budgeting process, prioritize work, enhance efficiency of maintenance operations, permit proactive management of disease and pest infestations and establish a basis for compensatory value. The inventory is currently maintained with the Davey Resource Group’s *Treekeeper 7* software, which allows the public to explore the entire map-based street tree inventory database online. As with London’s inventory, users can zoom in on a map of the City and click on individual tree points, providing them with a summary report about the selected tree (Figure A-2). Findings from Pittsburgh’s inventory resulted in over \$8 million in recommended priority-based maintenance work such as pruning and removal, and were incorporated into a 7-year management plan. These data were also used to conduct an i-Tree STRATUM (now Streets) benefit-cost analysis, which found that the city receives \$2.94 in benefits for every dollar spent on urban forest management.

Table A-4, above, outlines minimum required attributes for basic, intermediate and optimal levels of public tree inventory.

The list in Table A-4 is neither exhaustive nor complete, and many other important attributes may be collected. A detailed analysis of inventory attributes which are to be collected and processed should be conducted when a corporate asset management system is selected by the Town.

A description of the attributes in Table A-4 is outlined below:

- **Tree ID:** Trees are typically given an identification number in the inventory database. The number can simply correspond to the order in which trees were assessed (sub-optimal), it can be a composite number reflecting municipal address, geographic sector and block number (good), or it can correspond to a physical tree identification tag (best).
- **Location:** Tree location in the database can be denoted by municipal address or block ID, tree points can be mapped through airphoto interpretation (good), or tree location coordinates and crown diameter polygons can be included in a Geographic Information System database (optimal). All levels of inventory should include a municipal address to facilitate the implementation of work orders. GIS mapping can greatly facilitate desktop planning exercises such as infrastructure project design or tree establishment planning.
- **Location type description:** A description of the tree habitat type (e.g. hardscape tree pit, lawn, etc.) can facilitate management planning by directing certain activities, such as watering or mulching, to the sites where they are generally most appropriate or necessary.
- **Species:** This attribute is essential for assessment of urban forest structure. Botanical names should be used, and varieties and cultivars should be noted if possible.
- **Diameter (DBH):** This is a standard attribute for assessing tree size. It also enables a calculation of relative diameter (RDBH), which can provide some indication of urban forest health conditions.

- **Size and age attributes:** Attributes such as tree height, crown height, crown diameter and age class greatly facilitate maintenance planning and crew allotment, improve understanding of urban forest structure, and enable Leaf Area calculation, which is a better assessment of urban forest cover than canopy cover percentage.
- **Condition:** Tree condition may be assessed through a variety of methods. The most basic condition assessment is an overall scale-based rating (e.g. good, fair, poor). Often, such a basic assessment is insufficient to provide an accurate picture of a tree's true condition. At a minimum, condition ratings should distinguish between leaf and trunk condition. A higher level of detail assesses trunk integrity, crown structure and crown vitality individually. The optimal level assesses several components of stem and crown structure (e.g. root flare, stem, crown base, and scaffold branches) for a variety of indicators (e.g. cracks, growth deficits, wounds, decay, etc.) on an ascending, point-based scale. Such information can be used to schedule tree maintenance or inspection, as well as to develop a better understanding of tree risk and urban forest health and structure. Querying such a database can also generate species profiles to guide future tree establishment decisions.
- **Pests and Pathogens:** Visible signs of pests, diseases or decay pathogens should be noted as separate from general comments to enable more effective pest management and pest infestation response planning.
- **Work Recommendations and Priorities:** Managing and assigning maintenance recommendations is one of the most useful aspects of a street tree inventory, and perhaps the most important component of the transition from reactive to proactive urban forest management. Including recommendations within the inventory increases efficiency and reduces costs by both enabling directed maintenance and potentially reducing tree failures and associated liability. Work recommendations should be assigned in a standardized fashion (e.g. work code), and not in a general comments attribute field. An optimal inventory includes work recommendation codes and supporting comments, and prioritizes maintenance requirements on a time-based scale. Such an inventory can then easily be queried to develop work lists and time, cost and materials estimates.
- **Risk assessment:** An assessment of a tree's risk potential is an effective means to reduce liability, prioritize work recommendations and improve service delivery effectiveness and efficiency. Rating risk can also demonstrate the Town's fulfillment of its Duty of Care to ensure public trees are maintained in reasonably safe condition.
- **Conflict:** Trees may grow in conflict with overhead utility wires, other trees, signs, structures, sidewalks and other infrastructure. A basic inventory notes the presence or absence of conflicts, while more advanced levels of assessment note the type of conflict and, in order to ensure consistency and facilitate future queries, provide each type likely conflict with an alphabetical code.

A robust digitized public tree inventory will facilitate a wide range of urban forest management and planning initiatives. An inventory in the intermediate or optimal range, as determined by the number and variety of attributes collected and its integration with a corporate asset management system, will provide the Town with the best return on the investment associated with collecting inventory data.

At the time of writing, the Town is reviewing a number of asset management systems for implementation across the corporate structure. Prior to undertaking an inventory, the Town must ensure that the tree inventory database will be fully compatible with the corporate asset management system selected.

It is also important that the inventory system should be structured in such a way as to enable consistency between all assessors, thereby facilitating post-inventory database queries, analysis and work order processing. This can be best achieved by ensuring that as many data attribute fields as possible can be completed by using drop-down menus on handheld computer programs, and that assessments are check, scale, code, or point based, rather than descriptive or text based. The inventory should also be made compatible with the i-Tree software suite with a minimal level of data manipulation or processing.

It is recommended that Ajax undertake the process of collecting an inventory of public trees across the Town, including detailed street and park tree inventory data and sample-based woodland stand classification. Additionally, street and park tree data should be integrated into a corporate asset management system and Geographic Information System (GIS), and integrated into work order processing and cyclical grid pruning. Basic inventory data and mapping should be made publicly available.

Appendix D

Summary of Opportunities for Partnerships and Funding in Ajax

Organization	Program Name	Land Ownership	Program Goal	Opportunities in Ajax	Nature of Support	Cost / Value	Contact
CLOCA	Clean Water Stewardship Programs	private	To encourage and support Central Lake Ontario Conservation's watershed landowners to conserve, enhance and monitor the ecological health and biodiversity of the natural resources on their properties	Financial support (75% to 100% up to set limits) for implementation of habitat rehabilitation, as well as tree seedlings sales and planting programs for landowners with at least 0.8 ha (2 acres) in the CLOCA watershed.	Subsidized trees and shrubs from specified list. CLOCA staff will provide technical tree planting advice, order the trees, and arrange for shipment to a local cold storage facility. Landowners are responsible for picking up their trees from the designated cold storage facility and planting them.	\$0.45 to \$1.05 per seedling for a min. order of 100 seedlings.	Kathy Luttrell, Diana Shermet
Durham Catholic Board of Education	<i>no information provided</i>	public (institutional)	<i>no information provided</i>	Board could pick three schools per year for the Town to work with re. tree planting and maintenance.	Schools to provide land and teachers / students to plant and maintain the trees. Town of provide trees and technical guidance for planting and care?	unknown	Judy Gould
Durham Land Stewardship Council (DLSC)	Various programs and partners throughout the Region	private	Mandated to develop programs for private land use and to maintain and preserve rural areas and resources. **Rural emphasis but will consider large-scale urban reforestation projects.	DLSC is currently under staffed, but there may be "fringe" opportunities for support to larger landowners wanting to re-forest their lands.	Provide technical support (e.g., how and where best to replant), can coordinate tree orders and delivery (through Kemptville), and may provide small amounts of funding for approved projects. Requires landowner to contact them.	No cost; value of services varies from project to project.	Dan Whitmarsh, Chair, T. 905.717.0863, E: danielwhitmarsh@gmail.com
Durham Public Board of Education	ECO School Program; Greening of School Yards; Landscape Art	public (institutional)	Increase tree plantings (and naturalization) on school grounds.	Board could pick three schools per year for the Town to work with re. tree planting and maintenance.	Schools to provide land and teachers / students to plant and maintain the trees. Town of provide trees and technical guidance for planting and care?	unknown	Jody Dale
Durham Region Health Department	Chronic Disease Prevention	private or public	To reduce the burden of preventable chronic diseases of public health importance. Skin cancer prevention through educational support for more natural and artificial shade.	Made for Shade print resources and posters, Sun Safety print resources and posters Sun Safe School Handbook and promotional flyer Sun Safe Resource Package (Grade 2 teachers) Link to www.durham.ca	Provide support and resources about sun safety and the role shade plays in the prevention of the damaging health effects of ultraviolet radiation (UVR). Increasing awareness of the health benefits of trees, and encouraging tree planting on private lands.	No cost – (large quantities of resources may necessitate cost recovery)	Judy Elliott judy.elliott@durham.ca
Environment Canada	EcoAction Community Funding Program	public or private	Providing financial support to community-based, non-profit organizations for projects that have measurable, positive impacts on the environment.	Town could support or partner with a local non-profit organization to apply for a reforestation / restoration project in any one of a number fo identified potential restoration areas on Town or TRCA lands.	Program supports projects that address the following four themes: Clean Air - reducing air emissions that contribute to air pollutants; Clean Water - diverting and reducing substances that negatively affect water quality or focusing on water conservation and efficiency; Climate Change - reducing greenhouse gas emissions that contribute to climate change; Nature - protecting wildlife and plants, and protecting and improving the habitats where they live.	Unknown	Ontario Region 4905 Dufferin Street Downsview, Ontario M3H 5T4 Phone: (416) 739-4734 or 1-800-661-7785 (toll-free) Fax: (416) 739-4235 E-mail: ecoaction.on@ec.gc.ca

Organization	Program Name	Land Ownership	Program Goal	Opportunities in Ajax	Nature of Support	Cost / Value	Contact
Evergreen	Toyota Learning School Grounds Greening	public (institutional)	For schools wishing to create outdoor classrooms and food gardens to provide students with a healthy place to play, learn and develop a genuine respect for nature.	The Town could post / provide this information link to interested schools, and potentially provide technical support.	Grants	\$500 to \$2,000 for publicly funded Canadian schools (JK–Grade 12); \$500 to \$1,000 for not-for-profit daycares	355 Adelaide Street West Fifth Floor, Toronto, Ontario M5V 1S2 Toll free: 1-888-426-3138
Evergreen	Common Grounds	public	Greening on public open spaces in urban areas. **Community groups must be working in partnership with their local municipality or other institutional partner such as federal or provincial government agencies, crown corporations or publicly funded institutions (such as a university or hospital).	The Town could work with a community group to secure funding in support of greening a shared public space (e.g., the waterfront).	Grants	\$1,000 to \$12,000	356 Adelaide Street West Fifth Floor, Toronto, Ontario M5V 1S2 Toll free: 1-888-426-3138
Forest Gene Conservation Association (FGCA)	"Ontario's Natural Selections" Seed Source Certification Program (with Trees Ontario and OMNR)	private	Support biologically appropriate afforestation; increase awareness of importance of native species in forest conservation, management and recovery	Potential training on native seed collection for staff and/or students	Provide workshops on native seed collection and storage; provide information on Butternut	No cost?	Barb Boysen (Peterborough, ON), T. (705) 755-3284, E: b.boysen@ontario.ca
LEAF	1. Residential Planting Consultations (Toronto, s. York Region) 2. On-line Workshop and Tree Pick-up (Trial - North York Region) 3. Tree Planting Guides and In-Store Rebates (Trial - Kitchener-Waterloo/Guelph/Cambridge)	private	To ensure more native trees are planted in residential yards, and that the right tree is planted in the right place.	The Town is currently outside of LEAF's service area. However, depending on the results on trials (i.e., programs 2 and 3) they may consider expanding their service area. Alternately, another organization may adopt their model in Ajax.	Depending on the program: 1. Consultation with a LEAF arborist in participant's back yard, tree delivery and planting service. 2. Provision of on-line workshop for species selection, siting and care followed by tree delivery to control location. Provision of guides and in-store rebates at selected nurseries for native species.	\$25-\$35 per shrub; \$20-\$50 per back-yard consultation	Michelle Bourdeau Mgr, Residential Planting Programs T. 416-413-9244 ext.11 michelle@yourleaf.org
Ontario Trillium Foundation	Community Program or Province-Wide Program	public	To build healthy and vibrant communities throughout Ontario by strengthening the capacity of the voluntary sector, through investments in community-based initiatives. **Municipalities with more than 20,000 people are eligible except through partnership with a non-profit or charitable organization as the lead.	The Town could apply for a grant if they are part of a community collaborative that involves at least one eligible organization (i.e., a registered charitable or non-profit organization) and has a clear benefit to the community. ** Peterborough Green Up was successful in getting funding for urban forest inventory work with the City.	Grants (** for proposals led by non-profit or charitable organizations)	Community Program (up to \$15K) or Province-Wide Program (over \$15 K; up to about \$100 K)	Lenka Petric Durham Region / Peterborough Area Coordinator T. 1-866-443-3808
TRCA	UFORE	mixed	Conduct research and analysis for municipalities to help them understand the extent / structure / composition and value (from a "green infrastructure" perspective) of their urban forest. Provide a report of this analysis to support promotion of the urban forest, help guide urban forest management planning, and serve as a baseline for future monitoring.	TRCA has recently completed a UFORE study for the Town (2009), but is able to provide a UTC analysis (to facilitate the selection of priority planting areas) and conduct another UFORE analysis (2013?) to identify trends.	Provision of technical information and recommendations to support urban forest management.	No cost for the UFORE study (?) but yes for the UTC analysis?	Meaghan Eastwood, Lionel Normand, Laura del Giudici

Organization	Program Name	Land Ownership	Program Goal	Opportunities in Ajax	Nature of Support	Cost / Value	Contact
TRCA	Stewardship Program	mainly public	Naturalize / restore areas such as degraded ravines and woodlots, as well as plantable open spaces such as parks and road rights-of-way, with a diversity of native plants.	TRCA willing to assist in development of strategies to implement invasive species control measures. May also be opportunities to have TRCA Stewardship staff assist in a few locations?	Provision of labour, and possibly some planting stock, for naturalization efforts.	No cost?	Tom Hildbrand
Trees Canada	TD Green Streets Program	mixed	Support greening of urban municipalities across Canada.	Could apply for this funding to support one or more urban forest initiative.	Funds to be used for tree planting, inventory, maintenance and educational activities. R Can range from invasive species removal to revitalizing downtown streetscapes and supporting community planting programs.	Grants of up to \$15,000 for successful municipalities (from Trees Canada through TD Friends of the Environment Fund). Requires 50% matching funding from another source.	Melissa Nisbett Tree Canada 613-567-5545 ext. 224 mnisbett@treecanada.ca
Trees Canada	Greening Canada's School Grounds	public (institutional)	Support for greening school grounds across Canada.	Schools in Ajax could apply for this funding.	Provides to the selected schools: educational information, technical advice and financial support towards the transformation of their school grounds into environmentally enriched learning landscapes.	Up to \$10,000 value for successful schools. Application form available on-line.	222 Somerset St. West, Suite 402 Ottawa, Ontario K2P 2G3 Tel: 613-567-5545 Fax: 613-567-5270 Email: tcf@treecanada.ca
Trees Canada	Focus on Forests	public (institutional)	To provide materials for teachers to use in their classrooms to educate kids about the importance and care of the urban forest.	Tremendous free and accessible resource for the school boards.	On-line hands-on activities and support materials to assist teachers of all grade levels. The lesson plans are well organized and designed to be easily adapted to any teaching environment or grade level.	no cost	223 Somerset St. West, Suite 402 Ottawa, Ontario K2P 2G3 Tel: 613-567-5545 Fax: 613-567-5270 Email: tcf@treecanada.ca
Trees Canada	Corporate Greening for Carbon Credits	private	To support tree planting on corporate lands.	Participants are given a Carbon Certificate signed by a Registered Professional Forester legitimizing the plantings of trees, identifying their location, and estimating the tonnes of carbon potentially sequestered.	Tree Canada estimates the amount of carbon potentially sequestered by the number of trees planted. Useful to businesses who wish to enter their carbon credits on to the Voluntary Challenge Registry.	Business required to plant and maintain the trees themselves, but are provided with a "Carbon Certificate".	224 Somerset St. West, Suite 402 Ottawa, Ontario K2P 2G3 Tel: 613-567-5545 Fax: 613-567-5270 Email: tcf@treecanada.ca
Trees Ontario	Tree Planting Subsidy Programs: 1. Full Service Incentive Program (50 Cent Program)	private	To support tree planting on private lands.	Limited application in Town of Ajax, but should be supported and advertised to larger landowners who may be interested in reforesting portions or all of their lands. Potential partners include DLSC, CLOCA, TRCA.	Trees provided at \$0.50 each if agency provides tree planting, at least 1500 trees are planted (at 100 trees/ha), and a 15 year agreement is signed between the landowner and Trees Canada. ** Typically work through agency partnerships.	Post-planting care of trees.	Rob Keen, R.P.F., Director of Operations Phone: ext 230 Trees Ontario 200 Consumers Road, Suite 701 Toronto, ON, M2J 4R4 Toll free: 1 877 646 1193

Organization	Program Name	Land Ownership	Program Goal	Opportunities in Ajax	Nature of Support	Cost / Value	Contact
Trees Ontario	Tree Planting Subsidy Programs: 2. Landowner Tree Planting Program (10 Cent Program)	private	To support tree planting on private lands.	Limited application in Town of Ajax, but should be supported and advertised to larger landowners who may be interested in reforesting portions or all of their lands. Potential partners include DLSC, CLOCA, TRCA.	Trees provided at \$0.10 to agency for orders of 100 - 3,000 trees per site. Landowner plants trees but agency must ensure adequate space and growing conditions, and sign an agreement with Trees Canada. ** Typically work through agency partnerships.	Planting of trees provided, and post-planting care of trees.	Rob Keen, R.P.F., Director of Operations Phone: ext 230 Trees Ontario 200 Consumers Road, Suite 701 Toronto, ON, M2J 4R4 Toll free: 1 877 646 1194
Trees Ontario	Tree Planting Subsidy Programs: 3. 50 Million Tree Program	private	To support tree planting on private lands. Designed to significantly reduce landowner's costs of large-scale tree planting and thereby increase the number of trees planted.	Limited application in Town of Ajax, but should be supported and advertised to larger landowners who may be interested in reforesting portions or all of their lands. Potential partners include DLSC, CLOCA, TRCA.	Support provided for tree planting on sites of at least 2 ha at 1500 - 2200 trees / ha. Landowner must contribute \$0.15/tree as well as to some of the planting costs, be responsible for maintenance, and sign a 15-year agreement with Trees Canada. ** Typically work through agency partnerships.	Planting of some trees provided, and post-planting care of trees.	Rob Keen, R.P.F., Director of Operations Phone: ext 230 Trees Ontario 200 Consumers Road, Suite 701 Toronto, ON, M2J 4R4 Toll free: 1 877 646 1195

Appendix E

Relationship between the Ajax Urban Forestry Study (2009) recommendations and the recommendations of this Plan

Town of Ajax Urban forestry Study (2009) RECOMMENDATIONS	STATUS IN FIVE-YEAR MANAGEMENT PLAN (2011 – 2015)
1. Develop and implement a strategic urban forest management plan for all public and private property in the Town of Ajax.	Fulfilled through this Plan
2. Utilize the criteria and performance indicators developed by Urban Forest Innovations and Kenney (2008) to guide the creation of a strategic management plan and to assess the progress made towards urban forest sustainability.	Carried forward but with use of updated criteria (Section 1)
3. Conduct an Urban Tree Canopy (UTC) assessment of the Town of Ajax. This cover analysis will map the existing and potential tree cover and will facilitate the selection of priority planting areas. Future tree cover targets can then be determined accordingly.	Carried forward (Section 3)
4. Conduct a full UFORE analysis again in 2013 to capture trends in tree establishment as well as leaf area, species diversity, and tree health.	Deferred to the second Five-Year Management Plan to accommodate other priorities
5. Conduct a complete inventory of all publicly owned trees using the STRATUM protocol created by the USDA Forest Service. Update the inventory on an on-going basis by systematically entering all new plantings and tree removals into a municipal inventory database. Conduct a complete re-inventory every 5 years. The inventory should be used to guide the selection of new species for planting in order to ensure that diversity targets are being met.	Carried forward, but with modified timing (Section 2)
6. Develop and implement a private tree protection by-law that regulates the injury and removal of trees located on privately owned property. Specifications for protection to trees during construction activity must be included.	Deferred to the second Five-Year Management Plan to accommodate other priorities
7. Conduct a detailed assessment of potential opportunities to enhance urban forest stewardship through public education and outreach programs.	Fulfilled through this Plan
8. 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 ageing trees are over-represented.	Carried forward (Section 3)
9. Increase leaf area and tree cover at locations surrounding common emissions sources such as highways and industrial centres. Tree species that are pollution tolerant and that maintain a high stomatal conductance should be utilized in these locations.	Carried forward (Section 3)
10. Focus tree planting and establishment in “hot-spots” identified by thermal mapping analysis.	Carried forward (Section 3)
11. Apply and monitor the use of structural soils, sub-surface 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.	Carried forward (Section 3)

Town of Ajax Urban forestry Study (2009) RECOMMENDATIONS	STATUS IN FIVE-YEAR MANAGEMENT PLAN (2011 – 2015)
12. Encourage natural regeneration where appropriate by minimizing unnecessary disturbance such as grass mowing and high-impact public recreation. Selected areas in parks and open spaces should be fenced off to protect the growth of new saplings.	Carried forward (Section 7)
13. Implement a municipal standard for required soil volumes for all plantings on public property; a minimum of 2 cubic feet of soil volume for every square foot of future crown area spread is recommended; however larger soil volumes are strongly encouraged where possible.	Carried forward (Section 3)
14. Utilize the Pest Vulnerability Matrix during species selection for municipal tree and shrub planting.	Carried forward and developed as part of this Plan (Section 4)
15. Establish a diverse tree population in which no single species represents more than 5percent and no single genus represents more than 10 percent of the entire tree population city-wide or at the neighbourhood / street segment level.	Carried forward but amended to a more practical 30-20-10 ratio (Section 3)
16. Determine the “relative DBH” of the tree population in Ajax. Establish a tree population that is divided equally among the four relative age-classes as proposed by Urban Forest Innovations, Inc. and Kenney (2008).	Carried forward – for municipal trees only (Section 2 – rolled into tree inventory)
17. Utilize native planting stock grown from locally adapted seed sources on a project appropriate basis in both intensively and extensively managed areas.	Carried forward (Section 8; also 3 to some extent)
18. In collaboration with the TRCA, develop strategies for implementing invasive species control measures in infested areas.	Carried forward (Section 8)
19. Undertake a formal investigation of opportunities for green roof development.	Dropped – green roofs cannot accommodate medium and large stature trees
20. 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.	Fulfilled through this Plan, but without emissions analysis
21. Reduce residential energy consumption by providing direction and assistance to residents for strategic tree planting around buildings.	Carried forward (Sections 3 and 8)