

***Urban Forest Strategic Management Plan
for the
Township of Centre Wellington***

2009 - 2029

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for

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December 2008

Revised April 2009



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Executive Summary

This document is a strategic management plan for the urban forest in the urban area of the Township of Centre Wellington, including Elora, Fergus, and Salem. The plan sets out the steps necessary to achieve the vision and goals set by the communities collaboratively for the urban forest over a 20-year period.

The report works around a draft vision developed by the numerous stakeholders in the Township, which is to “increase canopy cover in the Township Centre Wellington by working collectively as a community”. While the vision is pending further refinement, we developed a set of goals for the urban forest in the Township. The report then describes the structure of the proposed plan, which will consist of a 20-year strategic plan for the years 2009 – 2028, supported by four five-year management plans. An annual operating plan for the first year, 2009-2010, was also developed. Adaptive management is essential in developing this series of management plans for the Township to respond to changes in the environment, the community and the direction of Town policy.

We describe the urban forest and the benefits this “green infrastructure” provides to the environment and the communities. A sustainable urban forest requires three components: diverse and healthy vegetation resource, a strong community framework, and appropriate management. A set of criteria and indicators have been developed to measure success and progress.

We then explain the context of the Township’s urban forest. This includes its geography and ecology, and human resources. Relevant policies at the Township and County levels that may affect urban forest management are examined. The Official Plans of the Township and the County set the planning framework, within which are the Tree Policy for Centre Wellington, tree by-laws and other policies.

Next we begin laying out the 20-year strategic plan. Stratification and a complete tree inventory will provide important basis for effective management. The inventory will provide information of the Township’s urban forest resources, including species composition, tree conditions, and available planting spots. Based on the inventory, the area can be stratified into five management units for implementing the five-year plans.

This plan includes an important discussion on tree habitat requirements, which will be incorporated into a tree establishment plan. The plan will also develop strategies for proactive management in terms of pruning, tree risk management, tree protection and invasive species management. We also examined the existing stewardship efforts by the communities and develop a public engagement plan to build on and develop the strength of these initiatives.

List of recommendations

The following list highlights the key recommendations made in this plan.

- 1) The urban areas should be ***divided into five urban forest management units*** in such a manner that their management needs are distributed more-or-less equally. These management units will be used to allocate activities within the 5- year management plans.
- 2) The Township should ***collaborate with the communities to complete a tree inventory*** for all street, park, and private trees within the first 5-year management plan.
- 3) The Township should complete a ***trail-side tree inventory*** for all parks and woodlands within the first 5-year management plan.
- 4) The Township should establish ***one permanent sample plot (PSP) per hectare*** in each woodland tract so that the woodlands can be monitored systematically over time. The Township will complete a forest inventory for all parks and woodlands in the PSPs within the first two 5-year management plans.
- 5) The Township should ***contract an urban forestry specialist with GIS training*** to administer the tree inventory software and database in the Department in 2009.
- 6) All Township of Centre Wellington residents ***should recognize that above- and below-ground tree habitat is a key determinant of urban forest longevity and function***, and that good habitat includes good soil quality and quantity and freedom from interference with competition (utilities, turfgrass, etc.).
- 7) Trees should be planted in ***soils of optimum quality*** (i.e. medium-textured soils such as loam, sandy-clay loam, and silt-loam) whenever and wherever feasible.
- 8) All trees being planted should be given an ***adequate soil volume*** of 0.6m³ of good-quality soil for every 1m² of potential crown projection area, whenever and wherever feasible.
- 9) The Township ***should focus on increasing leaf area***, or at minimum ensuring no net loss of leaf area, rather than increasing total canopy cover, as the primary objective for urban forest management.
- 10) The Township ***should clearly delineate responsibilities*** for tree planting and maintenance between the Public Works department (or other municipal government departments), community tree advocacy groups, and residents. The approach should be open to collaboration and cooperation.
- 11) The Township should require that all trees planted by third-party contractors come with a ***minimum 2-year warranty*** and aftercare period.

- 12) The Township should ***consider revising its Tree Policy*** to include more species on its list of approved trees, and to exclude Norway maple (*Acer platanoides*) and temporarily exclude ash (*Fraxinus* spp.) from the list.
- 13) The Township should ***focus its tree establishment efforts on native tree species***, but should not exclude non-native species based solely on their provenance.
- 14) The Township should ***ensure an adequate level of tree diversity*** through planting no more than 10% of one species, 20% of one genus, and 30% of one family of tree. Given the overrepresentation of the genus *Acer* – maple, the Township should focus on planting other genera except in the case of replacement.
- 15) The Township ***should proceed proactively to mitigate the effects of future climate change***, within reasonable limits, by establishing limited species suitability trials of more drought- and heat-tolerant species.
- 16) The Township should ensure ***all new plantings are matched with the appropriate site and soil type***.
- 17) All new plantings should be conducted and maintained in accordance with the ***standards of the Landscape Ontario Horticultural Trades Association***.
- 18) The Township should ***establish a long-term strategic nursery stock procurement agreement*** with one or more local nurseries.
- 19) The Township planning staff should strive to ***increase the proportion of pervious versus impervious surface*** cover in urban Centre Wellington.
- 20) ***No new plantings should be carried out on proposed road widenings*** without prior consultation with the County and Public Works.
- 21) The Township should consider adopting ***minimum stocking levels*** for street tree plantings.
- 22) All stakeholder groups without access to GIS analysis services ***should employ free, open-source GIS software*** to improve their knowledge of environmental conditions and infrastructure in Centre Wellington.
- 23) All new plantings ***should be recorded in the inventory***.
- 24) Over the twenty-year SUFMP the Township should establish a pruning cycle and a grid pruning program for street and park. Trees would be pruned in a 5-year cycle for all intermediate and mature trees and a 3-year cycle for all juvenile trees. Line clearing operations should be consistent with these pruning cycles. Through this time period pruning will shift from a reactive to a proactive maintenance approach.

25) Trees should be inspected in a systematic manner so that no problem is missed during regular pruning. All pruning activities should follow the ANSI A-300 Standards for Pruning, ISA Best Management Practices: Tree Pruning and the Urban Forestry Best Management Practices for Ontario Municipalities for clearance distances (McGauley 2000).

26) The Township should provide citizens with more advanced notice before pruning activities are carried out and inform the public of intent to have a 5-year pruning cycle and what that entails.

27) The Township should hire a certified arborist to develop the grid-pruning cycle after the inventory is complete. This person should also supervise and monitor pruning activities being carried out; budget permitting. Even though standards will be put into place there should still be ongoing supervision of contractors by either designated Township officials with experience and qualifications, or by an outside consultant, preferably an experienced International Society of Arboriculture Board Certified Master Arborist. The best way to proceed would be to have the an Arborist familiar with the Township write the specifications and prescribe treatment areas for pruning and other maintenance areas, supervise the contract, and inspect for quality throughout the duration of the contracts (Town of Banff 2008).

28) To ensure that the pruning cycles for young and mature trees are implemented there must be an increase in its capacity. The township will have to increase its capacity once the inventory and a tree risk assessment plan are carried out. It is recommended that more crews should be hired in order to proceed with the first grid-pruning cycle. Crews will follow the standards developed by the Township's arborist.

29) The Township should establish more collaborative and cooperative approach with Tree Stewards from the ECEE. It is recommended that Tree Stewards can focus on pruning activities of newly planted and young trees while Public Works is responsible for pruning of mature trees and emergency pruning.

30) The Township should undertake *inspections of risk trees* in the street tree population, and along nature trails.

31) The Township should *determine tree risk categories and acceptable risk levels*, and *develop an inspection protocol* based on established priorities and the data from the Tree Inventory.

32) The Township should *provide the staff and equipment resources* required to implement hazard abatement strategies.

33) The Township should *develop a tree cabling policy* that includes the provision of an inspection cycle. This policy will incorporate risk and heritage values.

34) Manuals on proper tree care, including diagrams, should be developed and circulated to all relevant parties, following the lead of other municipalities (Toronto, Mississauga, etc.).

35) In order to maintain its present canopy cover, The Township should adopt a policy to replace one removed tree with a number of trees that will maintain a comparable total leaf area; within the limits of feasibility.

36) The Township should hire two additional officers to inspect and enforce its tree by-laws.

37) The Township should adopt and enforce a system of tree protection zones around construction sites.

38) Centre Wellington needs to develop a comprehensive plan to deal with invasive species. This plan should include:

(i) ***Policies related to invasive species planting:*** For example, Centre Wellington's current tree policy does not allow Norway Maple (*Acer platanoides*) to be planted in proximity of natural areas (Centre Wellington Tree Policy). This list should be expanded to include other invasives. Planting of Norway Maple should also be eliminated.

(ii) ***Invasive species surveys:*** Surveys for invasives such as Gypsy Moth egg masses and Emerald Ash Borer should be regularly conducted. If they are found, Centre Wellington authorities as well as the Ontario Ministry of Natural resources must be notified in order to prevent their spread. The municipality can also carry out the steps necessary for their removal. These range from having to cut down the entire tree for Emerald Ash borer or Asian Long-horned beetle, to removing egg masses and destroying caterpillars and adult moths where possible for the Gypsy Moth (City of Toronto 2008a, City of Toronto 2008b).

(iii) ***Ensure a diverse, healthy urban forest:*** as international trade accelerates, the number of introduced species and hence the threat of invasive plants, insects, micro-organisms and animals, is continually increasing. It is thus essential to prevent attack by ensuring a healthy forest. This involves planting a mixture of different tree species on each street and maintaining a diverse age-class structure in the forest (Poland and McCullough 2006).

(iv) ***Create a strategy to deal with Dutch Elm disease:*** the economic impact of this disease has been enormous in many municipalities, where the elm was often the main shade tree lining the streets. The potential impact of this species on Centre Wellington's forest is unknown due to the lack of a tree inventory. It is imperative to conduct regular surveys for the disease. An integrated control system aimed at removing and destroying trees or infected branches, reducing beetle populations and preventing or treating trees by injecting fungicides should also be implemented (Rioux 2003).

39) The Township should continue private urban forest stewardship education program; Tree Stewards and try and expand the number of tree stewards.

40) The Township itself should provide more resources for citizens interested in any tree related matters; planting, tree care, pruning, etc.

41) Once the SUFMP is in place a copy should be provided on Centre Wellington's website to maintain transparency and enhance public involvement and communications.

42) The Township should continue with its community activities and coordinate a more collaborative approach as well as provide support to community groups involved in tree/woodlot issues

1. Introduction and Scope

The Township of Centre Wellington, Wellington County's largest municipality and one of Ontario's fastest-growing population centres, is located in close proximity to some of the province's most significant natural features, and among some of its most productive agricultural and commercial lands. The Township has a long and proud history of establishing and caring for urban trees, but a diverse set of imminent challenges to the sustainability of Centre Wellington's urban forest resources now demand long-term strategic planning for urban forest management.

The following strategic plan has been prepared as a tool to improve the management of Centre Wellington's urban forest resources on both public and private land. The plan covers the urban centres of Elora, Salem and Fergus and recommends management practices to improve the overall health and livability of this municipal area through the establishment and maintenance of a healthy and diverse tree cover.

It is expected that the plan will allow a diverse range of local stakeholders with interest in the social, ecological and economic well-being of Centre Wellington to work towards achieving common goals through building their knowledge of the urban forest, improving tree maintenance, establishment and protection practices, and engaging the community in stewardship over one of the most important components of urban infrastructure: trees.

As such, the plan has been prepared in such a way as to facilitate continual improvement in both planning and management. Although it is expected that the plan will be further improved upon review by community stakeholders, both prior to its implementation and throughout its 20-year planning horizon, the guidelines and recommendations contained within it are based on fundamental elements of sustainable urban forest management. Therefore, the plan has been prepared for use by the municipal government of Centre Wellington, and for all of its residents.

Centre Wellington has a diverse community of stakeholder groups interested in sustainable forest management, both in the urban and rural areas of the Township. Guided by strong and committed leaders, the engagement of these groups is one of the key factors behind the development of this plan, and one of the most promising indicators of its ultimate success in promoting truly sustainable forest management in Centre Wellington.

1.1 A (Draft) Vision for Centre Wellington's Urban Forest

In November of 2008, leaders of numerous stakeholder groups met at a workshop in Fergus to discuss and refine a vision for Centre Wellington's urban forest. This vision, initially outlined by Toni Ellis of the Elora Centre for Environmental Excellence (ECEE) – a key supporter of this plan – is:

***To increase canopy cover in Township Centre Wellington
by working collectively as a community.***

Participants in the workshop, including the four University of Toronto Master of Forest Conservation students responsible for preparing this plan, agreed that the initial vision requires refinement and should be augmented by a mission statement.

A subsequent vision-development workshop is planned for January 2009, and it is suggested that the new vision be refined to reduce the focus on increasing canopy cover by placing more emphasis on the variety of criteria and indicators of sustainable urban forest management. The plan has therefore been developed with both the draft and ultimate refined visions in mind.

1.2 *Goals and Objectives*

Aside from a guiding vision, the implementation of an urban forest management plan must be driven by specific goals and objectives. Through discussion with various stakeholders, the planning team has identified the following as important goals for Centre Wellington concerning its urban forest resource:

- *Make the Township of Centre Wellington a greener and healthier place to live*
- *Improve knowledge about the local urban forest resource with an inventory*
- *Increase total canopy cover and leaf area within the Township*
- *Improve the health of the urban forest by increasing diversity*
- *Simplify the tree establishment and maintenance processes in the Township*
- *Reduce the costs associated with urban forest management*
- *Foster a sense of pride and stewardship for the urban forest within the community*

The goals outlined above have been developed by the planning group based on discussion with various community members. The Township is encouraged to refine these goals as necessary during subsequent plan review processes.

1.3 *Strategic Plan Structure*

The urban forest management plan is a strategic plan with a 20-year horizon. The main objective of the plan is to facilitate the implementation of a forward-looking, science- and community-based and integrative approach to the management of Centre Wellington's urban forest resource.

A complete urban forest management plan includes a 20-year Strategic Plan, which presents guidelines and recommendations for the implementation of sustainable urban forest management in Centre Wellington. Under the Strategic Plan are four 5-year adaptive Management Plans, which are the first level of operational planning. These plans are designed to incorporate the principles of adaptive management, and should be modified every five years to reflect the successes and obstacles met during the previous Management planning period. Both the Strategic Plan and initial drafts of the four 5-year

Management Plans have been prepared by the planning group, and are presented in this document.

The implementation of this plan is translated into day-to-day “on the ground” operations through twenty Annual Operating Plans (AOPs) – the first of which has also been developed by the planning group. The preparation of subsequent plans will be the responsibility of the Township – which includes its government and its residents, as represented by stakeholder groups with an active interest in urban forest management. Figure 1 shows the temporal structure of the urban forest management plan. Figure 2 outlines the content included in the plan. Nodes highlighted in green indicate content included in the Strategic, Management and Annual Operating plans, with an increasing level of detail in each lower-tier plan.

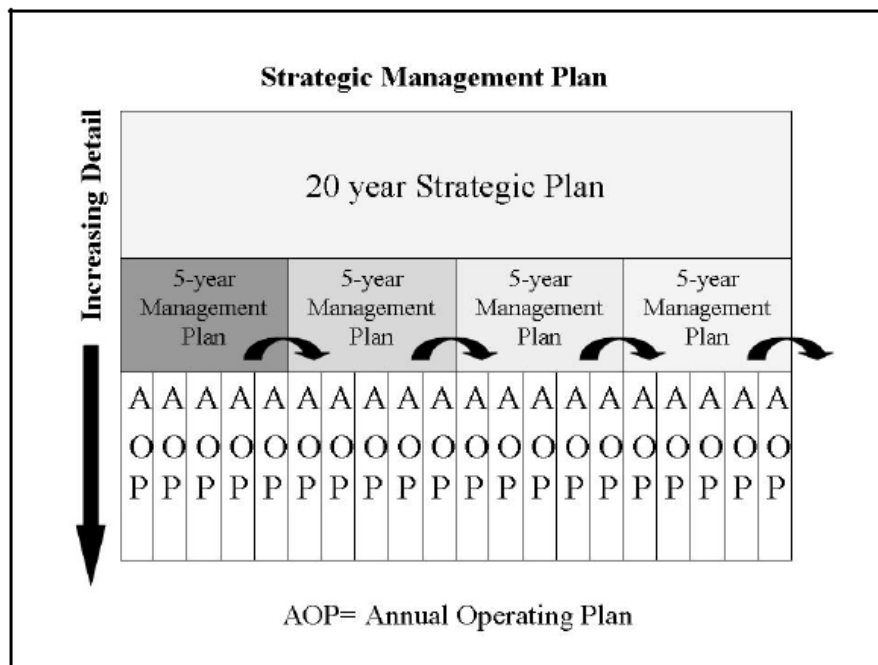


Figure 1: The structure of the urban forest management plan for Centre Wellington. Source: Urban Forest Innovations Inc and Kenney, 2008.

The plan has been developed to facilitate adaptive management. This means that as management progresses through the 20-year planning horizon and changes occur, all levels of the plan are subject to modification to respond to these changes to redirect and improve management practices. This requires systematic monitoring, which will be

accomplished by the implementation of an inventory and inventory maintenance strategy. This will ensure that all of Centre Wellington’s residents will continue to derive sustained and sustainable benefits from the Township’s urban forest well into the future.



Figure 2: The content of the plan. Adapted from Kenney, 2008.

1.4 The Urban Forest

Although residents of many communities value urban trees and forests it’s important to realize that protecting and conserving urban forests through proper management and conservation is vital to sustaining healthy communities and to maximize the benefits provided from the forest to residents now and in the future (Tree Canada, 2008; UFI Inc. and Dougan & Associates, 2007). The urban forest is made up of street trees, residential trees, park trees, woodlands and ravine plant and animal communities and ranges from trees in planters in the downtown core to backyard trees to the interspersed woodlots of a more rural landscape (Kenney and Rusak, 2000). Many researchers and managers refer to the urban forest as green infrastructure and agree that a well-managed green infrastructure contributes directly to neighbourhood vitality, overall health and livability

of the urban area, enhancement of business centre and by providing natural recreation environments (UFI Inc. and Kenney, 2008).

Canada has a largely urban population, with 80% of Canadians living in urbanized areas which represent just 0.2% of the total land area of Canada, mostly located in the south (Tree Canada, 2008). It is important to note that as landscapes urbanize, increased population density, built environments, human activity, and associated emissions tend to increase air temperatures, degrade air and water quality, and reduce human health and well-being (Nowak and Walton, 2005). Thus, as areas urbanize, sustaining tree cover becomes increasingly vital to sustaining human health, environmental quality, and quality of life (Nowak and Walton, 2005). As with any type of infrastructure, the urban forest requires regular maintenance and monitoring to ensure that it continues to function properly and provide benefits to its maximum capacity.

Urban forests provide a multitude of benefits for all of a city's or town inhabitants from an ecological, climatic, architectural, psychological and monetary point of view. The USDA Forestry Report (1990) notes that, "Trees are on the job 24 hours every day working for all of us to improve our environment and quality of life". They provide habitat and food sources for wildlife, cooler watercourses, mitigate noise and dust levels, improve air and water quality, absorb pollutants, sequester carbon and help conserve energy (Kenney and Rusak, 2000; Roswell, 2003; Nowak and Dwyer, 2007). There are also social benefits associated with the urban forest including reduce stress levels increased attractiveness and promotion of the social integration of older adults with neighbours (Nowak, 2006). The following is a list of benefits from the urban forest provided by Tree Canada:

- Sequestering of gaseous air pollutants and particulates
- Energy conservation through transpirational cooling, shade, and wind reduction
- Storm-water attenuation
- Noise buffering

- Provision of wildlife habitat for a variety of flora, birds, small mammals and other wildlife.
- Increased property value
- Improved aesthetics, and
- Psychological well being
- Trees provide passive recreation opportunities
- Trees help moderate the stress of urban life
- Trees promote understanding of the natural world
- Economic value

Urban forests have a substantial monetary benefit to the municipalities, provincial and federal governments (storm water attenuation, air quality mitigation, tourism, health care costs, etc.), to residents (property value, energy conservation, etc.) and business (tree care companies, nursery industry, aesthetics of retail areas).

On the iTree Tools iTree Calculator¹ you can enter information about a tree in front of your house and learn about the specific benefits that tree provides. The results are based on the Urban Forest Effects Model (UFORE) which is a computer model that calculates the structure, environmental effects and values of urban forests. As an example the results for a 50 centimetre diameter Sugar maple provides overall benefits of \$160 every year. This includes: eliminating 5,621 gallons of stormwater runoff during one year; raising the property value by \$74 in one year; adding 388 square feet of Leaf Surface Area in one year (In subsequent years it will add more, and the property value will increase accordingly); conserving 186 Kilowatt / hours of electricity for cooling and reduce consumption of oil or natural gas; and reducing atmospheric carbon by 652 pounds.

¹ Available at: <http://www.itreetools.org/treecalculator>

1.5 Urban forest sustainability

A general goal of urban forest management is to achieve a sustainable urban forest system, in which "the naturally occurring and planted trees in cities ... are managed to provide the inhabitants with a continuing level of economic, social, environmental and ecological benefits today and into the future" (Clark et al. 1997). Unlike natural or semi-natural forests, the urban forest does not generally have the capacity for self-renewal and maintenance, and active human intervention and management is essential to achieve sustainability goals (Clark et al. 1997). Thus enter the important role of tree managers and the surrounding communities in decision-making and management activities. The latter is all the more important due to the fact that trees on private properties often comprise the majority of urban forests (Clark et al. 1997).

To evaluate urban forest sustainability and management success, it is useful to develop and assess critical indicators. Clark et al. (1997) have developed a model of urban forest sustainability based on three components: vegetation resource, a strong community framework, and appropriate management of the resource. Within each component are a number of specific criteria for sustainability.

First, sustainable urban forests must possess a mixed species and size distribution that ensures diversity, resilience, and continuity of benefits. Sustainability goals may include adequate canopy cover, even age distribution, diverse species composition, and utilization and preservation of native vegetation. Second, the sustainability of urban forests should be achieved within a co-operative community framework, with involvement of various stakeholders such as large private and institutional landholders, industry, and neighbourhood organizations. Lastly, a comprehensive management plan and funding program by municipal governments promote coordinated action upon a shared vision. Important issues to be incorporated into such a management plan include tree protection, species and site selection for planting, tree maintenance and tree risk management (Clark et al. 1997).

2. Planning Context

2.1 Geographic Context

The Strategic Urban Forest Management Plan for the Township of Centre Wellington will consider all lands within the boundaries the villages of Salem, Elora and Fergus, as defined by the Township of Centre Wellington Municipal Official Plan (2005). Figure 3 shows the full extent of the Township of Centre Wellington, with the plan area outlined in red. Figure 4 outlines the geographic boundaries of Elora and Salem, and Figure 5 shows the plan’s spatial extent in Fergus. In all three communities, the plan boundaries correspond with the official municipal boundaries.

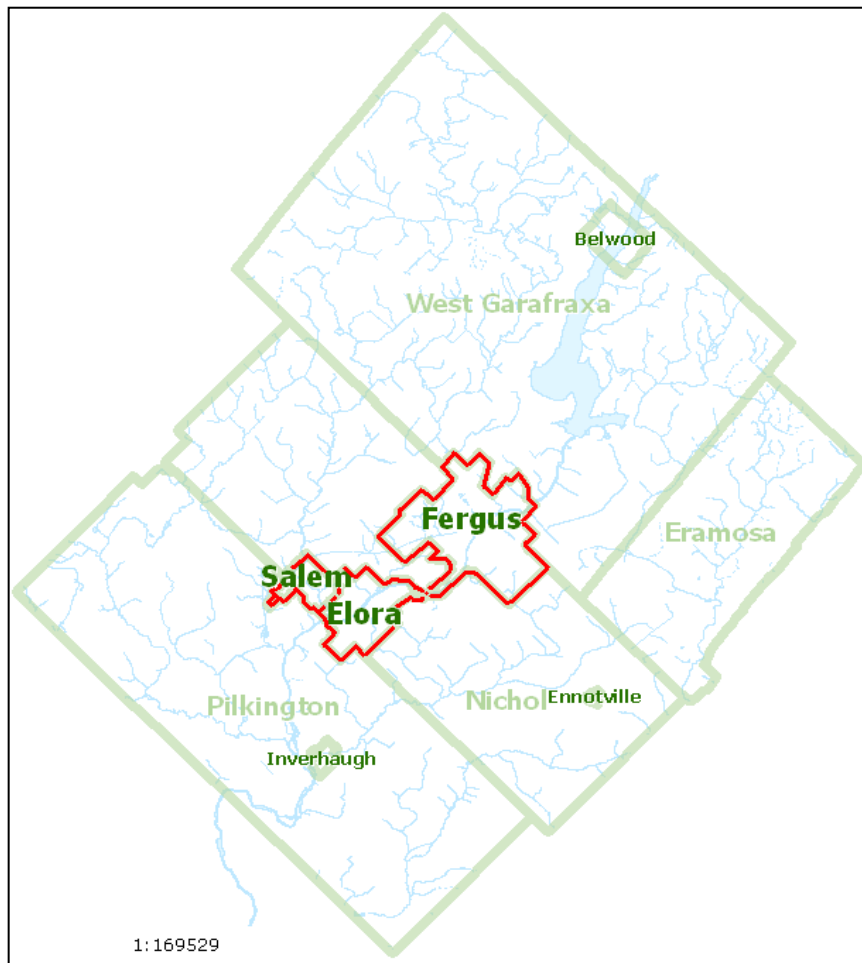


Figure 3: The Township of Centre Wellington, including rural areas outside the Plan area. Plan area is outlined in red. Adapted from Township of Centre Wellington Online GIS Mapping.

The plan will not consider outlying rural areas of Centre Wellington, including Pilkington, Nichol, Eramosa, West Garafraxa, or any hamlets or villages in those areas. The decision to exclude these areas from the plan was made because the different forest management issues and priorities which exist in rural agricultural landscapes (Racevskis and Lupi 2006) make the application of an Urban Forest Management Plan difficult. A similar but separate plan could be developed for Centre Wellington's more rural areas. The Plan will also not make recommendations for forest management in any of the Grand River Conservation Authority (GRCA) Conservation Areas within the Township, which are managed under existing GRCA plans.

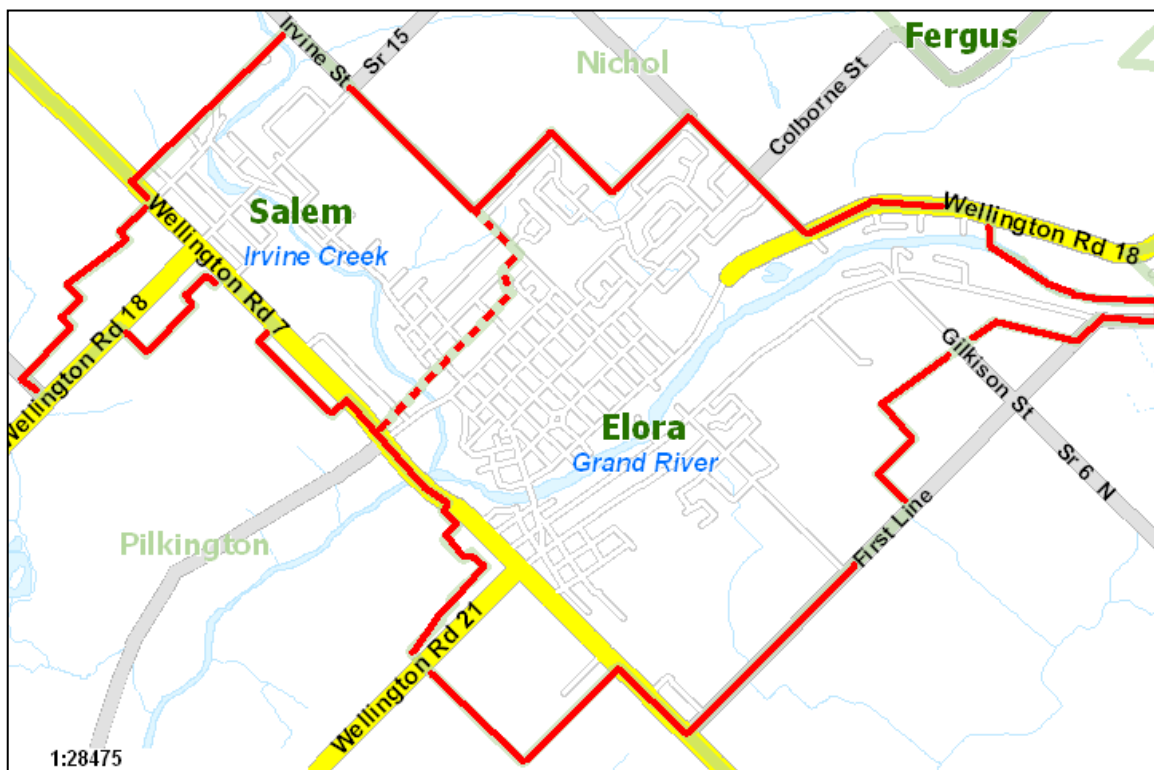


Figure 4: Boundaries of the Urban Forest Management Plan for the villages of Elora and Salem. Adapted from Township of Centre Wellington Online Mapping.

Land use in the Township urban areas is largely residential, as outlined in Schedule A-1 (*Appendix 1*) of the Municipal Official Plan (2005). Salem is almost entirely residential, while the Township's other urban land uses include highway commercial and industrial zones, residential transition areas, the villages' central business districts (CBD), 'Core Greenlands', and recreational areas. Several land use types are partially located within designated Heritage Areas, which border Grand River on both banks. Due to these scenic

areas' importance to the local tourism industry, as outlined in Section C.16 of the Official Plan (2005), the planning group has identified these zones as particularly sensitive to urban forest issues.

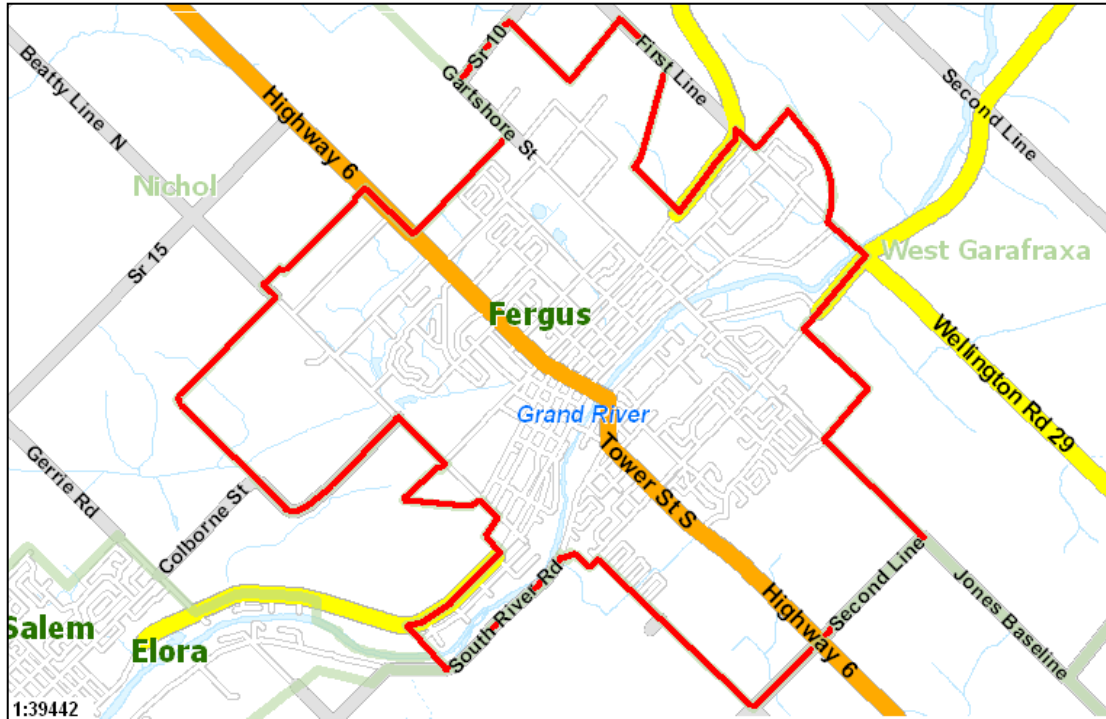


Figure 5: Boundaries of the Urban Forest Management Plan in Fergus. Adapted from Township of Centre Wellington Online Mapping.

2.2 *The Ecological Context*

The Township is located within the Manitoulin-Lake Simcoe ecoregion of the Mixedwood Plains ecozone (Environment Canada 2005). This ecoregion is characterized by warm summers and mild winters, with a mean annual temperature of 6°C and mean annual precipitation of 750-1000mm. Centre Wellington's southern location places it at the lower end of this range – higher precipitation levels occur in areas bordering Lake Huron. Precipitation is distributed evenly throughout the year.

The Township's dominant land cover is cropped farmland, with significant areas of mixed forest composed predominantly of Great Lakes-St. Lawrence type tree species. Sugar and red maple, American beech, eastern hemlock, red and white oak, basswood, red and white pine, paper birch, trembling aspen, and eastern white cedar make up the

majority of the tree component of such forests. The Township's urban forest only partially reflects the structure of existing woodlands in terms of species composition and age structure.

Centre Wellington's most important ecological feature is the Grand River, which bisects Fergus and Elora in an east-west direction, and is bordered by both communities' CBDs. The Township encourages naturalization of the riverfront, and two conservation areas – Elora Gorge and Elora Quarry – are within or directly adjacent to the Plan area. Irvine Creek is the second most-important riparian feature in Centre Wellington, and the confluence of these two water bodies has been defined as an Environmentally Sensitive Area (Township of Centre Wellington Online Mapping, n.d.). This has important implications for tree establishment in adjacent areas.

Situated west of the Niagara Escarpment, the region's topography is characterized by low rolling hills, underlain by carbonate-rich bedrock. The soil profile underlying the urban areas is dominated by a variety of Grey- Brown Luvisolic soils.

The chief land use in this region is agriculture, but the fast pace of urban development means that by the year 2022 some 33,000 people will make their home in Centre Wellington – an increase of almost 30% over the 2006 population of approximately 26,000. Sixty percent of this growth is expected to be in newly-developed areas, which will put increasing pressure on the urban forest through development, air pollution, soil compaction, salt use, etc. (Toni Ellis, pers. comm.). Former agricultural land is expected to see the most residential infrastructure development, which will pose unique challenges and opportunities for the urban forest. For instance, implementing improved tree establishment practices the first time around in these new developments will facilitate the sustainable management of the Township's urban forest. Currently, the total tree canopy cover of Centre Wellington is between 14% and 17% - strategic planting in new developments may significantly contribute to both increasing the absolute cover percentage and improving the spatial and age-class distribution of the urban forest.

2.3 Human context

The Township of Centre Wellington is one of the largest municipalities in Wellington County, consisting of approximately 26,050 residents with a population density of 64 people per sq. km (Centre Wellington 2007, Statistics Canada 2008). The majority (80%) of this population is 15 years and over – 41 years is the medium age for females, and 39 for males (Figure 6) (Statistics Canada 2008). The population consists of roughly the same number of males (49.4%) and females (50.6%) (Statistics Canada 2008).

The inhabitants of Centre Wellington are employed in a range of positions (Figure 7), however this Township has been described as a ‘rural municipality’ with many retired farmers living in the urban Centre (Ellis per. Com. 2008, Statistics Canada 2008). Overall, the employment rate (68%) and medium income (\$78,877) of the Centre Wellington population is higher than Ontario (62% and \$69,156 respectively) (Statistics Canada 2008). The Township was formed through an amalgamation of Fergus (8000 residents), Elora (3000 residents), and parts of Nichol, Pilkington, West Garafraxa and Ermosa Townships, and also has a minor aboriginal population of 230 people (Ellis 2008, Centre Wellington 2007).

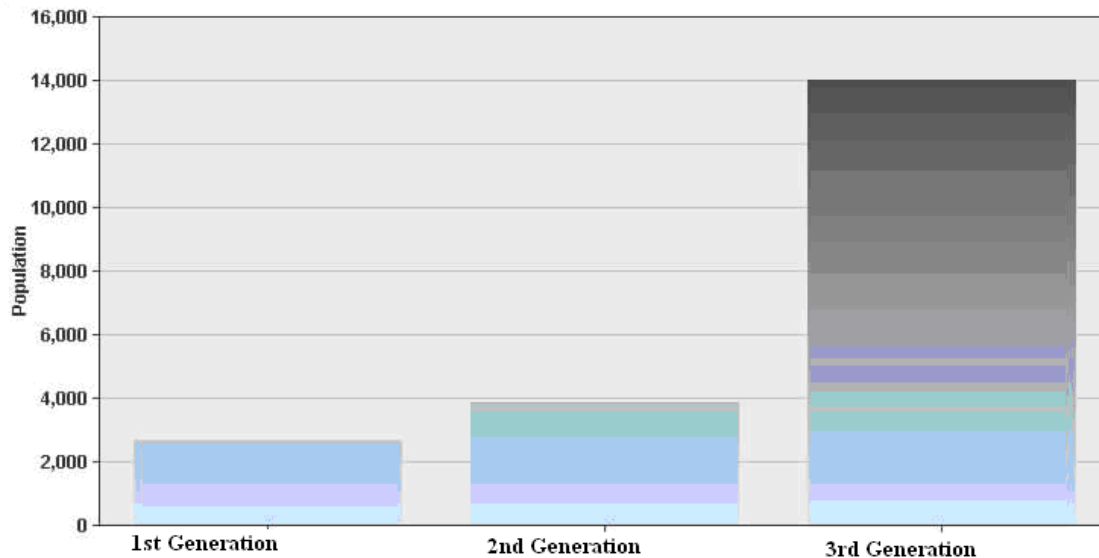


Figure 6: Centre of Wellington: Generation Status (2005)

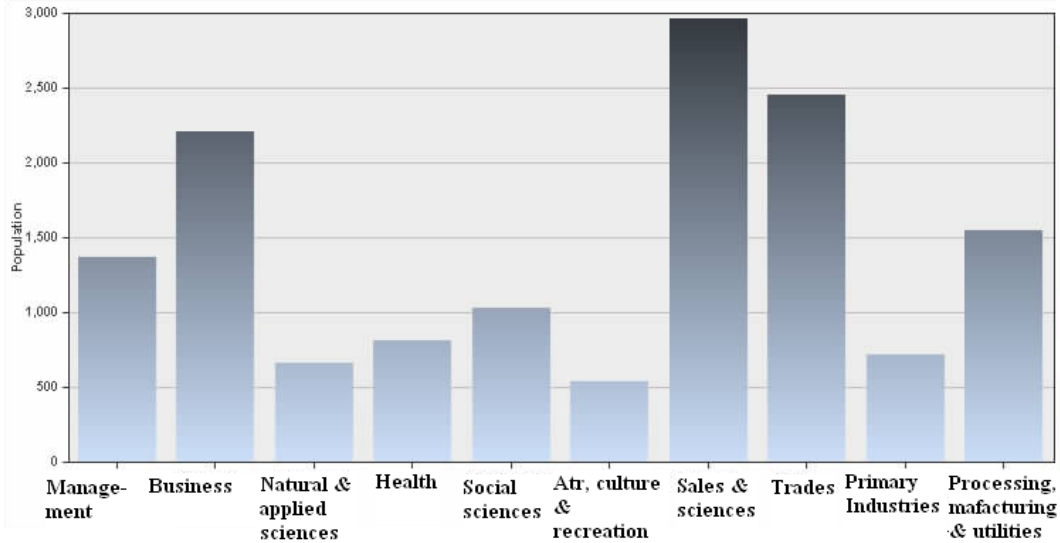


Figure 7: Centre of Wellington: Occupation status (2005)

2.4 The Policy Context

The policies that relate to the urban forest are the townships Official Plan (Township of Centre Wellington 2005) and Centre Wellington’s Tree Policy. In the Township there is currently no guiding plan specific to urban forestry where a vision is defined and specific steps are identified for its implementation. An overview of the relevant policy and planning documents in terms of how they relate to the urban forest is provided in the sections below.

2.4.1 Township of Centre Wellington Official Plan

The Official Plan was formally adopted in November 2003 and approved May 2005. The Official Plan sets the Township’s views on how land should be used, community organization, growth and the phasing of growth, investment in infrastructure and policy formation. It provides direction for future planning activities and for public and private initiatives aimed at improving and existing physical environment. The Centre Wellington Official Plan pertains to the Elora and Fergus Urban Centre, which includes Salem and Belwood; all other areas of the Township are governed by the County of Wellington’s Official Plan. Since this SUFMP will only apply for the urban areas of Elora and Fergus the County Wellington Official Plan has not described in detail.

It is evident from Section B.2 “Community Values” that the Township’s citizens place high value on the natural elements of their community; listing natural beauty high on the list of elements that make it unique. Among the major goals of the Township of Centre Wellington are to: 1. Maintain the high quality of life which residents of Centre Wellington currently enjoy; 2. Protect the unique natural resources of the community; 3. Ensure that adequate lands and services are available to allow for the future needs of the community; and 9. Ensure that adequate parks and open spaces are available to meet the recreation needs of all ages. In all of these cases the urban forest has a role in helping the Township reach these goals.

The Official Plan itself does not speak of the urban forest but it does speak to the importance of the environment and of natural ecosystems. Table 1 illustrates those sections of the Official Plan where the environment and natural systems are addressed. Many of the policies that speak to natural heritage also include areas that have trees on them (i.e., many of the City’s wetlands, environmental corridors and linkages). The Official Plan also identifies possible mechanisms for the protection, conservation and enhancement of natural heritage features of which forestry resources are considered an extension. Some of the mechanism that the Township can use are the: 1. Acquisition by the Township; 2. Requesting the Grand River Conservation Authority to acquire those lands associated with a hydrologic function and/or suitable for conservation purposes; 3. Entering into agreements with landowners to secure the protection of such lands; 4. Encouraging landowners to preserve or convey such land to a public agency or land trust.

Table 1: Policy statements relevant to urban forestry from the Township of Centre Wellington Official Plan (2005).

Policy Statement from the Township of Centre Wellington Official Plan	Section of the Official Plan
It is likely that the limits of the designated Fergus and Elora-Salem Urban Centres will be expanded in the future. Where expansion to an Urban Centre is proposed, the extent and direction of expansion shall be based on (among others): 3. The existing development pattern in the community, including consideration of existing and approved land uses; 6. Environmental costs and benefits; 7. The impacts on natural resources and the natural environment	Section B.5 Urban Area Expansion

Policy Statement from the Township of Centre Wellington Official Plan	Section of the Official Plan
The naturalization of the Grand River corridor is encouraged. Naturalization will improve the River’s water quality and the improvement of vegetation, wildlife and fisheries habitat associated thereto.	Section C.1 The Grand River under General Policies
Landowners are encouraged to maintain tree cover where it exists adjacent to streams or river valleys. Landowners are also encouraged to re-establish vegetation along open waterways.	Section C.3.5 Fisheries policies under C.3 Natural Heritage
The Township encourages the protection and preservation of existing trees and woodlots	Section C.3.9 Woodlands under C.3 Natural Heritage
The Core Greenlands designation may include wooded areas, particularly where these are also associated with other Natural Heritage features such as wetlands. The Township also recognizes that smaller wooded areas also have local significance. Wooded areas contribute to erosion control, groundwater storage and wildlife habitat. Where practical, these smaller woodlots should be protected, even if they are not included in the Core Greenlands designation. The Township adopts the following policies with respect to its wooded areas: 1. The Township encourages the protection and preservation of existing trees and woodlots; 2. The maintenance of forest cover along stream banks and river valleys is encouraged. 3. In instances where a development proposal may impact upon a significant woodlot, the Township will require that an Environmental Impact Assessment in accordance with Section E.1.3 be undertaken.	Section C.3.9 Woodlands under C.3 Natural Heritage
Environmentally sensitive areas may be included in the Core Greenlands designation. The areas will be protected from development or site alternations that would negatively impact them or their ecological functions.	Section C.3.10 Environmentally Sensitive Areas (ESAs)
The Township encourages the connection of Natural Heritage features. This may be achieved through the following means: 1. The protection and maintenance of all rivers and streams as environmental corridors, including provisions for minimum setbacks and vegetate riparian buffers; 2. Incorporating environmental corridors to be incorporated into the design of new developments or redevelopments, where practical. 3. Naturalization or vegetation of parks, open space and storm water management areas	Section C.3.12 Natural Heritage Corridors
The Township shall ensure that as many trees and other vegetation as possible are retained on site subject to development by requiring the submission of a tree inventory and saving plan for all applications, with priority being given to trees and other vegetation most suited to adoption of post-construction conditions	Section C.15.4 Landscape Design under C.15 Community Design
Economic development in Centre Wellington will be pursued within the context of a healthy community overall, and following the principles of Smart Growth – this means that resources devoted to economic development by the Township will be allocated in balance with those allocated to social development, environmental improvement, recreational opportunities, health care, youth programs, etc.	Section C.18 Economic Development
Detailed strategy for the protection of the natural environment including the preservation of natural areas, woodlots and vistas and the maintenance or enhancement of water quality, and establishment of an open space system and recreation facilities	Section D.11.4 Secondary Plan Requirements under D.11 Secondary Plan Areas

Although the current policy in the Official Plan is generally sound in terms of protection and enhancement of natural heritage it does not include a specific definition of the urban forest. This definition should include trees in both natural areas and throughout the urban Centres of Elora, Fergus and Bellwood on both public and private lands. The ultimate goal would be to recognize the urban forest with all the trees (both municipal and private) within it, regardless of location, as part to the green infrastructure and emphasize that like these other infrastructure components require management and regular reinvestment to function to capacity.

The policy could then speak to the protection and management of the urban forest as a whole, putting forward comparable goals for tree preservation and replacement on private and public lands, but tackling the implementation of these goals differently for municipal versus private trees.

2.4.2 Township Centre Wellington Tree Policy

The Township has a Tree Policy in place since 2002 administered by the Public Works department. In it the Township states that it is committed to the fact that trees are an integral part of their environment and a valuable asset to the community. It also states a specific problem with the urban trees; their age and stress. The policy outlines that planning and management will preserve a healthy diverse multi-aged tree population and that planning and management are thus necessary to maintain rural and urban tree populations. The policy discusses the following: goals and objectives, planting on municipal property, tree replacement, maintenance standards, stump removal, level of service, trimming/removal of mature trees, contracted services, tree pruning, tree planting, species and tree planting speculations.

The Tree Policy's goal is to provide a direction beginning with the initial selection of a tree, its planting and ongoing care and maintenance and eventual removal. More specifically it lists its goals as: establishing a tree-planting program with specific planting standards, specifications and recommendations; developing a tree maintenance program from initial planting of the tree to eventual removal due to external or environmental

factors; establishing a policy for planting of trees in new developments; and developing a species list of trees natural to the community, which would encourage species diversity in new plantings.

The idea of a proposed By-law to regulate tree trimming and cutting on private property has been put forth on a committee meeting on July 11, 2006. Staff were asked to conduct a preliminary investigation and bring forward relevant information for the Committee's consideration; however the committee members agreed to take no action on this matter at the time.

2.4.4 Policy Wellington County level

Wellington County Official Plan

Although it does not apply to the urban areas the Greenlands area objectives still pertain to areas in Centre Wellington outside of urban areas. The objectives surrounding Greenland areas are to provide protection to those aspects of the natural environment which can be harmed by urban development; to protect the community from those aspects of the natural environment which can pose a threat to public health and safety; to ensure that natural areas are protected and their natural beauty retained for future generations; to improve public access to natural areas where appropriate; and to encourage stewardship and enhancement of the local natural environment.

The Green Legacy program

The County of Wellington encourages local municipalities within the County to participate in tree planting. Trees will be delivered to municipal offices within the County for municipalities who are participating. This program is well under way and gets many requests to provide planting materials.

The Forest Conservation By-Law of the County of Wellington

This By-law is being developed by the County of Wellington to replace the Tree By-Law which is dated from 1994 and will deal with the conservation and sustainable use of woodlands. It will be addressed further on in this plan.

3. Strategic Urban Forest Management Plan 2009-2028

3.1 Stratification

Stratifying the community into areas with similar structure and tree resources will help interpret the inventory results and streamline management and planning (van Wassenauer and Kenney 2001). Stratification is primarily based on built infrastructure, as determined by the type of land use and zoning, and predominant age/size class of the trees. Important land use types to be considered in Elora and Fergus include commercial and industrial areas, residential areas (old and new), and natural areas/woodlands. The types and ages of the built infrastructure will have a strong influence on tree habitats. This will in turn influence the number and size of the trees, tree conditions, and available growing space. In Elora, for example, there are low/medium density residential areas that are relatively old with mature trees. There are also newer subdivisions of medium/high density, where the trees, if any, are relatively young. Building density, the predominance of hard surface, and underground infrastructure may limit the available growing space in these new subdivisions.

According to UFI Inc. and Kenney (2008), the age/size class of the trees can be classified as:

- Juvenile, e.g. recently established, small trees which can easily be pruned or “trained” from the ground using secateurs (<5m height).
- Intermediate trees are those that can be pruned from the ground using pole pruners (5-15m).
- Mature trees are those that must be pruned by climbing or from a bucket truck (>15m).

An area may be classified Based on its built infrastructure and predominant age/size classes of trees; for example, medium density residential – mature, or high density residential – juvenile.

Detailed stratification should result in five urban forest management units with a relatively even distribution of management activities (tree establishment, pruning, etc.) among AOPs within each 5-year management plan. The identification of these units will

be based on the spatial distribution of the built infrastructure and on information from the tree inventory, which is to be completed early in the first 5-year management plan. In the interim, we will work with the following four general management zones. The first zone is the commercial and industrial areas with juvenile trees; the second zone is the old, low/medium-density, residential areas with mature trees; the third zone is the new, high-density, subdivision areas with juvenile trees; and the last is the natural areas/woodlands.

3.1.1 Recommendation

1) The urban areas should be *divided into five urban forest management units* in such a manner that their management needs are distributed more-or-less equally. These management units will be used to allocate activities within the 5- year management plans.

3.2 Inventory

Inventory is an essential tool for the formulation of management strategies. It will identify details of the structure of the urban forest, such as species composition, the mixture of native and non-native species, tree conditions, management history, and plantable spots (van Wassenauer and Kenney 2001). Because a high proportion of the urban trees in the Township is private (about 94% in Elora), and because of active stewardship activities initiated by community groups such as Neighbourwoods, the Township collaborate with the communities in completing an inventory for trees on both municipal and private properties. The Township can provide such resources as training and equipment, while volunteers can be organized for the inventory.

A common inventory protocol is the NeighbourWoods© (Green-Up, undated). It has been well-tested as a cost effective approach to data collection. It is standardized to minimize bias among surveyors and over time and allows for standardized data entry to reduce error and facilitate training (Green-Up, undated). Most importantly, it is user-friendly and require very little training while providing adequate and relatively un-biased information.

The inventory data can be computerized and easily combined with mapping, such as with GIS, for a visual representation of the size and extent of the urban forest (van Wassenauer

and Kenney 2001). Many municipalities across North America use GPS to record tree location data, and, increasingly, use GIS tools to link geographic information to inventory data. (Wilson 2004). Inventory data can thus be easily developed into a database, whereby users can obtain information for both single trees and for the structure of the urban forest resources, and update any changes.

Through the inventory procedure, the observer records information on: tree location, including ownership; site characteristics, such as percentage hard surface; species name; tree size, including stem diameter at breast height (dbh), crown width, and total height; tree condition, gauged using 16 parameters related to the crown, trunk and root system, such as unbalanced crown, dead or broken branches, confined root space, etc.; and conflicts between trees and other infrastructure, such as traffic signs and wires (Green-Up, undated). A score is given to each of the condition parameters on a scale of 0 to 3, 3 denoting the most severe defects. A final score can be calculated for the tree with a weighted average of all these parameters, on which the condition of the tree can be classified, from “very poor” to “excellent”.

Conflicts with other trees and infrastructure are graded as none, existing, or potential (Green-Up, undated). As the inventory of existing trees is gathered, places where trees could be planted can also be noted. If experienced and/or trained, the observer can also estimate the size of tree that would be suited to grow in the available space (van Wassenauer and Kenney 2001).

The inventory should differentiate between intensively managed parts of the urban forest and extensively managed natural areas and woodlands. Trees, including street and residential trees, in the former, should be managed individually under arboricultural techniques, while the latter should be managed as a whole using silvicultural techniques resembling large-scale “non-urban” forestry (UFI Inc. and Kenney 2008). Detailed data collection for each individual tree is not necessary in natural areas/woodlands. Inventory for a stand can be done in sample plots, and the data can be extrapolated to the stand

level. One random sample plot of 0.04 ha per hectare should be established in each woodland tract for forest inventory and monitoring (Lowell 1997).

Nevertheless, trees along park and recreational trails should be inspected more carefully for hazard identification and risk management. First, information on the trail, such as goals of the trail, use survey results, use frequency, and safety issues, should be gathered. This information will assist in establishing management goals and priorities for different trails (Pokorny 2003, USDA 2004). A map with all useful information should then be developed, and an inventory for trail-side trees can be done using the sample Forest Park Trail Inventory sheet developed by the USDA (2004). Identified problem trees should be categorized and recorded as low-, medium-, or high-risk, or hazard, and be furthered inspected (for more information, please refer to USDA 2004).

Inventory results, when compared to the management goals, will provide the information necessary to establish a successful management strategy. Information from the inventory that should be addressed in the plan includes: public safety issues, maintenance needs, and the value of the urban forest, etc. (van Wassenaer and Kenney 2001). Priorities should be clearly established in the plan.

3.2.1 Recommendations

- 2) The Township should *collaborate with the communities to complete a tree inventory* for all street, park, and residential trees within the first 5-year management plan.
- 3) The Township should complete a *trail-side tree inventory* for all parks and woodlands within the first 5-year management plan.
- 4) The Township should establish *one permanent sample plot (PSP) per hectare* in each woodland tract so that the woodlands can be monitored systematically over time. The Township will complete a forest inventory for all parks and woodlands in the PSPs within the first two 5-year management plans.
- 5) The Township should *contract an urban forestry specialist with GIS training* to administer the tree inventory software and database in the Department in 2009.

3.3 *Inventory Maintenance and Inspection Plan*

The inventory database needs to be updated regularly because tree conditions are constantly changing. Development pressures, urban sprawl, climate change, invasive pests and plants, and natural aging of trees can result in changes to the structure of the urban forest over time (UFI Inc. and Kenney 2008). The initial data represent baselines against which to measure progress. Once the inventory is in place all changes to the health and structure of trees should be regularly entered into the system. As new trees are planted they should be added to the inventory and the plantable spots that they now occupy should be removed. Trees that are removed from the forest must be deleted from the inventory, and new planting spots recorded at these locations. Any arboricultural treatments that are undertaken must also be recorded.

3.4 *Tree Establishment Plan*

The following section of the Strategic Urban Forest Management Plan discusses the establishment, removal and replacement of trees. The section is divided into two parts:

- 1) **Background: Tree habitat requirements** - Outlines the optimum growing conditions for urban trees, and provides recommendations for their provision in Centre Wellington.
- 2) **Tree Establishment Plan** – Outlines tree planting priorities for Centre Wellington. Discusses species selection, planting location, canopy cover and leaf area targets, tree replacement, etc.).

3.4.1 **Background to Tree Establishment: Tree Habitat Requirements**

As all other living organisms, trees require certain environmental conditions to grow and thrive – these conditions make up the tree’s habitat. Although different tree species are adapted to different growing conditions, the basic habitat requirements of virtually all urban trees differ little. In order to persist in a healthy condition, trees need, among other things, sufficient above- and below-ground physical growing space for vertical and horizontal crown growth and root development. Soil quality and volume; moisture, light and nutrient availability; interactions with other infrastructure and organisms (especially humans) and climate are just some of many important habitat variables which may

contribute to a vigorous and healthy forest, or induce stress and possible mortality in urban trees.

The careful and concerted selection and maintenance of good habitat conditions is one of the most important considerations for sustainable urban forest management. It is important to remember that under the right conditions, trees are long-lived organisms, and have the potential to provide increasing levels of benefits to all inhabitants of the urban forest as they grow and mature. Providing the right habitat conditions and selecting trees genetically suited to their habitats are perhaps the most important steps to ensuring urban trees can achieve their maximum genetic potential for growth, health, and the provision of benefits – after all, a tree cannot move if it finds its habitat unsuitable. As long lived-organisms, trees will experience a wide range of environmental and social changes (Konijnendijk et al., 2005) – a suitable habitat is among the most important factors determining whether the tree will flourish or perish.

3.4.2 Tree Habitat Requirements

One of the most widespread, yet best-understood and therefore preventable, causes of premature urban tree mortality is inadequate soil rooting space and poor soil quality (Krizek and Dubik, 1987). Unfortunately, the natural below-ground location of a tree's most important appendages – the roots (see Figure 8) – lends credence to the old adage “out of sight, out of mind” (Landowner Resource Centre, 2000). The requirements for adequate rooting space, soil volume and soil quality are all-too-frequently overlooked in the urban setting, where roots must contend with below-ground utilities, highly-compacted or otherwise poor soils, and impermeable hard surfaces.

As roots are the vessels through which water, nutrients and oxygen move to sustain the tree, a rooting environment of suitable quality is essential to maintaining a sustainable urban forest. As such, the soil substrate must be able to hold a sufficient amount of water (referred to as water holding capacity, or WHC) to adequately meet an individual tree's transpirational and photosynthetic demands. Inadequate soil volume and quality will, among other things, lead to prolonged water deficits (drought), which will contribute to

tree stress and may lead to mortality (Lindsey and Bassuk, 1991). The ideal urban tree substrate will be well-drained and porous – such soils provide more useable water to the roots. Just as trees consume large amounts of water (Vrecenak and Herrington (1984) estimated that a large tree could use some 1000 litres of water per day), their roots also require oxygen to respire. Therefore, the right soil must provide access to both water and oxygen, as well as contain adequate nutrients. Medium-textured soils, such as loam, sandy clay loam, and silt loam types, typically have the optimal balance between porosity – providing water and air movement, water holding capacity, and nutrient availability, (Morton Arboretum, 2002) and should make up the below-ground component of urban tree habitat wherever and whenever possible. Soils must also be protected from compaction, which increases soil bulk density and reduces its ability to provide moisture and air to tree root systems, as well as hindering the ability of roots to grow (Unger and Kaspar, 1994).

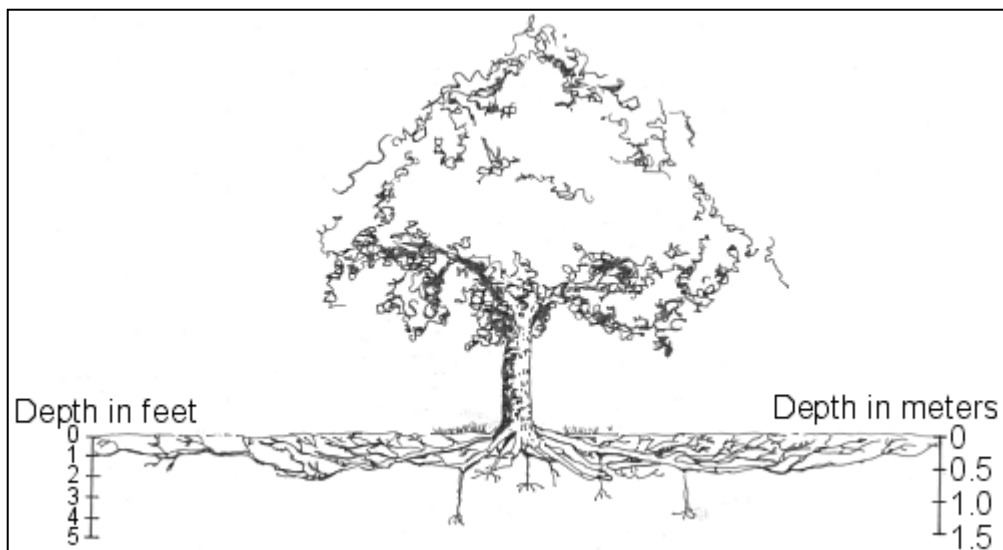


Figure 8: A tree's root system extends well beyond (up to 3 times) the drip line in an optimum growing environment. Adequate soil volume and growing space are critical to urban tree health. Image from University of Minnesota, 2006.

While the quality of the planting substrate is one of the most important considerations for below-ground tree habitat, adequate quantity is also a key to sustaining the health and vigour of any urban tree (Lindsey and Bassuk, 1991). DeGaetano (2000) cites “inadequate underground rooting space as one of the main contributors to the premature mortality of urban trees.” So how much soil is enough?

Lindsey and Bassuk (1991) estimated that, in an urban environment, roughly 0.6m³ of silt-loam soil in the rooting environment is required for every 1m² of a tree's crown projection area². For instance, a tree with a 6-metre crown diameter (or a crown projection area of about 29 square metres) and a leaf area index of 4 (the actual leaf surface area being 4 times that of the crown projection area – average for a deciduous street tree), would require approximately 6.2m³ of soil in the below-ground habitat. This means that, in order to access adequate moisture, an urban tree requires approximately 0.6m of good-quality soil depth, in an area equivalent to its crown projection. If such a soil depth is unattainable due to below-ground restrictions such as infrastructure or other hardpan, the surface area must be increased proportionally to a size greater than the crown projection area. These estimates are, however, derived from climate data for Ithaca, N.Y. As Ithaca is, on annual average, 1.3°C warmer and 40mm drier than Centre Wellington (adapted from Northeast Regional Climate Centre, 2008 and Environment Canada, 2004), it is possible that soil volume demands for Centre Wellington may in fact be slightly lower. The above recommendation was also derived based on the assumption that all of the tree's water use was supplied by rainfall – trees surrounded by hard surfaces such as concrete, or competitors for water such as turfgrass, will likely require a higher soil volume. Therefore, this requirement should be adopted as a baseline into all new plantings, whenever and wherever possible. If soil quality is deemed inadequate to provide sufficient access to water and/or nutrients due to poor soil texture, high compaction or other variables, the available below-ground planting environment must be increased in size and soil.

In addition to optimal soil quality and quantity, trees should be established in such a way as to avoid potential conflict with below-and above-ground utilities and other so-called “grey” (man-made) infrastructure, which may adversely affect soil volume, texture and drainage, and may subject the root system to damage when utility maintenance is conducted. Ensuring that such conflict is avoided necessitates coordination between

² The area below a tree's crown. Can be calculated by radius or diameter. Using crown radius, crown projection area = $\pi(\text{crown radius})^2$. Using crown diameter, crown projection = $(\text{crown diameter})^2 \times .7854$.

Township engineering staff and those engaged in tree establishment, as well as the selection of appropriate tree species for their planting spaces (see Section 3). Future developments should be designed in such a way to minimize the potential for conflict between trees (green infrastructure) and grey infrastructure.

3.4.3 Tree Establishment Plan

The establishment of new trees is an integral part in maintaining existing canopy cover (by replacing trees that have been removed) and in increasing total future canopy cover. It is therefore necessary to outline a comprehensive strategy for tree establishment, and the following section fulfills this purpose. The Tree Establishment Plan is intended as a reference for all users of the Strategic Urban Forest Management Plan for Centre Wellington. This component of the Plan contains the following sections:

- 1. Current planting practices and responsibilities**
- 2. Priorities for tree establishment**
- 3. Species selection and planting guidelines**
- 4. Spatial considerations for tree establishment**
- 5. Recommendations**

This part of the plan rests at the strategic level, and should be considered a guide for development and implementation of the more detailed 5-year management and 1-year operating plans.

1. Current planting practices and responsibilities

1a. Planting

Tree planting in Centre Wellington differs in its execution depending whether the trees are planted on public or private land. Responsibility for public (i.e. street) tree planting, with the exception of Parks and Conservation Area lands, is carried by the Centre Wellington Department of Public Works and is guided by the official Tree Policy

(06/02)³. In some aspects, the Tree Policy is well-informed and consistent with several best practices for urban forest management. For example, the policy 1) mandates the planting of relatively large-caliper (70mm) stock, ensuring better chances for tree survival, 2) emphasizes the use of native species where suitable, 3) recognizes the need for compatibility between tree size and location to avoid conflict with other infrastructure, and 4) recognizes the need for an ongoing 5-year pruning cycle. However, some aspects of the policy require improvement. For instance, the minimum replacement ratio of 2 new trees to 1 removed tree is generally insufficient to maintain no net loss of leaf area and canopy cover, or the benefits directly related to those factors. Additionally, though the Tree Policy provides a nominal list of species suitable for new plantings, it provides no additional information to help guide the selection process. This must be remedied, as not all approved species are necessarily equivalent in several respects, nor are they all equally suited to the same tree habitats. Furthermore, there is little if any other scientific or operational support for the implementation of the Tree Policy. One of the goals of this Plan is to support and improve the municipal Tree Policy.

Street tree planting under the Tree Policy is conducted under any one of three conditions. They are:

1. **Replacement** – a minimum of 2 trees are planted by Public Works for every 1 tree removed.
2. **Resident request** – trees may be planted on municipal property if a request is received from a resident. The request is placed on a prioritized waiting list, subject to budgetary and other conditions.
3. **Larger-scale community group planting** – typically conducted by tree stewards affiliated with the local Neighbourwoods tree advocacy program. Stewards identify plantable spaces or trees in need of replacement and request approval from Public Works. Such trees are planted at the expense of the community group. In 2008, Neighbourwoods planted approximately 100 trees, mainly as replacements.

³ Available at <http://www.centrewellington.ca/NR/rdoonlyres/1C556C80-02F7-46DA-BE03-C69CFFE67D03/3427/TreePolicy1.pdf>.

1b. Watering and mulching

Trees on private property are planted and maintained at the expense and discretion of the homeowner, and are not subject to the provisions of the Tree Policy. The Tree Policy recognizes the need for watering of new plantings, but does not delegate the responsibility to any party. In practice, the watering and mulching of newly-planted street trees is typically considered the responsibility of the adjacent homeowner, and local stewardship groups – particularly Neighbourwoods – encourage all homeowners to be proactive in this respect.

2. Priorities for tree establishment

Outlining a Tree Establishment Plan requires that priorities for tree establishment be defined. These priorities may be considered as guiding principles and operational tools for tree establishment. Key priorities for tree establishment include, but are not limited to:

- Ensuring no net loss of leaf area
- Increasing leaf area and canopy cover (crown projection area) over the long term
- Ensuring the selection of trees for their planting spaces and within the general matrix of the urban forest
- Increasing the diversity of tree species, genera and families in the urban forest
- Increasing the diversity and distribution of tree age classes
- Clearly defining and equitably distributing responsibilities for tree establishment and maintenance
- Improving the long-term health of the urban forest and its human and non-human residents
- Reducing the real costs of tree establishment over the long term by recognizing it as an investment in green infrastructure

The points outlined above are not ranked in terms of priority. They are discussed in greater detail below.

2a. Ensuring no net loss of leaf area

As Nowak (1994) and Kenney (2000) note, the vast majority of the benefits the residents of any urban forest derive from trees is directly attributable to leaf area – the total surface area of a tree’s leaves. As leaf area increases, so does the provision of all forest-derived benefits. Unfortunately, leaf area is often considered difficult to accurately determine without destructive or other time-consuming sampling, and is therefore frequently passed

over in discussion in favour of the more easily-determined measure of canopy cover – the area of ground covered by tree or shrub canopy. Thus, many management plans and stakeholders cite the need to increase canopy cover as a priority for tree establishment. While this is certainly a commendable goal, it does not accurately reflect the full spatial dimension of the urban forest in three dimensions, and does not address the differences in species attributes or the general structure of the urban forest (Kenney, 2000; Urban Forest Innovations, 2008). Leaf area is a more accurate way to incorporate these factors into planning to increase and improve the provision of benefits by the urban forest. It is for this reason that ensuring no net loss of leaf area, in addition to increasing total tree canopy cover, should be a key priority for the Tree Establishment Plan.

The only practical way to ensure no net loss of leaf area is to plant a leaf area equivalent to that of any tree removed in the Plan area. If one large-stature tree with a given leaf area is removed, that tree should be replaced with a number of small trees with an equivalent or greater total leaf area. This would ensure no net loss of leaf area and benefits to the community, and represent an investment in a greater canopy cover and leaf area for the future. Certainly, planting of this nature may represent a significant monetary expenditure and logistical challenge for the Township, but it is perhaps the most promising way to invest in the future urban forest. It also represents a significant improvement over the 2:1 replacement ratio recommended in the Tree Policy.

Assessing a tree's leaf area requires a small amount of calculation, but is relatively easy if certain parameters are known about the tree being assessed. Nowak (1996) presents the following algorithm to calculate a tree's leaf area based on diameter at breast height:

$$\ln Y = b_0 + b_1 X + b_2 S$$

where Y = leaf area (m^2), X = dbh (cm), S = average shading factor of the tree species. The regression coefficients are $b_0 = 0.2102$, $b_1 = 0.0586$ and $b_2 = 4.0202$. Shading factors for many common urban species, from McPherson (1984) are available in Appendix 1. This algorithm should not present a significant challenge to those responsible for tree establishment or replacement, but rather as an opportunity to establish a sustainable urban

forest resource for the future. By using this formula prior to tree removal, Township staff or others responsible for tree planting can determine how many smaller trees are needed to replace the leaf area lost by the removal of any single tree with relative ease. Given that this algorithm relies on an average derived shading factor, it is not the ideal way of assessing leaf area, but will be accurate enough for use as a general planning tool for tree establishment.

Perhaps the most significant challenge to ensuring no net loss of leaf area arises with the removal of large-stature trees from private property. When such a tree is removed (at a considerable expense to the homeowner), it may be easily replaced with one or two small trees planted on the same private lot. However, the leaf area immediately lost – a concern for the entire community – cannot be so easily replaced. For example, a large-stature silver maple with only 75% of its crown remaining would require upwards of 30 healthy young replacements (Urban Forest Innovations, 2008). If the Township is truly committed to increasing canopy cover in its urban areas, this type of contingency must be planned for well in advance.

2b. Increasing leaf area and canopy cover over the long term

A key objective for the community is to increase the tree canopy cover and leaf area over the long term (20+ years). In accordance with recommendations from American Forests, the community has recognized the importance of an urban forest canopy cover of between 30% and 40%. While attaining and maintaining this level of canopy cover should be a long-term strategic goal, it should not be a short-term priority for two key reasons. Firstly, a detailed inventory of the Township's urban forest resource is not available, nor is an accurate estimate of current urban canopy cover. While total canopy cover in Centre Wellington stands between 14-17% based on GIS analysis, its distribution in the urban centres (Elora, Fergus and Salem) is unknown, and may in fact be closer to or above the target level. Secondly, a focus on increasing canopy cover has the potential to manifest itself in planting trees at the expense of maintaining the existing canopy. For this reason, increasing leaf area and canopy cover over the long term should

be one long-term priority, but not the sole objective of urban forest management in Centre Wellington.

2c. Ensuring the selection of appropriate trees for their planting spaces and within the general matrix of the urban forest

2d. Increasing the diversity of tree species, genera and families in the urban forest

2e. Increasing the distribution of tree age classes

A diverse set of variables must be considered when selecting the appropriate tree to plant, including existing forest structure, site conditions, resident preferences, potential size, species, etc. See Section 3 of the Tree Establishment Plan for more information regarding tree selection.

2f. Clearly defining and equitably distributing responsibilities for tree establishment and maintenance

As discussed in Section 1 of the Tree Establishment Plan, while the responsibility for tree establishment and care on most public lands in Centre Wellington officially belongs to Public Works, it is often divested to private residents and community groups. While this in itself is not necessarily undesirable, this situation becomes problematic when it is not clearly communicated or if it leads to trees not being established when and where opportunities to plant them exist. Furthermore, the responsibility to maintain trees after planting (i.e. watering, mulching and pruning) should be clearly outlined and allocated. Table 2 presents a workable allocation of responsibilities which is suggested for consideration by the Township and all stakeholders with an interest in urban forest management. It is recommended that this aspect of the Plan be reviewed by Township Council for incorporation into official policies and applicable by-laws.

The above outlined distribution of responsibilities for the establishment of trees may appear complex at first, but it does not represent a major divergence from how trees are currently planted in Centre Wellington. Rather, it clearly delineates the relationships between stakeholders that should be maintained regarding tree planting.

The first column outlines the most common planting space types. If any person wishes to plant a tree in an area not outlined in Column 1, (s)he should always contact Public Works for approval.

The second column ascribes “responsibility for planting” to one or more groups, and requires further discussion. A group with the responsibility to plant is one which has some jurisdiction over the planting space. For instance, Public Works should strive to plant a certain number of trees annually, irrespective of the activities of residents or community tree advocacy groups. However, resident or advocacy groups may choose to a) suggest a planting space for Public Works’ planting or b) request additional planting. This is an example of “responsibility for establishment,” and includes the responsibility for raising the need for the planting to Public Works, planting site selection, species selection, etc. However, residents should not be allowed to physically plant a tree on public land – this should be left to Public Works staff, contractors, or trained members of community tree advocacy groups with Public Works’ approval. Trees planted by contractors on behalf of Public Works should have a minimum 2-year warranty and care guarantee (see Section 3f).

A note on community groups: In parts of urban Centre Wellington, tree advocacy groups such as Neighbourwoods have been very active in planting trees on public land and involving members of the community in the process - this should be encouraged. While this Plan identifies Public Works as the party responsible for physically planting trees on public land, community groups should be allowed the opportunity to do so at any occasion. This will require close coordination between the Public Works department and representatives of tree advocacy groups.

Table 2: Distribution of responsibilities for tree establishment.

Tree Location	Responsibility for Establishment	Cost Bearer³	Responsibility for Maintenance (w,m,p) *
Public boulevard (tree lawn)	Public Works² / Community Grp. ¹	Public Works / other ³	Public Works (m,p) Community Group (w,m)
Public boulevard (central reservation)	Public Works/ Community Grp. ¹	Public Works / other ³	Public Works (w,m,p)
Commercial street (sidewalk tree)	Public Works/ Community Grp. ¹ / Merchant ¹	Public Works (1/2), neighbouring merchants or BIA (1/2)	Public Works (w,m,p)
Front lawn (road allowance)	Public Works² / Community Grp. ¹ / Resident ¹	Public Works (2/3), Resident/ Community Grp. (1/3)	Public Works (m,p) Resident or Community Group (w,m)
Front lawn (private)	Resident / Community Grp.	Resident/ Community Grp.	Resident or Community Group (w,m,p)
Back yard	Resident / Community Grp.	Resident / Community Grp.	Resident or Community Group (w,m,p)
Municipal Park	Parks and Rec. / Community Grp. ¹	Parks and Rec.	Parks and Rec. (w,m,p)
Private woodlot/farm	Resident	Resident	Resident

Notes: **Bold text** indicates the party responsible for physically planting the tree. 1 – with approval of Public Works Dept., 2 – with written notice to Resident, 3 – tree establishment should not be constrained by Township budgets if other sources of funding are available. W – water, M –mulching, P – pruning. * - Trees planted by contractors on behalf of Public Works should always include a minimum 2-year aftercare guarantee.

On most public land, tree establishment should be paid for by Public Works. However, as noted, tree planting should never be constrained by Township budget limitations if such exist, and if other sources of funding are available. It is recommended that on the public road allowance section of residential front yards, residents or community groups contribute to 1/3 of the tree planting cost. This should encourage more planting on public land without significant costs to residents. On commercial streets (i.e. sidewalk trees in the CBD), the cost for planting should be divided between Public Works and the neighbouring merchants, who derive benefits from the presence of trees. In the case of shared responsibility between residents and community groups, residents should always be encouraged to cover the cost of plantings on their own land, thus saving more funds for planting on public land. Other cost responsibilities outlined should not require further explanation.

Perhaps the most contentious and unclear issue associated with tree establishment is that of maintenance, including watering, pruning and mulching. The responsibility for the provision of each of these maintenance aspects should depend upon who is most readily able to provide it, at the least cost and highest effectiveness. Major limb pruning on public trees should always be conducted by Public Works or contractors as part of the cyclical 5-year pruning plan. Well-trained community tree advocacy group members should be allowed to conduct minor pruning on public trees with the coordination of Public Works – this coordination is necessary in order to allow for inventory updating. Residents should be generally discouraged from pruning public trees, as unskilled pruning has the potential to cause serious harm. All new plantings should be pruned 2 years after establishment. Providing mulch is also an important consideration – Public Works should always provide the mulch needed for any new planting, and subsequent mulching. See Section 3f for watering and mulching guidelines.

2g. Improving the long-term health of the urban forest and its human and non-human residents

This priority serves as a guiding principle more than a real operational priority. All of the guidelines recommended in this Plan are targeted to improving the long-term health of the urban forest and its human and non-human residents by encouraging biological diversity and increased leaf area and canopy cover.

2h. Reducing the real costs of tree establishment over the long term by recognizing it as an investment in green infrastructure

Unfortunately, tree establishment is often a costly process. However, all stakeholders should recognize that the short-term expenditures of tree planting and maintenance can be repaid many times over when the appropriate guidelines are applied before, during and after the planting process. This represents a profitable investment in the green infrastructure of the community, promoting health and bringing down real costs associated with healthcare, energy use, water use and many other human activities. This recognition must inform all future Township policies and operations.

3. Species selection

Perhaps one of the most important idioms guiding tree establishment is:

“Plant the right tree in the right place!”

Selecting the correct tree for a given planting space is a difficult task, and one which demands a good deal of consideration if the planting is to be successful by allowing the tree to live up to (or close to) its full genetic potential and provide the maximum level of benefits that it can. Selecting the wrong tree for the site represents a poor investment strategy - the associated costs make a tree likely to die within a few years arguably worse than no tree at all. To ensure successful establishment and long-term viability, variables that must be considered before selecting which tree species will occupy any given site include, but are not limited to:

Site factors:

- soil quality: texture, material, drainage
- soil volume
- access to water
- above- and below-ground utilities and other infrastructure
- proximity to traffic: soil compaction, salt, potential for future damage
- potential for future development impacts
- sunlight availability

Tree-specific factors:

- size and shape: height, crown spread, crown form, growth rate
- leaf characteristics: coniferous or deciduous
- fruiting
- shade/exposure tolerance
- climatic adaptation
- water demand
- resistance to salt or other damaging factors
- native vs. non-native, invasiveness
- soil requirements: volume, quality, drainage etc.
- any other specific traits: thorns, odour, volatile organic compound emission, toxicity, etc.

Other factors:

- species, genus and family diversity of existing urban forest (requires inventory)
- public priorities: aesthetics, amenities, biodiversity, water source protection, etc.

Discussing each of these variables in detail would be beyond the scope of this Plan. Instead, Tables 3 and 4 summarize the important variables concerning the trees approved

under the Tree Policy of Centre Wellington. Information regarding other species is widely available in the literature base. The United States Department of Agriculture Forest Service Factsheets⁴ provide the most comprehensive information regarding most native and non-native coniferous and deciduous tree species. **Note:** in this plan, any tree naturally present in southern Ontario is classified as “native” – even if its natural range does not necessarily include Centre Wellington.

3a. Other suitable species

The list of approved species under Centre Wellington’s Tree Policy is limited to only 13 tree species – seven of which are non-native, one of which is recognized as invasive and is therefore unsuitable for planting, and two of which, at the time of publication of this Plan, should not be planted due to their high susceptibility to, and ability to host, the Emerald ash borer (*Agrilus planipennis*) – a devastating introduced beetle species. This effectively leaves four acceptable native species, or ten total species that are both approved and acceptable under the Tree Policy. Should only these species be planted, the future urban forest of Centre Wellington will neither exhibit the species nor structural diversity to allow the effective provision of benefits. Table 5 presents a list of other tree species deemed suitable or potentially suitable for the urban forest of Centre Wellington. The list is not exhaustive, and includes only native species. All stakeholders interested in tree establishment are encouraged to consult the vast body of literature for more information regarding species selection, and are further encouraged to plant a diversity of tree species in Centre Wellington (see Section 3c.). See Nowak and O’Connor (2001) for a comprehensive list of candidate species for planting. When selecting species for planting, it is important to select species suitable for the plant hardiness zone. Currently, Centre Wellington is situated in zone NA6 or C6. See Section 3c for more discussion regarding climate and climate change.

In some instances, planting trees in seemingly amenable spots may not be possible for any of a number of reasons. Perhaps residents simply do not want a tree on their property, or there is the potential for conflict between the tree and overhead utilities or other grey

⁴ Available at <http://hort.ufl.edu/trees/>

infrastructure, vehicles, or people. In such cases, the Township should endeavor to plant shrubs instead. Nowak (1994) estimated that shrubs sequestered and filtered out approximately 1/3 of airborne pollutants in Chicago through the same processes as trees.

3b. Native versus non-native planting

An often-divisive question in the practice of urban forestry is whether the planting of non-native tree species is an acceptable management option. There are several examples of non-native species planted for diverse reasons ultimately proving invasive and detrimental to the health of natural ecosystems. One such species is Norway maple (*Acer platinoides*), which is relatively hardy and has the capacity to spread its seeds over wide distances (Martin, 1999). Unfortunately, the invasiveness of this species was not recognized until many years after its widespread establishment in many North American urban areas, and its introduction serves as a cautionary tale for any non-native tree establishment. However, urban areas pose unique challenges to tree survival, and urban residents often desire values and characteristics better provided by non-native trees, such as showy foliage or flowers. In some instances, non-native species may simply be better suited to meet the objectives of a given urban forest management direction. It is therefore recommended that tree establishment in Centre Wellington focus on planting native tree species wherever and whenever feasible, but that non-native species be given consideration when the specific demands of the management situation warrant it. In other words, non-native trees should not be excluded on the sole basis of their provenance. Non-native species should always be assessed for their potential invasiveness, and should never be planted in close proximity to natural areas, including woodlots, conservation areas or other significant natural features. What defines close proximity will depend upon the species selected, and scientific literature should always be consulted for information about seed spread and reproductive capacity when there is any doubt.

Table 3: Trees listed as “approved for planting on municipal property” under the Centre Wellington Tree Policy (06/02) and their characteristics. Source: USDA Forest Service Fact Sheets, available at: <http://hort.ufl.edu/trees>.

Species	Common Name	Origin	Light Preference	Soil Tolerances	Drought Tolerance	Salt spray resistance	Salt soil contam. resistance	Notes
<i>Acer nigrum</i>	Black maple	Native	Full sun to ½ shade	clay; loam; sand; acidic; alkaline; well-drained	Moderate	None	Low	Similar to Sugar Maple
<i>Acer platanoides</i>	Norway maple	Non-native - Europe		clay; loam; sand; acidic; occasionally wet; alkaline; well-drained	Moderate	Moderate	High	Invasive, <i>should not be planted</i>
<i>Acer saccharum</i>	Sugar maple	Native	Full sun to ½ shade	clay; loam; sand; acidic; alkaline; well-drained	Moderate	None	Low	Many cultivars for urban use available
<i>Aesculus hippocastanum</i>	Common Horsechestnut	Non-native - Europe	Full sun	clay; loam; sand; acidic; alkaline; well-drained	Moderate	High	High	Attractive flowers, large hard fruit
<i>Fraxinus americana</i>	White ash	Native	Full sun to ½ shade	clay; loam; sand; acidic; alkaline; extended flooding; well-drained	Moderate	High	High	Ash trees should not currently be planted due to the threat of Emerald ash borer
<i>Fraxinus pennsylvanica (subintegerrima)</i>	Red ash (Green ash)	Native	Full sun to ½ shade	clay; loam; sand; acidic; alkaline; extended flooding; well-drained	High	Moderate	Moderate	
<i>Ginkgo biloba</i>	Ginkgo	Non-native - Asia	Full sun	clay; loam; sand; acidic; occasionally wet; alkaline; well-drained	High	Moderate	Low	Males must be planted, female fruit have strong unpleasant odour
<i>Gleditsia triacanthos</i>	Honey-Locust	Native	Full sun		High	High	High	var. <i>inermis</i> is thornless
<i>Malus spp.</i>	Apple spp.	Native	Full sun to shade	clay; loam; sand; acidic; occasionally wet; alkaline; well-drained	Moderate	Low	Moderate	Produces fruit, potentially messy and attractive to insects (plant w/ care)
<i>Quercus coccinea</i>	Scarlet oak	Non-native - Eastern USA	Full sun	clay; loam; sand; acidic; well-drained	Moderate	Moderate	Moderate	Attractive fall foliage
<i>Syringa reticulata</i>	Ivory-silk lilac	Non-native – Asia	Full sun	clay; loam; sand; slightly alkaline; acidic; well-drained	Moderate	High	Moderate	Attractive flowers
<i>Tilia cordata</i>	Little-leaf linden	Non-native - Europe	Full sun to ½ shade	clay; loam; sand; acidic; occasionally wet; alkaline; well-drained	Moderate	None	Low	Fast growing

Table 4: Potential height and crown diameters for trees listed in the Tree Policy.

Common Name	Potential Height (m)	Potential Crown Diameter (m)
Black maple	15-24	10-15
Norway maple	12-18	10-12
Sugar maple	15-24	10-15
Common Horsechestnut	15-24	12-15
White ash	15-24	12-18
Red ash (Green ash)	12-21	13-15
Ginkgo	18-21	10-15
Honey-Locust	15-21	10-15
Apple spp.	3 – 8	3 - 8
Redspire pear		
Scarlet oak	18-23	13-18
Ivory-silk lilac	6-9	4.5-8
Little-leaf linden	18-21	10-15

3c. Choosing species for diversity and climate change

Diversity

One of the hallmarks of a sustainable and healthy urban forest is a suitable diversity of tree species, genera and families across the urban area, and includes diversity in spatial distribution (i.e. few or no “pockets” of one or two tree species). Santamour (1990) suggests that a common-sense approach to a healthy urban forest means that a community should:

- (1) plant no more than 10% of any species, (2) no more than 20 % of any genus, and (3) no more than 30 % of any family.***

While Santamour specifically prescribes this distribution to new plantings, it is understood that it should ultimately be reflected in the composition of the entire urban forest, across all age classes. Furthermore, strips or blocks of uniformity (e.g. oak-lined avenues) should be scattered throughout the urban area to achieve spatial and biological diversity. Adhering to these guidelines should ensure that resilience to pest and pathogen

outbreaks or other natural disturbances, such as wind or ice storms, is “built in” to the structure of the forest.

While accurate planning for tree diversity necessitates an up-to-date tree inventory, there is enough information available about some of Centre Wellington’s urban forest to develop strategic guidelines for tree establishment with diversity and resilience in mind. A 1996 project, conducted in Elora by Kenney et al. to assess the contribution of the urban forest to offsetting energy costs, provides a preliminary inventory from which some information about the structure of Centre Wellington’s urban forest may be reasonably inferred. Note that this inventory was prepared solely in Elora. It is likely that the urban forests of Fergus and Salem share a relatively similar structure and composition, but only a detailed inventory can confirm this.

Table 5: Additional native candidates for establishment consideration.

Tree Species	Common Name	Native	Notes
<i>Amelanchier canadensis</i>	Downy serviceberry	Y – widespread	Small-stature
<i>Quercus macrocarpa</i>	Bur oak	Y – G.L.-St.Lawrence	Hardy, Medium-stature
<i>Carpinus caroliniana</i>	Blue-beech	Y – Carolinian	Small-stature
<i>Cercis canadensis</i>	Eastern redbud	Y - Carolinian	Small-stature
<i>Fagus grandifolia</i>	American beech	Y – G.L.-St.Lawrence	Large-stature
<i>Gymnocladus dioicius</i>	Kentucky coffeetree	Y – Carolinian	Hardy, Medium-stature
<i>Liriodendron tulipifera</i>	Tulip tree	Y – Carolinian	Large-stature
<i>Ostrya virginiana</i>	Ironwood	Y – G.L.-St.Lawrence	Medium-stature
<i>Pinus strobus</i>	White pine	Y – G.L.-St.Lawrence	Large-stature

Kenney et al. (1996) found that a full quarter of Elora’s trees are of the genus *Acer* – the maples. *Picea* – the spruces, make up 24%. On public land, maples account for 53% of trees, while ashes represent 17% of the village’s urban forest. In terms of species across the village (public and private land), only white cedar (*Thuja occidentalis*) exceeds Santamour’s 10% threshold, while Norway maple (*A. platinoides*) and white spruce (*P. glauca*) meet this level. On public land, a full 37% of trees are sugar maple (*A. saccharum*) and 16% are green ash (*Fraxinus pennsylvanica var. subintegerrima*). *T. cordata*, *A. platinoides* and Scot’s pine (*Pinus sylvestris*) also all exceed the 10%

threshold. Evidently, then, there are genera and species which are overrepresented in the urban forest of Elora. A similar situation likely exists in the rest of Centre Wellington's urban area, but as mentioned, only a detailed inventory will allow for a detailed assessment of the forest's diversity.

Until an inventory is conducted, it is recommended that tree establishment focus on planting other genera besides *Acer* and *Picea*. Public Works should plant maples only in the event that a large-stature maple is removed (see Section 2a. for a discussion about replacement.) Once an inventory is established, management can be adapted to form a strategic direction for future tree planting.

Climate change (adapted from GRCA, 2004)

The challenge of climate change is no longer merely a possibility, but a reality in Southern Ontario. Climate change predictions for northeastern North America generally foresee 2-3 degrees of warming, and a drier and warmer climate. This presents a significant threat to the health and sustainability of Centre Wellington's urban forest, and it is argued that conserving a broad genetic base (i.e. biological diversity) is a good "insurance policy" against climate change. This is a significant strategic and operational problem with respect to tree establishment, as trees will have to survive current and future climatic conditions. An important question is, therefore, whether tree establishment should focus on trees from currently-used seed sources,⁵ or if stock from more southern provenances should be introduced in advance of a warming climate.

From the Grand River Conservation Authority (2004):

"On an operational basis it is still recommended that we use seedlings from the same seed zone as the planting site, however, documenting the location of seed collection will become even more critical as we try to understand how different populations of trees are responding to climate change."

⁵ Local seed stock makes up the majority of public tree plantings in Centre Wellington today, through the county's Green Legacy program.

However, Centre Wellington should take a proactive approach to mitigating the potentially adverse effects of climate change upon the urban forest through strategic tree planting and limited species suitability trials. In terms of strategic planting, Public Works and tree advocacy groups should consider selecting more drought- and heat-tolerant tree species for future plantings, such as:

- Red maple (*Acer rubrum*)
- Hickories (*Carya spp.*)
- Kentucky coffeetree (*Gymnocladis dioicus*)
- Black walnut (*Juglans nigra*)
- Tulip tree (*Liriodendron tulipifera*)
- Pines (*Pinus spp.*)
- Oaks (*Quercus spp.*)
- Sassafrass (*Sassafrass albidum*)

Planting these and other tree species will contribute to increasing the biological diversity of Centre Wellington's urban forest, and would be a proactive step towards insuring against future climate change. Certain species (e.g. Sassafrass, Tulip tree) currently not planted in Centre Wellington should be initially established in limited numbers to safeguard capital investments against potential loss. Such plantings should be monitored regularly for growth, form and survival characteristics, with the potential for incorporation into future wider-scale plantings.

3d. Species to avoid or plant with care

There are several tree species which should not be planted in Centre Wellington under any conditions, and it is especially important to avoid planting them in the proximity of natural areas. These species include:

- **Norway maple (*Acer platinoides*)** – non-native, invasive in natural areas
- **Manitoba maple / boxelder (*Acer negundo*)** – semi-native, invasive in natural areas
- **Tree-of-Heaven (*Ailanthus altissima*)** – non-native, invasive, noxious odour from flowers, a fast-spreading urban weed
- **Amur maple (*Acer ginnala*)** – non-native, invasive
- **Ash species (*Fraxinus spp.*)** – native, a moratorium on ash planting should be imposed due to the threat from Emerald ash borer until the threat can be better evaluated or eliminated.
- **Siberian elm (*Ulmus pumila*)** – non-native, invasive in natural areas, weedy

Other trees are suitable for planting if sites are very carefully selected. There include weak-wooded or short-lived species which may be pose a concern for public safety, such as:

- **Poplars and birches (*Populus and Betula spp.*)** – native, suitable for planting in natural areas and near riverbanks, often weak-wooded and short-lived in urban areas
- **Northern Catalpa (*Catalpa speciosa*)** – non-native, may be planted but site selection very important, quite weak-wooded and messy, showy flowers and attractive foliage

3e. Soil types in Centre Wellington

As shown in Table 6, all trees have specific soil requirements. While some tree species may be site generalists and have a wider range of tolerances, every tree will experience optimal growth and survival when planted in its preferred soil and drainage type. It is therefore essential that all stakeholders with an interest in planting understand the difference between soil types, textures and drainage, and their relation to tree growth and survival. As mentioned in the Background section of this Plan component, medium-textured soils such as loam, sandy clay loam and silt loam typically provide the best compromise between water holding capacity, porosity and nutrients. However, the natural soils of Centre Wellington, especially in the urban areas, represent a diverse mix of soil types. This section outlines the spatial distribution of soil types in Centre Wellington and outlines a simple guide for soil and drainage identification. With this knowledge, Public Works, residents and community tree advocacy groups will be able to select the best tree for any given planting spot.

Soil type distribution in urban Centre Wellington

The distribution of soil types in Centre Wellington is listed in Table 6:

Table 6: Soil types in the urban areas of Centre Wellington. From Agriculture and Agri-Food Canada: ON35 – Soil Survey of Wellington County, 1963.⁶

Soil name	Location	Type	Texture	Drainage
Brant Fine Sandy Loam	E and W. of Salem	Grey-Brown Podzolic	Fine sand and silt loam	Good
Burford Loam	Most of Elora N and Fergus S of Grand River	Grey-Brown Podzolic	Gravel	Good
Colwood Silt	Isolated pocket in Elora N of River	Dark Grey Gelysolic	Fine sand and silt loam	Poor
Donnybrook Sandy Loam	Isolated pocket E of Salem	Grey-Brown Podzolic	Gravel	Good
Harriston Loam	Most of Fergus, central Salem	Grey-Brown Podzolic	Loam till	Good
Hillsburg Fine Sandy Loam	E of Fergus, N of Grand River	Grey-Brown Podzolic	Fine to medium sand	Good
Listowel Loam	Isolated pocket in Salem and Elora, some of S. Fergus	Grey-Brown Podzolic	Loam till	Imperfect
Muck	West of Salem	Organic matter		Very Poor
Parkhill Loam	Isolated crescent W of Fergus	Grey-Brown Podzolic	Loam till	Imperfect
Perth Loam	Pocket in NE Fergus	Grey-Brown Podzolic	Clay loam till	Imperfect

Whenever and wherever possible, the tree species to be planted should be matched with the soil type that best suits its requirements. A map of the spatial distribution of soil types in Centre Wellington is available from Agriculture and Agri-Food Canada, from Wellington County, or from Neighbourwoods.

Given that Centre Wellington has undergone urban development and expansion since the original soil survey was conducted in 1963, it is likely that soil conditions in the urban forest will not necessarily match those outlined in available maps and soil type surveys. Therefore, an easy way to determine basic soil structure is needed, and is outlined in Table 7. Soil type should always be determined prior to tree planting to ensure that the species slated for planting is suited to the planting space. Failure to ensure this compatibility represents a potential waste of limited capital resources, as trees planted in unsuitable soil are unlikely to experience optimal growth and chances of survival.

⁶ Available at: <http://sis.agr.gc.ca/cansis/publications/on/on35/intro.html>.

Table 7: Guide to determining soil type. Adapted from Ferguson Forest Centre.

Soil Texture	Visual Appearance	Reaction when squeezed in the hand		Ability to form a ribbon
		Dry Soil	Moist Soil	
Sand soils	Granular with easily detectable particles	Will not form a cast, or cast easily falls apart	Forms a cast that crumbles easily	Cannot form a ribbon
Loam soils	Low to moderately granular; Can form clumps/ clods when dry	Forms a cast that can be handled relatively easily	Forms a cast that can be easily handled	Pure loam cannot form a ribbon; Loam with more silt and clay will form a fragile ribbon
Clay soils	Fine texture with very few large particles; When dry, forms hard clumps	Forms a cast that can be handled freely	Forms a cast that can be worked and is cohesive	Forms a long, flexible ribbon

Soil drainage should also be assessed to inform species selection. Drainage is typically influenced by soil texture – soil with finer particles will generally hold water better than other soils. Soil drainage can be classified into four categories:

- **Well drained (Good)** – rapid drainage, no pooling of water on surface
- **Moderately drained (Moderate)** – occasional, brief pooling
- **Imperfectly drained (Imperfect)** – water pools, longer during wet periods
- **Poorly drained (Poor)** – water drains slowly, soil appears wet year-round

Drainage can be assessed with relative ease by a sample percolation test⁷, and suitable species should be selected for the soil type and drainage characteristics of the site.

3f. Planting and Watering Guidelines

Trees should be planted in accordance with generally-accepted guidelines. Neighbourwoods and the Elora Centre for Environmental Excellence have published a comprehensive guide to proper tree planting methodology. See the Landscape Standards of the Landscape Ontario Horticultural Trades Association for further information regarding proper planting procedures.⁸ Trees should be selected to meet the variety of criteria discussed in previous sections, and future potential tree size and shape must be taken into account. Every tree should be planted in a space where it has the greatest chance of achieving its inherent genetic potential for size, shape and vigour.⁹

All trees planted by a contractor on behalf of Public Works should include a minimum 2-year warranty and guaranteed aftercare period, as recommended by McGauley et al.

⁷ See: <http://www.extension.umn.edu/distribution/naturalresources/DD0583.html>

⁸ Available at: http://www.landscapeontario.com/attach/1134078236.Chapter_6_-_Plants_and_Planting.doc

⁹ For sizing guidelines, see: <http://www.arborday.org/trees/rightTreeAndPlace/size.cfm>

(2000). Shortly prior or upon termination of this warranty period, Town staff or designates (e.g. tree advocacy groups such as Neighbourwoods) should inspect the tree to determine if warranty conditions have been sufficiently met, or if a refund or replacement tree should be provided. Aftercare should then be provided according to the standards set by the Landscape Ontario Horticultural Trades Association,¹⁰ and in accordance with the designation of responsibilities recommended in Section 2f.

3g. Nursery stock procurement

High-quality nursery stock in adequate quantities is essential to successful tree establishment. It would be prudent to establish a long-term stock procurement strategy, part of which would be an agreement with one or more local nurseries to produce the requested stock well in advance of planting. The advance time will depend upon the desired stock size, and should be checked with the nursery. A strategic nursery stock procurement plan will allow Centre Wellington to effectively determine the future structure of its urban forest and effectively promote biological and structural diversity.

4. Spatial Considerations for Tree Establishment

Attention must be given to spatial considerations when establishing new trees in Centre Wellington. The previous sections have provided general guidelines for selecting street and backyard trees, but other variables may need to be taken into account to ensure the right tree is planted in the right space, in the right part of the urban area.

These may include:

- **Existing areas of relative species or age uniformity**
- **The spatial distribution of pervious and impervious areas**
- **Tree stocking**
- **New developments and future road widening**
- **Extensively managed areas (e.g. woodlots, trails, greenways, etc.)**
- **Access to and analysis of geospatial data**

¹⁰ Available at: http://www.landscapeontario.com/attach/1134078407.Chapter_17_-_Establishment_Maintenance.doc.

4a. Impervious and Pervious Areas

According to data from the Ontario Ministry of Natural Resources (2005), digitized from 2002 satellite data, the built-up areas of Salem, Elora and Fergus total 1192.40 hectares. Of this area, 943 ha, or 79%, are classified as impervious surface, while the remaining 249 ha, or 21%, are classified as pervious. Figure 9 presents a map of pervious and impervious surfaces in the Plan area. Impervious surfaces are those which do not allow for the absorption or permeation of water, and typically include constructed surfaces such as sidewalks, roadways or rooftops. Soils compacted by urban development are also highly impervious. Conversely, pervious surfaces include “green” areas such as lawns or forest cover, or other surfaces which more readily allow for the through-flow of water. Impervious surfaces may contribute to the pollution of groundwater (Arnold and Gibbons, 1996), and divert rainwater flows away from tree roots. Furthermore, many such surfaces directly contribute to the well-documented “urban heat island” effect (Landsberg, 1981).

Impervious surfaces present a dilemma for tree establishment planning. On one hand, most trees will likely fare more poorly due to higher temperatures and lower availability of water when established in imperviously-surfaced areas. On the other hand, their presence will help reduce the heating effect of low-albedo surfaces through processes such as evapotranspiration and shading (Akbari et al., 2001), thereby potentially providing greater net benefits than trees planted in pervious areas.

It is recommended that, when planting in areas with impervious surfaces (see Figure 9) extra care be given to selecting appropriate species and evaluating site characteristics such as soil texture, type and drainage.

Ultimately, increasing pervious surface cover in Centre Wellington should be a strategic objective for Township planning staff. However, suggesting means to implement such design is beyond the scope of this Plan. Rather, individual planting sites should be selected to provide good water infiltration, or improved to facilitate it.

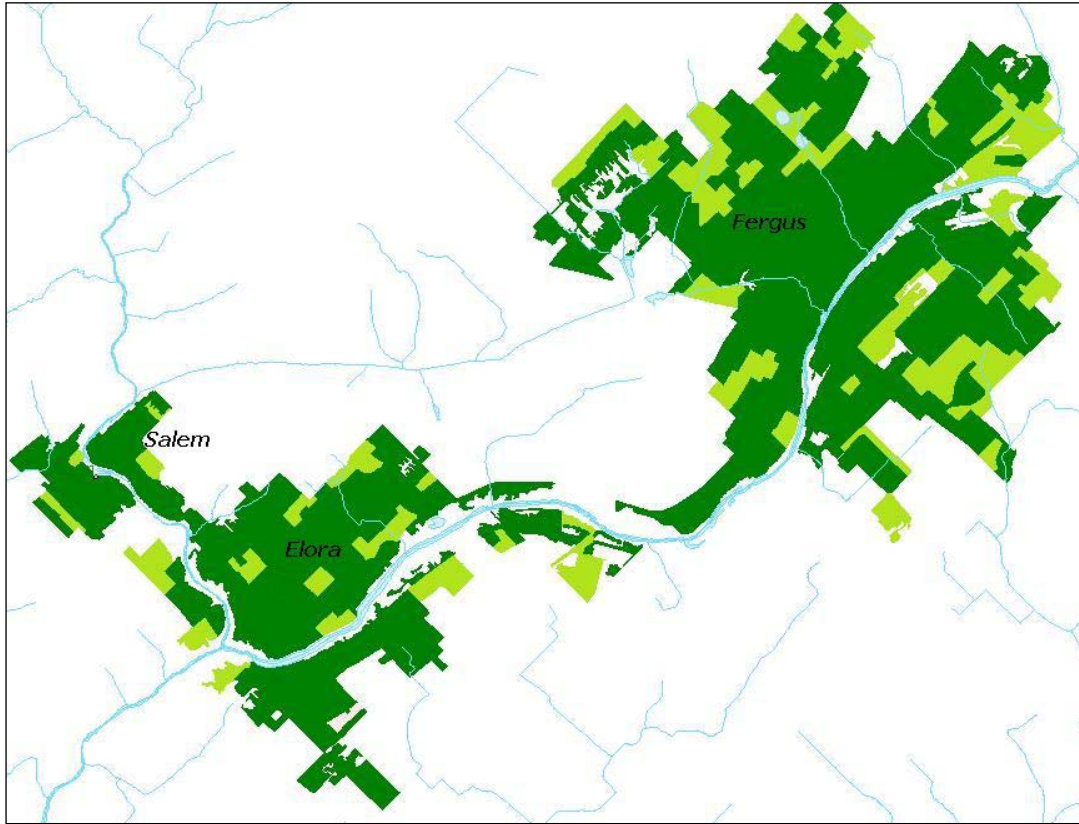


Figure 9: Impervious (dark green) and pervious (light green) surfaces in urban Centre Wellington. From MNR (2005).

4b. New Developments and Future Road Widening

New Developments

Centre Wellington is projected to experience population growth of almost 30% by 2022. This influx of inhabitants will necessitate the development of new housing, predominantly in subdivisions occupying former farm fields.¹¹ In Elora and Salem, draft approval exists for the development of 479 new lots, while a further 11 are proposed. In Fergus, 283 new lots have draft approval, and a further 202 are currently proposed. Given the previous land use on all of these lots was agriculture, tree cover here is almost non-existent, and tree establishment must be a priority. Centre Wellington's Tree Policy provides a comprehensive guideline for planting in new subdivisions and reconstructed developments, and should be adhered to.

¹¹ From Centre Wellington Online GIS, available at: <http://maps.centrewellington.ca/maps/Default.aspx>

Particular attention should be paid to species selection – the Tree Policy recognized that “a variety of tree species on each street is essential.” While it is impossible to recommend exactly how many of a particular species should be planted, and where, without a current inventory, Santamour’s (1990) 10% species, 20% genus and 30% family guidelines should be followed. Furthermore, Public Works must be willing to approve the planting of additional species beyond those approved in the Tree Policy (Section 3a.)

Road Widening

Public Works, residents and tree advocacy groups should be aware of proposed road widening projects within Centre Wellington, as outlined in Table 13 of the Wellington County Official Plan.¹² Road widening presents a significant challenge to the survival of existing or newly-established trees, especially if those trees are currently within boundaries of the proposed widened road, from which they will have to be removed. Therefore, new tree establishment should not take place alongside the roads proposed for widening without first contacting the County for a road widening project schedule.

4c. Tree Stocking

One component of the tree inventory for the Plan area will be a list of available planting spaces. Upon completion of the initial inventory, it will be possible for the community to decide if achieving and maintaining a minimum stocking level is an appropriate objective. Nowak and O’Connor (2001) recommend a 60% stocking level of all available planting spaces as a strategic goal for the city of Syracuse, NY. Full, 100 percent stocking of street trees is commonly defined as one tree per 15 metres. Percent street-tree stocking is calculated as:

$$FSD/(CD/T) \times 100$$

where FSD = full stocking distance (15 m); CD = curb or roadside distance (m); and T = number of trees.

¹² Available at: http://www.county.wellington.on.ca/document_download.aspx?id=2216.

4c. Extensively-managed Areas

While the management of urban forest resources generally calls for intensive management, some parts of urban Centre Wellington are densely wooded, and call for a different type of management. These areas, which include trailways, public and private woodlots, and natural areas such as the forests lining the Grand River and Irvine Creek. In some areas, tree establishment should be left to natural means, while in others it must be planned on a case-by-case basis in concert with the various local stakeholder groups who hold stewardship over these lands. These plantings may include establishing trees along former railways, planting along established trails, or establishing living snow fences along roadways. Recommending a strategic planting direction for these types of plantings in extensively-managed areas is beyond the scope of the Plan.

4d. Access to and analysis of geospatial data

Geospatial data is widely available for use by the Township through several sources. The Township itself maintains an online geographic information system (GIS) database,¹³ which is very useful for providing data about municipal planning, woodlot locations and other environmental data, as well as high-quality orthophotos. Wellington County also provides a free online GIS service, with similar attributes.¹⁴ The Grand River Conservation Authority provides highly-detailed environmental data, including soil and hydrological conditions, as well as utility and trail maps, through the free, online Grand River Information Network GIS system.¹⁵ This GIS provides users with more advanced functions than the municipal and county GIS services, and allows for data downloading for importation into more advanced console-based GIS utilities. Several free, open-source GIS software packages are available,¹⁶ and it is recommended that users of this plan without access to GIS analysis services provided by the Township of Centre Wellington make use of these resources to improve their knowledge of the spatial considerations outlined in the Tree Establishment Plan. Upon completion of the tree inventory, GIS

¹³ Available at <http://maps.centrewellington.ca/maps>.

¹⁴ Available at <http://www.wellington.ca>

¹⁵ Available at <http://www.grandriver.ca>

¹⁶ We recommend Quantum GIS, available at <http://www.qgis.org/> for its user-friendly interface and low resource requirements.

analysis will allow the incorporation of tree location vector and polygon data into improved tree establishment planning.

3.4.4 Recommendation

The following 18 recommendations for tree establishment on public and/or private land should be implemented by the appropriate parties in urban Centre Wellington, in order to ensure the provision of ongoing benefits derived from a sustainable urban forest. Note that “the Township” means all parties operating under this strategic plan, unless otherwise specified.

6) All Township of Centre Wellington residents *should recognize that above- and below-ground tree habitat is a key determinant of urban forest longevity and function*, and that good habitat includes good soil quality and quantity and freedom from interference with competition (utilities, turfgrass, etc.). **See Section 1a. through 1c. of Background.**

7) Trees should be planted in *soils of optimum quality* (i.e. medium-textured soils such as loam, sandy-clay loam, and silt-loam) whenever and wherever feasible. **See Section 1b. of Background and 3e. of the Tree Establishment Plan.**

8) All trees being planted should be given an *adequate soil volume* of 0.6m³ of good-quality soil for every 1m² of potential crown projection area, whenever and wherever feasible. **See Background.**

9) The Township *should focus on increasing leaf area*, or at minimum ensuring no net loss of leaf area, rather than increasing total canopy cover, as the primary objective for urban forest management. **See Section 2b.**

10) The Township *should clearly delineate responsibilities* for tree planting and maintenance between the Public Works department (or other municipal government departments), community tree advocacy groups, and residents. The approach should be open to collaboration and cooperation. **See Section 2f.**

11) The Township should require that all trees planted by third-party contractors come with a *minimum 2-year warranty* and aftercare period. **See Section 3f.**

12) The Township should *consider revising its Tree Policy* to include more species on its list of approved trees, and to exclude Norway maple (*Acer platanoides*) and temporarily exclude ash (*Fraxinus* spp.) from the list. **See Section 3a.**

13) The Township should *focus its tree establishment efforts on native tree species*, but should not exclude non-native species based solely on their provenance. **See Section 3b.**

- 14) The Township should *ensure an adequate level of tree diversity* through planting no more than 10% of one species, 20% of one genus, and 30% of one family of tree. Given the overrepresentation of the genus *Acer* – maple, the Township should focus on planting other genera except in the case of replacement. **See Section 3c.**
- 15) The Township *should proceed proactively to mitigate the effects of future climate change*, within reasonable limits, by establishing limited species suitability trials of more drought- and heat-tolerant species. **See Section 3c.**
- 16) The Township should ensure *all new plantings are matched with the appropriate site and soil type*. **See Section 3e.**
- 17) All new plantings should be conducted and maintained in accordance with the *standards of the Landscape Ontario Horticultural Trades Association*. **See Section 3f.**
- 18) The Township should *establish a long-term strategic nursery stock procurement agreement* with one or more local nurseries. **See Section 3g.**
- 19) The Township planning staff should strive to *increase the proportion of pervious versus impervious surface* cover in urban Centre Wellington. **See Section 4a.**
- 20) *No new plantings should be carried out on proposed road widenings* without prior consultation with the County and Public Works. **See Section 4b.**
- 21) The Township should consider adopting *minimum stocking levels* for street tree plantings. **See Section 4c.**
- 22) All stakeholder groups without access to GIS analysis services *should employ free, open-source GIS software* to improve their knowledge of environmental conditions and infrastructure in Centre Wellington. **See Section 4d.**
- 23) All new plantings **should be recorded in the inventory.**

3.5 Pruning Plan

As Centre Wellington's Tree Policy notes pruning plans are needed to prevent damage to human lives and property, and to preserve healthy aesthetically pleasing trees (Tree Policy, 2002). Perhaps the most common factors that determine pruning priorities are residential requests and emergency pruning. This can be classified as reactive management, most common in jurisdictions where no planning exists (UFI Inc. and Kenney 2008, UFI Inc. and Dougan and Associates 2007). This appears to be the case for Centre Wellington. Although the Tree Policy outlines that mature trees should be cut on a 5 year cycle and newly planted trees on a two year cycle most of the pruning is reactive

(Ken Elder, personal communication). Scheduling pruning based on these factors may actually increase liability for damages because many hazards remain unidentified until a failure occurs. This category may also include task pruning, which encompasses pruning for utility line clearing, maintenance of sightlines for vehicles and for pedestrian passage along sidewalks.

3.5.1 Transition from Reactive Pruning to a Proactive Approach

Although the first steps towards a more proactive approach have been taken in Centre Wellington with the Tree Policy (2002) there is a need within the 20-year SUFMP timeline to improve to a more defined planning approach and for this planning approach to be incorporated into the Township's policy. Tree health can be greatly increased by regular pruning, especially when the tree is young. Immature trees that are left unpruned can develop many structural problems such as weak branch structure, crossing branches and co-dominant leaders (International Society of Arboriculture 2005). This matter is well addressed in the Township's Tree Policy in terms of structural benefits as well as disease prevention benefits. This indicates that the Township is moving from a reactive approach to a more proactive one. If trees are healthy to begin with, because of preventative pruning, this in turn will reduce the necessity of more expensive and often intrusive corrective pruning during the normal life of the tree. If regular pruning is planned in a systematic manner, crews and equipment can work much more efficiently than if pruning is only done by request. When crews examine the urban forest in a block pattern for possible hazards and tree health problems, there is a reduction in citizen calls for emergency pruning (Luley et al., 2002) as well as reductions in storm damage and risk (Town of Banff 2008). Additionally, the crews often find problems that would not have been reported by residents (Halstead, 1999). The block pruning method can also focus on certain species that may require more attention. With block pruning the urban forest is maintained at a greater safety level, thereby decreasing liability for the municipality (McGauley et al. 2000). Regular pruning will result in an increase in the overall value of the forest due to the City demonstrating "reasonable care" in maintaining its urban forest; value will also increase because actual time and money spend maintaining trees will decline as problems are addressed before they become costly (City

of Walla Walla 2001). Systematic routine pruning is important for a number of reasons: it decreases the cost per tree pruned; reduces requests for special, non-routine services; improves safety and decreases tree liability; reduces insect and disease problems; improves tree condition and tree value; increases property value; and enhances public image (Town of Banff 2008).

Although the Tree Policy document outlines a 5-year cycle should be implemented this is not always the case. Most of the pruning is done after calls from citizens or when Centre Wellington Hydro comes in to do its line clearing (Ken Elder, personal communication). Reactive pruning such as this is not the most efficient or effective way to maintain tree health, it is recommended that Centre Wellington shift towards a more proactive approach to enhance the health of the urban forest, including both street trees and those located in parks. Most of the budget (\$140,000 for 2008) has gone to tree removal in recent years as many old Maples are declining due to drought conditions over the last seven years (Ken Elder, personal communication). In order for Centre Wellington to have an effective tree pruning program in needs to build its capacity to prune all its' trees in a systematic manner and be able to respond to emergency pruning and safety concerns in a timely manner.

Centre Wellington is aware that many of its trees are aging, however there are many young trees located in new development areas as well as from an increased planting effort. The Tree Policy (2002) addresses the fact that differently aged trees have different pruning needs. It addresses the need for young trees to be pruned on a shorter cycle at the beginning to address structural concerns.

In practice, trees at different stages of their development will receive different standards for frequency and extent of care (UFI Inc. and Kenney 2008). These stages are:

- Juvenile (e.g. recently established, small trees which can easily be pruned (training) from the ground using secateurs (<5m).
- Intermediate trees are those that can be pruned from the ground using pole pruners (5-15m).
- Mature trees are those that must be pruned by climbing or from a bucket truck (>15m).

As it is already outlined in the Tree Policy (2002) there should be a 5-year pruning cycle for all the intermediate and mature trees. Juvenile trees should be pruned 2 years after planting and then included in the 5-year pruning cycle. This will be consistent with the 5-year management plans for the SUFMP.

3.5.2 Recommendations

24) Over the twenty-year SUFMP the Township should establish a pruning cycle and a grid pruning program for street and park. Trees would be pruned in a 5-year cycle for all intermediate and mature trees and a 3-year cycle for all juvenile trees. Line clearing operations should be consistent with these pruning cycles. Through this time period pruning will shift from a reactive to a proactive maintenance approach.

25) Trees should be inspected in a systematic manner so that no problem is missed during regular pruning. All pruning activities should follow the ANSI A-300 Standards for Pruning, ISA Best Management Practices: Tree Pruning and the Urban Forestry Best Management Practices for Ontario Municipalities for clearance distances (McGauley 2000).

26) The Township should provide citizens with more advanced notice before pruning activities are carried out and inform the public of intent to have a 5-year pruning cycle and what that entails.

27) The Township should hire a certified arborist to develop the grid-pruning cycle after the inventory is complete. This person should also supervise and monitor pruning activities being carried out; budget permitting. Even though standards will be put into place there should still be ongoing supervision of contractors by either designated Township officials with experience and qualifications, or by an outside consultant, preferably an experienced International Society of Arboriculture Board Certified Master Arborist. The best way to proceed would be to have the an Arborist familiar with the Township write the specifications and prescribe treatment areas for pruning and other maintenance areas, supervise the contract, and inspect for quality throughout the duration of the contracts (Town of Banff 2008).

28) To ensure that the pruning cycles for young and mature trees are implemented there must be an increase in its capacity. The township will have to increase its capacity once the inventory and a tree risk assessment plan are carried out. It is recommended that more crews should be hired in order to proceed with the first grid-pruning cycle. Crews will follow the standards developed by the Township's arborist.

29) The Township should establish more collaborative and cooperative approach with Tree Stewards from the ECEE. It is recommended that Tree Stewards can focus on pruning activities of newly planted and young trees while Public Works is responsible for pruning of mature trees and emergency pruning.

3.6 *Tree Risk Management Plan and Hazard Abatement*

3.6.1 Tree Risk Management

Liability is a major concern of urban forest managers. Certain conditions in trees increase the likelihood of a tree's structural failure, in whole or in part. Tree risk management should include the inspection of tree defects, and the prevention and abatement of hazards. A "hazard tree" refers to "a tree that has structural defects in the roots, stem, or branches that may cause the tree or tree part to fail, where such failure may cause property damage or personal injury" (Pokorny 2003).

Using this definition, not every tree with a defect is hazardous. It is useful to classify tree defects into high, medium, or low risk levels, which can help determine how soon a tree will require corrective actions (Pokorny 2003). A tree rated "high risk" may require immediate attention; a tree with a low risk rating is a lower priority and may be addressed during regular maintenance pruning. It is therefore critical to determine the threshold of acceptable risk, which would require an understanding of tree biology but is equally dependent on public perception and the policies and objectives of the liable parties (Pokorny 2003).

Proper management should include hazard prevention as well as abatement. With proper planting and maintenance combined with regular pruning and inspections, there is less chance for weaknesses or defects to become hazardous. Tree defects and risk levels should be assessed through the inventory and inventory data analysis. High risk trees are a high priority in the early stages of the management plan. Currently, there is no systematic inspection process to identify trees at risk largely due to the lack of staff and resources. The identification of potential hazard trees are usually through volunteers, and, due to the high removal costs, trees are removed by Public Works staff only when inevitable (Ellis pers. comm.). A detailed tree inventory provides the basis for a comprehensive risk management plan that can better address the liability issue.

The current Township Tree Policy guidelines are a good starting point for a tree risk management plan, but several improvements should be incorporated into future operations. These include:

- Complete the tree inventory, with continual updates during cyclical pruning and any other management activities
- Categorize low-, medium-, high-risk, and hazard trees based on attributes used in the inventory protocols, such as dead branches or split trunks
- Query the inventory database to determine the numbers and locations of trees of different risk categories
- Determine an acceptable level of risk with input from Public Works staff and decision-makers such as city managers, city council, mayor, Parks and Recreation, and others
- Determine the staff and resources available to address tree risk issues
- Prioritize trees for maintenance or removal by risk rating and location (UFI Inc. and Kenney 2008)

3.6.2 Assessing Tree Risk

Based on the NeighbourWoods© manual (Green-up, undated), the attributes of primary interest for risk assessment are:

- **Large Dead or Broken Branches or Stubs.** Dead branches or stubs greater than 7 cm in diameter are considered. Evaluation is based on the approximate size and number of dead branches, limbs, or stubs. The most severe case (class 3) is when “the tree has one or more dead or broken branches or stubs which is (or was) a main branch (a scaffold branch. i.e. the diameter is more than 1/2 of the diameter of the main stem at the point of attachment).
- **Poor Branch attachment (V- Shaped Fork).** Poor attachment of branches or co-dominant stems (two or more stems growing at the same rate, from more or less the same position) may develop into included bark, and when they increase in size, they may result in cracks or even split from the trunk (class 3).
- **Lean.** Serious trunk lean, except in certain small trees or tall shrubs, can result in structural problems and may cause trees to fail, especially when the lean is greater than 15° with some soil cracking and/or uprooting (class 3).
- **Rot/Cavity.** In the advanced stages of decay, wood is consumed by fungi and insects resulting in rot and/or cavities. Older trees occasionally have large cavities or rot in

their trunks and main branches, which indicate serious decay and structural problems.

- **Cracks.** A crack is a “deep split through the bark, extending into the wood of the tree”. Cracks, especially in the stem, are considered the number one hazardous defect because they indicate the structural weakness of a tree.

This initial assessment gathered from the inventory will identify potential risk or hazard trees to be inspected in more detail by staff specifically trained in risk assessment. This then determines whether further testing or inspection is required or if immediate actions should be taken. The database user can also query it later for tree risk information. Trees with a score of 3 on poor branch attachment, lean, or rots should be a top priority for tree risk management.

Risk trees identified in the inventory need to be monitored. Trees with low and medium risks will not be immediately removed, but need to be inspected regularly. Dedicated staff will be required for tree inspections, and each tree should be re-inspected at least once every five years. As outlined in the pruning plan, pruning crews will be systematically working through blocks and when they are assessing pruning needs they can also be evaluating risks. Simple hazard abatement may be addressed through pruning. Any new risks should be added to the database as part of inventory maintenance.

3.6.3 Hazard Abatement

Once a hazardous defect has developed and been identified, there are a variety of approaches to managing and mitigating the hazard. In general, serious defects are more likely to be found in large trees than in small trees. Recognizing that large trees with large canopies provide exponentially more benefits than small trees, and that the Township has numerous heritage trees, efforts should be made to maintain large trees through techniques such as cabling and corrective pruning rather than removing them. These techniques can extend the life span of the old trees while new trees can be planted to replace them (UFI Inc. and Kenney 2008).

Some of the most common approaches for hazard abatement are (UFI Inc. and Kenney 2008):

1. **Remove dead wood** - Large pieces of dead or broken branches over a sidewalk, road, front yard, trail or other high-use area should be taken out of the trees before they fall down.

2. **Cabling** - Cabling of trees can be used to stabilize parts of the crown that could be prone to failure, mostly due to split trunks or large dead wood that cannot be easily removed. There are two types of cabling systems: static systems, generally installed where a crack already exists, and dynamic systems, used where the potential for failure exists under extreme conditions. Although cables aim to restrict the movement of tree crowns, they are usually stretchable within safe limits. Trees will thus be able to respond to the movement by building new wood and strength in the weak areas.

Cabling systems made of synthetic ropes with high breaking strengths are commonly available in North America. The cables will stretch (10% elongation) and can be fitted with shock absorbers to help buffer the impacts of wind events. The cables require no drilling for hardware to be installed and can therefore be used in even in some decayed wood. The cables may also be able to catch smaller parts that break off and prevent them from falling down to the ground. Experienced arborists should be hired to inspect for the needs of cabling and to install cabling systems.

Trees that have been cabled require more frequent inspection. Generally, these trees should be inspected once a year for the integrity of the cabling system and the risk level of the tree. Some inspections can be done from the ground, but as time passes, an arborist should inspect the anchor points and any changes in the tree's growth from within the tree (Pokhorn 2003).

3. **Crown reductions** - The aim of crown reductions is to reduce the crown weight by shortening the height of tall crowns or the length of long horizontal limbs. By reducing the length or the height, the safety of the pruned part will be increased. Crown reduction cuts should be made back to a healthy side branch that is at least one-third the diameter of the reduced part, if possible. For many older trees this is the last maintenance that can be

performed before the tree is finally removed. Crown reductions are often undertaken in conjunction with cabling.

4. **Tree removal** - if there is no corrective action that can be taken then the trees will have to be removed. When trees are removed, they should be replaced as outlined in the Tree Establishment Plan. If a tree is not planted in the same spot, restoration activities (stumping and soiling) should be performed.

3.6.4 Recommendations

30) The Township should undertake *inspections of risk trees* in the street tree population, and along nature trails.

31) The Township should *determine tree risk categories and acceptable risk levels*, and *develop an inspection protocol* based on established priorities and the data from the Tree Inventory.

32) The Township should *provide the staff and equipment resources* required to implement hazard abatement strategies.

33) The Township should *develop a tree cabling policy* that includes the provision of an inspection cycle. This policy will incorporate risk and heritage values.

3.7 Tree Protection Plan

Tree protection is an important part of urban forestry. It involves components such as bylaws, guidelines and policies related to protecting trees from injury caused by construction activities, hydro/utility practices, or even damaging practices by residents (topping etc.). The purpose of these components is to prevent damage to trees, instead of having to deal with damaged trees after the fact (UFI and Kenney 2007). Tree protection plans can also involve a strategy for tree replacement (UFI and Kenney 2007).

3.7.1 Tree Protection in Centre Wellington

(i) Woodlots

Under the Municipality Act (2001), all municipalities in Ontario have the power to enact tree cutting by-laws that protect woodlot trees, as well as to enact by-laws that protect individual trees. Wellington County is in the process of forming a by-law under this Act,

called the 'Forest Conservation By-law' (Wellington County 2008). This draft by-law includes the prohibition that: 'no person shall cause or permit the injuring or destruction of a tree growing in a woodland....' unless exempt by certain cases specified within the by-law (Wellington County 2008). Examples of exemptions are Christmas tree plantations, hydro work, surveys, roadways, where a building permit has been issued, and trees for a landowner's use (Wellington County 2008). (For the purposes of the Forest Conservation By-law, a woodland is 2 acres (0.8 hectares) or greater in size) (Wellington County 2008).

The by-law is meant to replace the tree by-law # 3961-94: 'a by-law to Restrict and Regulate the Destruction of Trees by cutting, burning or other means' (Wellington County 2008). This by-law was enacted in 1994 by the County of Wellington (which has the authority to do so under the *Trees Act*) and it is currently in force. The by-law describes tree cutting restrictions specific to different tree species, and regulations protecting young trees from damage. It also lists the situations in which trees may be destroyed. For example, trees may be destroyed to prevent disease/insects from spreading to other trees, or to improve the health and development of other trees in the stand (Wellington County 2008). Under this by-law a landowner or anyone acting on their behalf must notify an officer of the County Clerk to ensure the provision of the by-law. The penalty for breaking the by-law is a fine of up to \$5,000 or imprisonment for up to three months, or both (Wellington County 2008).

The new Forest Conservation By-law contains some key improvements over the previous one, for example:

- (i) The new by-law will employ a permitting system, not a notice of intent. This means that a harvest cannot occur until a permit is issued by the County.
- (ii) Under the current by-law, trees greater than 16 inches in diameter can be cut. The new by-law increases this to 18 inches in order to achieve a better level of forest health

(iii) The new by-law allows Tree Conservation Officers to immediately stop a logging or clearing operation via 'Orders to Discontinue activity'. Under the current by-law, the County must get a court injunction to stop the work.

(iv) Short Form Ticketable Offences: currently, the only remedy for a breach of the tree by-law is through the laying of charges and going to court. The Municipal Act allows tree by-laws to include short form ticketable offences on the spot.

Wellington County has two Tree Conservation Officers who report to the Planning Department (Wellington County 2008). Land owners wishing to cut trees notifies the County and these officers then makes a site visit to see if the by-law is being upheld (Wellington County 2008).

(ii) Protection of individual trees

The municipality of Centre Wellington is working with the Elora Centre for Environmental Excellence (ECEE) to protect heritage trees (ECEE 2008). The municipality may propose a by-law in relation to this in the future (ECEE 2008). In this scenario, heritage trees that become a hazard may still be removed (ECEE 2008).

Apart from heritage trees, there is no policy protecting trees on private residential property in Centre Wellington. One way to address this gap is through education. Damage to trees can often be prevented by educating tree owners or municipal departments involved in tree removals/replacements on proper tree care. Creating a private-tree by-law can also achieve this protection. However, this would require resources (i.e. more law enforcement officers, arborists, etc.) that may be better spent on other protection measures.

Finally, Centre Wellington has few guidelines protecting individual trees from harm during construction activities (Centre of Wellington 2002). The document 'Municipal Standards for Tree Planting in New Developments' states that street reconstruction should be done in such a manner as to minimize the impact on existing trees. It also states

that new sidewalks should be constructed with interlocking brick to allow water to penetrate to roots (Centre of Wellington 2002).

The intent to minimize impacts on trees could be achieved by adopting a system of tree protection zones around construction sites. This involves putting up protective fencing around trees in accordance with the International Society of Arboriculture (ISA) standards and banning construction activities within these zones (City of Regina 2006). This will be especially important to the construction of the new planned subdivisions.

3.7.2 Recommendations

34) Manuals on proper tree care, including diagrams, should be developed and circulated to all relevant parties, following the lead of other municipalities (Toronto, Mississauga, etc.).

35) In order to maintain its present canopy cover, The Township should adopt a policy to replace one removed tree with a number of trees that will maintain a comparable total leaf area; within the limits of feasibility.

36) The Township should hire two additional officers to inspect and enforce its tree by-laws.

37) The Township should adopt and enforce a system of tree protection zones around construction sites.

3.8 Invasive Species Plan

Part of the vision of Elora is to have a healthy, urban forest with high canopy cover. Invasive species can impede the fulfillment of this vision. An invasive species is a species occurring, as a result of human activities, beyond its accepted normal distribution and which threatens valued environmental, agricultural or other social resources by the damage it causes (Gurevitch and Padilla 2004). There are several invasive species in Ontario which have caused damage to forests – both urban and non-urban (Poland and McCullough 2006). Well known examples are the Asian Longhorned Beetle (*Anoplophora glabripennis*), the European Gypsy Moth (*Lymantria dispar*), the Emerald Ash Borer (*Agrilus planipennis*) and Dutch Elm Disease (Poland and McCullough 2006). Together, they kill a wide range of species such as maple, oak and ash (Poland

and McCullough 2006). Elora Township has a mixture of these vulnerable species so invasive species are a definite threat to its urban forest – in fact, Dutch Elm disease has already been found in the community (Environment Buzz 2008).

Apart from the insect and fungal threats mentioned above, invasive plants can also be a problem in the Grand River natural areas and woodlots of Centre Wellington. These species are typically fast growing, prolific seeding and aggressively competitive with native species (Rebbeck et al 2005). Examples in Ontario are Norway Maple (*Acer platanoides*), European buckthorn (*Rhamnus cathartica*) and dog-strangling vine (*Cynanchum rossicum*). Once established in a natural area these species are often difficult to manage and can permanently alter ecosystem composition and function (UFU and Kenney 2007).

Thus invasive species monitoring and management needs to be an integral component of Centre Wellington's UFMP. Efforts under the Plan can be coordinated, when appropriate, with the Canadian Food Inspection Agency, the Canadian Forest Service, the Ontario Ministry of Natural Resources, and other area municipalities (UFU and Kenney 2007).

3.8.1 Recommendations

38) Centre Wellington needs to develop a comprehensive plan to deal with invasive species. This plan should include:

- (v) **Policies related to invasive species planting:** For example, Centre Wellington's current tree policy does not allow Norway Maple (*Acer platinoides*) to be planted in proximity of natural areas (Centre Wellington Tree Policy). This list should be expanded to include other invasives. Planting of Norway Maple should also be eliminated.
- (vi) **Invasive species surveys:** Surveys for invasives such as Gypsy Moth Egg Mass and Emerald Ash Borer should be regularly conducted. If they are found, Centre Wellington authorities as well as the Ontario Ministry of Natural resources must be notified in order to prevent their spread. The municipality can also carry out the steps necessary for their removal. These range from having to cut down the entire tree for

Emerald Ash borer or Asia long horn beetle, to removing egg masses and destroying caterpillars and adult moths where possible for the Gypsy Moth (City of Toronto 2008a, City of Toronto 2008b).

- (vii) ***Ensure a diverse, healthy urban forest:*** as international trade accelerates, the number of introduced species and hence the threat of invasive plants, insects, micro-organisms and animals, is continually increasing. It is thus essential to prevent attack by ensuring a healthy forest. This involves planting a mixture of different tree species on each street and maintaining a diverse age-class structure in the forest (Poland and McCullough 2006).
- (viii) ***Create a strategy to deal with Dutch Elm disease:*** the economic impact of this disease has been enormous in many municipalities, where the elm was often the main shade tree lining the streets. The potential impact of this species on Centre Wellington's forest is unknown due to the lack of a tree inventory. It is imperative to conduct an inventory for elm and regular surveys for the disease. An integrated control system aimed at removing and destroying trees or infected branches, reducing beetle populations and preventing or treating trees by injecting fungicides should also be implemented (Rioux 2003).

3.9 Public Engagement Plan

3.9.1 Public Education

Education is a vital part of the urban forest management planning. The urban forestry is largely unrecognized by both the public and administrators. For urban forest to be effective an educational program must be implemented. The Oakville and Guelph SUFMPs both indicate that educational materials have to be drafted and circulated throughout the community. They also suggest that schools are an effective starting point as children provide a way of reaching the entire household (UFI Inc. and Kenney 2008; UFI Inc. and Dougan and Associates, 2007). Flyers and pamphlets are other common methods used to inform the community about the plan.

Objectives and Goals:

1. To increase the community's awareness and knowledge about Centre Wellington's urban forest.
2. To further promote resident's interest in terms of Centre Wellington's urban forest protection and enhancement.
3. To involve residents in caring for the urban forest.

Current Municipal Programs that Contribute to Urban Forest Education

Centre Wellington has a number of community programs that contribute to its resident's education on the urban forest. The Elora Centre for Environmental Excellence (ECEE) has produced a booklet *Our Community Tree Guide* (ECEE, 2008) which has compiled information on Centre Wellington's tree resources and information for residents. It contains a list of groups working with aspects of the urban forest (ECEE, 2008). The booklet also provides a brief summary paragraph on what each group is involved in. Some of the groups mentioned in the booklet include: Centre Wellington's Department of Public Works; Department of Parks and Recreation; Elora Cataract Trailway Association; Elora and Salem Horticultural Society; Evergreen Foundation; Friends of the Grand; Grand River Arboretum; Fergus and District Horticultural Society; Grand River Conservation Authority; Greenlands Centre Wellington; Green Legacy; NeighbourWoods; and Greenspaces for Wellington. Many of these groups are working closely with school groups where kids volunteer their time to be a part of greening the municipality doing everything from growing trees from seed to helping at nurseries to planting the trees on the ground (Toni Ellis pers. comm.).

The ECEE also sponsors a Tree Steward program with the aim to "bring people together in Centre Wellington, who love trees and are willing to volunteer to help plant and nurture them in our urban areas" (ECEE, 2008). Tree Stewards help on community planting and pruning days, working in teams with other Tree Stewards. Furthermore, they are responsible for trees in an area, often near their home, and conduct an annual survey of tree health. They also have an educational role as they serve as a resource for tree

related questions in their neighbourhood and raising homeowners' awareness about their trees and providing an ideal opportunity to talk about good tree care practices. Tree Stewards leave behind "door hangers" indicating what work was done and what work the householders can/should do.

In order to protect and enhance the urban forest all residents should be aware and appreciate the benefits of the urban forest as well as protect the urban forest so it can grow in a sustainable manner. A workshop titled "Tree Action Plan" organized by the ECEE in November 2008 was held to bring together the various community groups as well as the municipality (both Centre Wellington and the County of Wellington). Throughout the meeting several attendees emphasized the need for public education and establishing a direct connection with the public in order to promote their programs and urban forest conservation and enhancement (workshop). Behavior towards components of the urban forest found on private land is very personal and mostly unrestricted with the exception of the Private Tree By-law. However, repercussions of individual actions may affect the larger community in negative ways, possibly threatening the sustainability of the forest. Since individual landowners own approximately 80% of the urban forest (Kenney 2003), it is imperative that Oakville's urban forest education strategy contributes to real behavioural change towards the forest.

When pruning will be taking place near a residents' home, they receive a letter regarding tree pruning prior to the day the pruning will be done. When a block pruning approach is adopted by Centre Wellington, each resident in the relevant blocks should receive notice of pruning activity in advance of the scheduled day. The notice should be accompanied by a map to illustrate that their neighbourhood is pruned systematically once every cycle. This regularity and advance notice will also help to educate the Townships' residents about tree care needs and will be in conjunction with what Tree Stewards do in their neighbourhoods.

Increasing awareness and knowledge about the urban forest is necessary to encourage public interest and involvement in action plans. Current research reveals that the use of

media and printed materials are not always enough to inspire positive action (McKenzie-Mohr 2000; Wegelin and de Jong, 2000). In this respect Centre Wellington has provided its citizens with comprehensive information, however, in order to affect real change in society individuals need to see a direct connection between their own needs and benefits of changing their actions. They will then believe that the change is worthwhile and then would take steps towards changing their behavior (National Consumer Council, 2006; Wegelin and de Jong, 2000).

3.9.2 Recommendations:

39) The Township should continue private urban forest stewardship education program; Tree Stewards and try and expand the number of tree stewards.

40) The Township itself should provide more resources for citizens interested in any tree related matters; planting, tree care, pruning, etc.

41) Once the SUFMP is in place a copy should be provided on Centre Wellington's website to maintain transparency and enhance public involvement and communications.

42) The Township should continue with its community activities and try and coordinate a more collaborative approach as well as provide support to community groups involved in tree/woodlot issues

4. Budget

Significant investments must be made throughout the planning period to ensure sustainable urban forest management becomes a reality in Centre Wellington. The following section outlines a selection of important expected future expenditures which must be incorporated into municipal and community group budgets. The objective of this section is to prioritize and lay out what these expenditures will be and what parties should bear the financial responsibility for them. Table 8 presents the budget priorities for the strategic management plan. Expenditures are prioritized on a descending scale from 1-3. Note that "ongoing" means beginning in the first management plan phase and continuing throughout the planning horizon.

Table 8. Priorities for the Urban Forest Management Plan Budget.

Description of Expenditure	Priority	Responsibility/ Estimated Cost	Timing	Comments
<i>Inventory</i>				
Contracting volunteer trainer/coordinator	1	Municipal/volunteer / Cost depends on contract duration	During first management period	Trains volunteers on inventory protocol, coordinates sampling
Inventory equipment – Diameter and other sampling tools	1	Municipal/volunteer / Est. \$700	During first management period	Allows for effective undertaking of inventory
Inventory maintenance	1	Municipal / Cost depends on implementation	Ongoing	May be contracted or additional task for pruning crews if trained
<i>Tree Establishment</i>				
Calculating leaf area for all replaced and replacement trees	1	Municipal/volunteer / No additional cost	Ongoing	Results to be put into inventory database and replacement planning
Planting for species diversity and climate change	1	Municipal/volunteer / Between \$0 and several hundred per tree	Ongoing	Cost varies by number/source of trees planted and who plants
Review of Tree Policy	2	Municipal / No additional cost	2009	Must be reviewed, edited and passed by council
Testing soil and providing adequate soil prior to planting	1	Municipal/volunteer / Between \$0 and ~\$100 per tree	Ongoing	Testing no cost. May vary if high-quality soil needs to be provided in planting pit
Determining an adequate tree stocking ratio	2/3	Municipal/volunteer / No additional cost	During first management period	Requires collaboration between parties to determine desired ratio
Using GIS to support planting planning	2	Municipal/volunteer, Time cost for GIS coordinator depends on demand	Ongoing	Free software available for volunteer groups, learning time may be a cost
<i>Pruning Plan</i>				
Hire / sub-contract more crews to clear backlog	1	Municipal / part of est. \$180,000 tree removal budget	During first management period	Necessary to facilitate improved pruning cycle

Description of Expenditure	Priority	Responsibility/ Estimated Cost	Timing	Comments
Hire or contract a forester / arborist to establish a grid pruning cycle and monitor activities	2	Municipal/ Cost will vary by contract	During first management period	Potentially on Contract basis for initial establishment, monitoring may be done by PW
Hire or sub-contract crews for pruning once pruning cycle starts	1	Depends upon implementation structure / Ongoing cost	Ongoing	May requires increase in number of Public Works permanent staff
Collaboration between Tree Stewards and PW for pruning of new trees / those in private property	2	Municipal/volunteer / Minimal cost	Ongoing	May require one or two meetings / workshops
<i>Tree Risk Management</i>				
Contracted tree risk assessment/cabling specialist		Municipal/resident / Cost varies by tree	Per job basis	Brought in to competently assess individual trees for risk
<i>Tree Protection</i>				
Update municipal construction guidelines to include Tree Protection Zones	1	Municipal/ No additional cost	Within first management period	May generate revenue through fine levies
<i>Invasive Species Management</i>				
Train volunteers to identify invasive species	1	Volunteer group / Part of inventory training cost	Start of inventory process	
<i>Public Engagement</i>				
Conduct public information sessions about new Strategic Plan	1	Requires volunteer time from community group and PW staff / Minimal cost	Before Plan implementation	Allows input from public and improves community engagement
Printed information materials and distribution	2	Community groups / ~\$1000 est.		

4.1 Funding

The budget outlined above has highlighted key priorities for capital expenditures to ensure the success of the plan and the implementation of sustainable urban forest management in Centre Wellington. However, inadequate funding for municipal tree care and establishment programs is recognized as a major constraint to the implementation of this plan. Successful implementation will demand increased expenditures of municipal financial resources over time, but there are limited grant-based funding sources available to support sustainable resource management programs, including urban forest management. These include:

- The Ontario Trillium Foundation –
<http://www.trilliumfoundation.org/>
- The Environment Canada EcoAction Community Funding Program -
<http://www.ec.gc.ca/ecoaction/>
- Tree Canada Green Streets Program -
<http://www.treecanada.ca/programs/greenstreets/>
- Trees Ontario –
<http://www.treesontario.on.ca/programs/>

The volunteer community in Centre Wellington is already highly engaged in seeking external funding, and this practice should be continued. The Township, in conjunction with volunteer groups such as Neighbourhoods, should also consider establishing an “Adopt-a-Tree” program to offset costs associated with tree planting, pruning, watering, and other maintenance.

4.2 Plan Review

This plan is intended to be a “living document” to inform and guide sustainable urban forest management in the Township of Centre Wellington. It is expected and recommended that portions of this plan will be reviewed and renewed on a regular basis as new science informing urban forest management emerges, and as the municipality’s demographics, vision, goals and values change over time.

5. Five-Year Management Plans

We have presented some goals and key steps for achieving them at a strategic level in the 20-year plan. This plan will be further broken up into four five-year management plans, which will lay out more specific management activities to achieve the strategic vision. Due to the nature of the planning structure, the first management plan will contain the most details, while the subsequent plans will be adaptive and build on the achievements and experiences of the previous. We have listed the specific recommendations for the different components of the plan for the four five-year management plans.

5.1 Management Plan Years 2009-2013

5.1.1 Inventory and stratification

- Complete a detailed inventory for all trees in the first four years, using the NeighbourWoods© protocol.
- Areas with the oldest trees should be one of the priorities as many old trees have been taken down over recent years as they reached the end of their life spans. For both heritage and tree risk management perspectives, these over mature trees should be inspected to see what further actions can and should be taken.
- New subdivisions with newly established trees should also be a priority, as new trees need more maintenance in their first ten years. Identification of plantable spots in these new subdivisions is also important for new plantings.
- Detailed maps of the natural areas and woodlands, with locations of the trails, should be obtained. Trees along park trails should be inspected within the first four years using the sample Forest Park Trail Inventory sheet.
- For other parts of woodlands, one permanent sample plot of 0.04 ha should be established per hectare in a random manner for detailed inventory and future monitoring. Inventory in woodlands will take place during the first two 5-year plans.

- The inventory data gathered should be computerized and entered into a database. An urban forestry specialist with GIS training should be contracted to administer the tree inventory software and database in 2009.
- Once the inventory for all trees (except those in woodlands, which will be extensively managed) is completed and the database is in place, the community can be stratified into five management units with similar sizes and work load. This should be based on the age/size class distribution of the tree resources, which will determine planting, maintenance and other management needs. Activities in the following five-year management plans will be allocated based on these management units, focusing on one management unit each year.

5.1.2 Tree Establishment

- Tree establishment should follow technical guidelines outlined in the plan as of 2009's spring planting season
- Necessary policy changes to incorporate new responsibilities should be undertaken
- Establishment should focus on using up existing large stock available at local nursery, including maples but not ash
- Agreements with nurseries should be negotiated as soon as possible to begin growing other desirable species into large stock (e.g. oaks, beech)
- Avoid planting Norway maple and ashes.
- Begin limited climate change suitability plantings of recommended species
- Individual tree leaf area should be calculated prior to every tree removal and planting, and records stored for incorporation into inventory.

5.1.3 Pruning Plan

- Continue with Tree Stewards and train more people for pruning days to coordinate with Public Works on pruning of younger trees
- Hire crews to clear up pruning backlog within 5 years

5.1.4 Pruning Plan

- Within the first two years, the Town should engage in a process of categorizing low-, medium-, high-risk, and hazard trees based on attributes used in the inventory protocols, and determining an acceptable level or risk, with input from Public Works staff and decision-makers such as city managers, city council, mayor, Parks and Recreation, and others.
- Hazard trees identified in the ongoing inventory should be reported and inspected to determine further action. A tree cabling policy should be developed. While the inventory is being completed, continue on with current practice of tree pruning and removal.

5.1.5 Tree Protection Plan

- Develop a tree replacement policy; create educational manuals; and incorporating tree protection zones in municipal construction guidelines.

5.1.6 Invasive Species Plan

- Identify invasives in the street and house tree inventories, and in woodlots and natural areas where they can out-compete native species and reducing biodiversity.
- Update and devise invasive tree guidelines and policies.

5.1.7 Public Engagement Plan

- Community education and outreach is essential, continue activities but strengthen bonds between community groups through ongoing meetings as well as collaboration with the municipality
- Educational manuals on proper tree care (pruning, protection, etc.) should be provided to general public.

5.2 Management Plan Years 2014-2018

5.2.1 Inventory

- Complete inventory in PSPs in woodlands
- Update the inventory as pruning staff go around the blocks

5.2.2 Tree Establishment

- Assess needs for diversity of planting stock (spatial and otherwise)
- Continue monitoring species trials, assess for survival and health to inform future planting directions
- Consider adapting species selection based on trial results
- Leaf area replacement should be in full effect
- Take stock of ash tree condition, consider new plantings

5.2.3 Pruning Plan

- Undertake grid-based 5-year cyclical pruning activities based on inventory outputs
- Identify areas for improvement with respect to coordination of pruning activities with community groups

5.2.4 Tree risk management plan

- Establish an inspection protocol
- Query the inventory database and identify trees of different risk levels
- Further inspection of trees of high risk levels
- Mitigate or remove hazard
- Monitor trees of lower risk levels regularly

5.2.5 Tree Protection Plan

- Circulate manuals on proper tree care to all relevant parties

5.2.6 Invasive Species Plan

- Staff trained in identifying invasives should accompany staff responsible for updating inventories to survey trees for invasives. Alternatively, staff responsible for updating inventories should be trained in identifying invasives before field assessments.

5.3 Management Plan Years 2019-2023

5.3.1 Inventory

- Monitor the PSPs in woodlands
- Update the inventory as pruning staff go around the blocks

5.3.2 Tree Establishment

- Begin to assess mortality data to enable modeling of mortality/growth relationships in CW, to aid in canopy cover planning
- Incorporate species suitability trail results into planting planning

5.3.3 Pruning Plan

- Continue with the second pruning cycle. By this time pruning should be less costly once backlog and two pruning cycles have been done

5.2.4 Tree risk management plan

- Inspection of identified risk trees
- Mitigate or remove hazard
- Monitor trees of lower risk levels regularly

5.3.5 Invasive Species Plan

- Staff trained in identifying invasives should accompany staff responsible for updating inventories to survey trees for invasives. Alternatively, staff responsible for updating inventories should be trained in identifying invasives before field assessments.

5.4 Management Plan Years 2024-2028

5.4.1 Tree Establishment

- Incorporate suitability trial results into planting planning
- May result in a marked shift to different species types
- Rely on what previous 15 years have shown, learn from them

5.4.2 Pruning Plan

- Continue with pruning cycle

5.4.3 Tree risk management plan

- Inspection of identified risk trees
- Mitigate or remove hazard
- Monitor trees of lower risk levels regularly

5.4.4 Invasive Species Plan

- Staff trained in identifying invasives should accompany staff responsible for updating inventories to survey trees for invasives. Alternatively, staff responsible for updating inventories should be trained in identifying invasives before field assessments.

6. Annual Operating Plan 2009-2010

The Annual Operating Plan lays out the day-to-day operational activities each year. The priorities for the first AOP are outlined below.

6.1 Inventory

- Identify priority areas for inventory
- Hire a volunteer trainer and coordinator
- Trainings sessions should be provided at the outset for common tree species identification and assessment of the parameters used in the protocol. Field equipments necessary should also be provided, which may include diameter tapes

and other measuring tapes, protective footwear, etc.

6.2 *Tree Establishment*

- All Public Works and community staff should review establishment plan prior to spring planting
- General establishment processes may continue as usual for time being, but guided by plan recommendations.
- Tree Policy should be immediately reviewed and amended if possible, additional species should be planted even if not on “approved list”.
- All Public Works staff and community group planters should be familiar with planting requirements, soil testing, soil distribution, etc. (consider holding community info session).
- Extra consideration should be given to species selection – ash and maple should be avoided if possible
- Leaf area should be assessed for every removed and planted tree, recorded for future inventory.

6.3 *Pruning*

- The Township should hire more crews or subcontract work to clear backlog and to support current pruning operations.
- Once inventory is completed and the Township has been divided into the five areas; the Township should begin with its 5-year pruning cycles based on stratification.

6.4 *Tree Protection*

- Create educational manuals and begin the process of updating the municipal construction guidelines

6.6 *Invasive species*

- Update invasive tree guidelines and policies
- Identify invasives in tree inventories

6.7 Public Engagement

- The Township should organize a public meeting coordinated jointly by the municipality and community organizations to inform general public.
- In the first year of the plan an increased effort by the community organizations and the municipality through further outreach and education.
- The Township should, in collaboration with community groups, host workshops or public meetings to get community input to the vision and goals for the SUFMP.
- The Township should, in collaboration with community groups, hold information sessions about inventory to larger community. There should be similar workshops and information on the how the pruning cycle will be done and why it is necessary.

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Appendix 1 –

Shading factors for selected urban tree species. From McPherson (1984).

Tree species	Shading factor
<i>Acer Ginnala</i> Maxim. (Amur maple)	0.91
<i>Acer platanoides</i> L. (Norway maple)	0.88
<i>Acer rubrum</i> L. (red maple)	0.83
<i>Acer saccharinum</i> L. (silver maple)	0.83
<i>Acer saccharum</i> Marsh. (sugar maple)	0.84
<i>Aesculus hippocastanum</i> L. (horsechestnut)	0.88
<i>Albizia julibrissin</i> Durazzini (silktree)	0.83
<i>Amelanchier arborea</i> (Michx. f.) Fern. (downy serviceberry)	0.77
<i>Betula pendula</i> Roth. (European white birch)	0.82
<i>Carya ovata</i> (Mill.) K. Koch (shagbark hickory)	0.77
<i>Catalpa speciosa</i> Warder ex Engelm. (northern catalpa)	0.76
<i>Celtis australis</i> L. (European hackberry)	0.92
<i>Celtis occidentalis</i> L. (hackberry)	0.88
<i>Crataegus</i> × <i>Lavallei</i> Herincq. (Carriere hawthorn)	0.89
<i>Crataegus oxyacantha</i> L. (English hawthorn)	0.86
<i>Crataegus phaenopyrum</i> (L.f.) Medic. (Washington hawthorn)	0.76
<i>Elaeagnus angustifolia</i> L. (Russian-olive)	0.87
<i>Fagus sylvatica</i> L. (European beech)	0.88
<i>Fraxinus excelsior</i> L. (European ash)	0.85
<i>Fraxinus holotricha</i> Koehne. cv. Moraine (Moraine ash)	0.78
<i>Fraxinus pennsylvanica</i> Marsh. (green ash)	0.83
<i>Ginkgo biloba</i> L. (maidenhair tree)	0.81
<i>Gleditsia triacanthos</i> f. <i>inermis</i> Schneid. (honeylocust)	0.67
<i>Gymnocladus dioica</i> (L.) K. Koch (Kentucky coffeetree)	0.86
<i>Juglans nigra</i> L. (black walnut)	0.91
<i>Koelreuteria bipinnata</i> Franch. (Chinese flame tree)	0.9
<i>Koelreuteria paniculata</i> Laxm. (goldenrain tree)	0.81
<i>Liquidambar styraciflua</i> L. (sweetgum)	0.82
<i>Liriodendron tulipifera</i> L. (yellow-poplar)	0.9
<i>Malus</i> spp. Mill. (apple)	0.85
<i>Parkinsonia aculeata</i> L. (Jerusalem-thorn)	0.85
<i>Pistacia chinensis</i> Bunge. (Chinese pistache)	0.85
<i>Platanus</i> × <i>acerifolia</i> (Ait.) Willd. (London planetree)	0.86
<i>Platanus racemosa</i> Nutt. (California sycamore)	0.91
<i>Populus deltoides</i> Bartr. ex Marsh. (eastern cottonwood)	0.85
<i>Populus tremuloides</i> Michx. (quaking aspen)	0.74
<i>Pyrus communis</i> L. (pear)	0.8
<i>Quercus alba</i> L. (white oak)	0.75
<i>Quercus palustris</i> Muenchh. (pin oak)	0.77
<i>Quercus robur</i> L. (English oak)	0.81
<i>Quercus rubra</i> L. (northern red oak)	0.81
<i>Sapium sebiferum</i> (L.) Roxb. (tallowtree)	0.83
<i>Sophora japonica</i> L. (Japanese pagoda tree)	0.78
<i>Tilia cordata</i> Mill. (little-leaf linden)	0.88
<i>Ulmus americana</i> L. (American elm)	0.87
<i>Ulmus pumila</i> L. (Siberian elm)	0.85
<i>Zelkova serrata</i> (Thunb.) Mak. (Japanese zelkova)	0.8