URBAN FOREST MANAGEMENT PLAN

Township of Esquimalt, British Columbia

January, 2016

DAVEY RESOURCE GROUP

A Division of The Davey Tree Expert Company of Canada, Limited

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Prepared for: **The Coporation of the Township of Esquimalt**
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1 INTRODUCTION

The Township of Esquimalt is a municipality with approximately 16,209 residents, located in the Capital Region on the southeast coast of Vancouver Island in British Columbia (Township of Esquimalt, 2016). This region is one of the most biologically rich and variable areas in Canada as a result of major differences in terrain and climate between west and east. The forests in the region change from lush coniferous coastal and valley bottoms to steep sub-alpine ridges (Goldburn, 1996). The character of these forests is what makes the urban forest a major infrastructure asset and a key component of the Township's commitment to sustainability.

The municipality occupies an area of 10 square kilometres (1000 hectares). The township is located along the harbour of the Pacific Ocean and across from the City of Victoria. The Township celebrated its centennial year in 2012 and is one of the municipalities that make up the Capital Regional District. Within the urban limit, there are 41.2 hectares of serviced park land and 50 landscaped traffic islands (Esquimalt, 2016). The park land generally consists of sport fields, trails, horticultural sites and natural areas.

The Township of Esquimalt Forestry Program is operated through the Parks and Recreation Department. The Parks and Recreation Department was created in the early 1960s (Esquimalt, 2016). The Urban Forestry Program in Esquimalt has done remarkable work in developing several valuable components of effective urban forestry programs. Some highlights are:

- Parks and Recreation Strategic Plan
- The Township's Tree Protection Bylaw
- Development of important public educational material

The Township is now wisely planning to move from a largely reactive urban forest management to a proactive management, with the goals of achieving efficiencies, enhancing public safety and improving customer satisfaction.

1.1 Esquimalt's Urban Forest History

The Town of Esquimalt is a beautiful area with a rich and diverse history. The First Nations people of the Coast Salish linguistic group have been occupying the area since approximately 4000 years prior to European settlement. The Town of Esquimalt celebrated its centennial in 2012 and was incorporated on September 1, 1912. The name Esquimalt comes from the Anglicized version of the First Nations word "es-whoy-malth" (Esquimalt, 2016).

In 1843, the Hudson's Bay Company (HBC) James Douglas came to Esquimalt in search for a new trading post. While in Esquimalt he created treaties with the First Nations and started a HBC fort on the Victoria Harbour. He used land in the Esquimalt area for agricultural purposes, creating three large farms (Esquimalt, 2016). The first hydrographic survey of Esquimalt was completed in 1846 by the Royal Navy who was interested in the natural harbor. In 1865 the Royal Navy moved their headquarters to the Esquimalt area. In 1887 a military base was established and in 1910 was taken over by the Royal Canadian Navy. The creation of the naval base was the beginning of a small

settlement that continued to grow along Wharf Street (Esquimalt, 2016). The agriculture, naval base and settlement began to change the landscape of the Town.

In 1858, the discovery of gold along the Fraser River created a building boom in the town as miners started to flood the area on their way to the Fraser River. Development increased in the village and along Esquimalt Road. In 1886 the Esquimalt and Nanaimo Railway was constructed. The area was slowly becoming a place to build homes for Victoria's wealthy people. After the incorporation of the Town of Esquimalt, municipal services were incorporated into the village. Over the 20th Century, Esquimalt continued to expand, with the creation of the municipal town hall and greater expropriation of land (Esquimalt, 2016). With this growth came an increasing need to manage natural areas and urban forests in the Town.

The Parks and Recreation Department was created in the 1960s and is responsible for managing the Town's Urban Forest. In 2004, the department created a steering committee to help create a Strategic Plan with the help of Yates, Thorn and Associates (Esquimalt, 2016). Several programs have been established over the years to increase urban forest protection and maintain canopy cover. For example, a tree protection bylaw was enacted in 2007 and revised in 2015.

In the 2014 Annual Report, the Township identified a number of Urban Forestry and Greenway Management strategies in order to improve the state of Esquimalt's Urban Forest. Progress has been made in 2015 in updating the Tree Protection Bylaw, producing educational resource materials for the public, hosting community events, completing the municipal tree inventory, and updating Community Wayfinding in Greenways.

1.2 Urban Forest Management Plan

Davey Resource Group has worked closely with the Township to develop this Urban Forest Management Plan. This is intended to be a living document that influences and guides all levels of urban forest management from administration to operations.

The goals and objectives of the plan are as follows:

- Outline the history of the program.
- Assess and characterize Esquimalt's current urban forest.
- Conduct an i-Tree Streets analysis based on the latest municipal tree inventory.
- Review and assess the strengths and deficiencies in the urban forest management program and practices.
- Recommend strategies to improve practices and deal with urban forest management issues.
- Recommend a 10 year proactive management plan for 2017 to 2026.

2 PRINCIPAL INVENTORY ANALYSIS

2.1 Family, Genus and Species Distributions

Family, genus, and species compositions are the percentages of tree genera and tree species in relation to all inventoried trees. These distributions are important parameters for managing urban forest sustainability and the tree population's ability to respond to threats from invasive pests and diseases.

The inventory of Esquimalt's urban forest found 130 species representing 64 genera in 28 families. The following figures illustrate the top 10 distributions of species, genera, and families for Esquimalt:

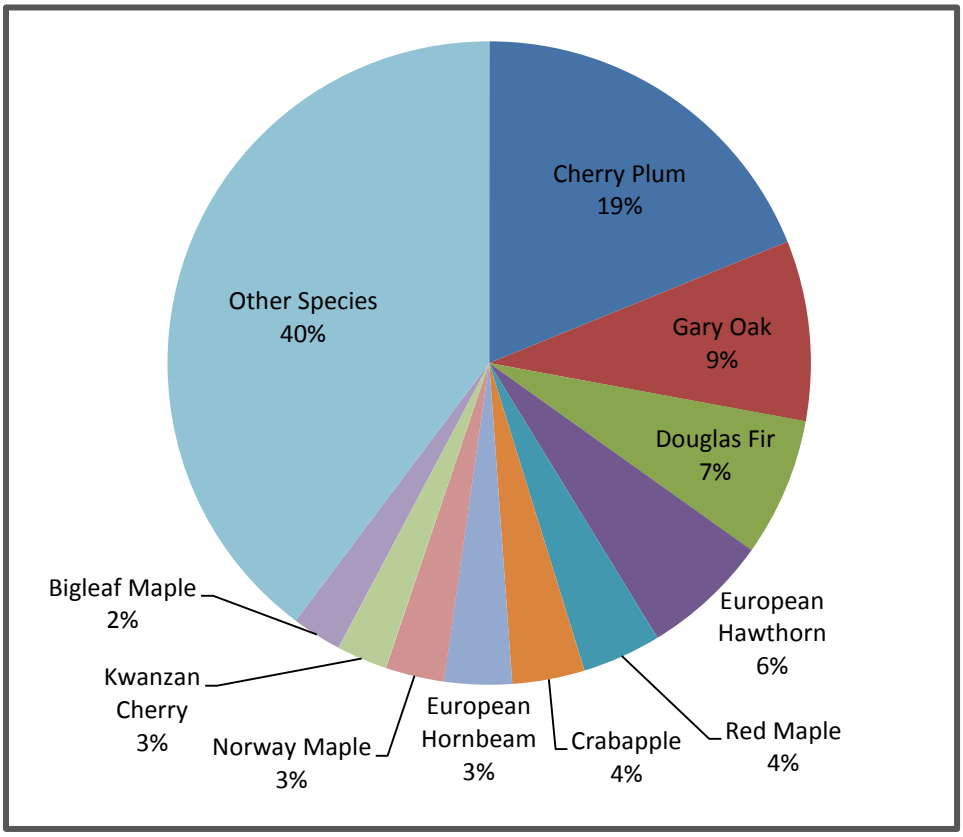

Figure 1: Top 10 species distributions

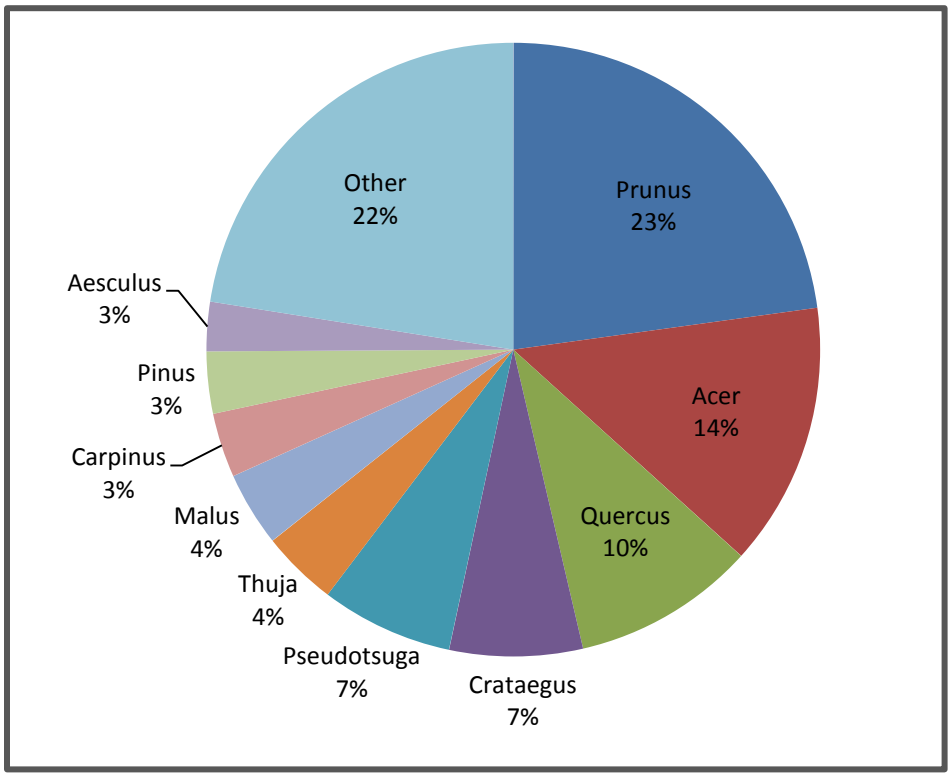

Figure 2: Top 10 genus distributions

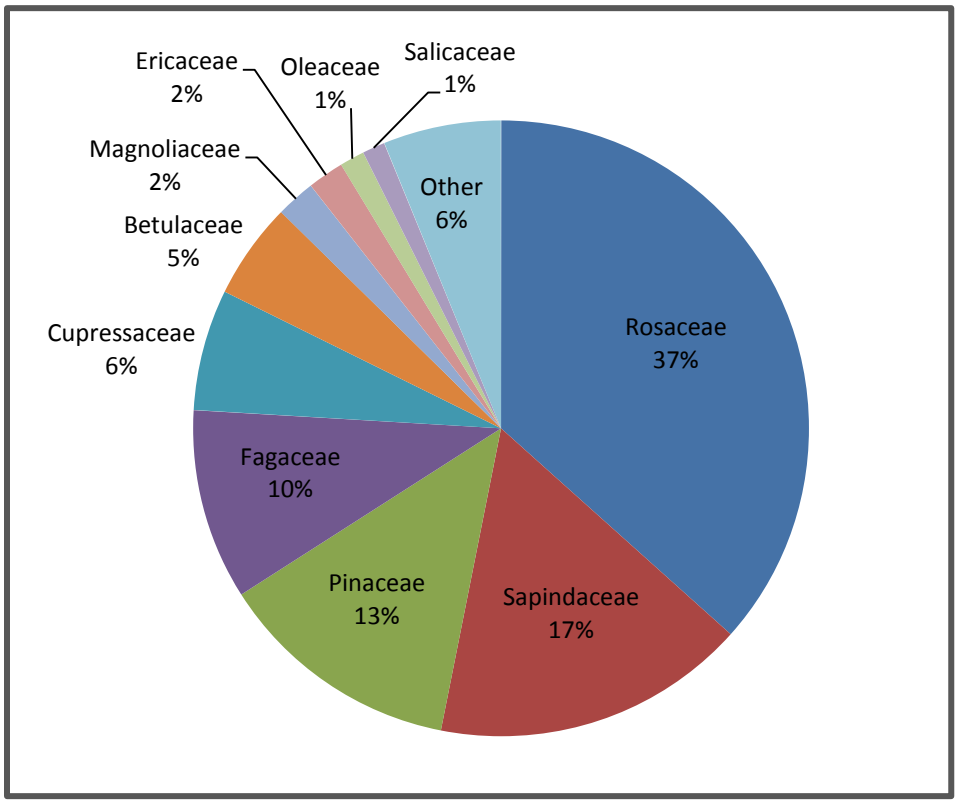

Figure 3: Top 10 family distributions

Figure 3 shows that the Rosaceae family comprises 37% of Esquimalt's urban forest. Within this family, 7 genera are represented, with a total of 21 unique species. As shown in Figure 2, Prunus is the most widely distributed genus in Esquimalt, followed by Acer and Quercus, respectively. 8 unique species are represented in the Prunus genus; however, 88% of the total Prunus population is cherry plum (*Prunus cerasifera*). Figure 1 shows that the four most widely occurring species is cherry plum at 19% (*Prunus cerasifera*), followed by garry oak at 9% (*Quercus garryana*), Douglas fir at 7% (*Pseudotsuga menziesii*), and European hawthorn at 6% (*Crataegus monogyna*),

A general rule of thumb for recommended maximum densities of species populations is to aim for densities that do not exceed 30% from a single family, 20% from a single genus, and 10% for a single species (Lilly & Currid, 2010). Consequently, the Rosaceae family, the Prunus genus, and the species *Prunus cerasifera* are over-represented in Esquimalt. This is called the "10-20-30 Rule for Tree Diversity" and it aims to reduce the catastrophic losses that can be seen when a harmful pest or disease is found in an area. Devastating losses can result, significantly impacting entire communities and resulting in millions of dollars in tree removal and planting expenses. Of course, the recommended densities may not be realistically achieved where climate may be a limiting factor. However, Esquimalt is fortunate to have a mild climate that is favourable to many species (Goldburn, 1996). This is seen by the 130 unique species inventoried. The urban forest in Esquimalt would benefit from incorporating larger proportions of less commonly planted species. More discussion relating to recommended tree species can be found in section 5.8 of this report.

2.2 Tree Condition

Tree condition is assessed by analyzing the percentages of good, fair, poor, and dead/dying trees. Condition is important to tree management because it provides information that helps determine the general health of the population, anticipate maintenance needs, and estimate associated tree care costs. The tree condition of Esquimalt's urban forest is shown in Figure 4.

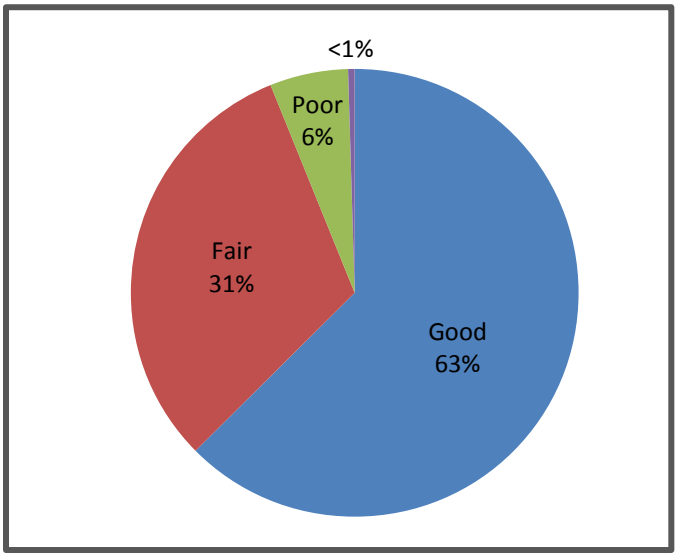

Figure 4: Tree condition distributions

Tree condition was rated based on a modified version of the International Society of Arboriculture's (ISA) tree condition rating system. It is important to note that inventories represent a "snapshot" in time, and an older inventory will no longer reflect current conditions. As there has been no previous complete inventory for Esquimalt's trees, it is not possible to comment on whether or not the condition of the trees has been improving or declining. Updating the inventory at intervals of no more than 10 years would be beneficial to understanding trends in the urban forest and whether or not management practices are effectively maintaining the trees. Subsequent inventories should follow the same condition assessment protocols if trends and comparisons are to be made. As shown in Figure 4 above, in 2015, 63% of the trees in Esquimalt were in good condition, with 31% in fair condition and the remaining 6% in poor condition. Only 22 trees (<1%) were found to be dead or dying. While there were a small percentage of trees in poor, dead, or dying condition, the Township should continue to improve the condition of its tree population through appropriate tree maintenance activities and by removing and replacing all poor and dead trees.

2.3 Size Class Distribution

Size class distribution is the proportion of trees by size, also described as the population's relative age. Size class distribution affects the benefits trees provide to the community and the sustainability of the urban forest. An ideal size class distribution has a higher percentage of young trees with percentages of established and maturing trees decreasing as the diameter increases. An ideal tree population distribution provides for an even flow of functional benefits that maximizes the ecological and aesthetic benefits that trees provide (Millward & Sabir, 2010).

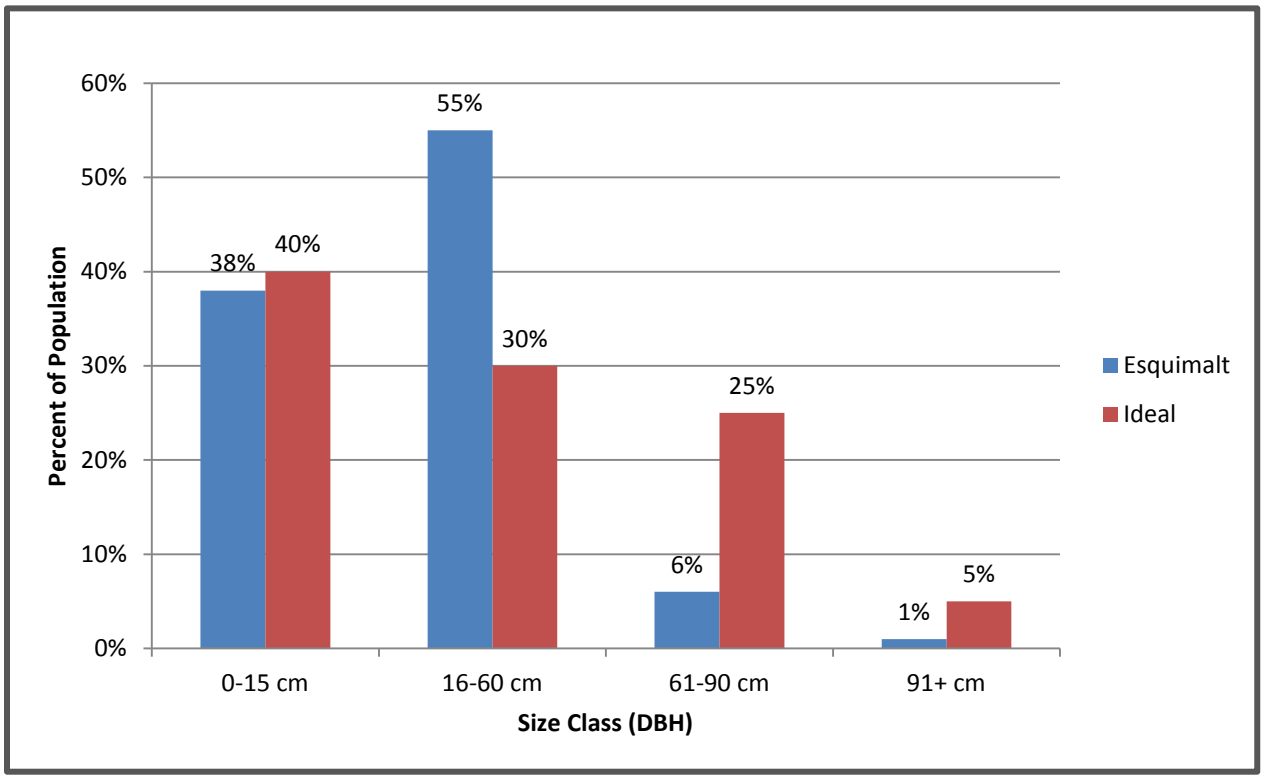

Figure 5: Size class distribution compared to an ideal distribution

As seen in Figure 5, the two major trends observed are that a large proportion (38%) of Esquimalt's inventoried trees are young (1-15 cm DBH) and that mature trees (greater than 61 cm DBH) only comprise 7% of the inventoried population. Over half of the population (55%) is within the 16-60 cm size class. To optimize the potential benefits the tree population can provide, the urban forest should have higher percentages of large-stature, mature trees.

2.4 Risk and Maintenance Analysis

One objective of the tree inventory was to determine the current maintenance needs for the public tree population. The high-priority maintenance recommendations are specific to protecting public safety and reducing high-risk situations. Nonetheless, all maintenance recommendations are directed at improving the overall health, safety, stability, and aesthetics of the urban forest, as well as the cost-effectiveness of the urban forestry program. It is important to understand that low risk tree defects such as young trees with included bark, have the potential to increase in risk if these defects (structural pruning) are not addressed within a reasonable time frame. By investing in trees when they are young through activities such as young tree training, it is possible to reduce the occurrences of major structural defects that pose higher risk in mature trees. With this in mind, it is important for the Township to develop a structured tree maintenance program to ensure that all aspects of tree maintenance are addressed. Further discussions and recommendations on this topic can be found in Section 5 of this report.

A tree found in the Township of Esquimalt where risk mitigation is necessary. ©

Maintenance recommendations provided in the tree inventory are determined by visual observation made from the ground. The structure and function of roots, trunk, scaffold branches, and canopy as well as the tree's location (relative to streets, sidewalks, utilities, signs, buildings, and traffic control devices), are all taken into consideration during each tree assessment.

Table 1: Risk ratings according to maintenance activity

Maintenance Activity	Risk Rating				Grand Total
	High	Moderate	Low	None	
Large Tree Clean		3	62		65
Medium Tree Clean		12	442		454
None			2,756		2,756
Small Tree Clean			655		655
Stump Removal				12	12
Tree Removal	2	8	268		278
Young Tree Train			441		441
Grand Total	2	23	4,624	12	4,661

Esquimalt's first priority is the safety of its citizens. Table 1 above summarizes the maintenance recommendations for Esquimalt's public tree population based on risk. Risk managers should prioritize maintenance activities for trees, with high risk maintenance activities being carried out immediately, followed shortly after by moderate risk maintenance activities. This will reduce the overall risk of the urban forest and increase safety within the community. Making maintenance decisions based on risk enables urban forest managers to use available funds more efficiently. The use of these funds can be focused on the high-risk situations first, effectively contributing the highest gain in overall safety.

It is important to understand that level II risk assessments consider only the known targets and visible or detectable tree conditions from the ground. The timeframe for the risk assessment is not considered to be a guarantee period. Furthermore, any tree, whether it has visible weaknesses or not, will fail if the forces applied exceed the strength of the tree or its parts. As trees are living organisms, their health, structure, and vigour can change in a short time depending on various abiotic and biotic environmental factors. Risk assessments are conducted to establish what level of risk, if any, may be present within a given timeframe. There is no way to predict a tree failure short of witnessing the failure in action. The tree owner's (risk manager's) level of tolerance of risks must be what determines if a tree should remain based on its assessment. With that said, there is always an inherent degree of risk associated with any tree despite any condition the tree may be in. To remove the risk would be to remove the tree.

3 BENEFITS PROVIDED BY TOWNSHIP OF ESQUIMALT'S STREET TREES (I-TREE ANALYSIS)

The Benefit-Cost analysis provides an important tool for Township staff, elected officials, and citizens to make informed decisions about funding urban forestry.

City trees provide a number of environmental benefits. Trees help to improve air quality, and reduce carbon dioxide levels. They also provide aesthetic, economic, social, psychological, and wildlife benefits. This chapter uses the Township's tree inventory and the i-Tree Streets model to assess and quantify the beneficial functions of the Urban Forest and to place a dollar value on the annual benefits they provide. These annual benefits are a "snapshot" of environmental benefits produced by trees during one year. I-Tree Streets calculates the benefits based on the best available science that provides a platform from which management decisions can be made.

The i-Tree Streets model is considered a high level of data analysis, the results of which the Township of Esquimalt can use to make informed decisions surrounding the urban forest. Beyond statistical calculations of public tree inventory data, i-Tree Streets provides a foundation upon which the Township's Parks & Recreation Department can promote its urban forest management program to elected officials, staff, allied organizations, and the community. The i-Tree Streets analysis was performed to quantify stormwater mitigation, energy consumption savings, aesthetics and other public values, air quality improvement, and carbon sequestration. Table 2 below presents the total annual benefits provided by trees that are included in Esquimalt's inventory and depicts them as a percentage of the total.

Attempting to quantify the benefits from trees is a progressive step in justifying Township resource allocation to the urban forest. Despite the utility of i-Tree Streets in accomplishing forest benefit modeling, it should be noted that the software was developed to model U.S. climate zones and air quality statistics, and is the only modelling tool available for this purpose. Hence, air quality benefits may also slightly differ from those values used in the model. Potential minor regional variations do not lessen the value of the i-Tree analysis as an excellent source of information for good decision making.

Table 2: Total annual benefits by category

Benefit Category	Benefit Total ($)	Benefit per Tree ($)	Percent of Total Benefits
Energy	15,228	3.27	3%
CO2	3,274	0.70	1%
Air Quality	5,984	1.29	1%
Stormwater	85,252	18.32	19%
Aesthetics/Other	348,583	74.92	76%
Total	$458,321	$98.50	100%

3.1 Stormwater Runoff Reductions

Trees reduce the volume of stormwater runoff in neighbourhoods and ultimately community-wide. This function and benefit is especially important in developed settings with increased quantities of impervious surfaces (such as roads, driveways, and buildings) and in areas in close proximity to surface waters. A tree's surface area intercepts and stores rainfall. The tree's root system absorbs water that infiltrates into the soil, thereby decreasing runoff. The soils ability to absorb water is also improved by a tree's root systems and foliage as it intercepts rainfall and reduces the occurrence of a soil hard pan layer forming. Additionally, trees intercept suburban contaminants such as oils, solvents, pesticides, and fertilizers which are often part of stormwater runoff, reducing pollution discharges into nearby waterways.

Esquimalt's street tree resource intercepts 11,650 cubic meters of stormwater annually, for a savings of $85,252 or $18 per tree. The population of Douglas fir, cherry plum, and Garry oak trees currently provides the greatest total benefit accounting for 2,424 m^3 (21%), 1,968 m^3 (17%), and 1,835 m^3 (16%), respectively. These species combined account for 54% ($45,567) of stormwater management savings.

3.2 Energy Consumption Savings

The energy savings that trees provide can be attributed to micro-climatic changes, shading, and wind reduction. Ambient air is cooled when leaves use solar energy during transpiration. Air movement in an urban setting is influenced by tree spacing, crown spread, and vertical distribution of leaf area. These key factors also reduce the amount of radiant energy absorbed by buildings and other hardscapes – cooling the air during hot summer months. Furthermore, in the winter, the trees provide wind protection to nearby buildings, helping to reduce heat loss. By moderating climate extremes on a local level, the savings provided by trees are realized by lowering cooling and heating costs.

Urban trees provide annual electric and natural gas savings equal to $10,842 and $4,386, respectively. Esquimalt saves a total of $15,228 per year and has an average annual savings of $3.27 per tree. The population of cherry plum, Garry oak, and Douglas fir currently provide the greatest total benefit accounting for a total of 50% ($7,572) of all energy savings. America elm (*Ulmus americana*) trees provide the greatest savings at $13.43 per tree.

3.3 Aesthetic Value and Other Benefits

It may seem difficult to place a dollar value on the benefits trees provide to the overall character of a community and the well-being of neighbourhood residents and visitors. However, trees provide added beauty to a landscape, privacy to homeowners, and refuge for urban wildlife, and these can be quantified. Studies support differences in property values reflected by the willingness of buyers to pay for the benefits associated with trees.

Aesthetic benefits, property value, social benefits, economic benefits, among other non-tangible related benefits, provide the Township of Esquimalt an estimated $348,583 annually, for an average

of $74.92 per tree. The population of American elms and red oaks (*Quercus rubra*) provide the greatest single tree benefits, at $249.34 and $247.74 per tree, respectively.

3.4 Air Quality Improvement

Urban environments benefit greatly from the presence of public trees. Trees release oxygen through photosynthesis and absorb gaseous pollutants in the form of ozone (O_3) and nitrogen dioxide (NO_2). Ozone reduction is also attributed to the trees' shading effect on hardscape surfaces, their cooling effect on ambient air from the transpiration process, and their contribution to reduced emissions from power generation. Trees intercept volatile organic compounds (VOCs), sulfur dioxide (SO_2), and small particulate matter (PM_{10}), such as dust, ash, dirt, pollen, and smoke from the air. Trees also emit air pollutants called biogenic volatile organic compounds (BVOCs) that contribute to the formation of ozone. The i-Tree Streets model takes this whole process into account.

Esquimalt's inventoried tree resource absorbs and averts 1,679 kg of air pollutants annually. The Township experiences net air quality improvement benefits equal to $5,987 per year, averaging $1.29 per tree. The population of cherry plum currently provides the greatest total air quality benefits accounting for 33% ($1,342.56) of all air quality enhancements. American elm provides the greatest single tree benefits at $5.45 per tree.

3.5 Carbon Dioxide Reduction

Carbon dioxide (CO_2) is used during a tree's photosynthesis process to produce the natural building blocks necessary for tree growth. This process takes carbon dioxide from the atmosphere and holds it as woody and foliar biomass. This is referred to as carbon sequestration.

Esquimalt's urban forest resource reduces a net 450,007 kg of CO_2 per year valued at $3,274 with the average savings of $0.7 per tree. The populations of cherry plum and Garry oak currently provides the highest sequestered CO_2 benefit, accounting for 74,569 kg (17%) and 60,010 kg (13%), respectively. Hedge maple (*Acer campestre*) provides the greatest single tree benefit of $2.73 per tree.

3.6 Summary of Total Annual Benefits

Esquimalt's inventoried trees provide $458,321 of annual benefits to the community and its environment. It is expected that the annual benefits may be much higher, however, as not all city trees are accounted for in the inventory, including natural woodlots. Table 2 shows that aesthetics and other benefits contribute the greatest benefits accounting for 76% of the annual total. Environmental benefits including energy savings, stormwater mitigation, air quality improvements, and carbon dioxide reduction contribute the remaining 24% of the total annual benefits. The lower proportion of total environmental benefits is possibly related to the size distribution (which is largely smaller/younger trees) and species selection.

Table 3: Total annual benefits per species

Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total ($)
Douglas Fir	2,016.88	288.50	842.62	17,739.21	48,512.02	69,399.24
Cherry Plum	2,951.43	542.51	1,342.56	14,398.91	43,714.74	62,950.15
Gary Oak	2,604.15	436.59	729.51	13,428.76	45,418.79	62,617.79
Norway Maple	988.78	184.88	400.80	5,234.78	20,377.31	27,186.54
Northern European Hawthorn	695.13	336.24	288.82	2,167.73	17,227.57	20,715.50
Red Maple	436.51	60.08	158.64	1,699.54	16,542.30	18,897.07
Bigleaf Maple	570.44	121.53	222.82	2,819.64	13,933.59	17,668.01
Scotch Pine	325.61	51.48	148.77	2,493.35	11,346.08	14,365.28
Western Red Cedar	291.08	46.05	132.55	2,264.04	10,771.26	13,504.98
Horsechestnut	495.44	98.03	198.23	2,826.23	7,901.04	11,518.97
Citywide Total	15,237.51	3,275.84	5,987.19	85,297.61	348,766.10	458,564.25

Table 4: Annual benefits of top 10 species ($/tree)

Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total ($)
American Elm	13.43	1.88	5.45	64.18	249.34	334.28
Dawn Redwood	10.68	1.53	4.28	99.34	196.48	312.32
Northern Red Oak	6.10	1.21	2.29	26.28	247.74	283.62
Weeping Willow	12.91	2.64	5.17	75.68	182.80	279.20
Boxelder	11.73	2.11	3.27	62.47	163.13	242.71
Silver Maple	9.06	1.91	3.52	46.11	179.08	239.68
Giant Sequoia	10.68	1.06	4.13	110.16	112.14	238.16
Ponderosa Pine	6.92	1.03	2.90	59.25	167.09	237.19
Green Ash	9.02	1.90	3.52	46.43	176.28	237.15
Atlas Cedar	6.09	0.93	2.67	46.96	174.70	231.35

3.7 Cost Benefit Ratio

It is clear that trees provide a multitude of benefits in the urban environment. However, in order for trees to be a good investment for Esquimalt, their collective benefits must outweigh the total costs of maintaining them. Applying a benefit/cost ratio is a simple but effective way of evaluating the Township's investment in its trees. As the overall value of Esquimalt's trees has been provided by the i-Tree Streets analysis, this can be compared with the total costs of managing them. In 2014, Esquimalt's total urban forestry operating budget amounted to $317,082. This includes all aspects of the Township's urban forest management program, from administration to operations. A more detailed analysis of the Townships urban forestry budget is provided in section 4.1.

As table 5 below shows, the Township receives $1.45 in benefits for every $1.00 that is spent in its urban forestry management program.

Table 5: Benefit-cost ratio

Benefit/Cost	Total ($)	$/Tree	$/Capita
Total Benefits	$458,321	$98.50	28.28
Total Costs	$317,082	$68.15	19.56
Net Benefits	$141,239	$30.35	8.71
Benefit/Cost Ratio	$1.45		

This supports the justification for more focused attention towards efficiencies and increased funding for urban forest management and maintenance. By increasing efficiencies, and proactively managing the Township's urban forest assets, the net benefits will improve, as Esquimalt will have a greater proportion of larger, healthier, and more structurally sound trees which will require less maintenance work. Implementing a proactive tree management program with cyclical pruning and a greater focus on young tree establishment and training is the first step to ensure that the benefits produced by the Township's trees far surpass the costs of managing them.

4 CURRENT STATE OF ESQUIMALT'S URBAN FORESTRY PROGRAM

A comprehensive evaluation of the current state of Esquimalt's municipal urban forestry program was undertaken per the Township's directive to improve efficiencies, service delivery, and ensure public safety. Primary operational tasks include tree planting, pruning, tree removal and watering.

4.1 Existing Operating Budget

The costs associated with managing Esquimalt's trees are an investment back into the community. In 2014, the Township's total related expenditures for trees were approximately $317,082. Approximately $68 per tree is spent on average during one year. Approximately 16,209 people live in Esquimalt and $20 per citizen is spent on trees each year.

Table 6 indicates that Esquimalt spends more money on tree planting than any other category (26 percent). The second greatest cost is demand (reactive) work such as pruning, removals, and pest and disease control (19 percent), with tree pruning (13 percent) and watering (9 percent) coming in third and fourth, respectively.

Table 6: Cost categories for urban forestry related activities (2015)

Activity		Hours	Labour Cost	Equipment Cost	Material Cost	Total Cost	% of Total
Demand Work	Pruning (70%)	1,151	$39,530	$3,452		$42,982	19
	Removals (20%)	329	$11,294	$986		$12,281	
	Pest & Disease Control (10%)	164	$5,647	$493		$6,140	
Administration – Planning, Permits, Customer Service, Inspections, Purchasing, Training, Meetings		340	$20,000			$20,000	6
Tree Planting		1,529	$52,521	$4,587	$25,000	$82,108	26
Tree Pruning		1,066	$36,617	$3,198		$39,815	13
Tree Removals		272	$9,343	$816		$10,159	3
Tree Watering		800	$26,736	$2,400		$29,136	9
Tree Assessments		384	$14,381	$1,152		$15,533	5
Hedge Trimming		468	$16,076	$1,404		$17,480	6
Branch Out - Invasive Plant Removal		12	$3,412	$36		$3,448	1
Tree Removals - Contractor			$16,000			$16,000	5
Consulting Arborists - Contractor			$10,000			$10,000	3
Repair/mitigation of infrastructure damage - Contractor			$4,000	$2,000	$6,000	$12,000	4

Activity	Hours	Labour Cost	Equipment Cost	Material Cost	Total Cost	% of Total
Total	6,515				$317,082	100

In 2014, 80 trees were planted throughout the Township. Therefore it cost approximately $1,026 per tree, including the costs of equipment, material, and labour. This does not include the cost of aftercare activities such as watering and young tree training.

4.2 Equipment

Currently, the Parks & Recreation department has one 30' bucket truck that is shared between forestry and public works. For forestry related jobs, it is used for work on small to medium sized trees. Work on larger trees requires larger equipment, which is contracted to external vendors.

In addition to the equipment mentioned above, there are root pruners, stump grinders, a chipper, and a large assortment of chain saws, power tools, and hand tools to accomplish typical arboricultural tasks. There are no in-house climbers; thus, no climbing equipment is kept on hand. Equipment is maintained and serviced by Public Works mechanics.

4.3 Staffing

There are currently three full-time positions dedicated to urban forestry operations within the Parks and Recreation Department. Positions and specific job details are as follows:

The **Manager of Parks and Facilities Services** reports to the Director of Parks and Recreation Services and is responsible for managing all aspects of operating, constructing and maintaining the Township's physical parks and recreation assets, and developing outdoor leisure and environmental services in parks. This position plays a leadership role in managing Departmental policy, human and financial resources, strategic planning, and ongoing implementation of the Township's corporate values. The Manager of Parks and Facilities Services oversees all urban forestry activities in the Township.

The **Parks Supervisor** reports to the Manager of Parks and Facilities and is responsible for providing leadership and supervision to the Parks staff team and oversees work related to horticulture, turf, urban forestry, park physical assets and event support. The Parks Supervisor oversees the implementation of the Township's integrated pest management policy. The Parks Supervisor also assists the Manager of Parks and Facilities Services in developing park related facilities and recruiting, promoting and developing parks staff.

The **Arborist II** reports to the Parks Supervisor and is responsible for carrying out the assessment, evaluation and rating of trees for hazard and retention potential and recommending species/varieties to be planted. The Arborist II supervises job site skilled and semi-skilled employees and coordinates work carried out by contractors in a number of tasks involving tree work. Other duties include tree assessments, park operational functions including invasive plant control, natural area restoration, tree maintenance and pruning, and integrated pest management.

The **Arborist I** reports to the Arborist II and is responsible for general park maintenance, including planting, pruning, hedge trimming, watering and general arboriculture and horticultural maintenance of trees. Some of the key duties include: inspecting trees; maintaining the tree inventory; identifying pests and diseases; identifying maintenance needs for trees; removing trees; assisting with the issuance of permits related to cutting and pruning of trees; responding to enquiries from the public regarding tree planting; and contacting suppliers for availability of plants and materials.

The **Gardener II** reports to the Arborist II and performs a variety of horticultural activities associated with the maintenance and operation of various park areas. This includes trimming hedges, fertilizing, weeding and edging lawn areas and flower beds, mulching and preparing soil for planting, applying pesticides to control pests, and pruning trees and shrubs.

Some urban forestry related work is handled by contractor services. For example, in a given year approximately $16,000.00 is spent on external vendors for both emergency and planned work, primarily on larger trees. An additional $10,000.00 is built into the annual budget for tree reports by consulting arborists.

4.4 Urban Forestry Programs and Initiatives

4.4.1 Tree Stewardship Program – Branch Out

In an effort to improve tree stewardship and protect its urban forest, the Township has developed the Branch Out program in 2015. The program supports care of Esquimalt's urban forests through community events and the creation and distribution of helpful resources. (*Info retrieved from parks brochure*). Esquimalt recognizes that the preservation, sustainability, and regeneration of urban forests depend on the actions taken by multiple Township departments, community, residents, organizations and businesses. The associated cost of running the program is approximately $3,000.00 per year.

Community event. Town of Esquimalt ©

4.4.2 Private Donations and Corporate Sponsorships

Esquimalt is fortunate to have generous donations from the British Columbia Hydro and Power Authority (BC Hydro). Each year, BC Hydro provides Esquimalt with donations of $8,000 - $10,000 towards tree planting, which is used primarily for planting beneath power lines. Suitable species are selected to avoid conflicting

with power lines.

4.4.3 Landmark Trees

Esquimalt recognizes its significant trees by listing them on the Heritage Tree list which is included in the Bylaw and can be found on the website.

Trees may receive Significant Tree designation under one or more of the following classes:

A. Outstanding specimen in size or shape
B. Rare or unique growth
C. Historical – planted by a pioneer or has other historical background
D. Group – may be along a boulevard or in a garden or park
E. Area – all of the trees in the specific area
F. Landmark – Usually a single well-known tree

4.4.4 Tree Protection Bylaws

The urban forest and greenway management strategy was identified in the 2014 Strategic Plan. As work on this initiative is ongoing, one of the latest achievements in 2015 was the revision of the Tree Protection Bylaw, No. 2664. The goals of the new Tree Protection Bylaw, No. 2837, as outlined in the Staff Report on May 19th, 2015, were to improve clarity, allow easier access for residents to enhance their landscaping, as well as enhance tree protection provisions in order to improve and grow Esquimalt's urban forest. The Township staff reviewed multiple municipal tree protection bylaws and engaged with numerous experts in the field of urban forestry in order to achieve the best management practices.

The revisions to the bylaw are aimed at providing increased clarity with regards to defining a protected tree, changing the required number of replacement trees as well as specifying a minimum dollar value, and adding permit exemptions regarding hazard trees, hedges, and pruning. These revisions are anticipated to positively impact Esquimalt's urban forest by reducing the net loss of urban forest canopy through replacement planting. Efforts of the improved Tree Protection Bylaw should be further aided by the education and outreach goals outlined in the Urban Forest Management Strategy.

In an effort to ensure a smooth transition for the revised Tree Protection Bylaw, Township staff has notified all relevant tree service companies, prepared a frequently asked questions brochure, and posted the new Bylaw along with relevant application forms and supporting materials on the Esquimalt website.

The newly enacted Tree Protection Bylaw applies to both public and private lands within the Township limits. The bylaw prohibits causing damage to any protected tree unless it is in accordance to the specified exemptions or an issued permit. Current permitting fees are $25 for the first three trees and $5 for each additional tree proposed to be removed or injured. The required number of replacement trees varies depending on the species and size of the tree being removed. Currently, the bylaw prohibits the removal of any tree with a DBH of 30 cm or more, wildlife trees,

trees used as nesting sites (raptors, osprey, or heron), replacement trees, significant trees, or any native tree (Douglas Fir, Grand Fir, and Western Red Cedar if greater than 1.2 m in height; Arbutus, Big Leaf Maple, Garry oak, Pacific Dogwood and Pacific Yew if DBH is 4 cm or greater).

4.4.5 Standards and Policies

Esquimalt has developed a number of standards and specifications that guide the processes involved with carrying out municipal tasks. They provide useful guidelines for performing urban forestry related activities and create consistency in operations as staff turnover occurs. Furthermore, policies and guidelines have been developed to provide standards in tree protection during the construction process. Some of the guidelines and standards included in the Schedule of the Bylaw include tree planting, tree protection barriers, measuring tree drip line, measuring DBH, and acceptable replacement trees.

4.4.6 Educational Materials

The Township has developed a series of educational brochures to provide useful information to the public regarding tree planting and care. To date, the brochures include: Pruning Mature Trees; Why Topping Trees Hurts; Why Hire an Arborist; Pruning Young Trees; Avoiding Tree Damage during Construction; and Tree Selection and Placement.

5 FUTURE URBAN FORESTRY INITIATIVES

5.1 Proactive Rotational Maintenance Program

To date, the maintenance of Esquimalt's urban forest assets has been largely reactive. The Township manages its trees by responding to requests by members of the public. This type of reactive management has been found to be inefficient and leads to a bottleneck of maintenance requests. Furthermore, reaction-based maintenance programs have been found to leave little room for maintenance activities that are not typically requested by the public. For example, young tree training or other preventative measures are frequently set aside in order to focus on requested tasks such as canopy raising or site inspections. Therefore, issues may arise as a generation of trees mature with unaddressed health or structural defects that in turn prompt the public to make requests for tree maintenance.

By managing the urban forest proactively and maintaining trees from the day they are planted, the future urban forest of Esquimalt will see a wider range of benefits from larger, healthier trees to reduced risk and reduced service requests from the public. Moreover, a healthier urban forest will add greater environmental and socio-economic benefits to the Township.

The proactive approach for Esquimalt would divide the urban forest resources by neighbourhood and implement a rotational maintenance program on a 5-10 year cycle that addresses all aspects of tree maintenance. By focusing maintenance activities according to geographic area, there will be less dispatch time needed for crews to get from site to site. Furthermore, public inquiries relating to routine tree maintenance activities can be addressed when the relevant neighbourhood is scheduled for work. Of course, as public safety is the top priority in any urban forest management program, there will always be some degree of reactive management necessary. For example, even well-maintained trees have the potential to fail or succumb to biotic and/or abiotic stress factors. Dead trees or trees with hazardous structural defects should be prioritized above routine rotational maintenance activities.

Contractor pruning trees. Township of Esquimalt ©

A 10 year rotational program is proposed for Esquimalt based on the neighbourhoods that exist within the Township's limits. The following budget is organized according to neighbourhoods.

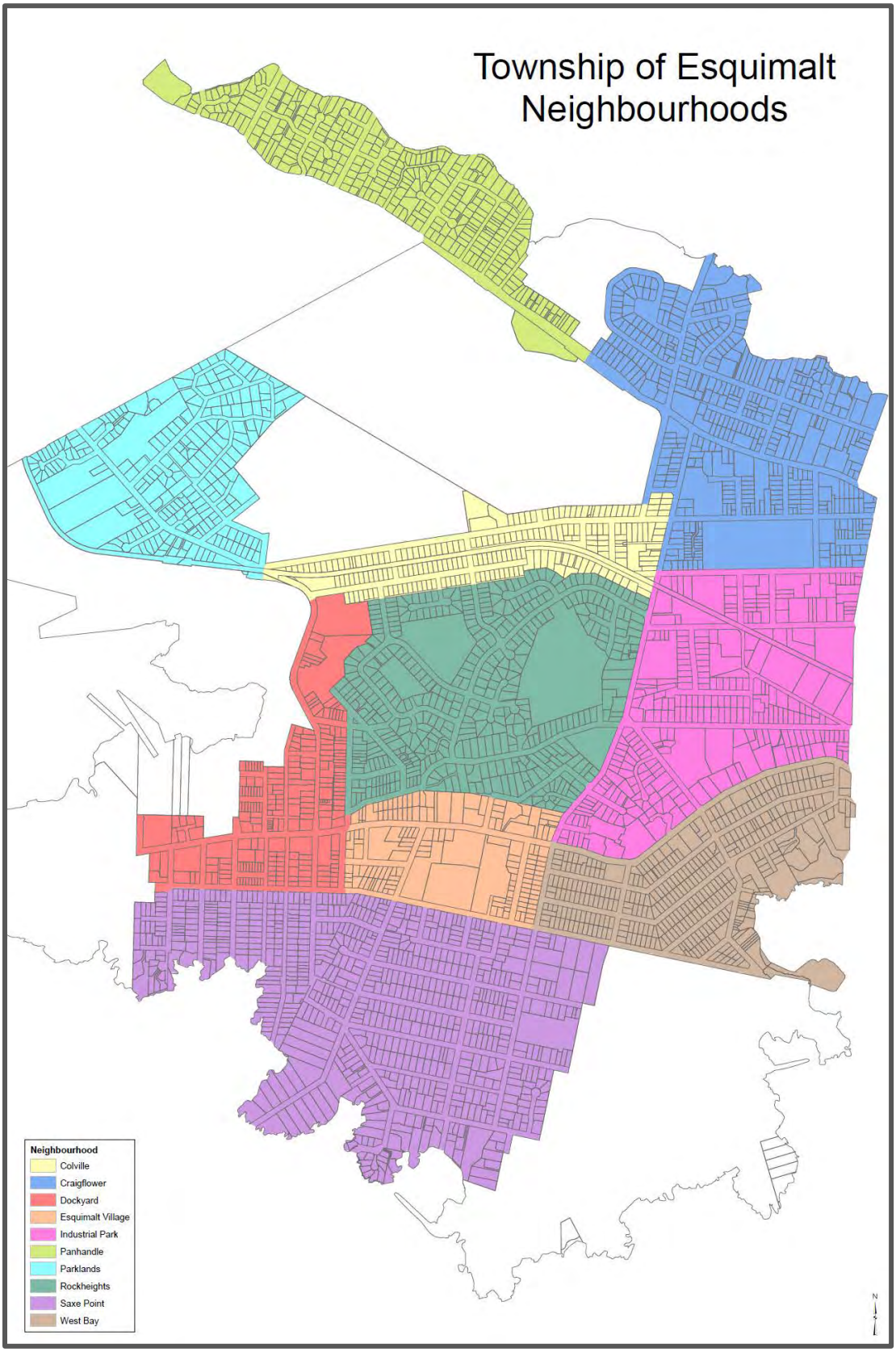
Township of Esquimalt
Neighbourhoods
Neighbourhood
Colville
Craigflower
Dockyard
Esquimalt Village
Industrial Park
Panhandle
Parklands
Rockheights
Saxe Point
West Bay
N

Table 7: A suggested 10-year operational budget for Esquimalt (2017-2021)

Activity	Diameter Class (cm)	2017 Saxe Point			2018 Craigflower			2019 Rockheights			2020 West Bay			2021 Industrial Park		
		Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total cost	Cost/Tree	# of Trees	Total Cost
Tree Pruning Includes tree clean, raise, reduce, and thin	0-15	$107	18	$1,920	$109	14	$1,523	$111	15	$1,665	$113	10	$1,132	$115	8	$924
	16-30	$160	113	$18,080	$163	64	$10,445	$166	25	$4,162	$170	24	$4,075	$173	21	$3,637
	31-45	$256	61	$15,616	$261	86	$22,456	$266	45	$11,985	$272	35	$9,508	$277	15	$4,157
	46-60	$320	17	$5,440	$326	41	$13,382	$333	42	$13,983	$340	25	$8,490	$346	8	$2,771
	61-75	$427	6	$2,560	$435	20	$8,704	$444	20	$8,878	$453	7	$3,169	$462	5	$2,309
	76-90	$512	3	$1,536	$522	2	$1,044	$533	8	$4,261	$543	4	$2,173	$554	3	$1,663
	91-105	$640	2	$1,280	$653	1	$653	$666	0	$0	$679	2	$1,358	$693	2	$1,386
	105 +	$853	2	$1,707	$870	1	$870	$888	0	$0	$906	3	$2,717	$924	2	$1,847
Activity Total			222	$48,139		229	$59,079		155	$44,934		110	$32,623		64	$18,693
Tree Removal *Not including stump removal or site restoration*	0-15	$135	7	$945	$138	9	$1,239	$140	5	$702	$143	2	$287	$146	14	$2,046
	16-30	$270	18	$4,860	$275	10	$2,754	$281	10	$2,809	$287	3	$860	$292	1	$292
	31-45	$405	26	$10,530	$413	15	$6,197	$421	10	$4,214	$430	24	$10,315	$438	2	$877
	46-60	$540	10	$5,400	$551	14	$7,711	$562	5	$2,809	$573	5	$2,865	$585	2	$1,169
	61-75	$675		$0	$689	3	$2,066	$702	4	$2,809	$716		$0	$731		$0
	76-90	$810		$0	$826	1	$826	$843	1	$843	$860		$0	$877		$0
	91-105	$1,480	1	$1,480	$1,510		$0	$1,540		$0	$1,571		$0	$1,602		$0
	105 +	$1,980	1	$1,980	$2,020	1	$2,020	$2,060		$0	$2,101		$0	$2,143		$0
Activity Total			63	$25,195		53	$22,812		35	$14,186		34	$14,326		19	$4,384
Stump Removal *Includes site restoration*	0-15	$135	7	$945	$138	9	$1,239	$140	5	$702	$143	2	$287	$146	14	$2,046
	16-30	$210	18	$3,780	$214	11	$2,356	$218	10	$2,185	$223	3	$669	$227	1	$227
	31-45	$315	26	$8,190	$321	15	$4,820	$328	10	$3,277	$334	25	$8,357	$341	2	$682
	46-60	$420	10	$4,200	$428	16	$6,854	$437	5	$2,185	$446	5	$2,229	$455	2	$909
	61-75	$525		$0	$536	3	$1,607	$546	5	$2,731	$557		$0	$568		$0
	76-90	$630		$0	$643	1	$643	$655	1	$655	$669		$0	$682		$0
	91-105	$735	1	$735	$750		$0	$765		$0	$780		$0	$796		$0
	105 +	$880	1	$880	$898	1	$898	$916		$0	$934		$0	$953		$0
Activity Total			63	$18,730		56	$18,416		36	$11,736		35	$11,541		19	$3,864
Young Tree Train	0-15	$12	110	$1,337	$12	66	$818	$13	48	$607	$13	59	$761	$13	41	$539

Activity	Diameter Class (cm)	2017 Saxe Point Cost/Tree	2017 Saxe Point # of Trees	2017 Saxe Point Total Cost	2018 Craigflower Cost/Tree	2018 Craigflower # of Trees	2018 Craigflower Total Cost	2019 Rockheights Cost/Tree	2019 Rockheights # of Trees	2019 Rockheights Total Cost	2020 West Bay Cost/Tree	2020 West Bay # of Trees	2020 West Bay Total cost	2021 Industrial Park Cost/Tree	2021 Industrial Park # of Trees	2021 Industrial Park Total Cost
Administration Planning, *Permits, Purchasing, Training, Meeting, Customer, Service, Inspections*				$20,000			$20,400			$20,808			$21,224			$21,649
Consulting Arborists *Contractor*				$10,000			$10,200			$10,404			$10,612			$10,824
Repair/ Mitigation of Infrastructure Damage *Contractor*				$12,000			$12,240			$12,485			$12,734			$12,989
Invasive Plant Removal				$3,448			$3,517			$22,845			$30,492			$57,606
Tree Assessments				$15,533			$15,844			$16,161			$16,484			$16,813
Pest & Disease Control				$6,140			$6,263			$6,388			$6,516			$6,646
Demand Work				$27,000			$21,682			$28,091			$28,653			$29,226
Hedge Trimming				$17,480			$17,830			$18,186			$18,550			$18,921
Tree Watering		$121	240	$29,136	$124	240	$29,719	$126	240	$30,313	$129	240	$30,919	$131	240	$31,538
Tree Planting		$1,026	80	$82,108	$1,047	80	$83,750	$1,068	80	$85,425	$1,089	80	$87,134	$1,111	80	$88,876
Grand Total				**$316,246**			**$322,570**			**$322,569**			**$322,569**			**$322,568**

Table 8: A suggested 10-year operational budget for Esquimalt (2022-2026)

Activity	Diameter Class (cm)	2022 Panhandle			2023 Parklands			2024 Dockyard			2025 Colville			2026 Esquimalt Village		
		Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost
Tree Pruning Includes tree clean, raise, reduce, and thin	0-15	$118	10	$1,178	$120	6	$721	$123	5	$613	$125	3	$375	$127	1	$127
	16-30	$177	42	$7,419	$180	15	$2,703	$184	15	$2,757	$187	29	$5,436	$191	15	$2,868
	31-45	$283	51	$14,415	$288	19	$5,478	$294	24	$7,058	$300	27	$8,099	$306	12	$3,671
	46-60	$353	14	$4,946	$360	14	$5,045	$368	7	$2,573	$375	16	$5,999	$382	4	$1,530
	61-75	$471	7	$3,298	$480	9	$4,324	$490	7	$3,431	$500	4	$2,000	$510	8	$4,079
	76-90	$565	6	$3,392	$577	11	$6,343	$588	1	$588	$600	4	$2,400	$612	2	$1,224
	91-105	$707	0	$0	$721	3	$2,162	$735	0	$0	$750	0	$0	$765	0	$0
	105 +	$942	0	$0	$961	3	$2,883	$980	2	$1,960	$1,000	2	$2,000	$1,020	0	$0
Activity Total			130	$34,648		80	$29,659		61	$18,979		85	$26,308		42	$13,500
Tree Removal Not including stump removal or site restoration	0-15	$149	6	$894	$152	7	$1,064	$155	6	$930	$158	2	$316	$161		$0
	16-30	$298	3	$894	$304	4	$1,216	$310	1	$310	$316	1	$316	$323	2	$645
	31-45	$447	7	$3,130	$456		$0	$465	8	$3,722	$475	4	$1,898	$484	7	$3,388
	46-60	$596		$0	$608	1	$608	$620	4	$2,481	$633	3	$1,898	$645	3	$1,936
	61-75	$745		$0	$760	1	$760	$775		$0	$791	2	$1,582	$807		$0
	76-90	$894		$0	$912		$0	$930		$0	$949		$0	$968		$0
	91-105	$1,634		$0	$1,667		$0	$1,700		$0	$1,734	1	$1,734	$1,769		$0
	105 +	$2,186		$0	$2,230	1	$2,230	$2,274		$0	$2,320		$0	$2,366		$0
Activity Total			16	$4,919		14	$5,879		19	$7,443		13	$7,745		12	$5,969
Stump Removal Includes site restoration	0-15	$149	6	$894	$152	7	$1,064	$155	6	$930	$158	4	$633	$161		$0
	16-30	$232	3	$696	$236	4	$946	$241	1	$241	$246	5	$1,230	$251	2	$502
	31-45	$348	7	$2,434	$355		$0	$362	8	$2,895	$369	5	$1,845	$376	7	$2,635
	46-60	$464		$0	$473	1	$473	$482	4	$1,930	$492	3	$1,476	$502	3	$1,506
	61-75	$580		$0	$591	1	$591	$603		$0	$615	2	$1,230	$627		$0
	76-90	$696		$0	$709		$0	$724		$0	$738		$0	$753		$0
	91-105	$811		$0	$828		$0	$844		$0	$861	1	$861	$878		$0
	105 +	$972		$0	$991	1	$991	$1,011		$0	$1,031		$0	$1,052		$0
Activity Total			16	$4,024		14	$4,065		19	$5,996		20	$7,276		12	$4,643
Young Tree Train	0-15	$13	39	$523	$14	17	$233	$14	23	$321	$14	23	$327	$15	15	$218

Activity	Diameter Class (cm)	2022 Panhandle Cost/Tree	2022 Panhandle # of Trees	2022 Panhandle Total Cost	2023 Parklands Cost/Tree	2023 Parklands # of Trees	2023 Parklands Total Cost	2024 Dockyard Cost/Tree	2024 Dockyard # of Trees	2024 Dockyard Total Cost	2025 Colville Cost/Tree	2025 Colville # of Trees	2025 Colville Total Cost	2026 Esquimalt Village Cost/Tree	2026 Esquimalt Village # of Trees	2026 Esquimalt Village Total Cost
Administration Permits, Customer, Service, Inspections				$22,082			$22,523			$22,974			$23,433			$23,902
Consulting Arborists Contractor				$11,041			$11,262			$11,487			$11,717			$11,951
Repair/ Mitigation of Infrastructure Damage Contractor				$13,249			$13,514			$13,784			$14,060			$14,341
Branch Out Invasive Plant Removal				$36,218			$35,657			$37,811			$23,855			$36.040
Tree Assessments				$17,150			$17,493			$17,843			$18,199			$18,563
Pest & Disease Control				$6,779			$6,915			$7,053			$7,194			$7,338
Demand Work				$29,810			$30,406			$31,015			$31,635			$32,267
Hedge Trimming				$19,299			$19,685			$20,079			$20,481			$20,890
Tree Watering		$134	240	$32,168	$137	240	$32,812	$139	240	$33,468	$142	240	$34,137	$145	240	$34,820
Tree Planting		$1,133	80	$90,654	$1,156	80	$92,467	$1,179	80	$94,316	$1,203	80	$96,203	$1,227	80	$98,127
Grand Total				**$322,564**			**$322,570**			**$322,569**			**$322,570**			**$322,569**

5.2 Tree Inventory and Risk Assessment Management

Many types of tree inventory systems have been used by cities to gather and organize information about their trees. A tree inventory system must meet the specific requirements of that municipality, and provide detailed and useful information that staff will utilize daily to manage workloads more efficiently.

A high-quality, complete inventory helps urban forest managers identify maintenance needs and gives them the ability to execute tasks much more efficiently. Work can be scheduled for specific areas where multiple operations can be performed in a single visit to that area. Overall, tree inventories help to provide increased efficiency, improved community relations, emergency preparedness, justified budgets, and documented actions. An added benefit is that inventories also help to identify characteristics of the urban forest and the tree population which is useful for resource managers when setting targets for improvements.

Esquimalt has been proactive as it has completed a comprehensive tree inventory in 2015. The strengths of this inventory include:

- A complete inventory of all public trees and available planting sites
- A hazard and risk assessment performed by a Certified Arborist
- Primary and secondary maintenance recommendations
- Geospatial information that is managed in a GIS optimized for urban forest management
- Unique identifiers for each tree
- Block side location information
- Multiple attributes including species, DBH, and overall condition

With a robust tree inventory put in place, the Township has set itself up for a successful urban forest management program. This information is vital for Esquimalt to move forward proactively; however, tree inventory data is a snap shot of the current conditions of the trees the moment they are assessed. While Esquimalt has been set up with the capability of managing and continually updating inventory data through the TreeKeeper software, it is inevitable that many trees will not be assessed on an ongoing basis.

Typically, an inventory will be relevant for a period of up to 10 years. After this 10 year period, the Township should consider either completing a full inventory, or partially updating the inventory each year by neighbourhood, as the routine maintenance is scheduled. By completing partial updates, the Township will be able to distribute the associated costs and build the inventory into the rotational maintenance program. For example, on year 11 (2027), the Saxe Point neighbourhood would be scheduled for routine maintenance (if it was initially scheduled in 2017). During this rotation, an inventory arborist would inventory the trees, and while the inventory is being conducted, primary and secondary maintenance recommendations would be used to fill work orders on routine work to be completed that year. The inventory arborist would inventory and assess trees a step ahead of the maintenance crews completing the tree work. Another great benefit of building the inventory into the rotational maintenance program is that the inventory arborist

would also be conducting risk assessments as part of a rotational risk assessment program. This would ensure that all trees are assessed at least once every 10 years.

In the interim, the inventory should be updated continually as maintenance work is completed and site inspections are made. Investing in hand held PDA's or tablet personal computers would enable Township staff to quickly and effectively update the inventory while in the field.

5.3 Managing Risk

Urban forestry programs typically highlight public safety as a priority. It is impossible to maintain trees free of risk; some level of risk must be accepted by the community to experience the benefits that trees provide. Developing and implementing a tree risk plan will increase public safety, reduce the potential woody debris loads generated by storms, and move Esquimalt one step closer to a proactive urban forestry program. A tree risk plan will locate trees with defects, plan for the remediation of high-risk situations, and implement the recommended maintenance work before the trees fail and create crisis management situations.

Township of Esquimalt ©

According to the USDA Forest Service, a tree is considered hazardous when structural defects in its roots, stem, or branches create an unacceptable risk of failure that may cause injury to people or damage to property (Pokorny et al., 2003). The word "hazard" often means that some threshold of acceptable risk has been passed and implies a sense of immediacy to some corrective action. Arborists who perform tree risk assessments are assigning tree risk ratings based on factors that include: likelihood for tree (part) failure; likelihood of the failed part impacting a target; and consequences of the impact. The risk assessor must also establish a timeline for assessment. Tree risk managers will then use these ratings to determine which trees are "hazardous" and need corrective action.

Tree defects often derive from injury or disease that seriously weakens part of the tree, predisposing the tree to failure. Defects also arise from poor tree architecture in stems and branches that lead to weak branch attachments, shallow rooting habits, and inherently brittle wood. Structurally sound and healthy trees may be considered high risk if they interfere with utilities, roadways, walkways, raise sidewalks, or obstruct motorist vision (Pokorny et al., 2003).

An effective tree risk program begins with an inventory of public trees that includes a tree risk assessment for each tree. The collected data should be placed in a software database system that

will organize and analyze the tree data so that tree risk priorities can be made. A tree risk manager (the Manager of Parks & Facilities Services of Esquimalt) can then review the list of trees and take steps to mitigate or completely remove the risk.

Sonic Tomography, an example of a Level III Assessment. ©

5.3.1 Recommended Risk Rating Methodology

While there are several tree risk rating methodologies in use, a municipality should ensure that the rating system they use is compatible with their tree inventory system. It is recommended that Esquimalt continue to perform risk assessments based on the International Society of Arboriculture (ISA) Basic (Level II) Tree Risk Assessment Qualification protocol, as used during the inventory in 2015. This assessment is a detailed visual inspection of a tree and the surrounding site, including potential targets. The tree risk assessor will first observe the tree at a distance, and then completely walk around the tree while assessing the site, roots, trunk, and branches. Simple tools may be used during this assessment; however, they are not mandatory. For example, the assessor may use a diameter tape and clinometer to measure the overall size of the tree and binoculars may be used to assess branches in the upper crown. With this assessment, internal, belowground, and upper-crown issues may be difficult to detect; however, the assessor may request that the tree be re-inspected and assessed in more detail if necessary (Smiley et al., 2012).

Once the assessment has been performed, information that is collected is used to categorize the level of risk the tree poses. Once a risk rating is assigned, mitigation measures can be recommended. Tree risk assesses the likelihood of a tree failing, the likelihood of striking a target, and the consequences of failure (Dunster et al., 2013).

According to the ISA, the likelihood of failure is categorized using the following guideline:

> **Improbable** – the tree or branch is not likely to fail during normal weather conditions and may not fail in many severe weather conditions within the specified time frame (typically 1-5 years).
> **Possible** – failure could occur, but it is unlikely during normal weather conditions within the specified time frame.

Probable – failure may be expected under normal weather conditions within the specified time frame.
Imminent – failure has started or is most likely to occur in the near future, even if there is no significant wind or increased load.

The likelihood of impacting a target is categorized using the following guideline:

Very low – The chance of the failed tree or branch impacting the specified target is remote.
Low – it is not likely that the failed tree or branch will impact the target.
Medium – the failed tree or branch may or may not impact the target, with nearly equal likelihood.
High – the failed tree or branch will most likely impact the target.

These two ratings are combined to determine the overall likelihood of failure and impact using the following matrix (Dunster et al., 2013):

Table 9: Likelihood matrix for Level II risk assessment

Likelihood of Failure	Likelihood of Impacting Target			
	Very low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

The consequences of failure are then categorized using the following guideline:

Negligible – Low-value property damage or disruption that can be replaced or repaired, and do not involve personal injury.
Minor – Low-to moderate property damage or small disruptions to traffic or a communication utility.
Significant – Property damage (moderate to high value), considerable disruption or personal injury.
Severe – serious personal injury or death, damage to high-value property, or disruption of important activities.

This information is combined with the likelihood of failure and impact to determine overall risk using the following matrix (Dunster et al., 2013):

Table 10: Risk rating matrix for Level II risk assessment

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

5.3.2 Mitigation Recommendations

Public safety can be increased and potential tree debris generated from storm events can be reduced if high-risk trees are remediated. Options include moving the target, pruning the tree, or removing the tree. Cabling and bracing and creating a wildlife habitat tree are options in some cases.

Moving a potential target away from a high-risk tree will reduce risk; however, it is only recommended if removal and pruning cannot be completed immediately. Removing the target does not prevent a tree from failing, it only reduces the risk. Typically, moving a target away from a tree that is likely to fail is a short-term solution and pruning or removal may be necessary to reduce the risk to acceptable levels (Pokorny et al., 2003).

Tree defects such as dead and/or broken branches can occur even when the rest of the tree is sound. In these cases, pruning the branch or branches can correct the problem and reduce the risk associated with the tree (Pokorny et al., 2003).

Pruning is recommended when:

- A branch is dead, but trunk condition is still acceptable.
- A branch of sufficient size and/or weight is cracked or decayed.
- A weak branch union exists and one of the branches can be removed.
- Branches have poor form, sharp angles, a twist, or bend.
- A branch is lopsided or unbalanced.
- A broken branch is lodged in the crown (hanger).
- A branch is improperly pruned or topped.
- A branch is obstructing the view of signs, signals, or limits visibility of traffic.

Although tree removal is usually considered a last resort and can stir emotions from the community, there are circumstances when it is necessary. Trees should be removed when corrective pruning or installation of hardware will not adequately reduce the risk or it is cost-prohibitive to correct the problems. Additionally, trees that cause obstructions or interfere with power lines and other infrastructure should be removed when their defects cannot be removed through pruning or other maintenance. A tree can also be considered a high risk if it adversely affects public service and safety goals such as obstructing proper sight distances at intersections, compromising uninterrupted power service, and heaving sidewalks.

Cabling and bracing does not repair a high-risk tree, but when done correctly by a trained arborist, it can reduce the amount of stress on branches with poor structure, thus reducing the amount of risk associated with the tree. Done incorrectly, cabling and bracing can create a more serious risk. Cabling and/or bracing is recommended as treatment for a high-risk tree only if the tree has significant historic or landscape value. Cabling and bracing systems should be monitored on a yearly schedule, and to manufacturer's specifications. Hardware requires replacement whenever changes to the tree or the hardware occur (Pokorny et al., 2003).

Some high-risk trees are good candidates for conversion into a wildlife habitat tree (Pokorny et al., 2003). Suggestions include:

- Trees with defects in low use areas.
- Trees with characteristics such as cavities suitable for wildlife habitat.
- Removing or reducing the size of defective scaffold branches.
- Shortening the trunk to minimize the chance that the tree will fail.
- Leaving cavities for wildlife to inhabit.

5.4 Tree Planting Program

Currently, Esquimalt's tree planting program is guided by an annual review of the Township's streets, natural areas, and parks. This review aims to determine where the greatest need for tree planting exists. Tree planting operations are also guided by property owner requests, replacement of removed trees, natural area planting in parks, and planned landscape planting in conjunction with construction and land development. The Township maintains an annual goal of planting a minimum of 80 trees.

Before a tree is planted on public property, the adjacent property owner is notified with a "Branch Out" door knocker that informs them of the proposed planting. Contact information is provided to give the property owner an opportunity to request an alternate species or to request to not have a tree planted. If requests for specific trees are made, the Township will send staff to meet with the owner to discuss what tree species may be suitable for the site. Property owners may also contact the Township at any time to request a tree to be planted. If a request is made, the typical wait time is up to 1year.

Earth day 2013. Town of Esquimalt ©

There are a number of cost-sharing programs put in place. BC Hydro provides a re-greening grant of $8,000 per year, citizens can donate trees, residents can share the costs of the tree planting if they wish to expedite the process or plant a particular species, and the Township receives $1,000 – 2,000 per year in private donations. Furthermore, Esquimalt receives roughly $15,000 annually for tree replacements through the permitting process. This money is placed in a trust fund to be used for tree planting initiatives throughout the Township.

Tree planting is completed by experienced and qualified personnel in accordance with ANSI A300 Standards. Trees are watered for a period of 1-3 years post-planting. The following recommendations are provided to improve the success of Esquimalt's tree planting program:

- Newly planted trees should be added to the Township's inventory using Treekeeper 7. This will allow all maintenance needs and work performed to be tracked.
- Trees should be inspected by Township staff or a Certified Arborist immediately after planting and again at the end of the guarantee period.
- Newly planted trees should be placed on a young tree maintenance program starting in the third year after planting.
- Maintain a database with mortality surveys for newly planted trees that fail to establish. These surveys would identify key factors causing mortality in order to improve the success of future planting efforts.
- Review and revise stock sourcing procedures as well as assess the success of various species and adjust planting densities accordingly.
- Township staff should inspect the work of tree planting contractors to ensure compliance with contract specifications
- Pre-inspect all tree stock at the nursery to ensure the delivery of quality trees.

5.5 Priorities and Key Planting Locations

As the human population of Greater Victoria continues to grow, there is an increasing need to promote sustainable development and raise awareness of the importance of the urban forest. A study on urban forest canopy cover in 2013 by Caslys Consulting Ltd., has found that from 2005 – 2011, Esquimalt has seen a 9.7% increase in impermeable surface area and a subsequent 5.8% decrease in treed land covers over the same time period. Overall, Esquimalt was found to have the third lowest amount of canopy cover when compared to other municipalities in the Capital Region District (Caslys Consulting Ltd., 2013). With this in mind, the Township needs to set canopy cover targets in place to ensure that no net loss of the urban forest and its potential benefits is realized. Action must be taken to reduce the rate of tree loss and to plant new trees where possible. Developing a planting program with set targets and key planting locations is an important step in achieving this goal.

In order for Esquimalt to improve its overall canopy cover, the Township must first determine what the achievable canopy cover targets would be. Currently, no canopy cover targets exist for the Township; however, resources exist to aid in making these decisions. American Forests (a non-profit conservation organization in the United States that promotes healthy forests and urban tree planting) has developed guidelines that can be used as starting points for communities to set their own goals. Targets are typically based on the community's unique mix of climate, geography, land-use patterns, resource structures, and attitudes. The research completed by American Forests suggests that an overall canopy cover target of 40% would be achievable for municipalities in the Pacific Northwest. This overall canopy cover target comprises a mix of canopy targets for various land uses as follows:

Table 11: Suggested canopy cover targets by land use

Land Use Type	Canopy Cover Target
Suburban Residential	50%
Urban Residential	25%
Street Right of Ways	25%
Central Business Districts	15%
Overall Total:	40%

With these suggested targets in mind, the Township will require an up-to-date urban forest canopy cover study to determine what the current levels are in the various land-use types across the Township. With this information, Esquimalt will be able to identify key areas (land use types) that require attention to tree planting and retention of existing trees.

Urban forest canopy cover is an important measure of urban forest sustainability. However, it is only one measure and does not, in itself, tell a complete picture. For example, it does not describe species diversity, age, and diameter distributions, or provide hazard tree assessments. With this in mind, maintaining an up-to-date tree inventory, setting targets on species diversity, and developing a proactive maintenance program are equally important. All of these tools, when used in combination, will ensure the long-term health and success of the urban forest.

5.6 Species Selection

As discussed in the Principal Inventory Analysis, recommended maximum densities of species populations are not to exceed 30% from a single family, 20% from a single genus, and 10% for a single species (Lilly & Currid, 2010). Esquimalt has 37% of its urban forest in the Rosaceae family, 23% in the Prunus genus, and 19% is the cherry plum (*Prunus cerasifera*) species. While Esquimalt was found to be rich in overall species diversity, the proportions of families, genera, and species can be better balanced.

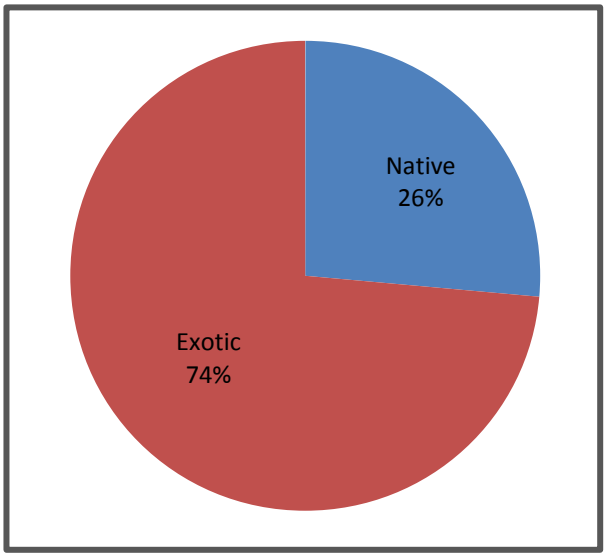

Figure 6: Native versus exotic population distribution

The use of native species is also an essential aspect of species selection. Of course, invasive species should be avoided, especially within proximity to natural areas, but even non-invasive exotic species may not provide as many benefits as their native counterparts. Native trees are essential for an urban forest to support local ecosystems. They are often the best species to select when it comes to adaptation to the local climate and tend to have the greatest resistance to local pests and diseases. On a cultural level, native species are part of Esquimalt's natural heritage which helps give the Township a unique character and sense of place. Even with these benefits in mind, however, a further analysis of Esquimalt's species distributions shows a preference to planting non-native species.

As shown in Figure 7, a total of 74% of Esquimalt's urban forest is composed of exotic species, with the remaining 26% being native. Furthermore, Figure 8 shows that of the 26% of the native species population, 60% is comprised of only two species. As a result, Esquimalt's urban forest has a low proportion and diversity of native tree species. These variables are important to bear in mind when selecting species for future tree planting efforts in the Township.

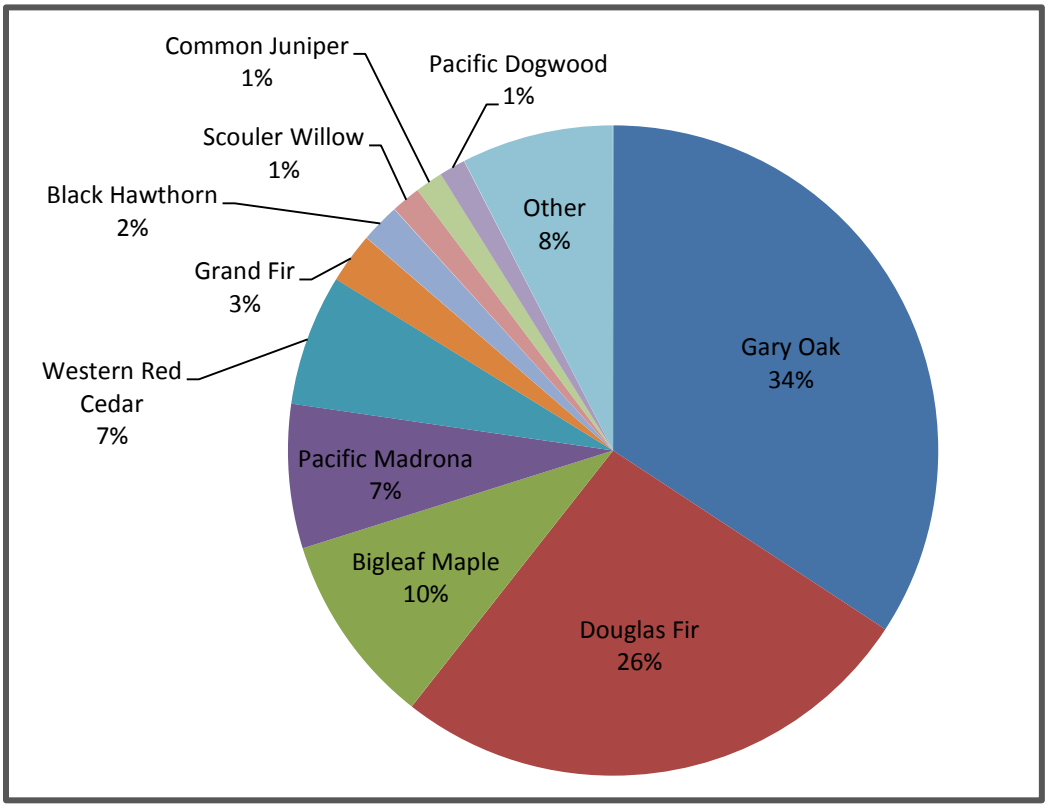

Figure 7: Top 10 native species distributions

Proper landscaping and tree species selection are critical components to the character, livability, and ecological quality of a community's urban forest. Urban trees require careful site selection as part of responsible planting practices. Adopting a philosophy such as "right tree, right location", will ensure that trees are selected that will best suit the chosen site.

5.7 Recommended Planting Lists

The recommended planting list provided is offered to assist all relevant community personnel in selecting appropriate tree species. These trees have been selected because of their functional characteristics and their ability to exist in the majority of soil and climate conditions found throughout the Esquimalt area. This suggested species list was compiled using excellent references including Dirr's *Hardy Trees and Shrubs* (Dirr, 2003), the *Manual of Woody Landscape Plants* (5th Edition) (Dirr, 1998), Trees in Canada (Farrar, 2007), as well as existing tree species lists for Esquimalt. Tree sizes have been categorized as small (1-9 m), medium (10-15 m), and large (16+ m), based on the references used to compile the list.

Table 12: Recommended coniferous trees for planting

CONIFEROUS TREES								
Scientific Name	Common Name	Cultivar	Mature Size	Boulevard	Parks	Woodlands	Tree Pits	Native
Abies balsamea	Balsam Fir		L		✓		✓	
Abies concolor	White Fir		L		✓			
Abies fraseri	Fraser's Fir		L					
Abies grandis	Grand Fir		L		✓	✓		✓
Abies lasiocarpa	Alpine Fir		L		✓	✓		✓
Abies procera	Noble Fir		L		✓			
Araucaria araucana	Monkey Puzzle Tree		L		✓			
Chamaecyparis nootkatensis	Nootka Cypress		M		✓			✓
Picea abies	Norway Spruce		L		✓			
Picea glauca	White Spruce		L		✓			
Picea omorika	Serbian Spruce		L		✓			
Picea pungens	Colorado Spruce	Glauca' 'Hoopsii' 'Koster'	L		✓			
Picea sitchensis	Sitka Spruce		L		✓	✓		✓
Pinus agriffithii wallichiana	Himilayan White Pine		M			✓		
Pinus contorta	Shore Pine		M		✓	✓		✓
Pinus monticola	Western White Pine		M		✓	✓		✓
Pinus ponderosa	Ponderosa Pine		L		✓			
Pinus radiata	Monterey Pine		L		✓			
Pinus thunbergii	Japanese Black Pine		L					
Pseudotsuga	Douglas Fir		L		✓	✓		✓
Sequoia sempervirens	Coast Redwood		L		✓			
Sequoiadendron giganteum	Giant Redwood		L		✓			
Taxus brevifolia	Pacific Yew		S-M		✓			✓
Thuja plicata 'Aurea'	Western Red Cedar	Aurea' 'Excelsior'	L		✓	✓		✓
Tsuga canadensis	Canadian Hemlock		L		✓			
Tsuga mertensiana	Mountain Hemlock		L		✓			✓

Table 13: Recommended deciduous trees for planting

DECIDUOUS TREES								
Scientific Name	Common Name	Cultivar	Mature Size	Boulevard	Parks	Woodlands	Tree Pits	Native
Acer buergeranum	Trident Maple		S	✓			✓	
Acer campestre	Queen Elizabeth Maple	Queen Elizabeth Maple' 'Red Shine Maple'	S	✓				
Acer ginnala	Amur Maple		S	✓				
Acer glabrum	Rocky Mountain Maple		M	✓	✓	✓		✓
Acer griseum	Paperbark Maple		S	✓			✓	
Acer macrophyllum	Bigleaf Maple		L	✓	✓	✓		✓
Acer platanoides	Norway Maple	Crimson King' 'Crimson Sentry' 'Deborah' 'Drummondii' 'Emerald Queen' 'Fairview' 'Globosum' 'Princeton Gold' 'Royal Red' 'Schwedleri'	M	✓				
Acer psuedoplatanus	Sycamore Maple		L	✓				
Acer rubrum	Red Maple	Armstrong Maple' 'Autumn Flame Maple' 'Bowhall Maple' 'Columnar Red Maple' 'Karpick Maple' 'Morgan Maple' 'October Glory Maple' 'Red Sunset Maple' 'Scanlon Red Maple' 'Scarlet Maple'	L	✓	✓			
Acer saccharum	Sugar Maple	Legacy Sugar Maple'	L	✓	✓			
Acer truncatum	Sunset Maple	Norwegian Sunset' 'Pacific Sunset'	M	✓			✓	
Acer x freemanii	Autumn Blaze Maple		M	✓				
Aesculus hippocastanum	Common Horsechestnut		L	✓				
Aesculus x camea	Red Horsechestnut	Briotii' 'Fort McNair'	M	✓				
Arbutus menziesii	Arbutus		M	✓	✓	✓		✓
Betula lanciniata	Weeping Birch		M	✓	✓			

DECIDUOUS TREES								
Scientific Name	Common Name	Cultivar	Mature Size	Boulevard	Parks	Woodlands	Tree Pits	Native
Betula nigra	River Birch		M	✓	✓			
Betula papyrifera	Paper Birch		M	✓	✓		✓	
Betula platyphylla	Asian White Birch		M	✓			✓	
Carpinus betulus	European Hornbeam	Fastigate' 'Franz Fontaine Hornbeam'	M	✓				
Catalpa bignoides	Common Catalpa		L	✓				
Catalpa speciosa	Western Catalpa		L	✓				
Celtis occidentalis	Hackberry		S	✓				
Cercidiphyllum japonicum	Katsura Tree		M	✓				
Cercis canadensis	Eastern Redbud		S	✓				
Cornus florida	Flowering Dogwood		M	✓				
Cornus nuttallia	Pacific Dogwood	Eddie White Wonder'	M	✓	✓	✓	✓	✓
Davidia involucrata	Handkerchief Tree		M	✓	✓			
Fagus grandiflora	American Beech		L	✓	✓			
Fagus sylvatica	European Beech	Autopurpurea' 'Dawyck' 'Dawyck Purple' 'Purpurea'	L	✓	✓			
Fraxinus americana	White Ash	Autumn Applause Ash' 'Autumn Purple Ash'	L	✓				
Fraxinus excelsior	European Ash	Westhof's Glory'	L	✓				
Fraxinus omus	Flowering Ash	Arie Peters'	M	✓				
Fraxinus pennsylvanica	Green Ash	Patmore' 'Summit' 'Urbanite' 'Leprechaun'	L	✓				
Ginkgo biloba	Maidenhair Tree	Princeton Sentry'	M-L	✓				
Gleditsia triacanthos inermis	Thornless Honeylocust	Shademaster' 'Skyline' 'Sunburst'	L	✓				
Juglans nigra	Black Walnut		L		✓			
Koelreuteria paniculata	Golden Rain Tree		M	✓			✓	
Laburnum watereri	Goldenchain Tree		M	✓			✓	
Liquidambar styraciflua	Worplesdon Sweetgum		M-L	✓	✓			
Liriodendron tulipifera	Tuliptree		L		✓			
Maackia amurensis	Amur Maackia		S	✓			✓	

DECIDUOUS TREES								
Scientific Name	Common Name	Cultivar	Mature Size	Boulevard	Parks	Woodlands	Tree Pits	Native
Magnolia acuminate	Cucumber Tree		M	✓				
Magnolia 'Galaxy'	Galaxy Magnolia		S	✓				
Magnolia kobus	Kobus Magnolia		S-M	✓				
Magnolia soulangiana	Saucer Magnolia		S	✓				
Malus floribunda	Japanese Crabapple		S	✓				
Malus x 'Prairiefire'	Prairiefire Crabapple		S	✓				
Metasequioa glyptostroboides	Dawn Redwood		L		✓			
Nothofagus antarctica	Antarctic Beech		M					
Nyssa sylvatica	Black Gum		M	✓	✓			
Parrotia persica	Persion Ironwood		S	✓			✓	
Phellodendron amurense	Amur Cork Tree		M	✓				
Platanus acerifolia	London Plane Tree		L	✓	✓			
Prunus blireana	Japanese Flowering Plum		S	✓				
Prunus cerasifera pissardi	Purpleleaf Plum		M	✓	✓		✓	
Prunus sargentii	Sargent Flowering Cherry		M	✓			✓	
Prunus serotina	Black Cherry		M		✓			
Prunus serrulat	Japanese Flowering Cherry		S	✓	✓		✓	
Prunus subhirtella	Higan Cherry		S		✓		✓	
Prunus virginiana	Chokecherry		S	✓	✓		✓	✓
Prunus yedoensis	Yoshino Cherry		M	✓	✓		✓	
Pyrus calleryana	Chanticleer Pear		S	✓				
Quercus acutissima	Sawtooth Oak		M	✓				
Quercus coccinea	Scarlet Oak		L	✓	✓			
Quercus garryana	Garry Oak		L	✓	✓	✓		✓
Quercus palustris	Pin Oak		L	✓	✓			
Quercus phellos	Willow Oak		L	✓				
Quercus robur	English Oak	Fastigiata'	L	✓				
Quercus rubra	Red Oak		L	✓	✓			
Quercus shumardii	Shumard Oak		L	✓	✓			
Sophor japonica	Upright Japanese		M	✓				

DECIDUOUS TREES								
Scientific Name	Common Name	Cultivar	Mature Size	Boulevard	Parks	Woodlands	Tree Pits	Native
	Pagoda Tree							
Sorbus airia 'Lutescens'	Whitebeam		M	✓			✓	
Syringa reticulata	Ivory Silk Tree		S	✓			✓	
Tilia americana	Basswood	Redmond'	L	✓				
Ulmus americana	American Elm		L	✓				
Zelkova serrate	Japanese Zelkova	Green Vase Zelkova'	M	✓			✓	

5.8 Urban Forestry Bylaws

As previously discussed, Esquimalt's revised Tree Protection Bylaw (No. 2837) has improved clarity, allowed residents easier access to enhance their landscaping, as well as improved tree protection provisions.

Esquimalt's latest Tree Protection Bylaw was reviewed and compared to those of other Canadian cities and was found to be comprehensive overall. If properly and adequately enforced, the Bylaw is a good foundation for the continuation and advancement of proper urban forest management and protection in Esquimalt. As the field of urban forestry and the methods of tree establishment and preservation continue to improve and evolve, and as the Township continues to grow and develop, the Bylaw should be reviewed and amended every 5-10 years, or as otherwise necessary.

The following recommendations are provided as a suggestion to be considered during future Bylaw reviews:

- Include a statement prohibiting the planting of trees on public property without the written consent of the Township.
- Establish a standard Minimum Tree Protection Zone (MTPZ) distance for all Protected Trees. Currently, the "Avoiding Tree Damage During Construction" brochure specifies 0.3 m of protection for every 2.5 cm of trunk diameter. This information would be beneficial to include in the Bylaw. MTPZ distances can also be established based on diameter classes and presented in table form in order to make them more accessible. MTPZs are useful for restricted sites, in situations where the crown has experienced dieback or pruning, or in situations where the drip line may be difficult to measure. Furthermore, MTPZs help to better protect conifers and fastigiate trees with typically narrow crowns. Stipulate that the MTPZ or Drip Line, whichever is greater, will be used to determine the Tree Protection Zone.
- Add language to the Bylaw that addresses concerns about protection of woodland buffers, ravines, and other natural areas.

- Create a list of species not permitted for planting on public property. Examples of species to prohibit may include those with prominent thorns, large fruits, and those known to be invasive.
- In Schedule "A", in "Prune" or "Pruning", specify where diameter is measured on tree limbs.
- In Schedule "A", include a definition for "Hedge".

5.9 Standards and Policies

Standards and Policies that were reviewed include Tree Planting, Tree Protection Barriers, and Trees and Construction. Creating such documents involves a range of tasks that includes gathering current accepted standards within the industry and applying those standards to current and local conditions. As new research and information becomes available, many standards need to be updated to reflect new arboricultural knowledge and techniques.

5.9.1 Tree Planting

Developing standardized tree planting specifications is beneficial because it sets the guidelines that developers, homeowners, and contracted tree planters should follow. These guidelines not only help to ensure that trees are planted correctly, but they also ensure accountability with those completing the work. Furthermore, setting standards in tree planting ensures that trees have a higher success rate in the short and long-term, which is favourable to the overall health and benefit of the urban forest in Esquimalt. For example, by specifying what trees can be planted under utilities and how far trees should be spaced from each other and surrounding infrastructure (such as roads, sidewalks, buildings, etc.), the amount of future tree related conflicts with these landscape features can be reduced. Upon reviewing the tree planting specifications provided by the Township, the following recommendations are made:

- Develop tree planting specifications for various planting sites such as raised planters, tree pits, and open areas.
- Comprise a list of suitable species for planting near overhead utilities.
- Determine appropriate distances for tree spacing to adjacent trees, property lines, and infrastructure such as sidewalks, roads, traffic signs, and utilities.
- Develop planting details for bare root and potted trees.
- Improve visual clarity of the Tree Planting Diagram as seen in Schedule "B" of the Bylaw.
- Review planting standards every 10 years to account for changes in industry standards.

5.9.2 Tree Protection Barriers

The current Tree Protection Barrier specification for Esquimalt includes a diagram specifying the construction material, location, and restrictions of barriers. This information is also included in the "Avoiding Tree Damage During Construction" brochure. The following recommendations are suggested to improve the accessibility of information and effectiveness of Tree Protection Barriers:

- Include standard signage to be posted on tree protection fences to inform the public and the contractors of the importance of the Tree Protection Zone. It is recommended that this signage be mandatory and installed on all sides of the barriers.
- Specify whether the barriers should be free-floating or anchored to the ground using T-bars or similar methods.
- Include standard dimensions on the diagram.
- Consider requiring plywood in place of plastic mesh screening when fill or excavate may be stored near a barrier. Plywood is not recommended near roadsides where visibility is essential.
- Consider adding sediment control fencing specifications for areas where fill or excavate are stored.
- State that protection fencing should be installed as per the approved Tree Protection Plan.
- Specify that approval of the Tree Protection Barriers is required prior to commencement of construction.
- Specify that protection barriers may not be altered without prior approval from Esquimalt staff.
- The diagram as included in Schedule "B" of the Bylaw should include all relevant information in a concise format.
- The brochure may include more supplementary information including pictures, who may install the barriers, root protection options for construction access points and sediment control options.

5.9.3 Trees and construction

The "Avoiding Tree Damage During Construction" brochure is aimed at providing supplementary information pertaining to construction and tree preservation. It includes information on how trees are damaged during construction, where to get advice for tree preservation options, planning, and installing tree protection barriers. This brochure was reviewed and recommendations are provided to help developers and property owners to better protect trees during construction.

- Include a section on Site and Landscape Plans that stipulates that the precise location of each tree, existing and proposed infrastructure, construction access points and staging areas, root exploration and pruning areas, Tree Protection Zones, and Tree Protection Barriers should be included in the plan. These plans would preferably be completed by a Certified Arborist.
- Include a section on Tree Replacement Plans with information on Tree Guarantee Deposits for replacement trees.
- Include a section on Arboricultural Work that stipulates what sort of tree preservation activities must be completed by a qualified Arborist and at what time. This may include root exploration, root and canopy pruning, construction monitoring, and post-construction reporting and remedial activities.

- Comprise a list of common tree species in Esquimalt that are intolerant of construction impacts.
- Add information pertaining to migratory birds and species at risk.
- Add information pertaining to shared trees, or neighbour owned trees that may be impacted by construction.
- Include specifications for horizontal root protection that may be necessary in places where required construction access limits the extent of Tree Protection Barriers.

While the brochure, overall, is a useful tool to aid development in taking the necessary precautions pertaining to tree preservation – these recommendations cannot be enforced if they are not developed into a set policy or standard. The short term (0-5 years) recommended goal for Esquimalt is to continue compiling this information and making it available on the Branch Out web page, while the long term (5-10 years) recommended goal is to develop the information into a formal policy.

5.9.4 Woodlands

Woodland buffers are natural, forested areas that exist on both public and private properties. These areas provide valuable canopy coverage and air quality benefits for the entire Township as well as site-specific benefits such as privacy, recreational opportunities, wildlife habitat, storm water retention, and energy reduction. Woodlands are an especially valuable municipal asset because they provide these benefits with very little investment in management, maintenance, and planting costs. Separate policies need to be developed in order to successfully maintain these landscape features and ensure their continued presence in the Township. These policies currently do not exist for Esquimalt. It is recommended that the Township review natural area protection standards developed by other municipalities which can be used as a basis for its own policy development in this area. The policy would ideally incorporate a target level of intact woodland canopy cover, which is important because it is possible to have a high total urban forest canopy cover while having little or no intact woodlands. These policies should help to guide land use decisions for publicly owned woodland buffers and incorporating them as appropriate bylaw provisions that would regulate the loss of woodlands on private property.

5.9.5 Other Standards and Policies

The benefit of adopting standards and policies is to guide the processes involved with carrying out municipal tasks and to provide useful guidelines for performing urban forestry related activities and creating consistency in operations as staff turnover occurs. The overall goal of these standards and policies is to improve the state of the urban forest and ensure its long term success. With this in mind, other recommendations include:

- Developing a policy that more trees will be planted each year than will be removed. Without this simple goal, a net loss of tree cover will occur in Esquimalt, reducing the overall benefits provided by its urban forest. Ensure that adequate funds are budgeted to maintain trees that are planted.

- Making tree preservation a more significant part of the plan/site review process for all Urban Forestry staff in all phases of site development.
- Reviewing the Township's policies and standards every 5 to 10 years and including public consultation concerning major revisions.

5.10 Public Relations and Education

Esquimalt may go through great lengths to manage and enhance its urban forest; however, for most municipalities, a large proportion of trees exist on private property. Residential and commercial property owners influence much of the Township's canopy cover through the actions they take to care for trees on their properties. The public further influences the urban forest through its ability to participate in public processes regarding land development and policy making. This influence can be seen on both public and private lands. As a result, it is vitally important for Esquimalt to educate and inform the public on the importance and benefits of the Urban Forest and to provide them with the necessary information and resources on all aspects relating to tree care and establishment.

Earth day 2013. Township of Esquimalt ©

5.10.1 Communicating the Program and Urban Forest Benefits

The citizens effectively own both the public and private urban forests. Without greater political support and increased citizen understanding and commitment, urban forest management in Esquimalt may not reach its full potential. Therefore, it is important for staff to communicate with and educate the public about the benefits of trees, the Urban Forestry Section's programs, and what can be done to improve both their own trees and public trees.

Creating a comprehensive communication plan will help deliver key messages. This plan would highlight the existing efforts and resources; identify opportunities, and integrate Township and stakeholder efforts and resources to maximize the effectiveness of all communication efforts. A number of actions can be taken to better promote the urban forestry program and public participation:

- Create a marketing campaign for urban forest programs to capture the attention and support of the community.
- Continue public and citizen urban forestry educational outreach through the Branch Out program. This program includes special events such as guided forest hikes and hands-on tree planting demonstrations and partnerships with local environmental organizations.

- Update the Township's website to include information about cyclical pruning, maps of zones, and schedules.
- Update the Township's website to include photos and recommended trees for planting.
- Develop a central, unifying theme or message for the urban forestry program that the Township and all stakeholders can use.
- Distribute the i-Tree benefits results to demonstrate the environmental impact and value of trees to internal and external customers of the urban forest management program.
- Develop a new program or adapt an existing program to work with local schools to address maintenance of existing trees and to identify opportunities to plant additional trees on school grounds. Assist schools to develop landscape plans for school properties that may include naturalized landscaping, outdoor classrooms, and natural playgrounds.
- Create an educational program orienting newly elected public officials to the Township's urban forestry program, efforts, and goals.

5.10.2 Training and Education of Staff

Training of Township staff involved in urban forestry is vitally important to the success of the program. A number of recommendations are made to improve staff training and education:

- All staff who performs tree related activities should become Certified Arborists or Certified Tree Workers through the International Society of Arboriculture.
- All staff performing tree risk assessments should hold a Tree Risk Assessment Qualification.
- Staff should attend urban forestry workshops for professional development. Knowledge they gain can then be presented and shared with other staff in the department.
- Create a specific budget item that provides dedicated funds for training and professional staff development.
- Incorporate webinar lectures during downtime to keep staff up to date with urban forestry and the latest solutions in tree management.
- Promote internal educational opportunities by increasing professional interaction, coordination, and communication between departments and staff regarding tree planting, maintenance, and tree preservation principles and practices.

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