District of Oak Bay

Urban Forest Management Strategy

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The Vision

Oak Bay is close to nature. Lush, gorgeous treed streets, gardens and wild places are integral to our community's sense of identity. Our urban forest is a diverse and healthy mix of native and non-native trees and plants with a special place provided for the Garry oak as our namesake and the keystone of our native ecosystems. The urban forest supports desirable birds, insects and wildlife and provides places for children to play and for people to connect with nature. Our community has protected, enhanced and restored the distribution of trees and greenery throughout our neighbourhoods. Even as neighbourhoods changed with urban development, we have preserved and renewed Oak Bay's urban forest legacy for future generations.

Executive Summary

Oak Bay's first urban forest strategy is the culmination of years of effort by the community, District staff and Council towards the development of a proactive plan to guide the future of the urban forest resource.

The urban forest of today is a legacy of the stewardship demonstrated early in Oak Bay's history. The plan's vision is about protecting and enhancing that legacy so that Oak Bay's green character and natural heritage persists for the enjoyment of future generations. Recognizing that change in the urban forest is inevitable as trees age, climate shifts and as urban renewal and development proceed, the strategy focusses on how the District's plans, programs and policies can preserve and renew the urban forest.

Oak Bay's urban forest faces several challenges but the community is well-equipped to respond given opportunities including:

- Strong public support for urban trees and urban natural areas;
- Capable staff and supportive District policies;
- Modest capacity to increase resourcing and funding for urban forest management;
- Increasingly affordable technology for mapping and managing the urban forest;
- A large and active community volunteer base actively working to maintain and restore natural areas within the urban forest;
- Eligibility for current funding programs from the Federal Government, Federation of Canadian Municipalities, Tree Canada and potentially others to plan and develop green infrastructure initiatives, engage the community, increase tree planting and improve habitat quality for rare species within the urban forest.

Implementation of the Urban Forest Management Strategy will increase the benefits produced by the urban forest for the community and will complement Oak Bay's broader community goals for climate change, natural environment, neighbourhood, built environment, parks and open space, and transportation.

The Challenges

- **Redevelopment and Other Forms of Development:** Oak Bay's aging housing stock replacement and the other forms of development to be considered could affect existing trees and space for future tree planting.
- **Tree Protection on Public and Private Land:** the current Tree Protection Bylaw does not adequately protect trees through the development process, replacement trees are not adequate to compensate for canopy loss and permit fees are insufficient to cover the cost of administration of the permits.
- **Public Works and Utilities:** the construction of new sidewalks and trails, the combined sewer separation and other capital works projects are likely to conflict with established trees.
- **Degradation of the Natural Environment:** Garry oak and other natural ecosystems in Oak Bay are fragmented and vulnerable to degradation from invasive species, fire suppression, deer grazing and trampling.
- **Climate change:** Warmer and drier summers, milder and shorter winters, more frequent and intense rain events will present challenges to both the urban forest and people of Oak Bay.
- **Healthy tree population:** Oak Bay's trees are healthy but aging trees will require increasing maintenance over time.
- **Managing water and soil:** The soil volumes that have historically supported Oak Bay's tree canopy are at risk from redevelopment or other forms of development, and water availability is expected to decrease due to climate change.
- **Trees and Urban Design**: Oak Bay's large tree canopy in the public realm is integral to the District's character and identity. Maintaining and enhancing Oak Bay's landscape character will require new and replacement plantings that strengthen existing plantings.

The Plan

The urban forest vision will be achieved by implementing the Urban Forest Management Strategy over a **15-year timeframe**. The objectives below summarize the direction for the priority actions to achieve Oak Bay's urban forest vision:

A. Protect and enhance canopy cover to approach 40% by 2045
B. Support a healthy, well-adapted and diverse tree population
C. Manage the urban forest for community climate change adaptation
D. Strengthen natural heritage to support healthy ecological systems and biodiversity
E. Engage and partner with the community to build stewardship of the urban forest

Recommendation Highlights

- Plant 1,400 new trees on public land and work with residents and institutions to plant 5,000 new trees on private property.
- Update the Tree Protection Bylaw to increase the number of trees protected on private land and strengthen tree protection during development.
- Develop public realm planting guidelines and create opportunities to establish more trees in streetscapes and to preserve or improve planting space.

- Implement a proactive zoned tree maintenance program and procure GIS-based mobile data collection technology to improve the urban forest inventory.
- Identify options for increasing green infrastructure projects on public and private land.
- Inventory Garry oak and associated ecosystems, rare and endangered plant species and invasive species throughout the District's natural areas.
- Develop a policy and action plan to guide the District's approach and priorities for improving open space connectivity and ecosystem restoration, and develop a natural area management framework.
- Develop an invasive species and pest management plan and continue to remove invasive species from rare ecosystems in Uplands Park and other natural areas.
- Establish a community engagement program to build stewardship of the urban forest.
- Establish partnerships with the Lekwungen people to represent First Nations values and perspectives in management and restoration of the natural environment.
- Continue to work with First Nations, the Garry Oak Ecosystem Recovery Team and community groups to restore and enhance Garry oak ecosystems.

1 Background + Context

1.1 What is the Urban Forest?

Urban forests include all of the trees and associated resources in urban areas (Nowak, et al., 2001). The urban forest is planted or retained by human design and occurs in and around urban areas where human habitation is concentrated and prioritized. Urban forests include publicly and privately-owned individual trees and groups of trees occurring across the range of urban land uses including parks and natural areas, residential neighbourhoods, streets, dense urban residential and commercial areas, and industrial areas (Figure 1).

> Oak Bay's urban forest has the largest urban population of Garry oaks in Canada and a mature canopy cover of 33% thanks, in large part, to the community's history of tree preservation.

Trees are the core focus of urban forest management because they are keystone structures that provide wide ranging services to our communities and form a critical part of our urban infrastructure. Urban forest ecosystems are characterized by the presence of trees but associated resources including understory plants, water, soil, air, micro-organisms, and wildlife are also a critically important part of the urban forest ecosystem. Each of these resources, in addition to people and the built environment, interact to influence the structure, function and distribution of the urban forest.

Figure 1. Cross-section illustrating the urban forest across a range of urban land uses.

1.2 What is Oak Bay's Urban Forest Strategy?

Oak Bay's Urban Forest Management Strategy (UFMS) establishes a shared vision for the future of the community's urban forest. The strategy defines principles, objectives and measurable targets towards achieving that vision and includes supporting recommendations for implementation over the next 15 years.

Oak Bay's UFMS responds to the specific opportunities and challenges facing the community's urban forest. The UFMS targets and recommendations are derived from best practices and a critical analysis of existing policy and management approaches, stakeholder engagement outcomes and available inventory data. Implementation of the UFMS will increase the beneficial services produced by trees and associated resources to complement Oak Bay's broader community goals for climate change, natural environment, neighbourhood, built environment, parks and open space, and transportation.

There is an opportunity to improve the awareness of Oak Bay residents about how the District manages trees on streets, in parks and in natural areas through the implementation of the Urban Forest Management Strategy.

1.3 Oak Bay's Urban Forest Context

1.3.1 People

The District of Oak Bay is located on the traditional territory of the Songhees and Esquimalt Nations, who self-identify as the Lekwungen people (The Bill Reid Centre, 2016). At the time of European colonization, Lekwungen village sites were distributed along the coastline (Figure 3) (Songhees, 2016) and most of the District was covered with Garry oak parkland or scrub oak ecosystems. First Nations controlled burning practices were critical in maintaining these ecosystems and promoting certain plant species for traditional uses. Since colonization, development has resulted in the loss of most of the natural ecosystems in the District (Fuchs, 2001) and the exclusion of prescribed fire, although Garry oaks still represent a large proportion of the District's urban trees.

Based on the 2011 census, the District of Oak Bay has a population of 18,015 people and a density of 1,710 people per square kilometers (Statistics Canada, 2011), which is high relative to Victoria's metropolitan area average (495 people/km^2) but low relative to the City of Victoria's population density (4,109/km^2). Most of the population resides in single family dwellings and are aged from 15 to 64 (median age 52). Approximately 30% of the population is 65 or older and approximately 10% are younger than 15.

1.3.2 Natural Environment

Oak Bay lies within the Coastal Douglas-fir moist maritime (CDFmm) subzone as defined by the Biogeoclimatic Ecosystem Classification (BEC) system (Ministry of Forests and Range, 2016), which infers areas of similar regional climate from vegetation, soils and topography. The CDFmm experiences warm, dry summers and mild, wet winters; winters are the mildest in Canada. The growing seasons are long and climatic moisture deficits are common each summer.

83% of Oak Bay survey respondents said that the **habitat for native plants and animals** provided by the urban forest is one of its most important benefits.

In Oak Bay, Garry oak ecosystems historically covered 850 ha or approximately 85% of Oak Bay's land area (Garry Oak Ecosystems Recovery Team Society, 2016). Parkland Garry oak communities occurred on deeper soils and scrub oak ecosystems occurred on shallow soils (ibid). Today, Garry oak ecosystems cover only 25 ha or 2.5% of Oak Bay's land area (ibid)[1]. Development has occurred over much of the Parkland Garry oak vegetation communities, where soil and topography were favourable for farming and urban development, but large Garry oak trees persist throughout much of the historic natural ecosystem distribution (Figure 2).

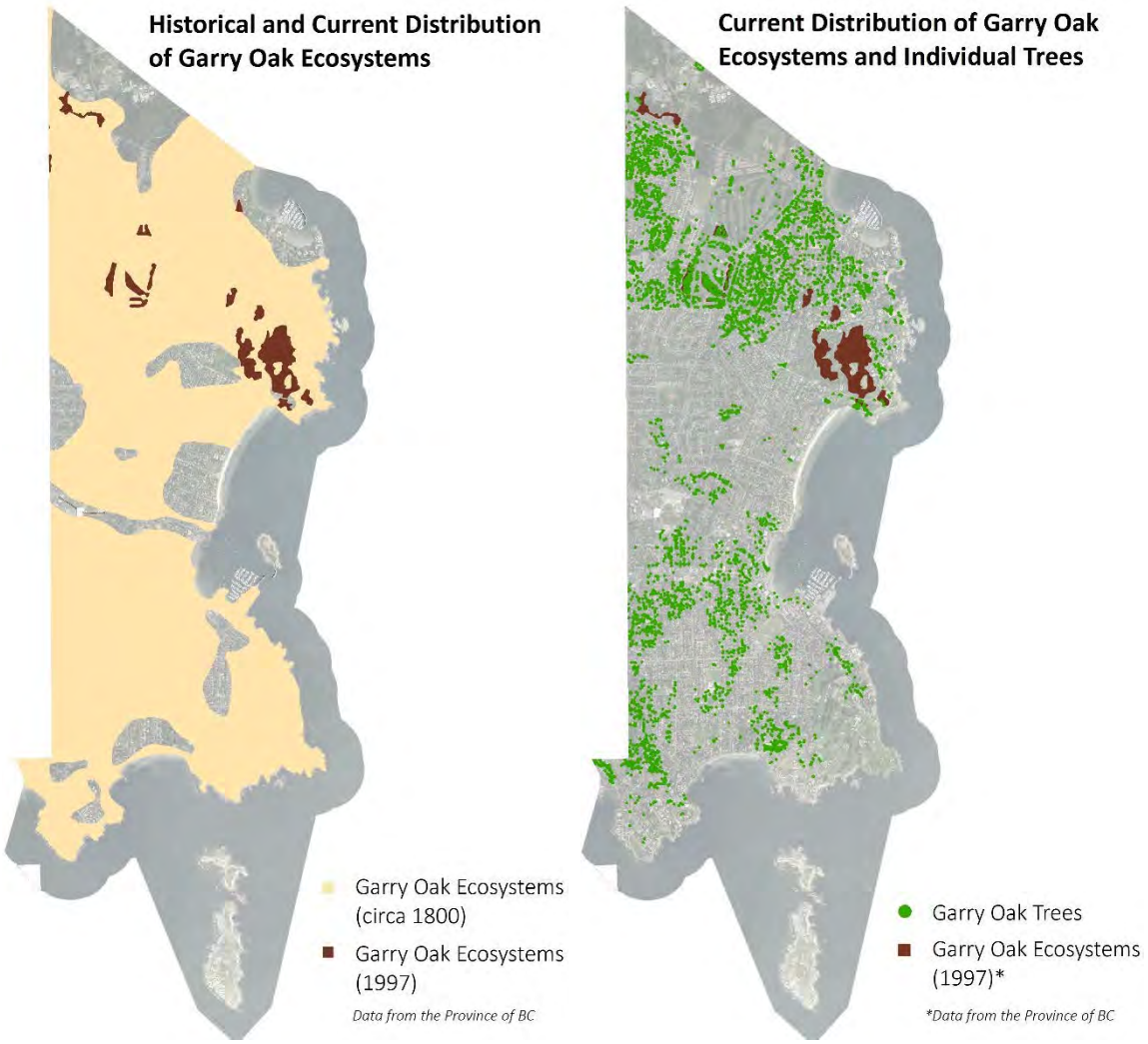


Figure 2. Historical and current distribution of Garry oak ecosystems (left) (Capital Regional District, n.d.), and current distribution of Garry oak ecosystems and individual trees (right) in Oak Bay (Garry Oak trees were mapped for the UFMS).

[1] Geospatial data on the Garry oak ecosystems for the Capital Regional District and Terrestrial Ecosystem Mapping are coarse; finer scale mapping may identify additional Garry oak ecosystems within Oak Bay's natural area parks.

The remnant ecosystems within the District's parks and natural areas consist of Garry Oak with mixed grass understory (typically scrub oak ecosystems on steeper terrain with rocky, shallow soils), Douglas-fir forests and rock outcrops. Oak Bay's remnant ecosystems in areas such as Uplands/Cattle Point support species that are considered at risk provincially and federally, and are of cultural significance to the Lekwungen people. Invasive species and human disturbance are threats to these valuable remnants.

(Kathleen Matthews CC-BY-ND 4.0)

The deep soils that cover much of Oak Bay are favourable for tree growth in urban areas. However, the precipitation falling is not sufficient to meet vegetation evaporative demand for water resulting in annual climatic moisture deficits. Oak Bay, based on historic climate normals, receives approximately 607.6 mm of precipitation annually, most of which falls between October and March. Less than 136.1 mm falls between April and September during the growing season (Environment Canada, 2016). To avoid drought impacts, moisture is needed from sources other than rain (e.g., soil moisture or irrigation). Across the District soil moisture is expected to be deficient for part of the long growing season; soil likely ranges from slightly or moderately dry (>0 to ≤3 months of soil water deficit) on sites with deep soils that naturally support large trees to very dry or excessively dry (> 3.5 months of soil water deficit) on sites with very shallow, rocky soils that naturally support lichen and grass communities. Trees growing in most sites in Oak Bay need to be at least moderately tolerant of drought to perform well.

1.3.3 Human Settlement and Urban Development

Before the arrival of Europeans, the Lekwungen people inhabited the area now known as Oak Bay, and multiple village and shell midden sites were distributed along the coast and creeks (Songhees, 2016) (

Figure 3). Colonial land development began around 1850 but, prior to the 1890s, was limited to a few farm houses, homes, hotels and cottages. After 1906, when Oak Bay was incorporated and roads, sewer and water infrastructure were built, the pace of development increased (

Figure 3). Development between 1916 and 1940 was fairly scattered, filling in vacant lots around pre-existing homes and developing small subdivisions. An increase in development between 1940 and the 1970 saw Oak Bay almost fully developed, with extensive construction in the Uplands neighbourhood, continued development around pre-existing homes, and the large-scale subdivision of Carnarvon Park built on the former fairgrounds (Figure 3). Since the 1970s, new development and redevelopment in Oak Bay has been fairly limited (

Figure 3).

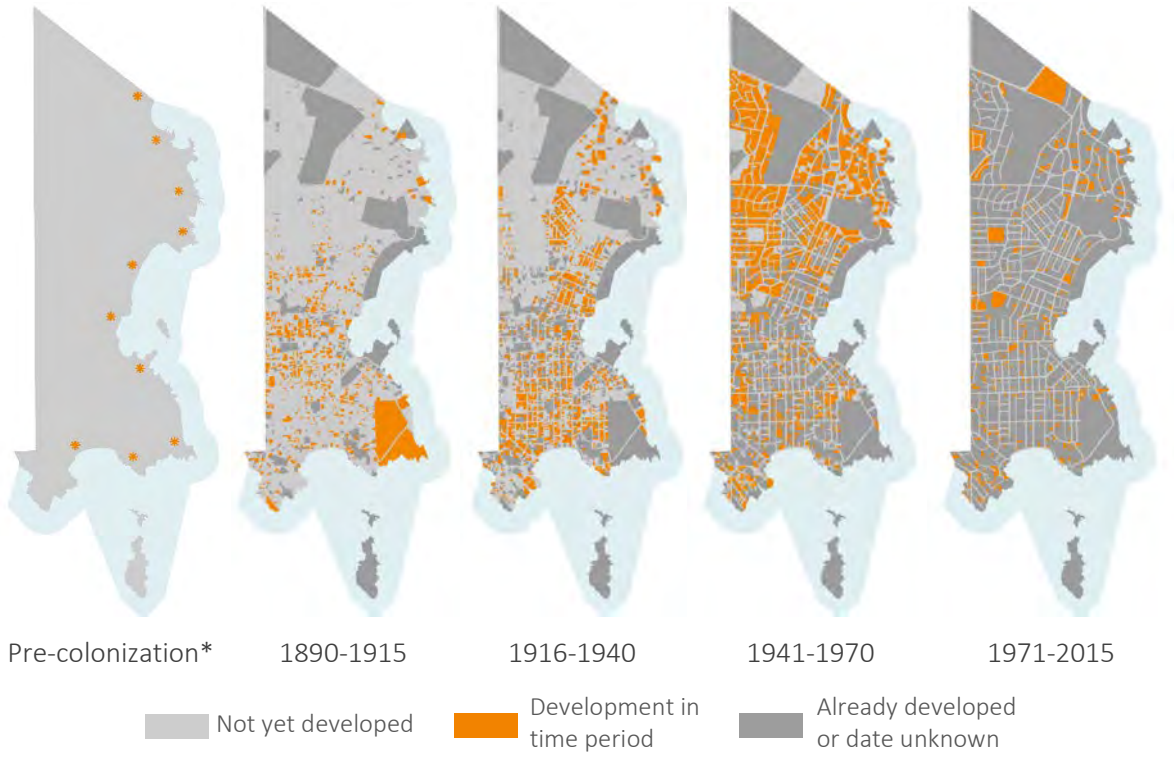


Figure 3. A timeline of the evolution of development in the District of Oak Bay.

*The traditional territory of the Lekwungen people encompasses the District of Oak Bay and beyond. Village sites and shell midden locations shown are based on mapping shared by the Songhees Nation.

The 300 lot Uplands subdivision, designed by John Olmsted between 1907 and 1908, was promoted as “Victoria’s Celebrated Residential Park” and great efforts were made to retain the Garry oak forest and views to Mount Baker (McCann, 2014). Every tree was mapped so that it could be incorporated into the design process and roads were designed to intersect at angles to create small public greenspaces or “parklets” (McCann, 2014). Olmsted recommended London Planes and maples be planted between the road and the sidewalk on several streets to complement the oaks (McCann, 2014) and the landscape design intent is still evident today. Uplands neighbourhood is protected provincially under the *Oak Bay Special Powers Act* (1935).

Despite the early completion of the design, most lots were not developed in the Uplands until the 1960s (McCann, 2014). Uplands Park, one of the largest and most noteworthy natural area parks in the district, was purchased by the District of Oak Bay and established as a park in 1946. Uplands Park is approximately 36 ha (including Cattle Point) and protects numerous sensitive ecosystems and species at risk. The municipality has protected a number of other, smaller natural areas including Anderson Hill, Costain's Corner, Kitty Islet, Loon Bay, Mary Todd Island, and Trafalgar Parks as well as the Native Plant Garden. In addition, the Capital Regional District has protected Walbran Regional Park, which spans the Oak Bay-Victoria border.

Based on historic images (Figure 4, Figure 5 and Figure 6), records of Olmsted's design intent, and the existence of large, mature Garry oak throughout the community today (Figure 2), tree retention and replanting was practiced from the beginning of the District's development history. Successful tree preservation leading to the existence of mature trees in the landscape today would have been aided by the fact that Garry oak was not valued as a timber source and that the early excavation for much of the District's infrastructure was done by hand. The Garry oak was also culturally important to European settlers, which may have contributed to efforts to preserve the parkland feel of Oak Bay; the Garry oak's deciduous oak character resonated with British identity, was aesthetically valued in streets and parks, and the species was uniquely native to a small area of the Pacific northwest (Cavers, 2009). Today, residents still value the beautification and heritage contribution of Oak Bay's urban forest.

Most Oak Bay survey respondents attach great importance to the **beautification and heritage benefits** provided by the urban forest.

There are some gaps in the distribution of present day Garry oak compared to historic ecosystem distribution in residential neighbourhoods, such as Carnarvon Park and adjacent to the Royal Victoria Yacht club (Figure 2). These gaps probably correspond to land uses associated with extensive clearing - such as farming, the fair grounds and racecourse - that preceded residential development.

Figure 4. Aerial view of Carley's Riding Stable (ca. 1955 Oak Bay Archives 2012-001-033; left) and the same area today (Google maps) shows little change in land use since the 1950s.

Figure 5. Aerial view of South Oak Bay (1949 Oak Bay Archives 1994-039-001) (left) and the same area today (Google maps). There has been little change in land use since the 1950s.

Oak Bay's urban form is dominated by single-family residences that generally support large amounts of tree canopy and pervious area. The minimum lot sizes range from approximately 300 m^2 in the highest density areas to in excess of 4,000 m^2 in the low density Uplands area. The limit of 30% - 40% maximum lot coverage and the approximately 7-10 m front setbacks required on residential properties has left room for large trees[2] to grow in road rights-of-way and in yards. Oak Bay is fully developed and the pace of redevelopment to date has been slow resulting in more gradual losses in tree canopy cover than is typical of faster growing municipalities. Given the age and small size of many existing homes, and with possible changes to the District's development policies, the pace of redevelopment and other forms of development may increase in the coming years. Tree canopy loss is expected to occur at an increasing rate due to large trees inevitably conflicting with development.

Figure 6. 1911 photos showing road construction tree retention on St David Street between Windsor Road and Brighton Avenue in Oak Bay (Oak Bay Archives 1994-001-030/031) and a large Garry oak that exists today on Falkland Road (Google Maps)

[2] Large trees are defined as having a potential height at maturity > 15 m and canopy spread of > 10 m (actual size can be smaller due to site conditions but size classification based on potential size under optimal conditions).

1.3.4 District Policy and Community Values

Oak Bay's Official Community Plan (*Bylaw 4620*, 2014) (OCP) acknowledges that the natural environment, including its urban forest and abundant Garry oaks, form the core of Oak Bay's identity and are fundamental to the desirability of Oak Bay as a place to live and a destination to visit. The District's strategic plans for heritage, active transportation, energy and climate change also contain goals that can be partially achieved through urban forest management. Figure 7 outlines Oak Bay's policy hierarchy in the context of current policies and potential policies related to urban forest management.

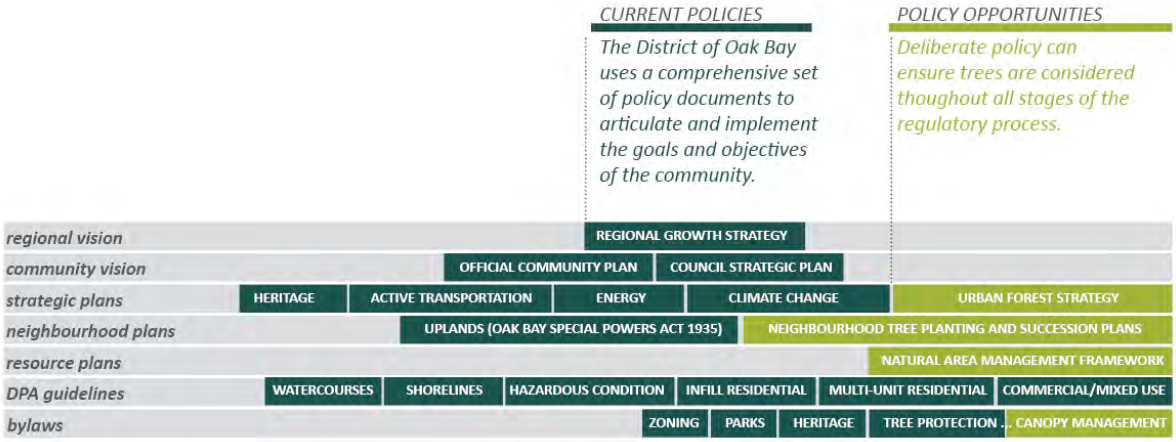


Figure 7. Oak Bay's policy context.

While the District's vision, OCP and strategic plans are broadly supportive of urban forest management, there are OCP policies and objectives that need to be well integrated with urban forest management to prevent conflicts with tree retention. For example:

- Capital projects such as the Uplands combined sewer separation project, complete streets program, sidewalk and crosswalk program and pathways and trail upgrades will need to integrate trees and tree protection into design and construction; and,
- Policies for new forms of development will need to integrate mechanisms that allow more density while conserving trees with high retention value and pervious areas.

The tree canopy is an integral part of Oak Bay's streetscapes and the majority of residents acknowledge a wide range of benefits associated with the urban forest. A recent survey of 316 community members (+/- 5.5% accuracy at the 95% confidence limit) found that the most important benefits provided by the urban forest were perceived as:

- Reduced stormwater runoff and improved flood control (86%)
- Habitat for native plants and animals (83%)
- Improved air quality (83%)
- Beautification of the District (80%)
- A place for heritage trees (79%)
- Carbon storage and sequestration (77%)

The complete survey results are provided in the District of Oak Bay Urban Forest Strategy Consultation Report (Diamond Head Consulting, 2016a). Consistent with these results, a survey conducted for the Heritage Strategy in April 2013 found that established streetscapes and

neighbourhoods were identified as one of the most significant heritage values of the District (by 65.7% of survey respondents).

1.4 Why Should We Value the Urban Forest?

Healthy trees and natural areas, through their structure and function, provide a wide range of beneficial environmental, social and economic services that improve the livability of urban areas and contribute to climate change mitigation and adaptation. The magnitude of the benefits produced is largely determined by canopy cover extent and forest structure (Dobbs, et al., 2011).

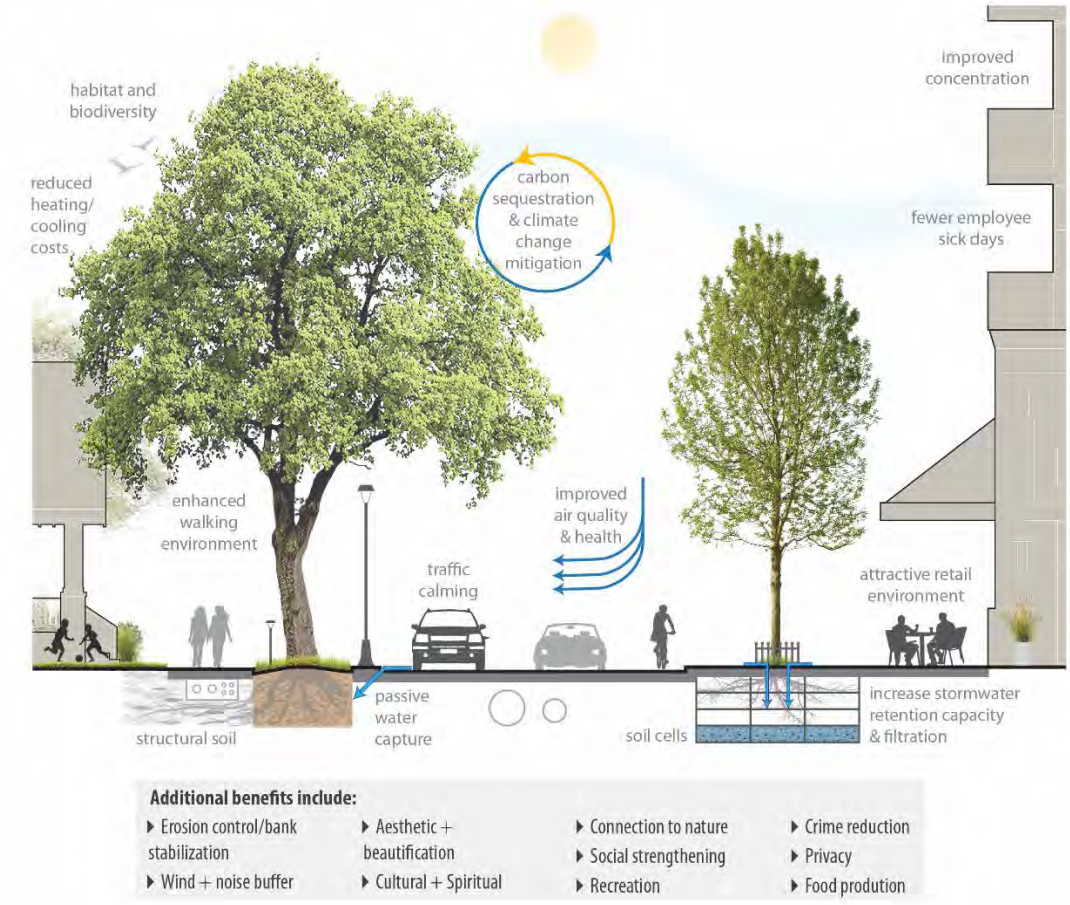


Figure 8. Street tree benefits.

The reported benefits of trees are numerous and provide evidence that trees make people happier, healthier and wealthier. For example, a recent study in Toronto found that having 10 more trees on your block has self-reported benefits equivalent to being seven years younger, or a $10,000 salary raise or moving to neighbourhood with a $10,000 higher median income. Studies have also found that views of or interaction with elements of the urban forest contribute to reduced health care costs, shorter hospital stays and a reduction in use of pain-killing medication. The availability of parks and open space increases in the frequency of routine physical activity, also leading to improved health outcomes. Kids with attention deficit disorder show less symptoms after playing in green outdoor settings. Patients with dementia or clinical

depression also benefit from views of or access to the urban forest. For further reading, references for some of these studies are compiled in Appendix 1.

Urban forests are valued as a tool for community climate mitigation and adaptation because they provide ecosystem services particularly related to stormwater management, biodiversity and urban heat. The urban forest's value as a climate adaptation tool is discussed in Section 4.5.

Urban forest ecosystems also include the associated resources that trees both support and need to thrive. For example, trees:

- provide shelter and food for beneficial wildlife;
- grow roots that absorb water and nutrients, and create spaces for air and water to infiltrate the soil;
- require soil that filters and stores water runoff and supports soil animals and micro-organisms; and,
- require pervious soil surfaces within which other plants may grow.

These associated resources are also intrinsically important to the ecology and livability of urban areas and contribute to strategic policy objectives such as rainwater and biodiversity management. When protecting trees, we are also protecting the space for future trees and the space for associated soil, water, air and biodiversity resources to persist in urban areas.

1.4.1 Why should we value large trees in urban areas?

People tend to accept the benefit and value of having large trees in urban parks without question. However, the benefits of large trees can be more controversial or less understood when they are located in streets or yards and come into conflict with other urban infrastructure such as roads, sidewalks, services and buildings. However, excluding large trees from neighbourhoods and streetscapes deprives people of the many benefits large trees provide and greatly reduces the value delivered by the urban forest.

Figure 9. The large tree argument.

Studies have repeatedly shown that the value returned by a large tree performing well in a streetscape exceeds the cost of maintenance (McPherson, et al., 2003) and, over its lifetime, returns approximately 16 times more value than a small tree. Large trees have longer life

expectancy and provide far greater canopy cover per individual tree. Infrastructure conflicts can be avoided or managed through good design that designates appropriate space for each type of infrastructure in the streetscape, and by selecting the right tree for the location. A small tree is the right tree when space is limited but to maximize benefits from the urban forest we must protect or create adequate space for large trees when planning urban infrastructure.

Large street trees, when well-planned and maintained, complement good urban design by contributing to complete streetscapes that function well for pedestrians, cyclists and vehicles. Large trees can provide a continuous canopy that grows tall enough to give clearance, whereas small trees provide fragmented canopy cover that never reaches a height to clear the road space. Trees can be used as landmarks to help with wayfinding and to create a unique sense of place at the street and community level. Trees soften the hard edges of the built form, create dappled light and add varied textures to streets, enhancing their visual appeal. When planted in rows, trees define the edge of pedestrian and roadway space, unify street blocks and create comforting cathedral-like canopies over roads and sidewalks.

The urban design benefits of trees are evident when travelling through Oak Bay's streetscapes of large, mature oak, elm, London plane, chestnut, linden and maple.

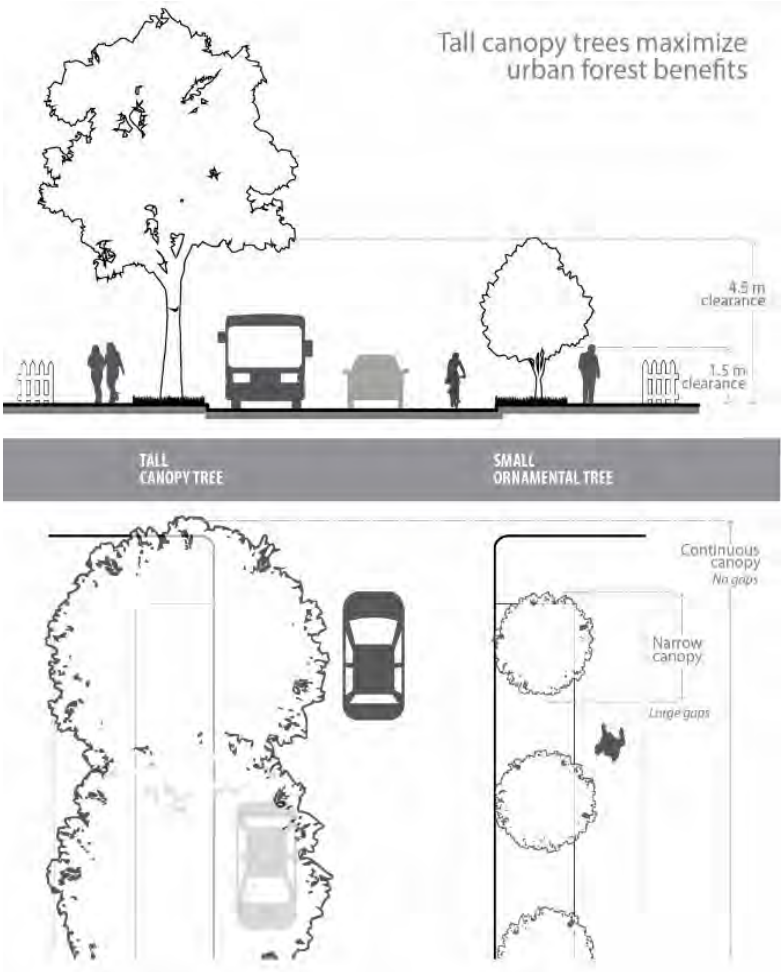


Figure 10. Given the room to grow, large canopy trees create a comfortable pedestrian space, maintain horizontal sight lines and allow vertical clearance while maximizing the functional benefits from trees.

2 Planning Process + Stakeholder Consultation

Oak Bay's Urban Forest Management Strategy planning process began with an in-depth review of existing plans and policies that might influence and provide direction to urban forest management. The review included the Official Community Plan, Council Strategic Plan, Zoning Bylaw, Tree Protection Bylaw, Heritage Strategy Plan, Climate Change taskforce among others. Departmental interviews and a Council briefing occurred early in the project in order to define the priorities from an organizational perspective and to orient the UFMS to the District's perceived opportunities and challenges. The outcomes of this initial review phase are included in the Oak Bay Urban Forest Background Report submitted to the District (Diamond Head Consulting, 2016b).

Public and stakeholder groups were consulted, prior to beginning work on the draft UFMS, through a 'Town Hall' workshop that attracted approximately 60 participants and a self selected survey that received in excess of 300 responses. A second face-to-face opportunity for input was provided via a booth at the Oak Bay night market. The results of the community engagement sessions and survey are provided in the Consultation Summary (Diamond Head Consulting, 2016a). The public consultation outcomes from this early consultation framed the community priorities for the UFMS and provided an indication of which policy directions would be most supported by the community.

Canopy, surface cover and plantable spots analyses were conducted to provide baseline metrics from which the community can measure future achievement, and to inform setting targets for the future. Canopy cover projections were then made based on assumptions about the future number of trees planted and replaced.

The analysis of policy, consultation outcomes and urban forest metrics identified the issues and opportunities facing Oak Bay's urban forest and fed directly into drafting the vision, objectives and targets for the plan. Recommendations for actions the District can implement to achieve the UFMS were developed in response to the issues and opportunities that exist in this unique community.

The draft was presented at an open house held on October 20, 2016 and was then made available for feedback online. Submissions were reviewed and incorporated into the final draft presented to Council.

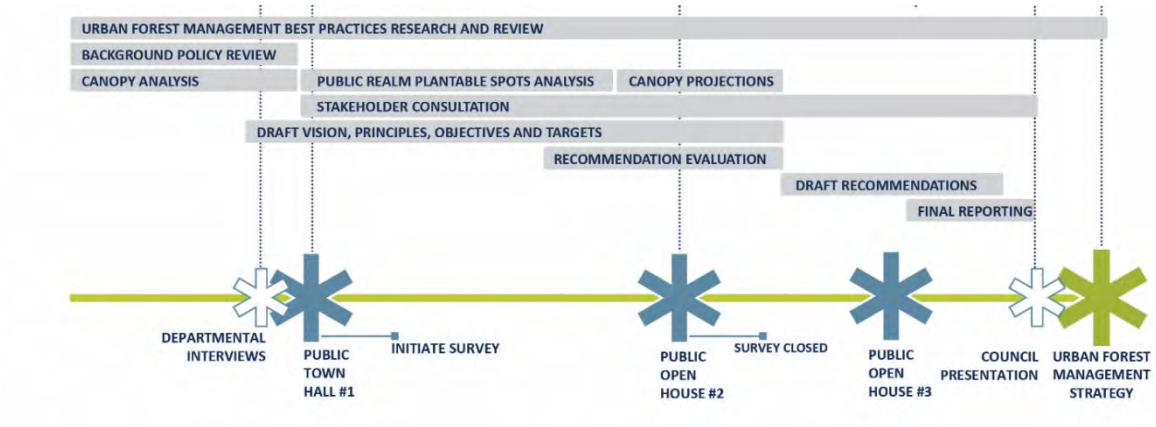


Figure 11. Oak Bay's Urban Forest Management Strategy process

3 Inventory + Analysis

3.1 Oak Bay's Tree Inventory

3.1.1 Tree Species Diversity

While Oak Bay does not yet have an inventory of its trees, Parks staff estimate that the municipality manages more than 10,000 trees on public land. Of those, District staff estimate that Garry oak, which is common in both streets and parks, accounts for roughly 35% of the tree population. Other deciduous trees prominently represented in the public realm include London plane, American elm, oaks, birch, beech, horsechestnut, linden, arbutus, mountain ash, crabapples and various plum and apple species. Common coniferous species include Douglas-fir, pines, western redcedar, giant sequoia and Deodar cedar.

Given that private land accounts for a much greater proportion of the District's canopy cover, private land trees are expected to far exceed the number of public trees, with Garry oak also being the most common species on private land.

3.1.2 Age Diversity

The age of Oak Bay's urban forest is not precisely known but it is clear that some Garry Oaks were present pre-development and the large, mature London planes and elms were likely planted between the 1920s and 1940s after road construction was completed in those areas. The oaks, elms and planes have life-spans of 300 - 500 years when growing in favourable park or forest conditions. In urban settings, life-spans of these trees are typically more limited but still exceed 100 years. The reduced lifespan of long-lived trees is a result of the fact that urban trees are often under stress due to conditions imposed by urban development, such as hydrological changes, reduced permeability, reduced soil volume or physical damage or disturbance to the tree above or below ground. In addition, trees in streets and yards cannot be safely retained for as long as they can be in parks and forests because of the higher number of targets (i.e., people, cars, homes etc.) that could be impacted by tree failures. Most large, mature trees in Oak Bay appear to be in good health and are expected to have a safe useful life expectancy exceeding the term of this plan; however, it is likely that some large, mature trees will have to be replaced over the term of this plan either due to development impacts or the trees being no longer safe to retain in the landscape. Arrival of a new pest or disease also has the potential to cause the premature loss of large, mature trees.

Several shorter-lived species planted in Oak Bay are reaching the end of their life-expectancy. Paul's scarlet hawthorn, silver birch, plum, cherry and mountain ash are declining in several locations. Their decline is attributed in part to age and in part to drought stress that has made the trees vulnerable to pests and disease. Bronze birch borer (birch), leaf spot disease (hawthorn) and white mottle rot (mountain ash) are responsible for some losses. Replacements are anticipated to be required over the next 5 to 10 years on approximately 11 streets (Figure 12).

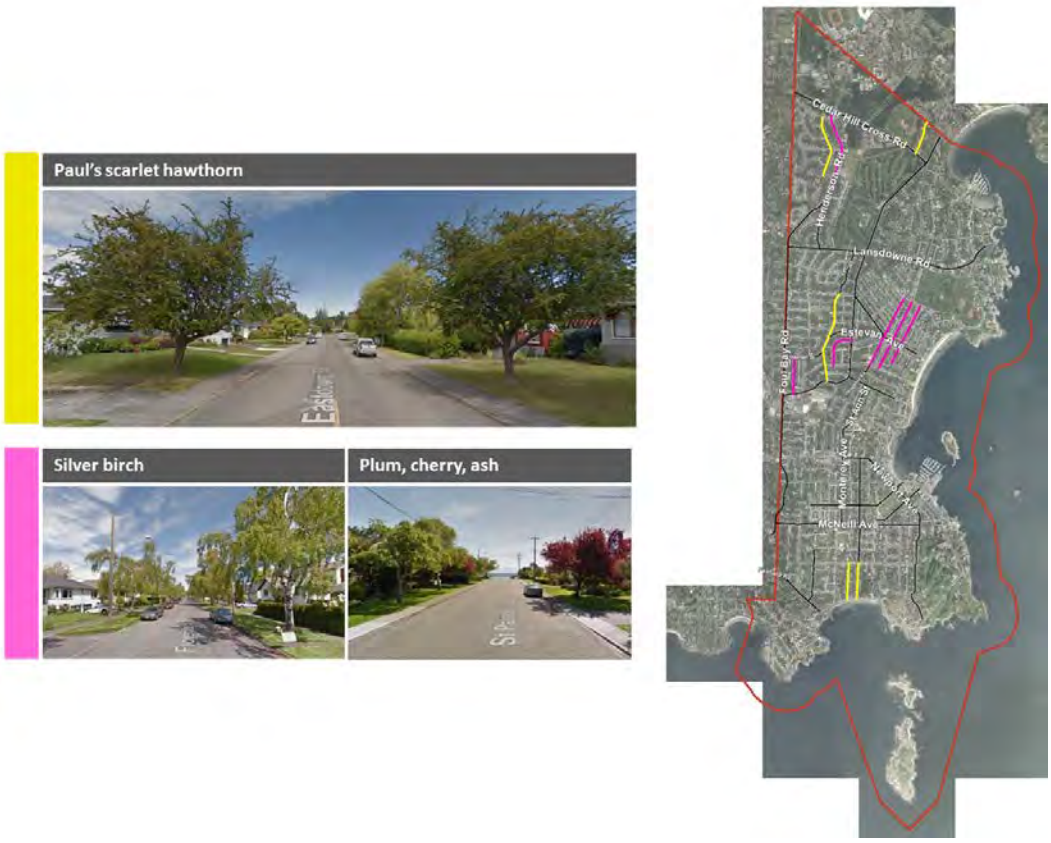


Figure 12. Streets where replacements of hawthorn, birch, plum, cherry and mountain ash are anticipated in the next 5-10 years.

3.2 Oak Bay's Natural Area Inventory

Oak Bay does not presently maintain an inventory of its natural area ecosystems; however, Provincial data collection projects have included sensitive ecosystem, terrestrial ecosystem mapping (TEM) and red and blue listed species mapping of Oak Bay (Figure 13).

Sensitive ecosystems within the municipality include coastal bluffs, woodland and terrestrial herbaceous ecosystems. The university lands also include some older forest and riparian areas (B.C. Ministry of Environment, 2016).

The TEM is another form of ecosystem inventory that groups ecosystem types based on climate, physiography, surficial material, bedrock geology, soil and vegetation. In Oak Bay, TEM identified areas of rock outcrop, beach, Douglas-fir forest, Fescue-Camas, Garry Oak-Brome, Cedar – Grand fir – Foamflower, and Cladina – Wallace's selaginella (B.C. Ministry of Environment, 2016).

Sixty-three occurrences of species and ecosystems at risk (provincial red and blue list) are presently identified within the municipality (B.C. Conservation Data Centre, 2016) (Figure 13). These occurrences include Garry oak California brome ecological communities, two species of invertebrate animals, two species of non-vascular plants and 31 species of vascular plants (B.C. Conservation Data Centre, 2016) (Appendix 2).

The data collected in each of the datasets above is dynamic and will change over time as areas are developed or restored, or as new red/blue listed occurrences are found or extirpated. The absence of red/blue listed records in an area does not mean that no species or ecosystems at risk are present; detailed surveys conducted in the appropriate season are the only way to confirm the presence or absence of a species or ecosystem at risk.

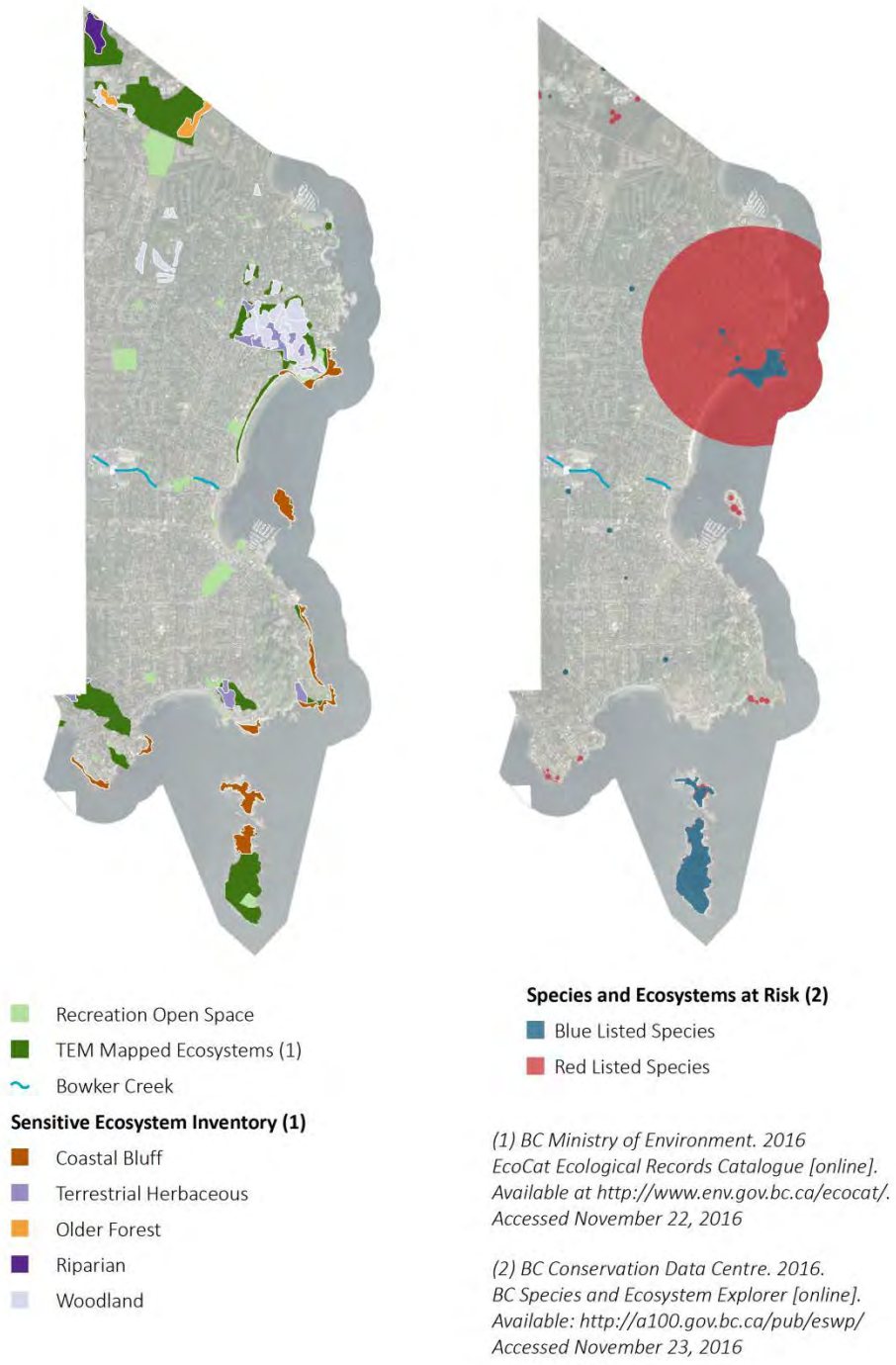


Figure 13. Natural areas inventory mapping available for Oak Bay.

3.3 Measuring Canopy Cover and Ecosystem Services

The urban forest is commonly measured using canopy cover, which is essentially measuring the cover of tree leaves, branches and stems per unit area of ground surface when viewed from above. Tree canopy cover offers a good measure of the extent of the urban forest and is an indicator of the magnitude of ecosystem services it provides. Ecosystem services refer to services provided to people by ecosystems and include things like clean air and water, shade and cooling, and recreation.

Canopy cover is a commonly used measure of the urban forest because it is cost-efficient, easy to measure and comparable between municipalities. However, tree canopy cover is not a direct measure urban forest structure and function. Field data collection to measure structure, size, distribution, condition, biomass and leaf area would provide more accurate information on structure and function but is expensive and requires specialized analysis. As an alternative, the US Department of Agriculture (USDA) has developed a suite of free tools called 'iTree' to allow users to collect more basic information on the urban forest and still estimate ecosystem services using models based on averages of actual data collected in scientific studies.

In Oak Bay, canopy cover was measured using iTree Canopy, which samples surface cover with randomly distributed points over aerial photography. The error range varies based on the sample size and the user must be proficient at distinguishing tree canopy from shrub canopy. Canopy cover is expressed as a percentage of the total land area and ecosystem services are estimated based on average ecosystem services per unit of canopy cover. While this approach has limitations, it provides very good canopy cover accuracy and gives an initial estimate of ecosystem services for the area. If more accurate ecosystem services estimates are required (e.g., for tree valuation), iTree also provides a tool called iTree Eco that requires detailed data inputs to run more complex models that incorporate tree structure and health attributes, species and location. Outputs from iTree Eco also include building energy savings and data summaries to describe the structure of a community's urban forest. An iTree Eco analysis was beyond the scope of the UFMS but remains an option should more accurate ecosystem services values be required in the future.

The District of Oak Bay's canopy cover ranks among the highest, at 33% +/- 1.49%[3], compared to other cities in the region (Figure 14). While Oak Bay's canopy ranks on par with Campbell River, there is a notable difference in population density, natural forest cover and the amount of undeveloped forest land between the two municipalities. Where Campbell River's undeveloped forest land accounts for almost half of its 33% canopy cover and comparatively little is distributed in developed neighbourhoods, Oak Bay's canopy has been intentionally retained and planted throughout its fully developed neighbourhoods, parks and institutional lands. Oak Bay's canopy cover today is a legacy of intentional urban forest management practiced from the early days of the District's incorporation.

[3] Oak Bay's OCP reported an iTree canopy result of 38% +/- 1.54% using a 2013 orthophoto, which differs from the 33% +/-1.49 reported here for 2015 and from the 35% reported for 2011 in the Capital Regional District's Land Cover Mapping (Calsys Consulting Ltd., 2013). However, after reviewing all points in our recent analysis, we believe the 38% result is incorrect, possibly due to tall shrubs being attributed as tree cover.

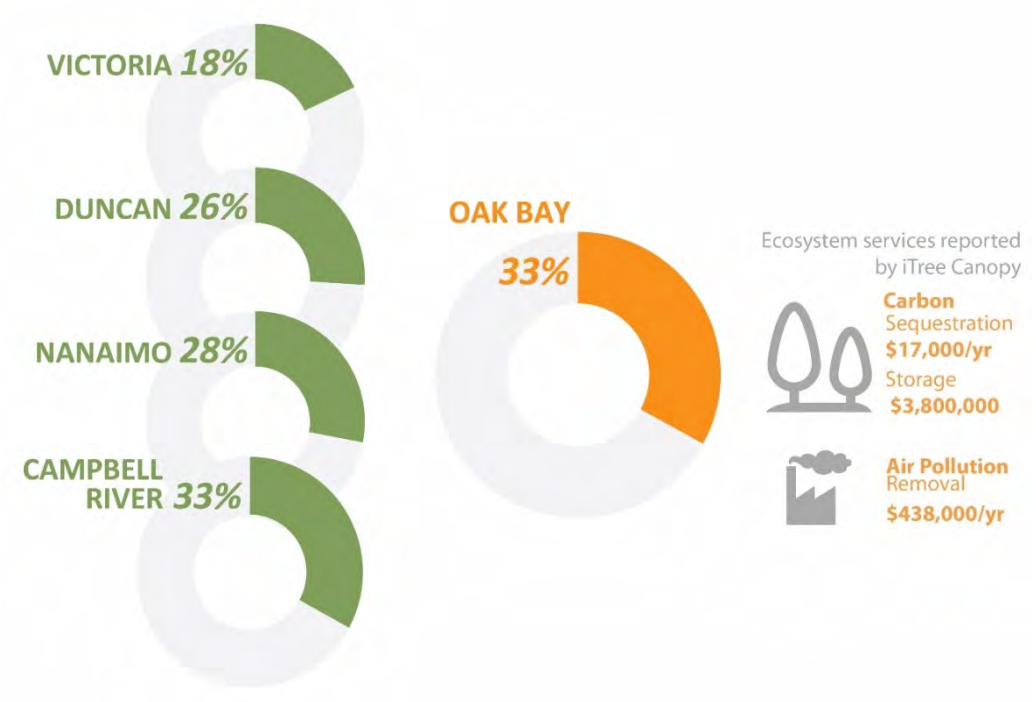


Figure 14. Regional canopy cover comparison

3.4 Measuring Canopy Cover by Land Use

Canopy cover is distributed unevenly across Oak Bay's land uses and geography (Figure 15 and Figure 16). The Uplands neighbourhood is the land use with the greatest canopy cover, likely as a result of its large estate properties, narrow roads and generous setbacks that contribute to its parkland setting. Garry oak dominates the Uplands neighbourhood and mature trees are abundant in both public boulevards and on private lands. While there are some opportunities to increase canopy cover on individual parcels and some parks, in Uplands the greatest emphasis will be on canopy retention on private land and public boulevards as redevelopment occurs.

Community and institutional land use includes the University of Victoria, Oak Bay schools and recreation centre, and Oak Bay Marina. The high canopy cover of this land use is almost entirely due to the forested Victoria University lands. There are opportunities to increase canopy cover on institutional lands. The University of Victoria, Glenlyon Norfolk School and golf courses are already involved with commitments supportive of Oak Bay's urban forest.

At 35%, parks and open space have a canopy cover that would typically be considered low for the broader forested eco-region; however, Oak Bay's retained natural ecosystems in parks have a naturally low canopy cover and increasing canopy cover could increase wildfire hazards in natural parks. There are opportunities to increase canopy cover in landscaped parks, and around the edges of active use sports fields and open areas.

Oak Bay's roads have a high canopy cover of 34%, likely due to the narrow road surfaces and broad public boulevard/front-yard setbacks to homes, as well as the mature canopy in many locations. The emphasis on managing canopy cover in Oak Bay's roads will be on infill planting in neighbourhoods with lower canopy cover, boulevard tree protection during development and

succession planning to replace trees that have reached the end of their safe useful life expectancy.

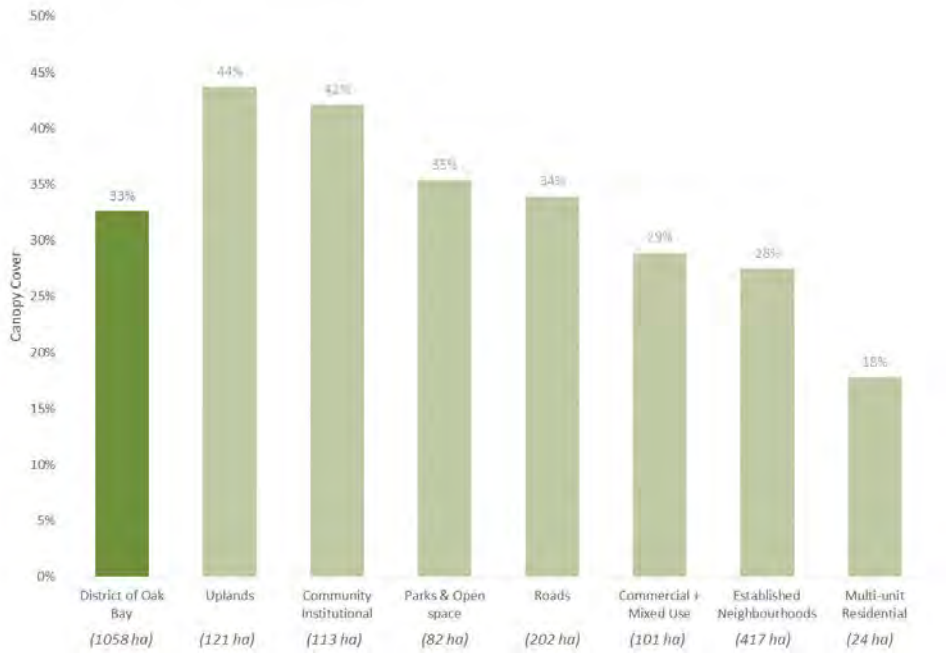


Figure 15. Canopy cover graphed by land use

Commercial and mixed uses include golf courses, which results in a higher canopy cover than would typically be expected in commercial and mixed use land uses. Opportunities to increase canopy cover in this land use are typically limited because of the types of usage.

Private land established neighbourhoods have the second lowest canopy cover of Oak Bay's defined land uses and, at 42% of the land area, represent the greatest opportunity for canopy cover increase in the District.

Multi-residential land uses have the lowest canopy cover. While there are some opportunities to increase canopy cover over individual parcels, the higher density and underground parking structures or surface parking will limit those opportunities. Multi-residential land use is presently only 2% of the land area and has little impact on overall canopy cover.

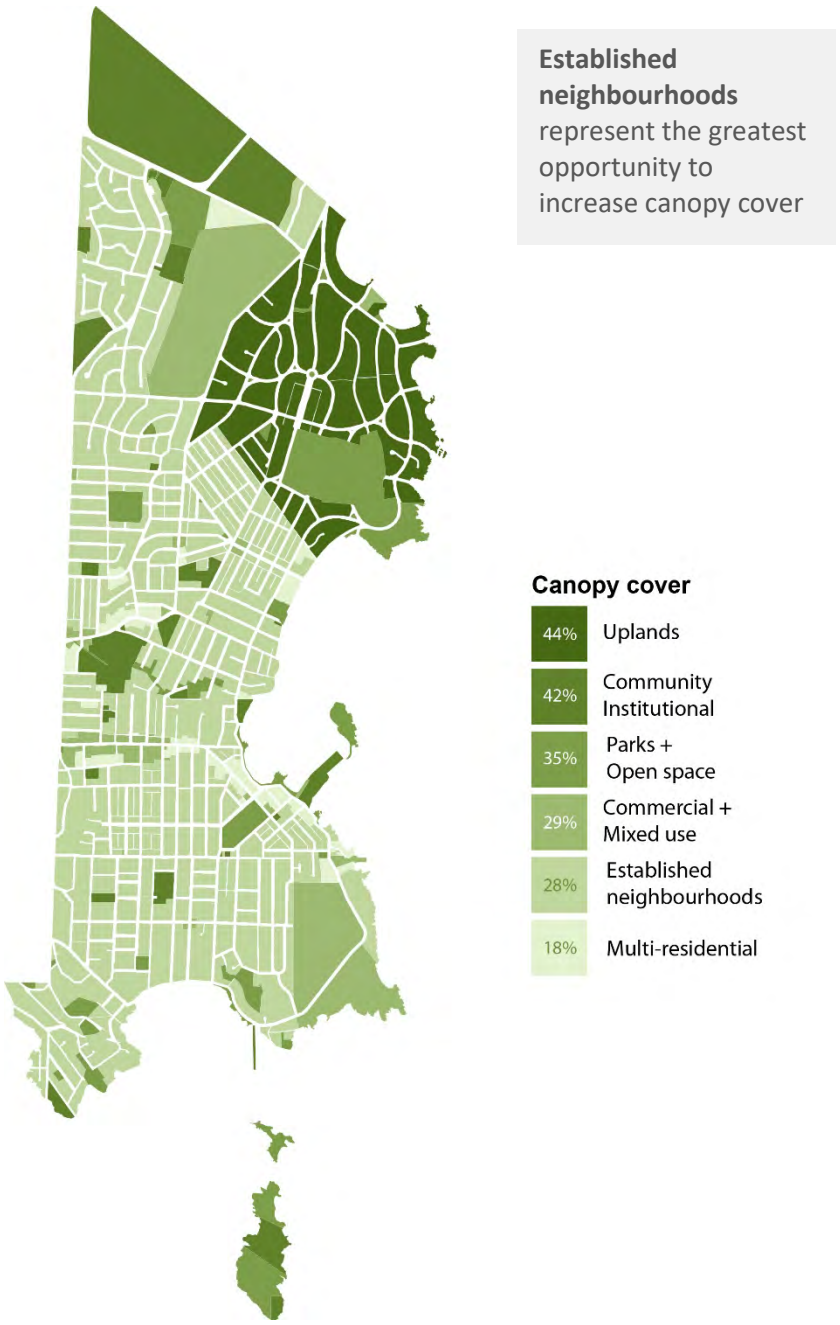


Figure 16. Canopy cover mapped by land use

3.5 Measuring Surface Cover by Land Use

Surface cover in this report represents the surface area currently covered by tree canopy relative to the areas that are softscape (pervious to water and potentially plantable) and the areas of hardscape (impervious to water and not plantable). Softscape (Figure 17) includes land cover such as bare dirt, lawn or shrubs. Canopy cover refers to tree canopy cover. Hardscape refers to surfaces such as roofs, roads or other paved surfaces that are assumed to be impervious to water. Typically, canopy cover percentages decrease with increasing hardscape cover in municipalities; however, many of Oak Bay's roads are a notable exception.

Overall, the District has almost equal proportions of canopy cover, softscape and hardscape (Figure 17). For comparison, Victoria's impervious cover exceeds 50% (Calsys Consulting Ltd., 2013). In Oak Bay, multi-residential and road land uses have the highest proportions of impervious hardscape surfaces. As previously noted, the canopy cover over roads is exceptional given the high impervious cover, likely due to narrow road surfaces and broad, uninterrupted pervious medians typically containing large, mature trees. At the other end of the spectrum, parks and open space, and commercial and mixed use have the lowest cover of impervious hardscape but have limited opportunities for tree planting due to natural tree cover and active recreation or commercial uses. The Victoria and Uplands golf clubs account for a large proportion of the pervious area in the commercial and mixed use land use. Oak Bay's planting opportunities on public land will consist primarily of infill planting adjacent to roads and around sports fields. To increase canopy cover, the District will need to work with owners and land managers in the established neighbourhoods, Uplands, and community institutional land uses to plant additional trees.

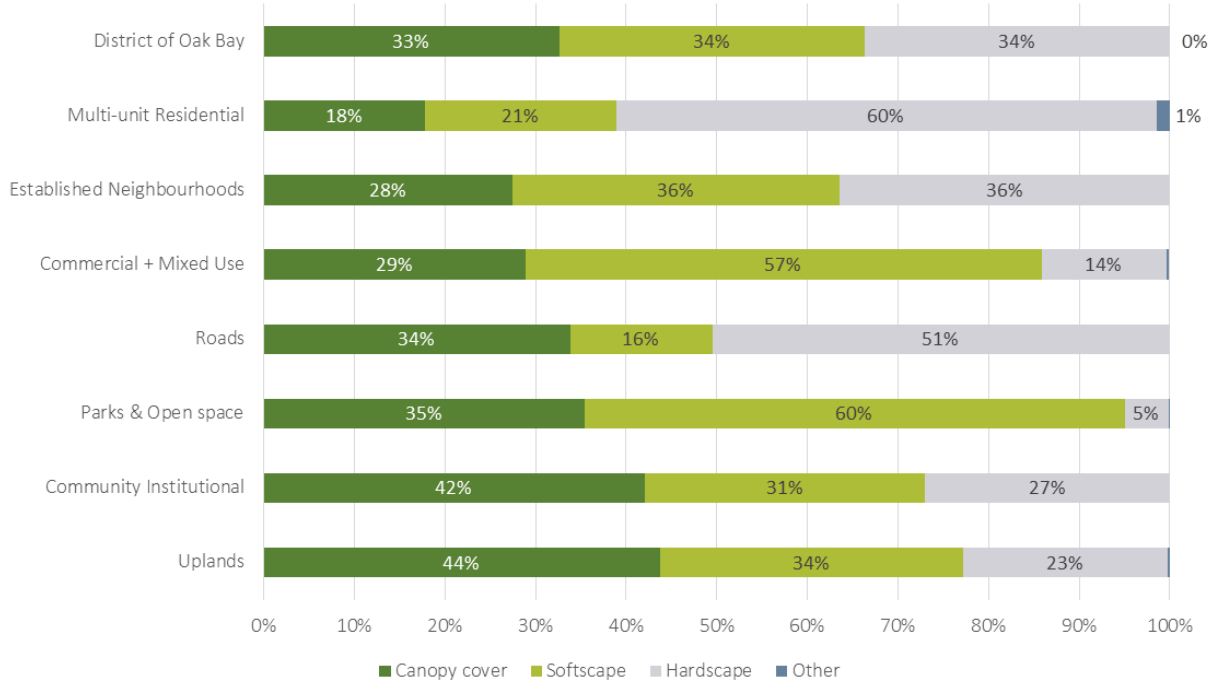


Figure 17. Surface cover graphed by land use.

3.6 Measuring Changes in Canopy and Pervious Cover over Time

While we do not have accurate estimates of Oak Bay's canopy cover prior to European settlement, it was likely higher than today given the extent of development. Overall, the canopy was more open than is typical of the Douglas-fir dominated forests that occur in the north of the District. Garry Oak parkland ecosystems on deep soil were typically lush camas and wildflower meadows with a fairly open Garry oak tree canopy maintained by prescribed fire.

iTree Canopy was used to measure canopy cover and change over time. The earliest air photo available for canopy analysis was from 2002 and the latest was from 2015. Oak Bay's canopy cover has not significantly decreased over the last decade (Figure 18)[4]. The lack of significant canopy decrease is probably due to the slow rate of redevelopment and other forms of development in Oak Bay. While the difference in canopy between 2002 and 2015 was not statistically significant, an analysis of tree removals and replacements based on five years of bylaw records indicated a net loss of trees. On private land, removals were occurring at a rate of approximately 115 protected trees per year with only 1 in 3 trees replaced. On public land, removals were occurring at a rate of approximately 70 trees per year but being replaced at roughly 1 to 1.

Given the net loss of trees on private land, it is likely that Oak Bay's canopy is gradually declining. As a coarse estimate of the rate of loss, we can convert the annual removal estimates to canopy area; using an average canopy size of 85 m^2 yields a canopy loss rate of 0.14% per year, or 1.4% per decade. The rate of loss would be partially off-set by the replacements planted. Continuing to collect and monitor tree removal data will enable better estimates of the rates of decline and growth.

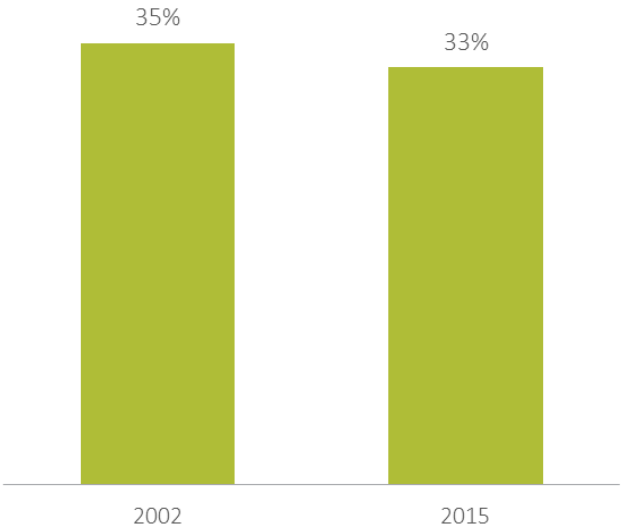


Figure 18. Canopy cover estimated in Oak Bay using i-Tree for 2002 (error +/- 1.97%) and 2015 (error +/- 1.49%) suggests that the difference between 2002 and 2015 canopy cover is not significant.

[4] The Capital Regional District's Land Cover Mapping reported Oak Bay's canopy cover as 37% for 2005 and 35% for 2011 (error +/- 6%) (Calsys Consulting Ltd., 2013) but these results are not significantly different due to the range of error.

Several potentially suitable methods for monitoring canopy change over time are summarized below:

1. I-Tree Canopy: Presently the most cost-effective tool for tracking canopy change over time because it is a free tool that only requires a recent orthophoto as an input and yields reasonable accuracy; however, an i-Tree Canopy analysis needs to be repeated for each spatial area of interest so if, for example, the District wanted to understand canopy cover at the lot level and to look at how it was changing over time it would not be practical to use i-Tree.
2. LiDAR, ideally combined with hyperspectral imagery, can be used to define accurate polygons of tree canopy and map them across the entire community (Figure 19). The LiDAR provides height and shape of tree canopies while the hyperspectral imagery provides colour bands to further refine the product. Canopy polygons can then be summarized by any spatial area, including individual lots, which would allow tracking of canopy cover parcel by parcel. LiDAR technology is becoming increasingly affordable making the technology more accessible.
3. Satellite land cover imagery is sometimes used for coarse scale analysis of canopy cover across large areas as it was for the Capital Regional District's forest cover mapping project (Calsys Consulting Ltd., 2013). The accuracy of canopy estimates in large-scale projects is often not as good because resolution is generalized to a large pixel size (e.g., 1 m x 1 m) and canopy is estimated as a percent of the pixel. Another limitation is that the definition of canopy is based on spectral bands and does not typically have heights so isolating tree canopy has challenges. However, satellite land cover data is available in 10 cm x 10 cm resolution and, as technology improves, height data is also being collected at a coarse resolution. As technology improves, satellite data may become an accurate alternative to LiDAR.

Presently, repeated i-Tree Canopy or LiDAR based canopy measurements provide the most suitable canopy change monitoring options for municipalities. Between measurements, tracking removals through the bylaw process on private land and tracking removals on public land will provide a more continuous indication of the rate of canopy loss.

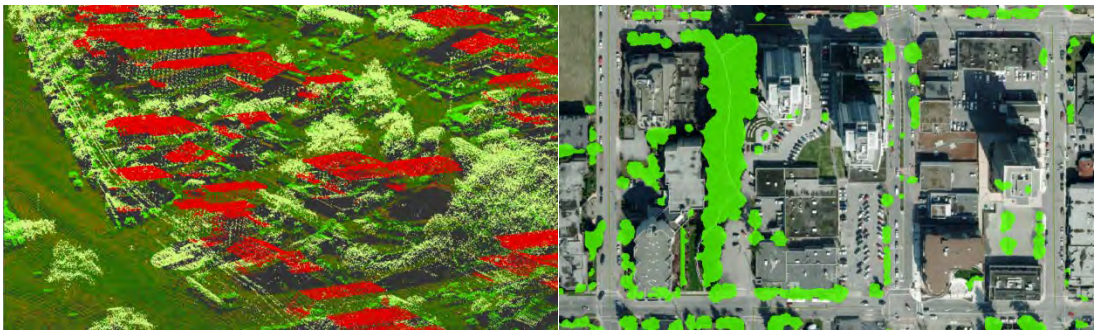


Figure 19. Examples of classified LiDAR (left) representations of land surface and canopy polygons derived from it (right) (LiDAR image courtesy of Andrew Plowright).

3.7 Establishing a Canopy Cover Target for Oak Bay

How much canopy cover is enough? As yet, there are no published benchmarks or thresholds that Canadian communities can use to guide setting urban canopy cover targets. Communities also vary in their natural ecology, urban development, planting opportunities, character and values, which means that no single canopy cover target is appropriate for all cities. Striving to maximize the cover of large trees and pervious surfaces in urban areas helps to produce important benefits like stormwater interception, cool summer microclimates and healthy habitats for people and wildlife. It may never be practical to restore canopy and pervious cover to pre-development forest conditions but the more closely we mimic functional natural ecosystems and allow natural processes to work, the less we should have to intervene with engineered solutions, and the more resilient our communities and ecosystems should be to extreme weather and climate change.

Landscape level drivers of canopy cover

A US study of the urban forest resource found that, at the landscape scale, variability in tree cover between urban areas was primarily explained by three factors: 1) ecoregion type; 2) population density; and, 3) land use. In urban areas that developed in forested ecoregions, the average canopy cover was 34% while areas that were grasslands or desert were lower (18% and 9% respectively) (D.J. Nowak, 2001). Percentage tree cover was found to decrease with increasing population density primarily due to the increase in impervious surfaces. Land use was a factor because the highest tree cover was typically found in park or residential land uses, or on vacant forested land, so a community's canopy cover was also influenced by its proportion of those high canopy cover land uses.

When examining the three factors that were important drivers of canopy cover in the US study, we anticipate that maintaining or increasing Oak Bay's present canopy cover is realistic. Oak Bay is expected to remain a forested ecoregion under climate change, though water may become more limiting (see Section 4.8). Population growth is forecast to remain slow to 2026 (Capital Regional District, 2011), and the OCP plans for modest growth of 0.5% per year, which would add about 90 new residents/36 new dwellings a year; population density is not expected to become especially limiting in the near term. The land use distribution is also anticipated to remain relatively stable given that the community is already fully developed (assuming no large-scale changes such as development of forested university lands or major road widenings). Figure 20 shows which land uses contribute most to Oak Bay's canopy area today.

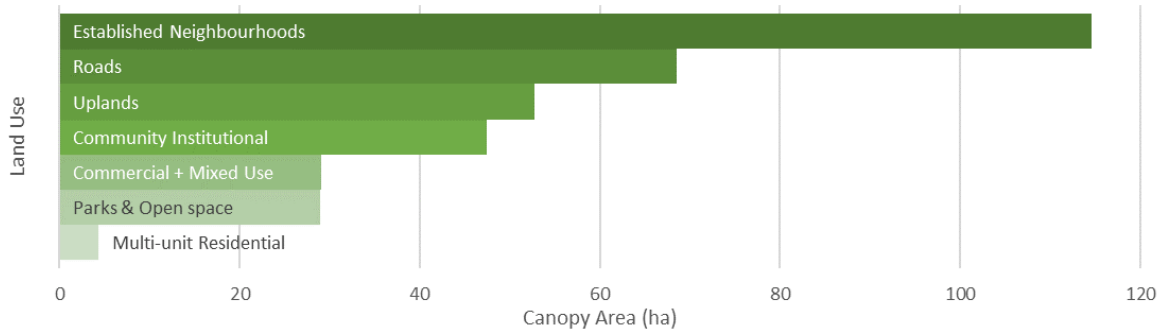


Figure 20. Canopy cover area graphed for each land use

Current opportunities

Potential planting spots in the public road right-of-way and in parks were estimated to total approximately 1,200 potential trees (Figure 21). Few spots were located in parks because they are either naturally treed or constrained by alternative uses (e.g., sports fields, playgrounds, buildings etc.). The largest opportunity to grow canopy exists on private land and primarily in established neighbourhoods.

Anticipated canopy growth and loss

Canopy growth from the existing tree population is expected to be low given that most trees in the population are already mature. Some tree losses are anticipated due to capital works, redevelopment and other forms of development; however, the rate is expected to remain gradual due to the slow rate of population growth. Some tree losses will also occur as trees reach the end of their useful life expectancy. Limited data is presently available to estimate loss rates but, based on an analysis of 5 years of removals, a coarse rate of 200 trees per year provides a first estimate. Successful replacement planting can compensate for these losses over time.

Community character and values

The community of Oak Bay has, through numerous planning initiatives, demonstrated that the urban forest is highly valued. The current and previous OCP acknowledge the natural environment and landscape character as being fundamental to the desirability of Oak Bay as a place to live and a destination to visit. Garry oak in particular is valued and protected as a symbol of the community and its natural heritage. Policy initiatives related to climate change, sustainability, tree protection and heritage have repeatedly supported protection and enhancement of the urban forest.

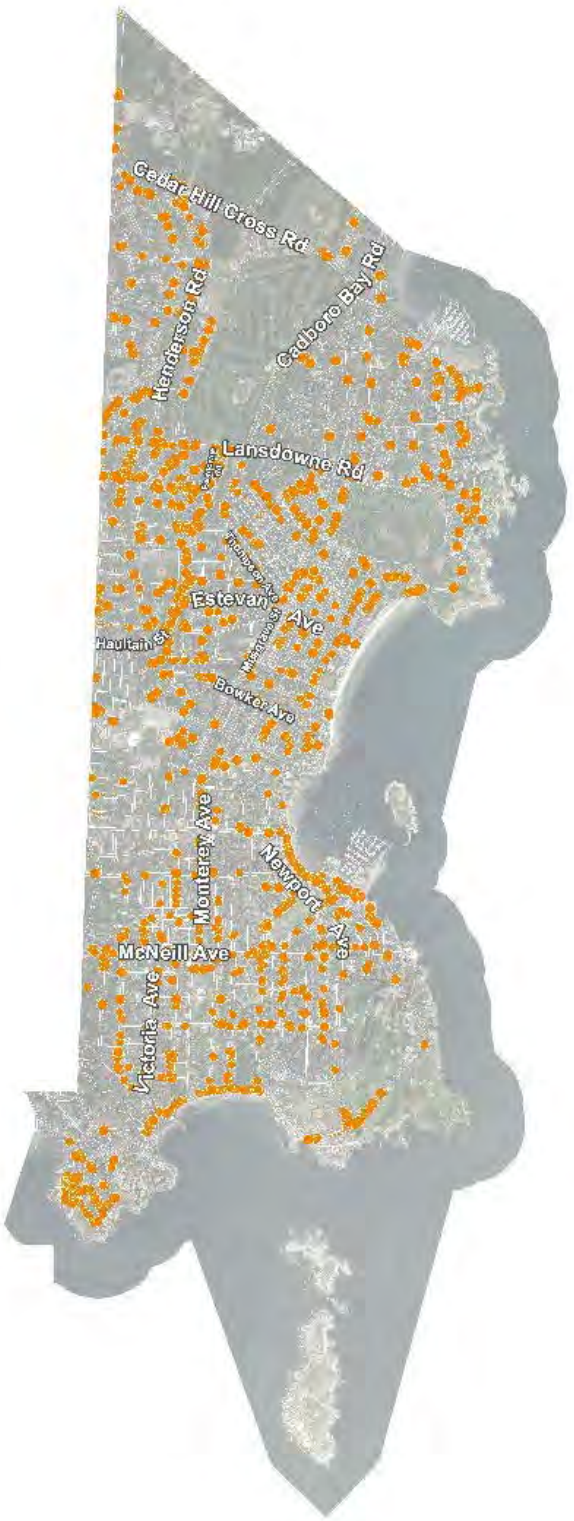


Figure 21. Locations in parks or roadways with planting potential based on softscape and soil volume (underground services not considered).

Public consultation completed for the 2013 Oak Bay Heritage Plan noted that residents expressed strong connections with the 'green' quality of the community, including streetscapes characterized by mature street trees, lanes with natural features, private gardens and trees (District of Oak Bay, 2013). Residents also valued Oak Bay's creeks, rocky outcrops, hills, Garry oak and arbutus ecosystems, Uplands Park, mature trees and spectacular views.

A survey completed in 2016 reinforced these earlier findings with 80% and 70% of respondents respectively agreeing that trees are important for the beautification and the identity of Oak Bay (Diamond Head Consulting, 2016a). When asked about whether to increase canopy cover, 76% of respondents agreed that the District should aim to increase canopy cover; only 8% disagreed and 16% were uncertain. Survey accuracy for Oak Bay's population was +/- 5.5% at the 95% confidence interval; however, the survey was predominantly filled online and respondents self-selected, which may have introduced bias into the results.

Oak Bay's Canopy Cover Target

Based on anticipated development and canopy trends, planting opportunities and the community's values, an aspirational canopy cover target to **approach 40% by 2045** should drive the District's urban forestry program and inspire the community to contribute. Reaching this target will require policy adjustments, a modest public realm planting program and an ambitious private realm planting program.

Acknowledging that the outcomes for canopy increase on private land will be variable, it is anticipated that the District's canopy cover will ultimately reach between 36% and 40%, and any figure in this range should be considered a success. Reaching the target will exceed the 15 year timeframe for plan implementation but the actions taken in the next 15 years will put the District on track to reach the target by 2045. Table 1 breaks the canopy cover targets down by land use area (Figure 16) and approximate number of new trees needed. Targets are intended to enable at least 30% of non-tree or building cover on private land for light access.

Table 1. Canopy cover targets by land use for the District of Oak Bay.

Land use (main zoning)	Estimated number of parcels	Current Canopy Cover	Approximate Target	Approximate increase in total number of trees*
Established neighbourhoods (RS 3-5)	4,968	28%	35%	3,700 medium trees
Uplands (RS 1 – 2)	641	44%	45%	150 large trees
Community institutional (P2)	13	42%	50%	900 large trees
Commercial and mixed Use (C/P3)	78	29%	10%/30%	130 medium trees
Multi-unit residential (RM)	132	18%	20%	60 medium trees
Parks and open space (P1)	180	35%	38%	200 large trees
Roads	-	34%	38%	1,000 medium trees
Oak Bay District	**6,072**	**33%**	**36-40%**	**6,000 medium to large trees**

*Large and medium trees are average sizes. Small to large trees will be appropriate depending on location and constraints.

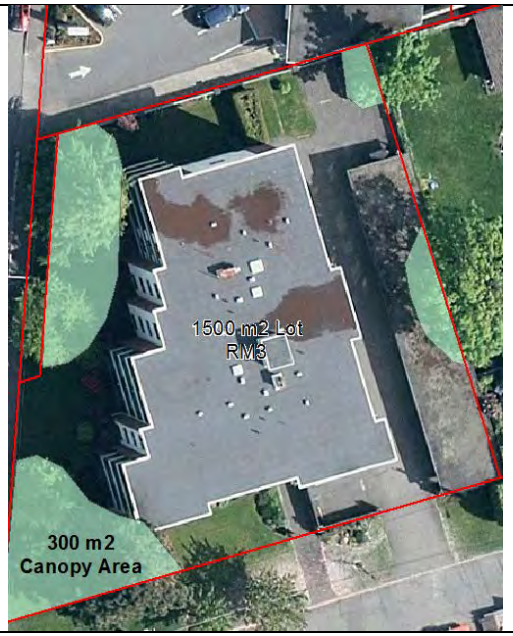
The examples in Table 2 show, for typical sized lots in various zonings, the size of trees that could be planted to meet the proposed canopy cover targets and how much of the lot would be covered by canopy area.

Table 2. Examples of the number of trees and minimum canopy extent needed to meet canopy cover targets by zoning.

Zoning Type	Example of No. of Trees by Size Class*			Canopy Area Example
	Small (25 m^2)	Medium (50 m^2)	Large (125 m^2)	
Uplands RS-1 and RS-2 (canopy target 45%)				
RS1 zoned 5,400 m^2 lot would need to plant trees to cover **2,430 m^2** at maturity. *Canopy target 45%*	97, or	49, or	19	
RS2 zoned 2,000 m^2 lot would need to plant trees to cover **900 m^2** at maturity. *Canopy target 45%*	36, or	18, or	7	

Zoning Type	Example of No. of Trees by Size Class*			Canopy Area Example
	Small (25 m^2)	Medium (50 m^2)	Large (125 m^2)	
Established neighbourhoods RS-3, RS-4 and RS-5 (canopy target 35%)				
RS3 zoned 2,000 square foot lot would need to plant trees to cover 700 m^2 at maturity. *Canopy target 35%*	28, or	14, or	6	
RS4 zoned 1,000 square foot lot would need to plant trees to cover 350 m^2 at maturity. *Canopy target 35%*	14, or	7, or	3	
RS5 zoned 700 square foot lot would need to plant trees to cover 245 m^2 at maturity. *Canopy target 35%*	10, or	5, or	2	Similar to RS4 example

Zoning Type	Example of No. of Trees by Size Class*			Canopy Area Example
	Small (25 m^2)	Medium (50 m^2)	Large (125 m^2)	
Community institutional P2 (canopy target 50%)				
P2 zoned 5,000 m^2 lot would need to plant trees to cover 2,500 m^2 at maturity. *Canopy target 50%*	100, or	50, or	20	
Commercial and mixed use C1 to C5 and P3 (canopy target C 10%/P3 30%)				
C1, C3 or C5 zoned 500 m^2 lot would need to plant trees to cover 50 m^2 at maturity. *Canopy target 10%*	2, or	1	N/A	
P3 zoned 10,000 m^2 lot would need to plant trees to cover 3,000 m^2 at maturity (e.g., golf course, yacht club). *Canopy target 30%*	120, or	60, or	24	

Zoning Type	Example of No. of Trees by Size Class*			Canopy Area Example
	Small (25 m^2)	Medium (50 m^2)	Large (125 m^2)	
Multi-unit residential RM (canopy target 20%)				
RM1, RM2 or RM3 zoned 1,500 m^2 lot would need to plant trees to cover 300 m^2 at maturity. *Canopy target 20%*	12, or	6, or	2	

*Tree canopy area based on canopy credits given for acceptable trees listed in Appendix 5.

4 Issues + Opportunities for Urban Forest Management

4.1 Redevelopment and Other Forms of Development

Oak Bay's Official Community Plan incorporates an objective to consider increasing density through infill development while respecting and conserving neighbourhood character. In addition, housing stock in Oak Bay is ageing and the rate of redevelopment may increase over the term of this plan. Policies related to redevelopment and other forms of development including infill need to be examined for opportunities to integrate conservation and enhancement of canopy cover and pervious[5] surface cover. This section focuses on single-family dwellings in Established Neighbourhood land uses because they are the dominant land use in Oak Bay.

4.1.1 Redevelopment

Redevelopment of existing properties often results in a loss of canopy cover and reduced pervious surface. Reasons for loss include:

- Rebuilding to the maximum allowable lot coverage (typically larger than the current home footprint) (Figure 22);
- Adding driveways through the front yard or increasing paved surfaces in the yard; and,
- Site grading, servicing, landscaping or other soil disturbances.

Redevelopment typically leads to a reduction in pervious cover and canopy cover unless tree protection, zoning or other policy incentives integrate measures to minimize those losses and create space for replacement trees.

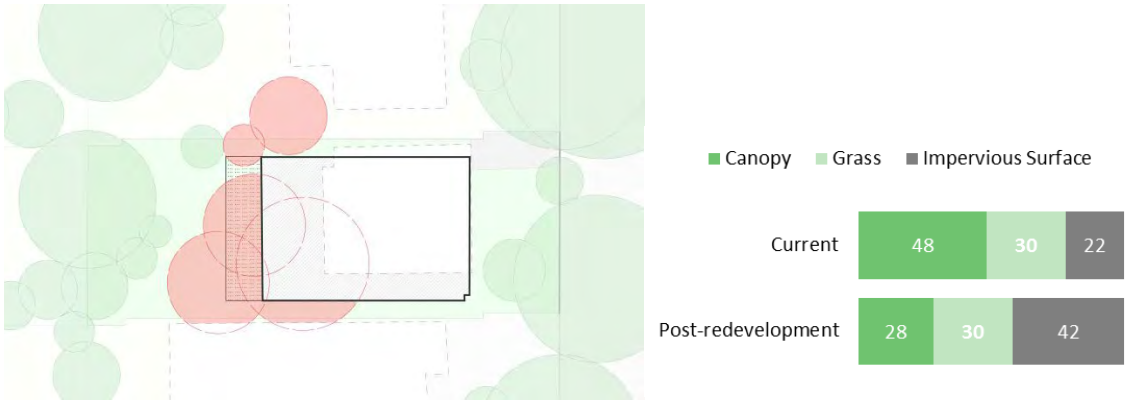


Figure 22. Canopy loss (red) shown for an existing home in Oak Bay if replaced with a new home with maximum building coverage of 35% and a paved patio in the back yard.

83% of Oak Bay survey respondents agree that the amount of **paved surface** allowed on future development sites **should be restricted**.

78% of Oak Bay survey respondents agree that **a standard should be set for the amount of soil required for every tree** planted to ensure the tree has adequate room to grow.

[5] Pervious surfaces allow water to pass through them, unlike impervious surfaces such as concrete; they include surfaces such as lawns, bare soil, gravel and sand.

4.1.2 Other Forms of Development

The district of Oak Bay's OCP includes policy to address infill residential development in Established Neighbourhoods. The Official Community Plan suggests that the types of infill to be considered will include secondary suites, duplexes, triplexes, laneway houses and garden suites. The example shown in Figure 23 represents a garden suite style of infill development based on Victoria's Garden Suite Policy (City of Victoria, 2011). The cause and extent of canopy loss due to a garden suite type of infill is expected to be similar to redevelopment in Oak Bay but separate footprints and extensions of servicing may make tree retention more complex.

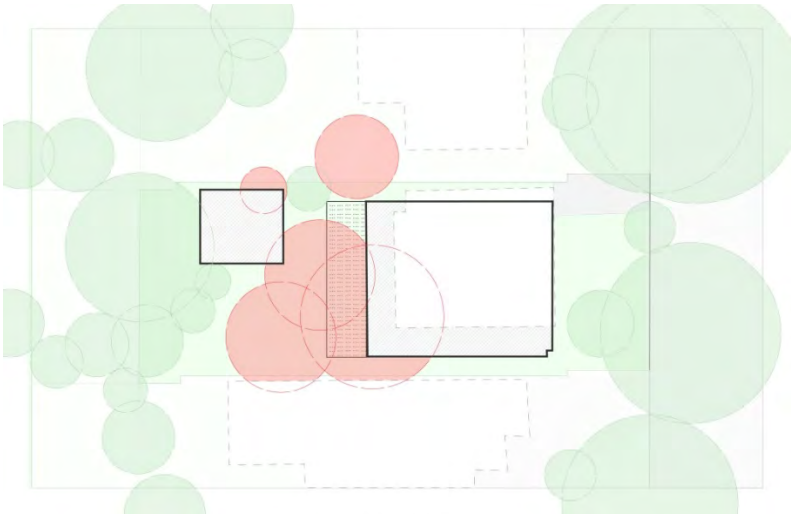


Figure 23. Canopy loss (red) shown for a redevelopment that includes a new home and garden suite as an example of one type of infill policy that may be considered in Oak Bay.

Considerations for mitigating the impacts of redevelopment and other forms of development in Established Neighbourhood land uses include …

- Maintaining the current front setback requirements to protect the integrity of existing streetscapes
- Designing the shape of building footprints and the location of services to maximize retention of suitable trees
- For single family dwellings with garages, allowing relaxations in driveway width and encouraging pervious driveways
- Encouraging retention of pervious surfaces and associated soil volume, or compensation using engineered features like green roofs
- Discouraging driveways and off-street parking requirements for infill suites
- Allowing relaxations for the location of accessory buildings based on tree retention both for the building location and height (e.g. Victoria garden suite policy)

POLICY EXAMPLE: Victoria's Garden Suite Policy (City of Victoria, 2011)

- Typically applied for sites with minimal size of 550 sq. metres *(that would include all single-family zones in Oak Bay, with RS-5 lots being the smallest)*

- Siting of the suite prioritizes the protection of:
    1. Neighbouring properties' trees; and,
    2. Subject property's trees.
- Recommends pervious outdoor cover + encourages green roofs
- Does not affect the property's parking requirements

4.2 Tree Protection on Public and Private Land

Oak Bay's tree bylaw (*Bylaw No. 4326*) currently protects trees greater than 60 cm and native trees greater than 10 cm (Garry oak, arbutus, yew, black hawthorn and dogwood trees) unless they are within an approved building envelope. A small number of Significant Trees are also defined in the Bylaw, and these are protected even within the building envelope. When protected trees are permitted for removal, they must be replaced at a 2:1 ratio when the tree is outside the footprint of a new house or accessory building. Protected trees removed due to a disease, the foreseeable damage to a building or significant structure or undue hardships must be replaced at a 1:1 ratio. Protected trees do not currently need to be replaced if removed because they are a hazard, causing damage, damaging utility wires, to install underground or overhead services, to install a driveway or if a tree was destabilized by construction. Native trees must be replaced with native trees except Garry oak, which must be replaced with Garry oak.

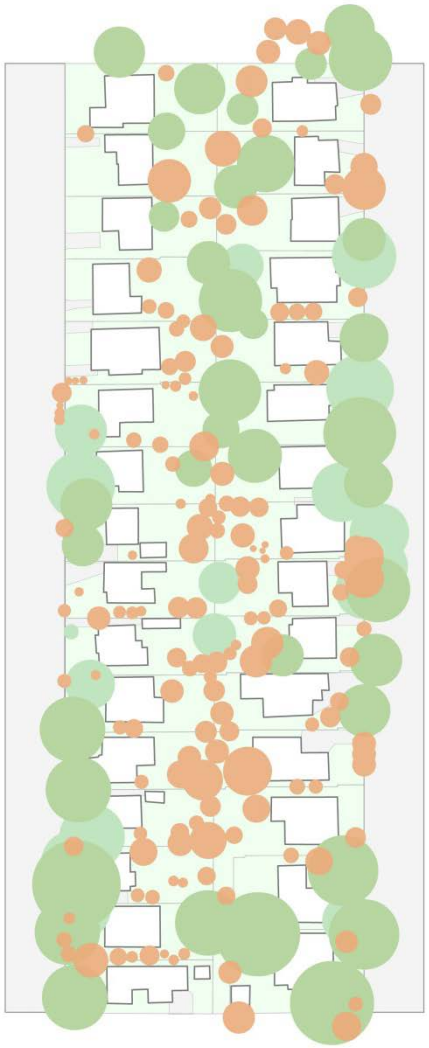


Figure 24. A representation of trees (orange) not protected by Oak Bay's Tree Bylaw based on size (based on a block in the Established Neighbourhoods).

For a typical block in the Established Neighbourhoods land use, Figure 24 illustrates the trees that would not be protected (in orange) and those that are protected (light green for size and dark green for Garry oak) under the bylaw based on size. Additional green 'protected' trees would not require a permit for removal if within an approved building envelope or for public works. Trees that do not require a permit for removal do not require replacement and their removal typically contributes to a net loss of canopy during development.

The reasons for permitting removals under the bylaw relate to eliminating hazards or dying trees, promoting the health and vigour of native trees, facilitating development (external the building envelope) and preventing or mitigating infrastructure damage. The bylaw implies that alternative solutions are generally sought unless tree retention would or is imposing an 'undue

hardship'. While the permit issuing reasons are generally sound, some of the language is vague and open to broad interpretation. For example, undue hardship is not defined and nor is a risk threshold for hazard, which enables discretionary interpretation.

Removal is also permitted to eliminate a situation where a water line, sewer pipe or drain pipe is being chronically blocked or damaged by roots; while this certainly occurs it is not necessarily reasonable justification for tree removal. Roots grow, where there is adequate oxygen, in response to moisture in the soil and therefore typically continue to grow towards the source of moisture. If pipes are leaking moisture then tree roots will typically grow towards that moisture source. Once roots reach moisture source they grow rapidly to take advantage of the water, either creating a blockage in the pipe or sometimes expanding in size adjacent to pipe and crushing it. Tree roots blocking pipes are typical in locations where the infrastructure is old and already failing; therefore it is already in need of replacement by the time tree roots increase the severity of that failure and bring it to our attention. If the pipe is replaced or lined so that it doesn't leak, then the roots will not invade the pipe.

Permit fees in the current bylaw are $30 for the first three trees and $5 for each additional tree; these amounts do not cover the cost of staff reviewing and processing permits. The current tree bylaw requires securities to be paid by the developer for replacement trees and held for three years at $500 per tree. However, securities are not held for protected trees so, if a tree is damaged during development, the District can levy a fine but retains no compensation for the loss of that tree. Maximum bylaw fines are $10,000 and cannot be increased under BC law. While fines are effective if the perpetrator is caught in the act, damage to trees is not always observed and the tree may not show signs of decline until up to 5 years later. Securities can provide significant incentives to design around and modify work practices around protected trees.

85% of Oak Bay survey respondents agree that **securities should be taken to protect trees that are to be retained** in the development process.

82% of Oak Bay survey respondents agree that a **minimum canopy cover should be required for new developments** and, if not provided, that payment is made for equivalent planting on public land.

72% of Oak Bay survey respondents agree that the **number of trees that must be replaced** for every tree being removed should increase.

60% of Oak Bay survey respondents agree that the **bylaw should be strengthened** to include trees of a smaller size.

During the public consultation event many people raised issues about protecting more trees under the bylaw, strengthening the rules for tree protection and replacement in development, the need for more replacement trees, higher penalties and greater enforcement. Consistent with that message, steps to strengthen the bylaw received significant majority support in the public online survey (accuracy estimated to be within +/- 5.5% 19 times out of 20 for Oak Bay's population). However, survey respondents self-selected, which introduces bias into the results because it attracted respondents with an interest in the issue. IP address mapping shows 90% of respondents were using computers in the Oak Bay area.

While the survey suggests that there is majority support in the community for strengthening the bylaw by regulating trees of a smaller size, those not in favour are strongly opposed indicating that the issue is polarizing. Bylaw changes must strike a balance between encouraging/requiring tree protection and becoming overly burdensome in terms of administration and cost to landowners. While some individuals who apply for a building or development permit have ample resources to provide securities, others will have much more limited budgets. Reducing the size of protected trees has the benefit of increasing the number of trees considered for tree protection and replacement on a site but also increases the cost of bylaw administration and the amount of securities taken.

A factor likely contributing to the polarization of the community's perception of trees and tree regulation on private land is that benefits from trees are typically a public good that cannot be commercialized. It is a mandate of municipal governments to provide services for the public good but not all homeowners are enthusiastic about paying to maintain a private tree for the benefit of the broader community. Some residents suggested that the District should provide financial rebates to assist homeowners with maintenance of their large trees, which is an approach some communities elsewhere have started to adopt. Changes to the bylaw must consider the impacts on Oak Bay residents and further public consultation is likely required prior to implementing a bylaw update to ensure that it has majority public support.

POLICY EXAMPLE: New Tecumseth Tree Maintenance Program

- The Town provides a yearly financial incentive in the form of a refund on the cost of maintaining the health of trees on private property.
- Pruning, trimming and crown maintenance are eligible and 50% of the cost is covered up to a maximum rebate of $250 per year per property.
- Tree removals are not eligible.

Considerations for strengthening and improving the tree bylaw include …

- Modestly reducing the minimum size of protected trees
- Strengthening the language regarding reasons for issuing a permit authorizing tree cutting or damage
- Allowing pruning of private trees to occur without a permit under specified conditions and enforcing fines or revoking business licenses when pruning standards are not met
- Removing the definition of building envelope and requiring all protected trees on a property to be subject to the tree permit process (i.e., including trees in the building envelope)
- Requiring an arborist report to inventory the trees on site and make recommendations for retention, removal and tree protection
- Requiring arborist supervision of works near the critical root zone of retained protected trees
- Taking securities for the protection of retained trees to be released contingent on arborist confirmation that tree protection measures were followed and no damage occurred
- Requiring all developments, by zoning, to meet minimum canopy replacement requirements, even if no trees are being removed on the property
- Incorporating any future changes to zoning into minimum canopy replacement requirements
- Expanding the permitted uses of cash-in-lieu of canopy replacement or securities retained to enable funds to be used towards enhancement of the urban forest beyond tree planting on public land (e.g., to fund tree maintenance rebates for private trees, invasive species removal, habitat restoration etc.)
- Increasing permit fees (except for hazardous or diseased tree removals) to reflect the cost of administering the permits

4.3 Public Works and Utilities

The District's OCP prioritizes several urban infrastructure projects that have the potential to impact trees. The Uplands combined sewer separation project, complete streets program, sidewalk and crosswalk program and pathways and trail upgrades will need to integrate trees and tree protection into design and construction.

4.3.1 Complete Streets and Trail Upgrades

Installing sidewalks and trails often requires tree removals due to direct conflicts with trees or tree roots. Retained trees can also be impacted by the increased soil compaction in high use areas. The impacts on trees can be mitigated through design, materials and construction. Keeping paths to a minimum width for accessibility, allowing paths to move around trees, using rubber or pervious sidewalks or maintaining pervious surfaces and constructing surfaces above grade are all examples of methods to minimize tree removals. If constructing new medians or roundabouts, ensure that the compacted road-base is excavated to rooting depth and that adequate soil volume is provided for the trees.

4.3.2 Combined Sewer Separation

The District has embarked on a project to separate combined sewers in the Uplands community. Excavation to connect the new stormwater or sewer system to homes has the potential to impact tree root zones. To date, staff have recommended that the location of service connections be determined on a property by property basis to impact the least trees.

While Council is required by the province to conduct the sewer separation project, the potential for downspout disconnection to reduce the strain on stormwater infrastructure and provide additional water for the urban forest remains. Disconnecting roof downspouts redirects rooftop runoff from the district stormwater infrastructure into an on-site pervious surface area that holds the water and allows it to infiltrate back into the soil. Removing roof runoff from the pipe network could not only significantly reduce the strain on district infrastructure, but also improve water quality and replenish the soil water reservoir to improve vegetation health.

POLICY EXAMPLE: Victoria's Stormwater Utility Tax and Rainwater Rewards Program

The City of Victoria now charges a stormwater utility separately from property tax. The utility tax is calculated using:

- Intensity (impact on stormwater system) based on property/zoning type
- Impervious area
- Street cleaning, based on frontage length
- Codes of practice for properties with 10 or more parking spaces or certain uses

Citizens can reduce their stormwater bill using the Rainwater Rewards Program that offers credits for onsite rainwater management. The rainwater management methods that can be used include rain barrels, rain gardens, swales and permeable paving. Disconnected downspouts feed into these systems. It is anticipated that the program will both reduce the volume of rainwater entering pipe infrastructure and reduce the pollutant load by allowing stormwater to infiltrate on site.

4.3.3 Utilities

Utility clearance pruning is required when powerlines occur in streetscapes. Applying best practices and improving integration in managing clearance pruning can improve efficiencies in service and costs for both utilities and urban trees. Planting planning can incorporate guidance on tree selection and placement to minimize tree growth into the limits of approach for power lines or other utility clearance limits. Typically, small trees that will not grow into the powerlines, or large trees that can be successfully pruned around powerlines are the two options for tree selection in order to avoid future conflicts. Undergrounding powerlines can also avoid overhead conflicts; however, trenching for underground services can damage root zones therefore undergrounding is best done in streetscapes without mature trees or where there are no root zone conflicts. Services also need to be installed at a depth and distance from potential tree planting locations that enables trees to still be planted in streets.

Considerations for public works and utilities…

- Improving interdepartmental review processes for the District Arborist to provide input capital works projects
- Considering the potential for downspout disconnection or interception of other rainwater runoff to increase infiltration and water availability for the urban forest
- Selecting trees that are suitable under powerlines

4.4 Degradation of the Natural Environment

4.4.1 Remnant Garry Oak and Associated Ecosystems

The District of Oak Bay was dominated by Garry oak ecosystems prior to urbanization (Figure 25). Today, the landscape is mostly developed with some fragments of natural ecosystems remaining in the Uplands Park and parts of the Uplands Golf Course (Figure 26). Remnant Garry oak ecosystems are defined by naturally occurring Garry oak trees and a semblance of the ecological processes and communities that dominated prior to European settlement (Garry Oak Ecosystem Recovery Team, 2013). Associated ecosystems lack Garry oak trees but are still considered Garry oak ecosystems because they contain similar associations of plant and animal species. Garry oak and associated ecosystems are some of Canada's most endangered and house more than 100 species at risk (Garry Oak Ecosystem Recovery Team, 2013).

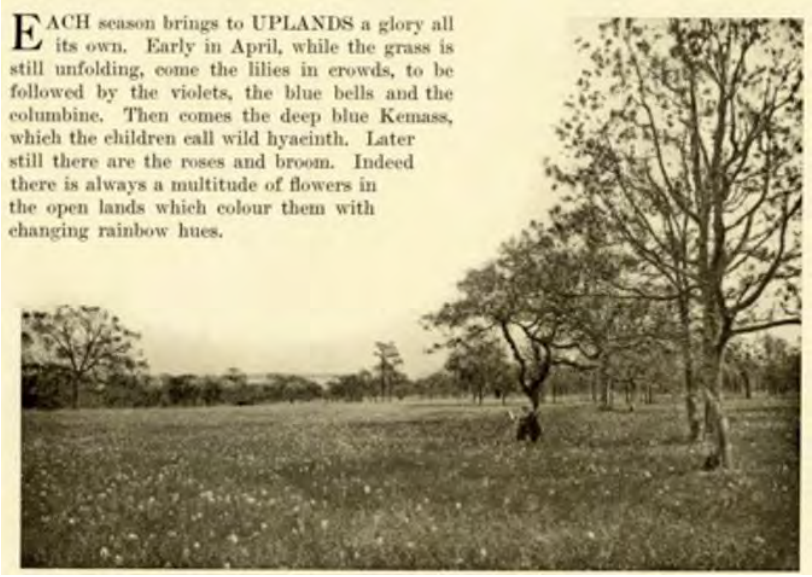


Figure 25. Promotional booklet from the 1920s for the Uplands showing a parkland Garry oak ecosystem in May (Oak Bay Archives 1995-005-015).

In Oak Bay, remnant Garry oak ecosystems are fragmented in small patches and are considered at risk of disappearing. Threats to the persistence of these ecosystems and the species within them come primarily from development and destruction, invasive non-native species, recreation, fire suppression and overgrazing by deer. The Garry Oak Ecosystem Recovery Team (GOERT) provides numerous resources on Garry oak ecosystems and guidance for development practices, restoration and gardening to promote the protection and enhancement of Garry oak ecosystems. The people of the Lekwungen Nation managed the landscapes of the District prior to European settlement and hold Traditional Ecological Knowledge for the restoration and management of these ecosystems.

Residents of Oak Bay have been very active in caring for their community's Garry oak ecosystems and natural areas. Numerous volunteer groups work to advise the District on environmental management and to physically control the presence of invasive species and protect and restore the natural areas.

4.4.2 Garry Oaks in Urban Areas

Most residents place a high degree of importance on the urban forest providing **habitat for native plants and animals**.

While most of the Garry oak ecosystems have been lost or substantively degraded, many Garry oak trees persist on streets and private properties through the historical distribution of those ecosystems (Figure 2). Most of the Garry oak trees are distributed in the north and south ends of the District with the large gap between Bowker Avenue and Lansdowne Road likely due to the past clearing for former land uses like agriculture, the racecourse and fairgrounds. The highest density of Garry oaks is found in the northern and Uplands neighbourhoods.

Garry oaks have proven reasonably resilient as an urban tree in Oak Bay and are successful as a street tree. Given that the Garry oak's range is so limited, its success as an urban tree is a windfall for persistence of the species in Canada. However, connectivity of Garry oaks throughout Oak Bay could be improved. The existing and potential Garry oak dominated streets shown on Figure 26 highlight streets that already have a large Garry oak canopy cover and streets that could be planted to improve their connectivity. The map also shows that private and institutional land uses could contribute to enhancing Garry oak canopy distribution in the District in locations where those ecosystems historically existed (Figure 26).

Adjacent to natural areas and in suitable locations on public and private land it may be possible to partially restore Garry oak ecosystems and provide better buffers for the more intact remnant ecosystems. Even home gardens can contribute to ecosystem restoration by replacing lawn with meadows, or planting native grasses and shrubs.

4.4.3 Other areas of interest

In addition to its Garry oak ecosystems, the District of Oak Bay features areas of ecological interest such as its ocean shoreline, rocky outcrops and Bowker Creek and Douglas-fir dominated forests in the north of the community. In recent years, efforts have focused on the restoration of Bowker Creek, in particular along the Oak Bay High School where work was completed in 2016 (District of Oak Bay, 2016). The restoration improved the riparian areas and naturalized the creek's channel. Such interventions not only provide more natural spaces for Oak Bay residents but can also help to mitigate negative environmental impacts such as flash flooding that occur as a result of urbanization.

Oak Bay's golf courses, the Victoria University Lands and numerous other parks provide managed green spaces dispersed throughout the district that could form hubs for an open space network from which to enhance connectivity and strengthen native biodiversity throughout Oak Bay.

Considerations for enhancing the natural environment…

- Inventorying Garry oak and associated ecosystems, rare and endangered plant species, and invasive species throughout the District's natural areas
- Establishing partnerships with the Lekwungen people to incorporate First Nations values and perspectives in management and restoration of the natural environment.
- Developing a natural area management framework to address access and recreation usage
- Developing an invasive species and browse management plan

- Developing a biodiversity policy or action plan to guide the District's approach and priorities for improving open space connectivity and ecosystem restoration
- Continuing to work with First Nations, the Garry Oak Ecosystem Recovery Team and community groups to restore and enhance Garry oak ecosystems on public land
- Providing environmental protection and ecosystem restoration incentives for developers, golf courses and institutional land managers
- Educating residents to protect and restore Garry oak ecosystems on private land

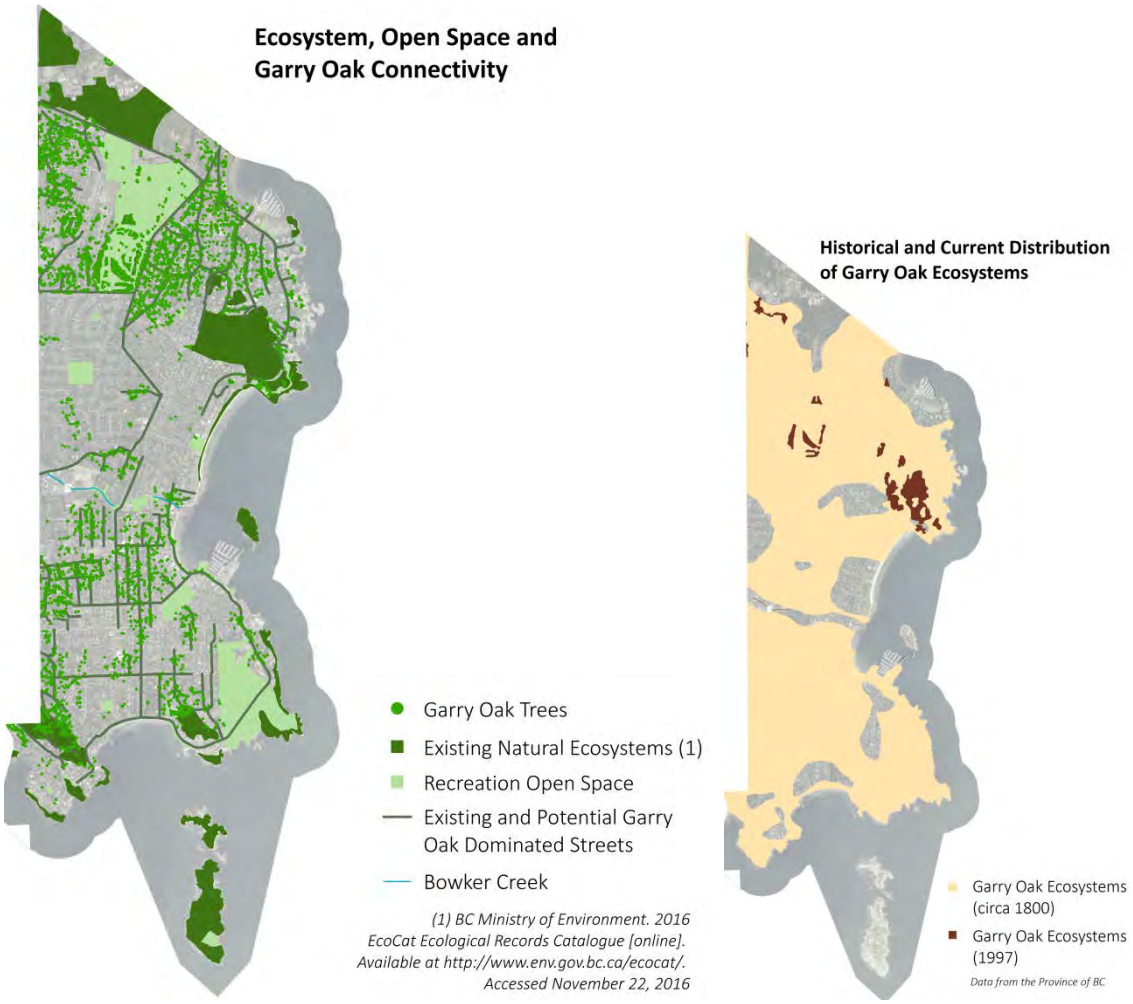


Figure 26. Garry oak trees and potential open space 'hubs' in the District of Oak Bay (left) and inset of historical and remnant distribution (right).

4.5 Climate Change Mitigation and Adaptation

Climate change is expected to impact both our communities and our urban forests in a variety of ways. Urban forests are a potential tool to help communities mitigate and adapt to climate change. The term mitigation refers to direct efforts to reduce or prevent greenhouse gas emissions causing climate change. The urban forest contributes to climate change mitigation by sequestering carbon, reducing energy consumption and reducing air pollution. Adaptation refers to minimizing the negative impacts of climate change when they occur. Urban forests assist with climate adaptation by, for example, providing shade and cooling in hotter summers and absorbing the stormwater from extreme weather events.

4.5.1 Projected future climate and urban forest impacts

Oak Bay's climate is projected to warm by 2.5 degrees Celsius by the 2080s. Summer precipitation is predicted to decrease by 20%, while winter precipitation will increase by 9%. Frost free days are predicted to increase by 20 days per year. These projections are sourced from the Pacific Climate Impacts Consortium Plan2Adapt Tool[6] and represent ensemble mean values from 15 different Global Climate Models (GCMs) using a high and low greenhouse gas emission scenario. Climate change is predicted to impact Oak Bay's urban forest primarily by the effects described in Table 3.

Table 3. Climate changes and anticipated impacts on the urban forest

Climate Change	Climate Effect	Urban Forest Impact
Warmer, drier summers	↓ soil moisture, reservoir water supply	↓ tree growth and natural regeneration
	↑ length of drought	↑ tree mortality
	↑ length of wildfire season ↑ severe and intense wildfires	↑ tree mortality
	↑ heat days (exceeding 30°C)	↓ tree growth
Milder winters, longer and warmer summers	↑ Insect and disease outbreaks ↑ New invasive pests, diseases and plants	↑ tree mortality (species specific) ↓ native biodiversity
Warmer summers	↑ Ground level ozone	↓ tree growth (some species)
Sea-level rise, more frequent and intense rainfall events	↑ flooding and waterlogged soil ↑ debris flows ↑ soil salinity	↓ tree growth (localized) ↑ tree mortality (localized)
Milder winters, more frost free days	↑ average annual minimum temperature ↓ frosts	↑ range of species suitable for Oak Bay climate

[6] https://www.pacificclimate.org/analysis-tools/plan2adapt

Increasing frequency and intensity of windstorms is often listed as a climate change impact for the southwestern BC but there is limited evidence and agreement within the scientific literature and among climate models so it is not listed as an impact. Windstorms remain the most common disturbance events experienced by urban forests in our region.

The best way to ensure that the urban forest is well adapted to future climate is to grow healthy and resilient trees in good planting sites with adequate soil volume, good water infiltration and drainage, and to protect trees from disturbance. Future species selection will need to consider diversity and drought tolerance. A list of tree species suitable for planting in Oak Bay's current and future climate is provided in Appendix 5. Oak Bay's current sites typically support healthy large trees because they have ample soil volume and have not had disturbance in their root zones. In addition, Oak Bay's native species, and Garry oak in particular, are expected to have adequate drought tolerance for the projected future climate.

4.5.2 Using trees for community climate adaptation

Urban forests provide ecosystems services that can help communities to adapt to climate change. Specific climate adaptation benefits that urban forests provide include shade and cooling, stormwater management, air pollution reduction, water quality improvement, erosion control, carbon sequestration and wind buffering. Metro Vancouver's design guidebook for maximizing climate adaptation benefits with trees provides a range of design scenarios and guidance for planting design and species selection for climate adaptation (Diamond Head Consulting, 2016c).

Trees can also provide energy savings by shading buildings during the summer. Planting design and species selection are important for achieving benefits for specific locations. For example, if planting trees around buildings for shading and energy conservation, **it is best to place trees adjacent to the east and west facades** that receive the most solar radiation and passive solar heating given sun angles and duration during summer months. Deciduous trees are typically preferred (unless creating a wind break) because they allow winter sun to reach the building, reducing heating costs. Placement on the south side of buildings is less preferred because tree canopy must extend directly over the building to provide any summer benefit and the tree then interferes with winter solar access. Placement around buildings may also need to consider solar panels should roof panels become more common in Oak Bay; the same placement principles apply but tree selection and placement should aim to cast shade over building facades rather than the roof.

While Oak Bay doesn't have large continuous forested areas to support landscape level wildfires, there are locations with forest or natural area interface and, in those locations, creating FireSmart landscapes around homes by using fire resistant trees and shrubs and avoiding coniferous trees within 10 m of structures should be a consideration.

4.5.3 Using trees for community climate mitigation

Trees sequester and store carbon and remove pollutants from the environment, contributing to the reduction of GHG emissions. Based on 2015 reporting for the Climate Action Revenue Incentive Program (CARIP), the corporate emissions for the municipality were 1,051 tonnes of Carbon Dioxide (District of Oak Bay, 2015). Based on the i-Tree canopy analysis Oak Bay's tree population is estimated to:

- Sequester 3,270 tonnes of Carbon Dioxide annually
- Store 97,490 tonnes of Carbon

These are first order estimates based on a canopy assessment and are not equivalent to an inventory of the carbon sequestered or stored in the urban forest. Typically an inventory would need to be completed by a Registered Professional Forester to obtain timber appraisal and stand health data to input into a carbon model using the BC Forest Carbon Offset Protocol methodology.

Urban trees have the potential to be counted towards emission reductions under the Green Communities Committee Carbon Neutral Framework. One option available is the avoided forest conversion projects. The urban forest may be considered avoided forest conversion if forested lands greater than 1 ha are transferred to municipal ownership and set aside for conservation when they could otherwise be developed for a non-forest land use. A second possible option is to count the broader urban forest and its management towards emissions reduction by having projects third party verified (i.e., afforestation or reforestation in manicured parkland or with street trees, or demonstrating the offset impact of improved forest management or ecosystem restoration). This latter option is challenging because the project needs to be designed, usually with consultant assistance, and then validated by an acceptable third party. Typically the cost per tonne of offsets achieved using either of the options discussed above is greater than the cost of purchasing offsets. However, as methodologies are refined and technologies become cheaper it may become more attractive to municipalities to account for their natural assets as carbon offsets.

Considerations for climate change mitigation and adaptation…

- Increasing regulatory protection for trees, soil volume and permeability
- Conversion of turf grass understories to native plants to reduce mowing and irrigation requirements, or allowing grass to grow longer to reduce mowing requirements
- Selecting species that are well adapted to future climate
- Integrating the urban forest into public and private site design for climate adaptation
- Exploring ecosystem valuation tools (e.g., i-Tree Eco, TEEB etc.) to report, and ultimately account for, carbon offset and other climate adaptation benefits provided by the urban forest
- Exploring options to integrate trees and green infrastructure options for improving building energy efficiency into the Strategic Energy Management Plan and projects for its implementation.

4.6 Maintaining a Healthy Tree Population

Maintaining a healthy tree population is essential for having an urban forest that maximizes the beneficial ecosystem services provided to the community. Tree mortality rates should be as low as possible to maintain a stable tree population and avoid the costs and carbon emissions associated with frequent replacements. Individual trees should be healthy to avoid the costs and carbon emissions associated with pruning, watering or other treatments to reduce stress. Tree diversity should be managed to address the potential risks of large-scale tree mortality from pests and diseases.

4.6.1 Tree Mortality Rates

In urban street tree populations, annual mortality rates typically range from approximately 3.5-5.1% (Roman & Scatena, 2011). Oak Bay is likely at the low end or below this average range because the growing conditions are very good compared to most cities. Mortality rates in urban tree populations also vary throughout age and size classes with much higher loss rates in the first few years after planting compared to mortality rates once trees are established (Roman, et al., 2013).

While the research on urban tree mortality rates is limited, some findings suggest that it is young tree mortality, rather than the loss of mature trees, that drives urban tree population cycles (Roman, et al., 2013; Richards, 1979). The reason for this finding is that large trees are typically in the landscape for a very long time (~50-150 years) and are removed as individuals reach the end of their safe useful life expectancy, possibly decades apart. By comparison, young trees or smaller, short-lived species need to be replaced much more frequently (e.g., within 3 to 30 years of planting) and therefore drive replacement needs. By that logic, an urban forest that is comprised mostly of long-lived species and has low young tree mortality should have the most stable tree population (excluding pest and disease or extreme weather related mortality events).

More data needs to be collected in order to understand Oak Bay's tree size distribution and associated tree mortality rates. At this time our assumptions are based on anecdotal evidence but are presented as a starting point for decision-making:

- Oak Bay has limited space for new tree planting and has not planted high numbers of trees annually in recent history (average 70-100 trees per year), suggesting that mortality rates are low overall and the tree population has been stable;
- Trees in large size classes currently have low mortality rates in Oak Bay, have persisted in the landscape for a long time, and represent a large proportion of Oak Bay's tree population;
- Trees in large size classes will require increasing maintenance in the coming decades to remove deadwood and reduce the canopy as their life expectancy declines; and,
- Replacements are anticipated in the next five years for Paul's scarlet hawthorn, silver birch, plum, cherry and mountain ash, which are typically short-lived species in smaller size-classes that do not represent a high proportion of Oak Bay's tree population.

There is a risk that the mortality rate for trees in the large size classes will increase if large numbers of trees reach the end of their useful life expectancy at the same time. It will be

important to monitor the rate of senescence in order to predict whether or not the District is likely to face a spike in removals and replacements beyond the term of this plan.

4.6.2 Individual Tree Health

Declines in tree health, other than those related to age, are typically due to stressors like drought, storm damage, pests and disease and construction damage (Figure 27).

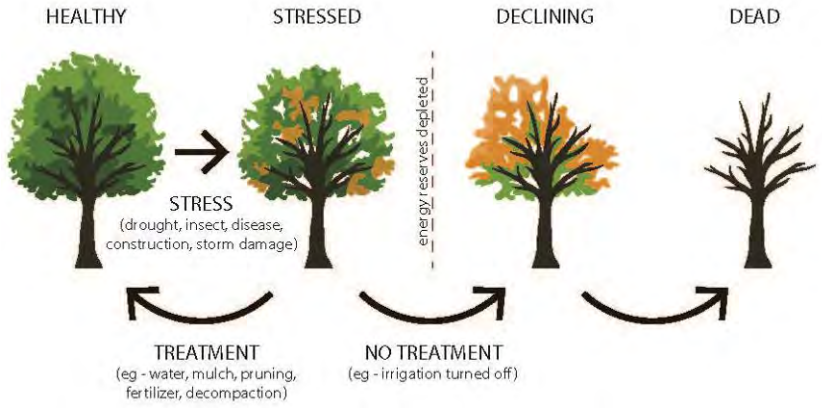


Figure 27. At the end of their lives, trees naturally enter the mortality spiral but stress hastens this transition (adapted from Clark and Matheny (1991))

Scheduling regular maintenance throughout an urban tree's life is important for maintaining a healthy urban tree population, maximizing tree lifespans, and managing potential risks. Pruning early in a tree's life promotes good branch structure, reducing the potential for branch breakage problems to develop as the tree matures and avoiding the costs and risks associated with those failures. Healthy, semi-mature and mature trees with good structure typically don't need much pruning but should be inspected at regular intervals to identify any maintenance needs. When trees become over-mature, more regular inspections and pruning are required again to extend the tree's useful life expectancy in the urban landscape. Regular maintenance comes at a cost but, by extending the lifespan of trees in the landscape, maximizes the benefits returned by each tree and reduces the cost of premature tree removal and replacement.

Oak Bay's tree population is currently in good health overall. Soil volume and soil quality in most parts of Oak Bay is adequate to support healthy, long-lived trees. Oak Bay's climate lacks adequate summer precipitation to meet vegetation water use requirements therefore plants must obtain water from soil or other sources like irrigation in order to avoid drought stress. The combination of drought adaptations in trees and Oak Bay's soil volume and soil quality are critical to growing healthy, long-lived trees in the District. Young trees need irrigation in the summer but established trees are able to tolerate typical annual drought if they are well adapted to the climate. Occasionally the region experiences more severe drought, during which even established trees may need irrigation if they are showing signs of stress (e.g., premature defoliation, canopy dieback).

Severe storms periodically affect the region and can cause tree damage by breaking branches or, if soils are saturated, uprooting trees. The soil volumes available to trees in Oak Bay typically promote good root anchoring and Garry oak, which is the dominant large tree, is not prone to

uprooting; high winds tend to break their boles and branches. Proactive tree maintenance to prune deadwood and weakened branches is an important approach for reducing the extent of storm damage in trees. Enforcing tree protection measures during construction is also important to ensure that roots are not damaged and at increased risk of root plate failure.

Several pests and diseases can cause widespread tree mortality. Existing species of concern to Oak bay are sudden oak death, Douglas-fir bark beetle, birch leaf minor, Armillaria root disease and gypsy moth. Sudden oak death affects a wide range of species including oaks, maples, arbutus and Douglas-fir but is particularly devastating to red oaks. Fortunately, oaks in the white oak group (including Garry oak) are not thought to be susceptible (Swiecki & Bernhardt, 2013; Hansen, et al., 2005). Maintaining tree health, proactive tree maintenance, species selection and monitoring for emerging pests and disease are important for preventing large-scale tree mortality. Browse by deer is also an issue for some young trees with palatable foliage.

4.6.3 Tree diversity

A resilient tree population needs to include a diversity of tree species selected to maximize urban forest benefits and to reduce vulnerability to losses associated with pests and disease. Setting tree diversity targets in urban forests is often guided by 'rules-of-thumb' such as the 10-20-30 rule for planting no more than 10% of any species, 20% of any genus and 30% of any family. For temperate climates, this rule is probably reasonable at the genus and family level (Kendal, et al., 2014). However, we recommend only apply diversity targets to introduced species. Native species like Garry oak should be excluded because such a target would threaten Oak Bay's native biota and the functionality of native ecosystems that have already proven effective at delivering important ecosystem services.

Establishing a diversity target is useful for driving tree planting selection; however, it is important that the population be primarily composed of species that are proven in Oak Bay's climate. Species that are proven long-lived in Oak Bay are good candidates for maximizing benefits. Unproven species should be trialled before they are integrated into the planting program. A recommended planting palette for Oak Bay is provided in Appendix 5.

Considerations for maintaining a healthy tree population…

- Collecting tree inventory data that includes species, date planted (where possible), dbh, height, condition, size class at maturity, safe useful life expectancy and tracks date removed for trees in Oak Bay
- Monitoring branch, stem and whole tree failures, and browse or pest incidences by species and individual tree location
- Increasing regulatory protection for trees, soil volume and permeability
- Implementing a young tree formative pruning, young tree fencing for browsed species, and a cyclical pruning program for semi-mature to over-mature trees
- Selecting species that are well adapted to future climate
- Implementing a young tree watering program
- Monitoring emerging pests and diseases and responding rapidly to quarantine any new occurrences
- Selecting for long-lived trees and managing the diversity of tree species planted in the urban forest (excluding native trees)
- Trialling new trees that have the potential to be long-lived in Oak Bay

4.7 Managing Water and Soil

The successful establishment and growth of trees and vegetation is primarily dependent on access to soil and water. When natural areas become urban areas they typically become less pervious and, instead of water infiltrating into the soil, water runs off the surface as stormwater. Soil is also often compacted or removed and replaced with poorer quality fill. Typical development practices reduce long-term vegetation health and create waste stormwater that needs to be managed by the community. By changing our practices to protect soil volume, quality and permeability, we can increase the water stored in the soil and available to vegetation and decrease the volume of storm water that we need to manage.

4.7.1 Soil

Tree roots are typically concentrated in the upper 1 m of soil (but will be shallower or deeper depending on availability of air and water). Trees need access to sufficient soil volume to maximize their growth and minimize conflicts with other below ground infrastructure. When precipitation is insufficient to meet the water requirements of trees, roots access water stored in the soil. A tree pit containing 2 m^3 (1.4 m x 1.4 m x 1 m) of sandy loam soil holds about 13% or 25 L of plant available water (Bertrand, et al., 1991). An American elm with a diameter of 70 cm is estimated to use up to 1,000 L of water per day and needs a soil volume of approximately 80 m^3 (e.g., 10 m x 8 m x 1 m) (calculated as defined in (Lindsey & Bassuk, 1992).

While more soil is generally better, a volume of between 0.3 m^3 and 0.6 m^3 soil per unit area of projected crown area (m^2) should be provided (Linsey & Bassuk, 1991; Lindsey & Bassuk, 1992) (Figure 28). Solutions for load bearing sidewalks or parking areas, such as trenches to connect soil volume, suspended pavements supporting soil volume below, soil cells and structural soils can be used to increase soil volume under hardscapes. It is much more cost efficient to protect or restore soil conditions during the construction of new landscapes than to retro-fit existing landscapes. Oak Bay's parcel sizes, setback and lot coverage requirements in the Zoning Bylaw typically enable the retention of ample volume to support large areas of canopy in most streetscapes and on private property (assuming the bulk of the remaining land area remains softscape). Commercial and multi-family land uses are more constrained due to parking requirements and may require engineered solutions for soil volume under hardscape.

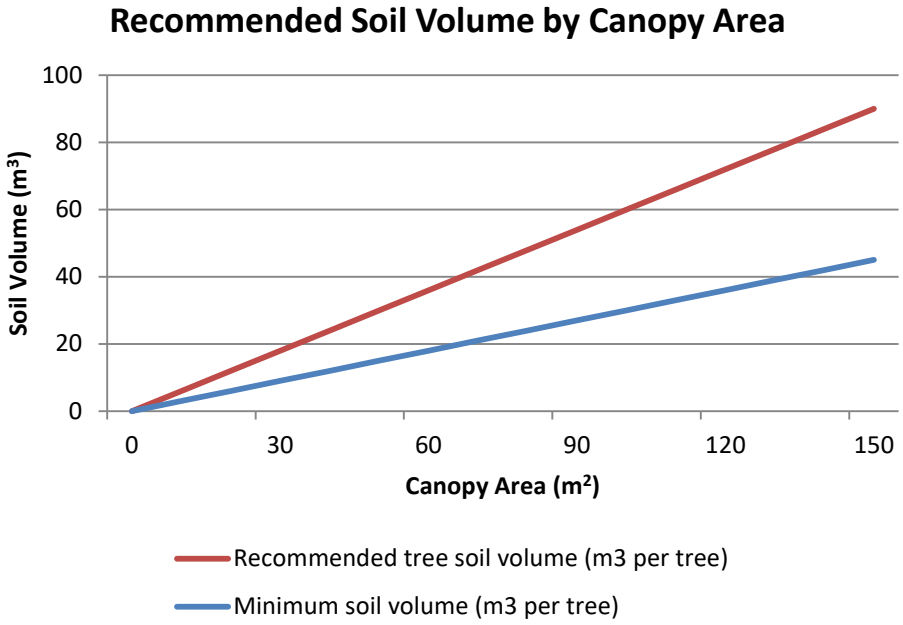


Figure 28. Recommended soil volume by canopy area.

4.7.2 Water Availability

Summers are predicted to become warmer and drier under climate change. Oak Bay's ecosystems typically already experience a period of soil moisture deficit. We expect the soil moisture deficit during the summer to lengthen and intensify under climate change except in locations with a stable water source (e.g., groundwater seeps, shallow water tables or irrigated areas).

Small soil volumes and impervious surfaces reduce the water available to plants. When surfaces are largely impervious, water cannot infiltrate into the soil. When soil volumes are small, the water storage capacity is also small. Soils under hardscape or small soil volumes are expected to dry out even more rapidly under climate change increasing the drought stress experienced by urban trees. To prevent or reverse these conditions, permeability below the canopy should be maximized, soil volume targets should be met and stormwater, where possible, should be redirected into pervious areas for infiltration into the soil for storage.

4.7.3 Stormwater Runoff

The movement of water across the surface of urban areas creates numerous problems for municipalities. Stormwater runoff is created when rainwater is not able to infiltrate the ground or evaporate and it drains over the landscape, collecting surface pollutants and causing erosion or flooding. In many municipalities stormwater is collected in the sewer, which then overflows during heavy rainfalls. Redirecting rainfall to piped infrastructure also reduces the amount of water stored in the soil and gradually flowing out as groundwater that replenishes stream flow.

With the planned separation of the sewer from stormwater, the District of Oak Bay will avoid the sewer overflow issue. However, the other negative impacts of stormwater will remain.

The urban forest can play an important role in slowing, reducing and cleaning stormwater runoff. In forested areas, tree canopy intercepts rainwater which runs down tree stems to the ground. The pervious surfaces and soil volume associated with the urban forest infiltrate and store the water. Water is then returned to the atmosphere through evapotranspiration or gradually drains underground. Some surface runoff will still need to be managed using pipes, particularly during high rainfall events, but the total volume can be reduced using urban greenery and greenspaces as part of engineered 'green infrastructure'.

86% of Oak Bay survey respondents place a high degree of importance on the urban forest **reducing stormwater runoff and improving flood protection**

The protection of pervious surfaces and soil is a key part of improving stormwater management and supporting healthy trees and vegetation. Numerous municipalities are regulating or encouraging pervious area retention and on-site stormwater management in new developments using zoning bylaws, utility taxes, or redevelopment requirements.

POLICY EXAMPLES:

Zoning Maximum Impervious Area

In the City of Vancouver, single-family residential zones specify a maximum impervious for buildings and structures as well as other surfaces such as driveways

Stormwater Utility Tax Relief

The City of Victoria recently implemented a tax based on impervious area, property type and frontage and code of practice

New Development Rainwater Capture Targets

The City of Vancouver requires that all new large developments reduce runoff and improve water quality by capturing and infiltrating rainwater on-site

Considerations for managing water and soil…

- Increasing regulatory protection for trees, soil volume and permeability
- Redirecting stormwater into pervious areas for gradual infiltration into the soil

4.8 Trees and Urban Design in the Public Realm

When trees are intentionally planted in groves or organized patterns throughout urban landscapes they weave together natural areas and urban land uses, contributing to the beauty and functionality of urban areas as much as street patterns and architecture do. Trees and landscape character are fundamental to the desirability of Oak Bay as a place to live and a destination to visit. The mature, overarching canopy provided by trees in Oak Bay's streetscapes is a particularly striking aspect of the District's urban design.

While the majority of Oak Bay residents want to maintain and enhance the current landscape character, including the contribution of Garry oak and other large trees in both streets and parks, there are voices that call for small trees to be used in streets instead of large trees. Replacing large trees with small trees will not maintain Oak Bay's landscape character, and will not maximize benefits from the urban forest.

Typically, preference for small trees in streets is driven by the concerns about maintenance and risk management of large trees. Maintenance and risk management are centrally important to urban forest management, and are the price the community pays for having a healthy urban forest that benefits the community. We accept that roads, sewers, buildings and cars require maintenance and carry inherent risk but we continue to use them because they provide us with benefits that improve our quality of life overall. However, when poorly designed - whether trees, roads, sewers, buildings or cars – disservices can outweigh the benefits provided. To avoid disservices, planting designs must consider tree placement and selection of the right tree for the right place.

Oak Bay's broad public boulevards and front yards with space for large, mature trees give many Oak Bay streetscapes the green, parkland feel that is so valued by the community. As Oak Bay's trees are replaced, urban infrastructure is renewed and development policy is updated, it will be important to maintain the space for trees and to have design guidelines in place for tree replacement to ensure that Oak Bay's landscape character in streetscapes is maintained and urban forest benefits are maximized.

A planting structure for Oak Bay is presented in Figure 29. Streets that are dominated by Garry oak, or have the potential to connect Garry oak canopy are highlighted in yellow. Collectors and higher traffic streets have been highlighted for large or medium deciduous (except where there are powerlines and small trees may be preferred on one side) to create continuous boulevards. The remaining residential streets are denoted as small/medium/large given that street tree planting is usually a continuation of front yards and will need to be flexible to the existing character of the yard. However, the considerations for design guidelines presented below should still apply in general. Coniferous trees are not recommended for street tree plantings except where they border open space or are within a wide boulevard such as a roundabout where they will not cast winter shade over structures.

Considerations for street tree design guidelines…

- Using urban tree canopy to enhance connectivity between natural areas and to unite land uses
- Where Garry oak groves are present on adjacent park or private land, continuing that landscape character into the streetscape
- Planting trees in regularly spaced rows that define the pedestrian and roadway space

- Planting trees close enough together to form a continuous, canopy ceiling
- Creating homogeneity in texture, pattern, light and shade by planting the same species (or species of similar scale, form and texture) for 1-2 blocks at a time
- Planting trees curbside where possible to extend the canopy over the street
- Selecting large trees that will cover and contain the pedestrian space rather than small trees that interrupt and fragment the pedestrian space, except where screening is needed or there are constraints like high-voltage power lines
- Planting a second row, or grove of trees where boulevard space allows
- Placing trees to frame, not obscure, views to the ocean and Mount Baker
- Selecting deciduous trees in streetscapes with building frontages to maintain winter solar access
- Maintaining or providing adequate soil volume to support healthy trees

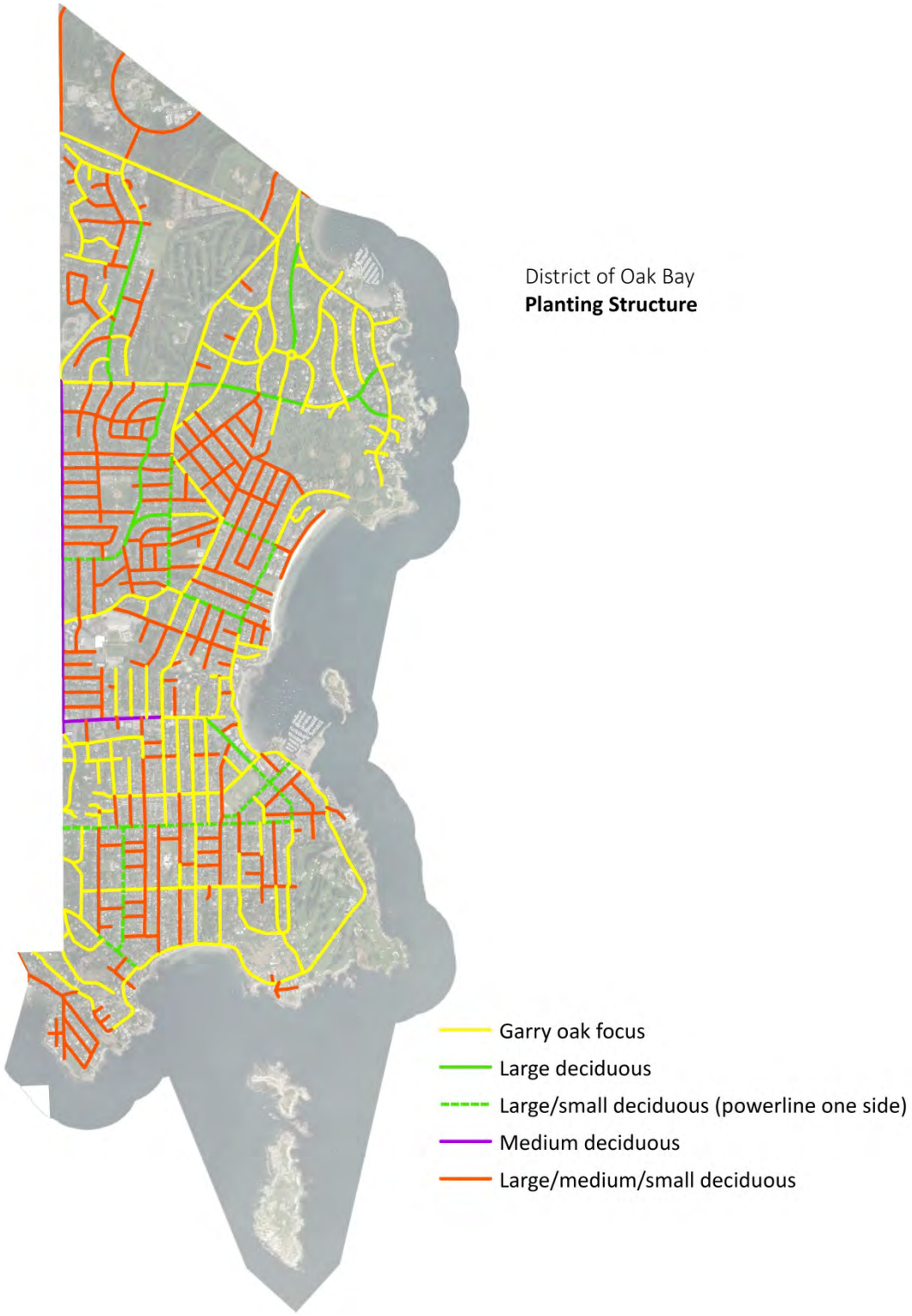


Figure 29. Proposed street tree planting structure for Oak Bay.

5 The Urban Forest Management Strategy

5.1 Community Vision Statement 2045

Oak Bay is close to nature. Lush, gorgeous treed streets, gardens and wild places are integral to our community's sense of identity. Our urban forest is a diverse and healthy mix of native and non-native trees and plants with a special place provided for the Garry oak as our namesake and the keystone of our native ecosystems. The urban forest supports desirable birds, insects and wildlife and provides places for children to play and for people to connect with nature. Our community has protected, enhanced and restored the distribution of trees and greenery throughout our neighbourhoods. Even as neighbourhoods changed with urban development, we have preserved and renewed Oak Bay's urban forest legacy for future generations.

The vision for Oak Bay's Urban Forest Management Strategy was developed in collaboration with the community and District staff. The vision is values-based, guides decision-making and promotes intervention towards a preferred outcome.

5.2 Strategy Principles

The following principles for urban forest management were consolidated from the aspirational goals of Oak Bay's Official Community Plan (Bylaw 4620, 2014).

- Protect and enhance natural features, parks and open space
- Mitigate and adapt to climate change
- Sustain the characteristics of Oak Bay's neighbourhoods and conserve Oak Bay's heritage
- Encourage and support services that enhance community and social well-being
- Encourage and establish infrastructure for active modes of transport
- Provide effective and reliable utility infrastructure and services

These broad principles inform the more focused objectives and management actions of the Urban Forest Strategy.

5.3 Strategy Objectives

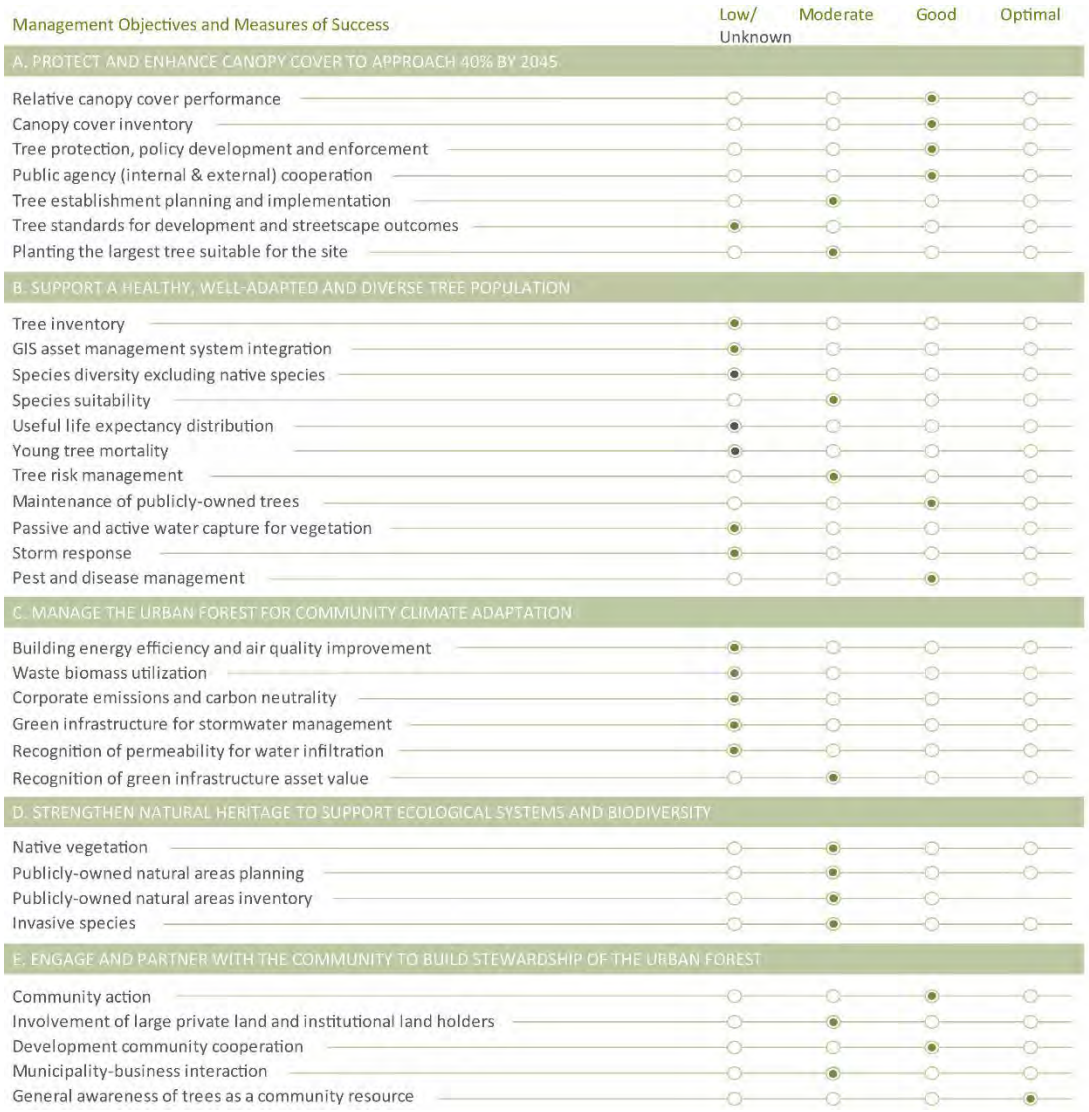
Five key objectives emerged from a comprehensive review of existing policy, as well as consultation with the public and staff (Diamond Head Consulting, 2016a; Diamond Head Consulting, 2016b). These objectives guide the priority actions and measurable targets defined for implementation of the Plan:

A. Protect and enhance canopy cover to approach 40% by 2045
B. Support a healthy, well-adapted and diverse tree population
C. Manage the urban forest for community climate change adaptation
D. Strengthen natural heritage to support healthy ecological systems and biodiversity
E. Engage and partner with the community to build stewardship of the urban forest

5.4 Objectives, Targets and Performance Indicators

A framework of targets and performance indicators has been defined for each objective in accordance with best practices in urban forest management and the issues and opportunities identified for Oak Bay. The original methodology for this framework stems from "A Model of Urban Forest Sustainability" (Clark, et al., 1997) and "Criteria and Indicators for Strategic Urban Forest Planning and Management" (Kenney, et al., 2011). Building on this framework, Diamond Head Consulting have modified the performance indicators based on our professional experience in the region, input from other professionals and research cited in this document, to address the local conditions and meet planning and sustainability goals of Oak Bay.

The District's current performance relative to these defined indicators has been measured in order to provide a baseline from which to measure success in implementing the plan. The summary "dashboard" (below) presents the baseline 'performance' of Oak Bay's urban forest management capacity at the time of this report. The details for each performance indicator can be found in Appendix 3.



6 Implementation Framework

6.1 Priority Actions and 5 Year Implementation Plans

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
		Years 1 – 5			
A	1	To achieve a canopy cover target to approach 40% by 2045, over the next 15 years: • **Plant approximately 200 trees per year on public land**: o Plant approximately 200 new trees on District-owned park and civic lands o Plant approximately 1,000 new trees on District-owned roads o Replace every tree removed on public land (~70-100 per year) • **Work with residents to plant** approximately 4,000 new trees on private property (to be driven by the Tree Bylaw and tree subsidies: programs that provide funding include Tree Canada's Greening Canada's School Grounds and a good example of a tree subsidy program with high public uptake is Vancouver's $10 tree sales and #Treelationships tree matching quiz[7]) • **Work with institutional land managers to plant** approximately 1,000 new trees	• District planting crew extended for 8 weeks • New 'Urban Forester' planning load • New 'District Engagement and Grants Coordinator' (resource shared across departments) • Co-op students	✓	• Budget redistribution • Parcel tax • Rates • Tree Canada grants • Nursery subsidies • Private donations • Cash-in-lieu generated by bylaw
A	2	When planning public realm plantings, follow the public realm planting guidelines provided in Appendix 6.	• Existing resources		

[7] http://vancouver.ca/parks-recreation-culture/treelationships.aspx

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
A	3	**Update the District's canopy cover every 5 years**. Between measurements, track public tree removals and replacements, and private tree removals and replacements through the bylaw process to estimate annual canopy loss/gain.	• Existing resources • Co-op student • Consultant project in five years to re-measure canopy	✓	
A	4	**Update the Tree Protection Bylaw** to address some or all of the changes outlined in Appendix 4 and enhance the process by which the District Arborist reviews arborist report submissions for tree protection permits and provides input to Building & Planning on design of shape and location of structure footprints and location of services to protect trees with high retention value. Signing authority for tree permits associated with development may need to lie with Building & Planning. Update the District's website and educate the public, developers and tree care industry about the changes. Expand the definition of eligible uses for funds generated as cash-in-lieu to include public tree planting, public land ecosystem restoration, citizen forester projects, and rebates for tree planting, maintenance or ecosystem restoration on private land.	• Existing resources • New 'Urban Forester' permit review load • New 'Clerical' part-time position **Note:** Current staff time allocation for permit review can be redistributed to B10 inventory data collection.	✓	

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
A	5	**When making changes to Zoning, Infill and Parking Bylaws or Development Guidelines, explore opportunities** to: • Maintain setbacks from the front lot line • Allow relaxations in driveway width and encourage pervious surface materials • Discourage driveways and off-street parking requirements where they would conflict with existing trees. • Set pervious surface and associated minimum soil volume targets (0.3 m^3 to 0.6 m^3 of soil per square metre of expected canopy projection) or, where not achievable, use of engineered features like green roofs • Allow relaxations for the location of accessory buildings to protect trees with high retention value.	• Existing resources		

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
A	6	**Work with Engineering & Public Works** to: • **Develop public realm planting guidelines** and standard specifications for planting standards, soil volume standards and District tree protection for public works projects. • Create a process by which the **District Arborist reviews public works projects** and provides input on location, excavation and construction methods of public works to protect trees with high retention value. Ensure tree protection for District and private trees is considered within upcoming road works and sidewalk projects. Projects should include an arboricultural review of existing assets and options for retention, removal and replacement with the budget for these works included in the project budget review. • Investigate the feasibility and funding options for **green infrastructure alternatives that redirect stormwater** into pervious areas for gradual infiltration into the soil when designing public works projects. • Identify and prioritize public realm opportunities to **build new or retrofit plantable space**, and to **develop green infrastructure** (i.e. raingardens) **for streetscapes**. • Create opportunities to establish more trees in streetscapes and to preserve or **improve plantable space as part of the infrastructure renewal process**. • Identify and prioritize locations with potential for **conversion of turf grass understories to native plants** to reduce mowing and irrigation requirements.	• Existing resources • Possible consultant project for public realm planting guidelines and standards specifications • Possible consultant project for feasibility and funding options for green infrastructure (see recommendation C16) • New 'District Engagement and Grants Coordinator' (resource shared across departments)	✓	• Budget redistribution • Parcel tax • Rates • Federation of Canadian Municipalities Green Municipal Fund

Objective	Action	Recommended Actions + Targets		Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
B	7	In addition to demand maintenance, implement a **proactive zoned tree maintenance program** consisting of either:		• Additional 2 arborists annually for a 3 month period of cyclical pruning (to meet acceptable pruning cycle recommendation)	✓	• Budget redistribution • Parcel tax • Rates
		Best practices recommendation for Oak Bay: - Structural pruning of young trees 3, 6 and 9 years after planting A pruning cycle of 5 years for all street trees, and park trees with constant target occupancy - A pruning cycle of 10 years for park trees with frequent or occasional target occupancy - A list of senescing trees requiring inspections every 1 – 2 years for street or park trees with constant target occupancy	**Acceptable pruning cycle recommendation:** - Structural pruning of young trees 3, 6 and 9 years after planting A pruning cycle of 7 years for all street trees, and park trees with constant target occupancy - A pruning cycle of 12 years for park trees with frequent or occasional target occupancy - A list of senescing trees requiring inspections every 1 – 2 years for street or park trees with constant target occupancy			
B	8	**Procure GIS-based mobile data collection technology** that will enable continuous update (concurrent with the maintenance cycle) and improvement of the urban forest inventory within the corporate asset management system and, when possible, quantify the value of services they deliver, the cost of maintenance and their appreciating value over time. Tree asset management may be part of an integrated municipal system or independent software linked to municipal systems.		• Existing resources • Software and equipment procurement	✓	• Budget redistribution

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
B	9	**Select species that are suitable for future climate** and well suited for the particular site and constraints (see Appendix 5 for a potential species list). Target selection of 80% of trees that are large and long-lived and, among non-native species, ensure that no genus exceeds 20% of the population.	• Existing resources		
B	10	**Collect tree inventory data** that includes species, date planted (where possible), dbh, height, condition, size class at maturity, safe useful life expectancy and tracks date removed for trees in Oak Bay.	• Existing resources (redistribution of staff time from A4) • Co-op students		
B	11	**Monitor branch, stem and whole tree failures**, and browse or pest incidences by species and individual tree location.	• Existing resources		
B	12	Investigate and test solutions for **fencing young trees to prevent browse** where browse related mortality is an issue.	• Existing resources		
B	13	**Extend the young tree watering program** from 4 to 6 months per year to better meet annual watering requirements.	• District watering crew extended for 8 weeks	✓	• Budget redistribution • Parcel tax • Rates
B	14	**Monitor emerging pests and diseases** and responding rapidly to quarantine any new occurrences, liaise with CFIA to identify emerging forest pests of concern, incorporate best management practices based on the ISA's Best Management Practices Series – Integrated Pest Management.	• New 'Urban Forester' position • Budget response required in event of outbreak	✓	• Budget redistribution • Parcel tax • Rates
C	15	Continue to compost and mulch, up-cycling, or re-use the woody debris generated during urban forest management activities.	• Existing resources		

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
C	16	Identify and prioritize options for: • **Green infrastructure projects** on District land. • Integrating **trees and green infrastructure for building energy efficiency** into the Strategic Energy Management Plan and projects • **Ecosystem valuation tools** (e.g., i-Tree Eco, TEEB etc.) to report, and ultimately account for, carbon offsets, building energy savings, stormwater management and other climate adaptation benefits provided by the urban forest on District land. • **Regulatory, funding and valuation options** to encourage downspout disconnection and **onsite stormwater management** on private property (e.g., City of Victoria Stormwater Utility).	• Existing resources • Possible consultant project for feasibility and funding options for green infrastructure • New 'District Engagement and Grants Coordinator' (resource shared across departments)	✓	• Budget redistribution • Parcel tax • Rates • Federation of Canadian Municipalities Green Municipal Fund
D	17	**Inventory Garry oak and associated ecosystems, rare and endangered plant species** (building on existing datasets) **and invasive species** throughout the District's natural areas.	• Existing resources • New 'District Engagement and Grants Coordinator' (resource shared across departments) • Possible consultant project for specialized inventories • Possible citizen science partnership • Co-op students	✓	• Habitat Stewardship Program for Species at Risk (if part of broader stewardship program inclusive of D18)

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
D	18	Develop a: • **Policy and action plan** to guide the District's approach and priorities **for improving open space connectivity and ecosystem restoration**. • **Natural area management framework** to address native ecosystem conservation (including rare ecosystems and species), invasive species management, access and recreation usage.	• Existing resources • New 'District Engagement and Grants Coordinator' (resource shared across departments) • Possible consultant project	✓	• Habitat Stewardship Program for Species at Risk
D	19	**Develop an invasive species and pest management plan** (include deer browse).	• Consultant project	✓	• Cash-in-lieu generated by bylaw
D	20	**Continue to remove invasive species** from rare ecosystems in Uplands Park and other natural areas.	• Existing resources (already in annual budget and existing grant secured)		
E	21	**Establish a community engagement program** to build stewardship of the urban forest with a **focus on ecosystem restoration, training 'citizen foresters' to perform structural pruning on young trees, undertake Fall leaf clean-up** for residents who are not able, and to support private tree planting.	• Existing resources • New 'District Engagement and Grants Coordinator' (resource shared across departments)	✓	• EcoAction Community Funding Program • Tree Canada Funding Programs • Cash-in-lieu generated by bylaw

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
E	22	**Establish partnerships with the Lekwungen people** to represent First Nations values and perspectives in management and restoration of the natural environment.	• Existing resources • New 'District Engagement and Grants Coordinator' (resource shared across departments)	✓	• EcoAction Community Funding Program Habitat • Stewardship Program for Species at Risk
E	23	**Continue to work with First Nations, the Garry Oak Ecosystem Recovery Team and community groups to restore and enhance Garry oak ecosystems** on public land, and to educate or incent developers, golf courses and institutional land managers to restore and enhance ecosystems on private land.	• Existing resources • New 'District Engagement and Grants Coordinator' (resource shared across departments)	✓	• EcoAction Community Funding Program • Habitat Stewardship Program for Species at Risk
			Years 6 – 10		
A	24	**Add canopy cover, tree inventory and green infrastructure spatial data into the corporate asset management system** and, when possible, quantify the value of services they deliver, the cost of maintenance and their appreciating value over time using available tools or expert analysis (e.g., iTree Eco, iTree Design, avoided stormwater costs, The Economics of Ecosystems and Biodiversity [TEEB] methods etc.).	• Existing resources		
B	25	**Develop a storm response plan** to facilitate rapid response and clean-up in the event of widespread tree damage	• Existing resources • Co-op students		

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
B	26	**Trial new trees** that have the potential to be long-lived in Oak Bay and trial new tree planting infrastructure in challenging planting locations (for example, planting curb bulges, rain gardens or hardscapes with soil cells)	• Existing resources and developer funded projects for planting infrastructure		
B	27	Mine tree removal data to **identify any patterns that indicate repetitive site or species performance issues** and correct them.	• Existing resources Co-op students		
C	28	**Incorporate rainwater interception calculations and water pollution reductions for tree canopy and vegetation cover into** any future **integrated rainwater management plan or flooding analysis** and compare costs and benefits associated with traditional stormwater systems.	• Possible consultant project (in the event that a rainwater management plan is initiated)		
C	29	**Account for tree carbon storage and sequestration** in GHG reduction and include the figures in District reporting to raise awareness of the urban forest's contribution.	• Existing resources • Co-op students		

Objective	Action	Recommended Actions + Targets	Resources Required	Budget Increase (See Section 6.2)	Potential Funding Sources
E	30	**Upgrade to an internal/external online GIS mapping service** for Oak Bay (should be integrated across municipal departments because it has broader application than the items recommended below) to assist with: • Tree permit process (identifies parcels, orthophotos, city trees, utilities, service request history, sensitive ecosystems, red-blue listed species Development Permit Areas etc.). • Querying the tree inventory (basic attributes and maintenance history). • Canopy area measurement (parcel boundaries, polygon measurement tools). • Making the tree and ecosystem inventory layers available to the public online in a format that displays ecosystem service benefits and permits people to submit information to the District.	• Existing resources or possible consultant project	✓	• Budget redistribution • Parcel tax • Rates • Neighbouring municipalities or the Regional District may be willing to support by sharing their technology
			Years 11-15		
B	31	Assess the street trees that are within the zoned maintenance program for Useful Life Expectancy (see Appendix 7) to monitor age distribution and anticipate likely timing of successional replacement planting.	• Existing resources or possible consultant project	✓	• Budget redistribution • Parcel tax • Rates

6.2 Budgeting and Resourcing

Two main funding sources are proposed for consideration to cover implementation of the plan:

1. Identify internal and tax base options to increase current budget for staffing and maintenance.
2. Cash-in-lieu paid through the development process tracked for urban forest spending on public tree planting, ecosystem restoration projects, citizen forester projects and private tree planting or maintenance rebates.

Consideration of additional funding sources to supplement the program should include:

1. Private donations to sponsor the urban forest.
2. Grants from organizations such as Tree Canada, the Federal Government and the Federation of Canadian Municipalities.

The table below suggests a potential funding timeline for the recommendations with cost or new resource implications:

		Recommendation	Increase to Annual Budget	One-off Amount	Grant Process	Engagement
YEAR 1	A1	**Public tree planting program**	$23,000			
	B7	Proactive zoned **tree maintenance program**	$50,000			
	B8	Procure **GIS-based mobile data collection technology** (either independent or integrated municipal asset system)		$15,000		
	B13	2-month **watering** crew contract extension	$10,000			
	A1, A4, B14	New **FTE 'Urban Forester'**	$95,400			
		YEAR 1 TOTALS	**$178,400**/yr	**$15,000**		
YEAR 2	A1, A6, C16, D17, D18, E21, E22, E23	New **FTE 'District Engagement and Grants Coordinator'** (review position after year 1 based on grants obtained)	$95,400			
	A6, C16	**Identification, feasibility, prioritization and policy options** to		Projects and	✓	

	fund/incent **green infrastructure projects** in the public and private realm (est ~$50,000 - $80,000 depending on scope)		matching funds dependant on grant funding		
E21	**Community engagement** program		Projects and matching funds dependant on grant funding	✓	✓
A1	**Planting program** private land incentives		Projects and matching funds dependant on grant funding	✓	✓
A4	New **0.25 FTE 'Clerical'**	$23,455			
E22	Establish **partnerships with the Lekwungen people**		Projects and matching funds dependant on grant funding	✓	✓
E23	Continue to work with stakeholders to **restore and enhance ecosystems** (education and projects)		Projects and matching funds dependant on grant funding	✓	✓
D17	**Natural areas inventory** of ecosystems, rare and endangered plant species and invasives (~est. $15,000 - $30,000 depending on scope)		Projects and matching funds dependant on grant funding	✓	
D18	**Natural areas management framework** and policy/action plan for connectivity and restoration (~est. $15,000 - $30,000 depending on scope)		Projects and matching funds dependant on grant funding	✓	✓
	YEAR 2 TOTALS	**$118,855**/yr	**Matching funds**		

YEAR 3+	A6	Public realm **planting guidelines and standard specifications**	**$10,000**	
	D19	**Invasive species and pest** management plan	**$30,000**	✓
	A3	Update **canopy cover** (i-Tree Canopy est. $4,000 OR LiDAR est. $12,000 if LiDAR already acquired)	**$4,000 - 12,000**	
	E30	Upgrade to internal/external **online GIS mapping service**	**$20,000 minimum**	
	B31	Assess the **useful life expectancy** of street trees	**$10,000**	

6.3 Monitoring and Review

Progress over time should be measured against the performance indicators, and ultimately the targets established for each objective. In general, it is recommended that progress against the performance indicators be assessed at 5 year intervals and that the management actions resulting from the Strategy be reviewed and modified to improve assumptions and achieve targets (e.g., increase or decrease number for planting program based on actual canopy area changes observed). This 5-yearly review should be recorded as a brief 'interim update' attachment to the Strategy to summarize any revisions to actions.

Four quantitative metrics will require periodic data collection in order to assess performance indicators:

1) Percent canopy cover (update in 2020, 2025 and 2030)

2) Number of trees planted per year (assess annually)

3) Percent in each genus and family (update in 2020, 2025 and 2030)

4) Percent in each ULE class (measure after 2025)

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Appendix 1 – Urban Forest Benefits: References

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Appendix 2 – Species and Ecosystems at Risk in Oak Bay

Source: Publicly available occurrences (B.C. Conservation Data Centre, 2016).

Row Labels	Count of Occurrence ID
Ecological Community	2
Quercus garryana / Bromus carinatus	2
Invertebrate Animal	3
Coenonympha tullia insulana	2
Erynnis propertius	1
Nonvascular Plant	6
Entosthodon fascicularis	2
Syntrichia laevipila	4
Vascular Plant	52
Abronia latifolia	1
Acmispon americanus var. americanus	3
Allium geyeri var. tenerum	1
Alopecurus carolinianus	3
Anagallis minima	2
Callitriche marginata	1
Carex tumulicola	2
Castilleja levisecta	1
Castilleja victoriae	4
Helenium autumnale var. grandiflorum	1
Heterocodon rariflorum	1
Hosackia gracilis	1
Isoetes nuttallii	2
Juncus kelloggii	1
Limnanthes macounii	4
Lupinus densiflorus var. densiflorus	1
Microseris bigelovii	2
Orthocarpus bracteosus	1
Potentilla gracilis var. gracilis	1
Psilocarphus elatior	1
Ranunculus alismifolius var. alismifolius	1
Ranunculus californicus	1
Sanicula arctopoides	3
Sanicula bipinnatifida	2
Sericocarpus rigidus	2
Sidalcea hendersonii	1
Silene scouleri ssp. scouleri	1
Trifolium depauperatum var. depauperatum	1
Triphysaria versicolor ssp. versicolor	4
Viola praemorsa ssp. praemorsa	1
Zeltnera muehlenbergii	1

Appendix 3 – Performance Indicator Tables

The tables presented below provide an evaluative framework based on the key objectives identified for Oak Bay's urban forest management. Performance indicators and best management practices (BMPs) are grouped according to each theme and can be used to monitor performance over time, while providing a realistic evaluation of where the District of Oak Bay sits in relation to achieving its strategic objectives. These BMPs have been modified to address the local conditions and meet planning and sustainability goals of Oak Bay.

Objective: A	**Protect and enhance canopy cover to approach 40% by 2045**			
Assessment Criteria	**Indicators for Urban Forestry Performance**			
	Low	**Moderate**	**Good**	**Optimal**
Relative canopy cover	The existing canopy cover equals 0%-50% of the target.	The existing canopy cover equals 51%-70% of the target.	**The existing canopy cover equals 71%-90% of the target.**	The existing canopy cover equals 91%-100% of the target.
Canopy cover inventory	No inventory.	Visual assessment.	**Sampling of tree cover using aerial photographs or satellite imagery.**	Capture of tree cover by polygons in GIS using remote sensing.
Tree protection policy development and enforcement	No or very limited tree protection policy.	Policies in place to protect public and private trees without enforcement.	**Policies in place to protect public and private trees with enforcement.**	Integrated municipal-wide policies that ensure the protection of trees on public and private land are consistently enforced and supported by significant deterrents.
Public agency (internal & external) cooperation	Conflicting goals among departments and/or agencies.	Common goals but limited cooperation among departments and/or agencies.	**Informal teams among departments and/or agencies are functioning and implementing common goals on a project-specific basis.**	Municipal tree protection policy implemented by formal interdepartmental/ interagency working agreements on all municipal projects.
Tree succession and establishment planning and implementation	Tree succession and establishment is ad hoc.	**Tree succession and establishment occurs on an annual basis.**	Tree succession and establishment is directed by needs derived from a tree inventory and opportunities assessment.	Tree succession and establishment is directed by needs derived from a tree inventory and opportunities assessment and is sufficient to meet canopy cover objectives.
Tree standards for development and streetscape outcomes	**Limited tree related guidelines, specifications and standards.**	Guidelines, specifications and standards adequate to meet canopy cover goals in some areas but are not yet	Guidelines, specifications and standards adequate to meet canopy cover goals and implemented for some plans and	Guidelines, specifications and standards adequate to meet canopy cover goals and are widely implemented across

Objective: A Protect and enhance canopy cover to approach 40% by 2045				
Assessment Criteria	**Indicators for Urban Forestry Performance**			
	Low	**Moderate**	**Good**	**Optimal**
		implemented.	projects.	plans and projects.
Planting the largest tree suitable for the conditions and character of the planting location	Trees planted without consideration of the site conditions.	**Tree species are considered in planting site selection.**	Community-wide guidelines are in place for the improvement of planting sites and the selection of suitable species.	The largest trees suitable for the sites are planted. All trees planted in sites with adequate soil quality and quantity, and growing space to achieve their genetic potential.

Objective B: Support a healthy, well-adapted and diverse tree population				
Assessment Criteria	**Indicators for Urban Forestry Performance**			
	Low	**Moderate**	**Good**	**Optimal**
Tree inventory	**No inventory.**	Partial inventory of publicly-owned trees in GIS.	Complete inventory of street trees and intensively managed park trees in GIS.	Complete inventory of publicly-owned trees including natural areas (polygons) and significant private trees (if protected) in GIS.
GIS asset management system integration	**No integration.**	Street trees and intensively managed park trees in district-wide asset management system.	Street trees and intensively managed park trees in district-wide asset management system with values and costs accounted for.	Green infrastructure in district-wide asset management system with values and costs accounted for.
Species diversity excluding native trees	Few genera dominate the entire planted tree population district-wide and three or more genera represent more than 20% of the entire planted tree population, or a single genus exceeds 30% of the population.	Few genera dominate the entire planted tree population district-wide and no more than two genera represent more than 20% each of the entire planted tree population. No single genus exceeds 30% of the population.	No genus represents more than 20% of the entire planted tree population district-wide.	No more than 20% of any genus and 30% of any family in the planted tree population.
Species suitability for their site and current and future	Less than 50% of trees are of species considered suitable for their site and	**50% to 75% of trees are of species considered suitable for their site and**	More than 75% of trees are of species considered their site and current and future	All trees are of species considered suitable for their site and current and

Objective B: Support a healthy, well-adapted and diverse tree population				
Assessment Criteria	**Indicators for Urban Forestry Performance**			
	Low	**Moderate**	**Good**	**Optimal**
climate	current and future climate	**current and future climate**	climate	future climate.
Useful life expectancy[8] (ULE) distribution of street and intensively managed park trees in the community	Any ULE class deviates more than 30% from optimal.	Any ULE class deviates more than 20% from optimal.	Any ULE class deviates more than 10% from optimal.	60 % with a ULE of > 30 years, 30% with a ULE of 10 - 30 years, and 10% with a ULE of < 10 years.
Young tree (1-5 years following planting) mortality rates	Young tree mortality >10%	Young tree mortality 5.2 – 10%	Young tree mortality 3.5-5.1%	Young tree mortality <3.5%
Tree risk management	Request based/reactive system. No formal risk management policy. The condition of the urban forest is largely unknown.	**Areas within the district are prioritized for assessment. Little annual budget is allocated to carry out the work. No formal risk management policy.**	Formal risk management policy is in place and partially implemented.	Formal risk management policy in place and fully implemented.
Maintenance of publicly-owned, intensively managed trees	Publicly-owned trees are maintained on a request/reactive basis. No systematic (block) pruning.	Publicly-owned trees are maintained on a request/reactive basis. No systematic (block) pruning. All immature trees are structurally pruned.	**All publicly-owned trees are systematically maintained on a cycle determined by workload and resource limitations. All immature trees are structurally pruned.**	All mature publicly-owned trees are maintained on an optimal pruning cycle. All immature trees are structurally pruned.
Passive and active water capture for vegetation	**Passive and active water capture are not intentionally designed into vegetated landscapes**	Development Permit Area Guidelines incorporate passive and active water capture considerations for vegetated landscapes.	Development Permit Area Guidelines incorporate passive and active water capture considerations for vegetated landscapes, and the value of avoided wastewater treatment and irrigation costs is quantified in an	Development Permit Area Guidelines incorporate passive and active water capture considerations for vegetated landscapes, assets are captured in the asset management system, and design outcomes are certified by a nationally recognized

[8] The ULE is an estimate of how long a tree is likely to be viable in the landscape based on health, amenity, environmental services contribution and risk to the community. The methodology will be provided in a technical appendix to the Urban Forest Management Plan.

Objective B: Support a healthy, well-adapted and diverse tree population				
Assessment Criteria	**Indicators for Urban Forestry Performance**			
	Low	**Moderate**	**Good**	**Optimal**
			asset management system.	certification program.
Storm response	**Response plan is based on visual assessment and call-out requests.**	A call-out procedure, roles and responsibilities, and criteria for prioritizing tree hazards and removing debris is in place.	A comprehensive action plan for responding to storm damage in the urban forest is in place.	A comprehensive action plan for responding to storm damage in the urban forest is in place and a response drill occurs periodically.
Pest and Disease Management	No integrated pest management plan and no pest management.	No integrated pest management plan and reactive pest management.	**No integrated pest management plan but IPM policy is in place and IPM is practiced.**	An integrated pest management plan is in place and implemented.

Objective C: Manage the urban forest for community climate adaptation				
Assessment Criteria	**Indicators for Urban Forestry Performance**			
	Low	**Moderate**	**Good**	**Optimal**
Building energy efficiency and air quality improvement	**Landscapes planted without consideration of the location for building energy efficiency and air quality improvement.**	Energy Conservation Development Permit Area Guidelines incorporate tree and landscape considerations for building energy efficiency and air quality improvement.	Energy Conservation Development Permit Area Guidelines incorporating tree and landscape considerations are implemented and value of energy efficiency and air quality improvements is quantified.	Energy Conservation Development Permit Area Guidelines incorporating tree and landscape considerations are implemented and design outcomes are certified by a nationally recognized certification program.
Waste biomass utilization.	**Waste from the urban forest is not utilized.**	Waste from the urban forest is measured and tracked over time.	Business case made to Council for utilization of woody waste.	Waste wood from the urban forest is utilized to meet demand.

Objective C: Manage the urban forest for community climate adaptation				
Assessment Criteria	**Indicators for Urban Forestry Performance**			
	Low	**Moderate**	**Good**	**Optimal**
Corporate emissions and carbon neutrality	**Carbon storage and GHG emissions reductions by district trees not measured and tracked over time.**	Carbon storage and GHG emissions reductions by district trees is measured and tracked over time but is not reported on in community climate initiatives.	Carbon storage and GHG emissions reductions by district trees is measured and tracked over time and reported on in community climate initiatives.	Carbon storage and GHG emissions reductions by district trees is measured and tracked over time and reported on in community climate initiatives, and is recognized as contributing to offsets towards meeting Climate Action Charter commitments.
Green infrastructure, including tree canopy, designed for stormwater management.	**Tree canopy and/or green infrastructure is not managed or accounted for as wastewater management assets.**	Development Permit Area Guidelines incorporate considerations for tree canopy and/or green infrastructure stormwater management.	Development Permit Area Guidelines incorporate considerations for tree canopy and/or green infrastructure stormwater management, and the value of avoided wastewater treatment cost is quantified in an asset management system.	Development Permit Area Guidelines incorporate considerations for tree canopy and/or green infrastructure stormwater management, vegetation assets are captured in an asset management system, and design outcomes are certified by a nationally recognized certification program.
Recognition of permeability for water infiltration	**Permeability of surfaces is not factored into watershed, stormwater and flood management planning initiatives.**	Extent of impervious surface is known and the benefit of increasing permeability is recognized in local government planning documents.	Extent of pervious surface is known, Development Permit Area Guidelines incorporate permeability considerations and the value of avoided wastewater treatment costs is quantified in an asset management system.	Permeability targets and canopy cover targets are included in Zoning Bylaw and the value of avoided wastewater treatment costs is quantified in an asset management system.
Recognition of green infrastructure asset value within local government	No recognition of value of natural forms and functions within local government.	**Local government recognizes the value of natural forms and functions but does not yet have adequate information to protect or enhance green infrastructure.**	Local government recognizes the value of natural forms and functions and has inventoried green infrastructure within an asset management system.	Local government recognizes and accounts for the value of natural forms and functions within an asset management system, and invests in green infrastructure protection and enhancement.

Objective D: Strengthen ecological systems and biodiversity				
Assessment Criteria	**Indicators for Urban Forestry Performance**			
	Low	**Moderate**	**Good**	**Optimal**
Native vegetation	Voluntary use of native species on publicly and privately-owned lands.	**The use of native species is encouraged on a project-appropriate basis in public intensively and extensively managed areas.**	The use of native species is required on a project-appropriate basis in public intensively and extensively managed areas.	The use of native species is required on a project-appropriate basis in both public and private intensively and extensively managed areas.
Publicly-owned natural areas management planning and implementation	No or very limited active stewardship of natural areas.	**Reactionary stewardship in effect to facilitate public use (e.g. hazard abatement, invasive species management, trail maintenance).**	Area specific management plans in effect focused on management, protection and restoration of each ecosystem type or feature.	Biodiversity strategy in effect to manage, restore and protect existing and future green infrastructure network throughout the municipality.
Publicly-owned natural areas inventory (e.g. woodlands, ravine lands, etc.)	No or little information about publicly-owned natural areas.	**Publicly-owned natural areas identified with defined ownership and/or management responsibility.**	Publicly-owned natural areas identified and mapped in GIS with defined ownership and/or management responsibility.	Publicly-owned natural areas and green infrastructure are captured within a GIS based 'Ecological Inventory' that classifies ecosystem types, habitat features, ownership and/or management responsibility is defined.
Invasive species	Invasive species are recognized and invasive species are controlled in <5% of infested natural areas on an ad hoc basis.	**An invasive species management plan is in place. Woody invasive species are controlled on at least 50% of infested natural areas. Non-woody invasive species are controlled on an ad hoc basis with special attention to small infestations of highly problematic species such as Carpet Burweed.**	An invasive species management plan is in place. Woody invasive species are controlled on at least 75% of infested natural areas. Non-woody invasive species are controlled on an ad hoc basis with special attention to small infestations of highly problematic species such as Carpet Burweed.	An invasive species management plan is in place. Woody invasive species are controlled on at least 90% of infested natural areas. Non-woody invasive species are controlled on an ad hoc basis with special attention to small infestations of highly problematic species such as Carpet Burweed.

Objective E: Engage and partner with the community to build stewardship of the urban forest				
Assessment Criteria	**Indicators for Urban Forestry Performance**			
	Low	**Moderate**	**Good**	**Optimal**
Community action	No organized community action.	Isolated or limited number of active groups and locations with intermittent activities.	**Community groups partner in urban forest management but involvement is ad hoc.**	Community groups partner in urban forest management and formal agreements are in place.
Involvement of large private land and institutional land holders (e.g., schools, UVIC, golf courses etc.)	Low or no understanding of issues	**Educational materials and advice available to landholders.**	Clear goals for tree resource by landholders. Incentives for preservation of private trees.	Landholders develop vegetation resource management plans (including funding).
Development community cooperation	Limited understanding or support for district-wide goals and objectives.	Understanding of district-wide goals and objectives but with limited support and understanding of the role of the urban forest and the value added by green infrastructure.	**Some sectors of the development community understand the role of the urban forest and the value added by green infrastructure is often reflected in design and built outcomes.**	The development community understand the role of the urban forest and the value added by green infrastructure is always reflected in design and built outcomes.
Municipality-business interaction	Limited understanding or support for district-wide goals and objectives.	**Understanding of district-wide goals and objectives but with limited support and understanding of the role of the urban forest and the value added by green infrastructure**.	BIAs understand and support urban forest management in their neighbourhoods.	BIAs partner in urban forest management to fund urban forest projects at the neighbourhood level.
General awareness of trees as a community resource	Trees seen as important to the community but in conflict with other objectives.	Trees acknowledged as providing environmental, social, and economic services.	The general public understands the role of the urban forest.	**The general public understands the role of the urban forest and advocates for protecting and enhancing the value it provides to the District.**

Appendix 4 – Summary of Recommended Bylaw Changes

The following points refer to existing sections within Tree Protection Bylaw 4326 and are intended to moderately increase the number of trees protected on private property, strengthen tree protection during development, and shift the replacement requirements associated with development to a canopy-based approach so that replacements contribute to the canopy target to approach 40% by 2045. Recommended changes are:

- Interpretation
    - Change "protected tree" (b) to any tree with a dbh greater than 40 cm
    - Define 'undue hardship'
    - Define Arborist, Geotechnical Engineer and Landscape Architect
    - Define Arborist Report (in addition to the typical requirements for content of an arborist report, include a requirement to inventory the total canopy area on site and the total canopy area that is proposed for removal)
    - Define Tree Replacement Plan (require the plan to propose the type, number and location of trees and the canopy area each tree is expected to achieve at maturity)
    - Define a tree
    - Define Canopy Area (calculated as the total canopy area in m^2, when viewed from above, within the legal lot lines, and that is contributed by a tree, not a shrub)
- Permit requirement 2
    - Remove 2(2)
    - Add a new clause under permit requirement so that, when applying for a development permit:
        - A tree protection permit is required to address the protection of retained trees even if no trees are proposed to be cut.
        - A tree protection permit is required to address the replacement of tree canopy even if no trees are proposed to be cut.
- Trees Within Building Envelope (3)
    - Remove (3).
- Strengthen language in 6 Permit Issuing Authority to:
    - Alter 6(1) to read "to eliminate a high or extreme risk (ISA TRAQ) tree or part thereof that cannot be mitigated to moderate or lower risk by pruning."
    - Alter 6(2) to read "to eliminate a hazard caused by interference with utility wires that cannot be mitigated by pruning under Section 16."
    - Alter 6(3) to read "to eliminate a situation where pressure or penetration from tree growths above or below ground is causing damage to a building or part thereof, or to a significant structure, and there is no other reasonable solution that would not impose an undue hardship. The District may require a report from a qualified Geotechnical Engineer and an Arborist to confirm that the tree is the cause of the structural damage."
    - Remove 6(11) and instead rely on 6(1) and 6(3)
    - Consider grouping 6(4,5,6,7,8) and 6(2,3,9,10,12) as 6(2a..x) and 6(3a…x) as so that there are three key clauses 6(1) trees removed for hazard, 6(2) trees removed for development, 6(3) trees removed for reasons other than hazard or development
- Add in 6 Permit Issuing Authority: "In respect of 6(4,5,6,7,8), upon application, the Manager of Parks Services shall issue a permit authorizing the protection of retained protected trees and/or replacement of protected trees."
- Replacement Trees 10
    - Alter 10(1) to read "As a condition of the granting of a permit under Section 6(1,2,3,9,10,12) for the removal of a tree, the owner of the parcel on which the tree was

located must plant on the parcel 1 replacement trees in locations approved by the Manager of Parks Services in consideration of accepted arboricultural practices.

- Add a new clause to read "As a condition of the granting of a permit under Section 6(4,5,6,7,8), the owner of the parcel must plant on the same parcel replacement trees in locations approved by the Manager of Parks Services in consideration of accepted arboricultural practices up to or exceeding the canopy cover target defined for their Zoning (see table below).

Zoning	Target
Established neighbourhoods (RS 3-5)	35%
Uplands (RS 1 – 2)	45%
Community institutional (P2)	50%
Commercial and mixed Use (C/P3)	30%
Multi-unit residential (RM)	20%
Other	To be defined by Manager

- Alter (4) so to read "Unless otherwise approved by the Manager of Parks Services after considering limitations imposed by characteristics peculiar to the species along with local availability, a replacement tree must be selected from the list in Schedule C and have either a height not less than 1.5 metres when planted, or a basal diameter of not less than 4 centimetres.
- Alter (7) so that for permits issued under 6(1,2,3,9,10,12) the security taken is $500 per replacement tree.
- Alter (7) so that for permits issued under Section 6(4,5,6,7,8) the security taken is $200 per m^2 of canopy to be replaced up to a maximum of $50,000 per lot.
- Add a new clause to require securities for tree protection be taken for permits issued under Section 6(4,5,6,7,8) so that, for protected trees: <40 cm a security of $1,000 per tree is taken; 40 - 60 cm a security of $2,500 per tree is taken; for trees > 60 cm a security of $5,000 per tree is taken; for significant trees a security of $10,000 is taken. Up to a maximum of $50,000 per lot. Securities should be held for 1 year after final occupancy and upon submission of a report by the arborist outlining how tree protection measures were followed as defined in the letter of undertaking and upon acceptance by the Manager that tree protection met the conditions of the permit.
- Alter 10(9) to enable to enable securities for replacements to be instead paid as cash-in-lieu that the municipality may put towards purchasing and planting trees on land owned by the Municipality, or towards ecosystem restoration, or towards the funding of a rebate program for tree planting and maintenance on private land.
- Remove 10.1 and rely on 10(1)

- Permit Application Process 11
  - Alter 11(2)(a) to read "In respect of 6(2,3,9,10,12) a seventy-five ($75) non-refundable application fee for the first tree and $25 for each additional tree."
  - Alter 11(2)(b) to read "In respect of 6(4,5,6,7,8) a five-hundred ($500) non-refundable application fee."
  - Alter 11(3) to add
    - "(c) except in respect of an application under Section 6(1), title searches for the lot or lots on which the protected trees proposed to be cut or removed are located, obtained from the Land Title Office within the previous 72 hours, along with copies of any covenants or similar agreements registered against title to the lot and relating to the use of the lot or the cutting or removal of trees on the lot."
    - "(d) where the protected tree is a shared tree, a letter from the owners of the adjacent lot consenting to the protection, cutting or removal of the shared tree, together with current contact information for each of those owners."

        - "(e) in respect of 6(4,5,6,7,8):
            - an arborist report from an arborist retained by the applicant, certifying that the protected tree(s) proposed to be cut or removed meet one or more of the conditions set out in subsection 6(4,5,6,7,8), and specifying any conditions under which the proposed retention, cutting or removal of a protected tree may take place. In assessing the conditions under which the proposed retention, cutting or removal of a protected tree may take place, the arborist report shall consider and recommend the appropriate extent, timing, and phasing of tree protection, cutting and removal to address public health and safety concerns, minimize impacts to adjacent properties, protect retained trees, and protect other environmental features or functions.";
            - "a letter of undertaking signed by the arborist, applicant, excavator operator and builder detailing the activities to be supervised by the arborist including, but not limited to, proper installation of tree barriers, demolition, excavation, servicing and landscaping when it is within or close to the critical root zone of protected trees"
            - "a tree replacement plan prepared by an arborist or landscape architect"
- Protection During Construction: I, Remove 12 and rely on 13
- Protection During Construction: II, alter 13 to read "as a condition of the issuance of a tree protection permit, the Manager of Parks Services, acting reasonably, may specify the arboricultural, construction and excavation practices that must be followed in order to minimize such damage, with which the owner of the parcel on which the arboricultural, construction or excavation work is being carried out and every person carrying out such work shall comply.
- Pruning 16
    - Alter 16(1) to read "A tree management permit is not required for the pruning of a protected tree provided that the pruning is conducted in accordance with the standards and recommendations of the International Society of Arboriculture. Pruning shall not include:
        - The removal of more than 25% of the crown in one season
        - Topping to remove the top portion of a tree's main leader
        - The pruning or removal of a structural root within the critical root zone of a protected tree."
    - Enforce fines for improper pruning and revoke business licences of tree care companies that do not follow the bylaw.
- Add Appendix 4 as Schedule C for acceptable replacement trees.

Appendix 5 – List of Acceptable Trees for Oak Bay

The following large, medium and small tree species lists are recommended as acceptable species suitable for Oak Bay's current and future climate. The list is not exhaustive and should be expanded based on local experience and current information on species performance.

Large Canopy Trees = Canopy Cover Credit of 125 m^2 per tree

COMMON NAME	BOTANICAL NAME
Grand fir	*Abies grandis*
Field Maple	*Acer campestre*
Caucasian maple	*Acer cappadocicum*
Big leaf maple	*Acer macrophyllum*
Sycamore maple	*Acer pseudoplatanus*
Red maple	*Acer rubrum*
Sugar maple	*Acer saccharum*
Shantung maple	*Acer truncatum*
Freeman maple	*Acer x freemanii*
Yellow buckeye	*Aesculus flava*
Common horsechestnut	*Aesculus hippocastanum*
Ruby red horsechestnut	*Aesculus x carnea*
Red alder	*Alnus rubra*
Monkey puzzle	*Araucaria araucana*
Pacific madrone/arbutus	*Arbutus menziezii*
European hornbeam	*Carpinus betulus*
Chinese chestnut	*Castanea mollissima*
Spanish chestnut	*Castanea sativa*
Common catalpa	*Catalpa bignonoides*
Western catalpa	*Catalpa speciosa*
Atlas cedar	*Cedrus atlantica*
Deodar cedar	*Cedrus deodara*
Kastura	*Cercidiphyllum japonicum*
Yelllowwood	*Cladrastis kentukea*
Handkerchief tree	*Davidia involucrata*
Snow gum	*Eucalyptus pauciflora*
European beech	*Fagus sylvatica*
American ash	*Fraxinus americana*
European ash	*Fraxinus excelsior*
Manna ash	*Fraxinus ornus*
Ginkgo	*Ginkgo biloba*
Kentucky coffeetree	*Gymnocladus dioicus*
Arizona walnut	*Juglans major*
Black walnut	*Juglans nigra*
English walnut	*Juglans regia*

COMMON NAME	BOTANICAL NAME
Sweet gum	*Liquidambar styraciflua*
Tulip tree	*Liriodendron tulipifera*
Southern magnolia	*Magnolia grandiflora*
Kobus magnolia	*Magnolia kobus*
Siberian crabapple	*Malus baccata*
Dawn redwood	*Metasequoia glyptostroboides*
European hop hornbeam	*Ostrya carpinifolia*
Persian ironwood	*Parrotia persica*
Empress tree	*Paulownia tomentosa*
Amur cork tree	*Phellodendron amurense*
Norway spruce	*Picea abies*
Sitka spruce	*Picea sitchensis*
Scotch pine	*Pinus sylvestris*
London planetree	*Platanus x acerifolia*
Cottonwood	*Populus balsamifera ssp. trichocarpa*
Sargents cherry	*Prunus sargentii*
Yoshino cherry	*Prunus X yedoensis*
Douglas fir	*Pseudotsuga menziesii*
Callery pear	*Pyrus calleryana*
Sawtooth oak	*Quercus acutissima*
White swamp oak	*Quercus bicolor*
Scarlet oak	*Quercus coccinea*
Hungarian oak	*Quercus frainetto*
Garry oak	*Quercus garryana*
Holly oak	*Quercus ilex*
Burr oak	*Quercus macrocarpa*
Pin oak	*Quercus palustris*
English oak	*Quercus robur*
Red oak	*Quercus rubra*
California redwood	*Sequoia sempervirens*
Giant redwood	*Sequoiadendron giganteum*
Japanese pagoda tree	*Sophora japonica*
Western redcedar	*Thuja plicata*
False arborvitae	*Thujopsis dolabrata*
Little-leaf linden	*Tilia cordata*
Large leaf linden	*Tilia platyphyllos*
Silver linden	*Tilia tomentosa*
Caucasian lime	*Tilia x euchlora*
Western hemlock	*Tsuga heterophylla*
American elm	*Ulmus americana*

COMMON NAME	BOTANICAL NAME
Japanese elm	*Ulmus davidiana*
Scotch elm	*Ulmus glabra*
Siberian elm	*Ulmus pumila*
Japanese zelkova	*Zelkova serrata*

Medium Canopy Trees = Canopy Cover Credit of 50 m^2 per tree

COMMON NAME	SCIENTIFIC NAME
Silk tree	*Albizia julibrissin*
Paper birch	*Betula papyrifera*
California incense cedar	*Calocedrus decurrens*
American hornbeam	*Carpinus caroliniana*
Japanese hornbeam	*Carpinus japonica*
Hinoki false cypress	*Chamaecyparis obtusa*
Sawara false cypress	*Chamaecyparis pisifera*
Giant dogwood	*Cornus controversa*
Pacific dogwood	*Cornus nuttallii*
Turkish hazel	*Corylus colurna*
Hardy rubber tree	*Eucommia ulmoides*
Honey locust	*Gleditsia triacanthos*
Chinese flame tree	*Koelreuteria bipinnata*
Golden rain tree	*Koelreuteria paniculata*
European larch	*Larix decidua*
Sweetbay magnolia	*Magnolia virginiana*
Red lotus	*Manglietia insignis*
Tupelo	*Nyssa sylvatica*
American hop hornbeam	*Ostrya virginiana*
White spruce	*Picea glauca*
Serbian spruce	*Picea omorika*
Colorado blue spruce	*Picea pungens*
Shore pine	*Pinus contorta var. contorta*
Limber pine	*Pinus flexilis*
Austrian pine	*Pinus nigra*
Ponderosa pine	*Pinus ponderosa*
Chinese pistacio	*Pistacia chinensis*
Trembling aspen	*Populus tremuloides*
Bitter cherry	*Prunus emarginata*
Willow oak	*Quercus phellos*
Black locust	*Robinia pseudoacacia*
Korean mountain ash	*Sorbus alnifolia*
Whitebeam	*Sorbus aria*
Bald cypress	*Taxodium distichum*

Nootka cypress	*Xanthocyparis nootkatensis*
Silk tree	*Albizia julibrissin*
Paper birch	*Betula papyrifera*
California incense cedar	*Calocedrus decurrens*
American hornbeam	*Carpinus caroliniana*
Japanese hornbeam	*Carpinus japonica*
Hinoki false cypress	*Chamaecyparis obtusa*
Sawara false cypress	*Chamaecyparis pisifera*
Giant dogwood	*Cornus controversa*
Pacific dogwood	*Cornus nuttallii*
Turkish hazel	*Corylus colurna*
Hardy rubber tree	*Eucommia ulmoides*
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Serbian spruce	*Picea omorika*
Colorado blue spruce	*Picea pungens*
Shore pine	*Pinus contorta var. contorta*
Limber pine	*Pinus flexilis*
Austrian pine	*Pinus nigra*
Ponderosa pine	*Pinus ponderosa*
Chinese pistacio	*Pistacia chinensis*
Trembling aspen	*Populus tremuloides*
Bitter cherry	*Prunus emarginata*
Willow oak	*Quercus phellos*
Black locust	*Robinia pseudoacacia*
Korean mountain ash	*Sorbus alnifolia*
Whitebeam	*Sorbus aria*
Bald cypress	*Taxodium distichum*
Nootka cypress	*Xanthocyparis nootkatensis*

Small Canopy Trees = Canopy Cover Credit of 25 m^2 per tree. Fruit trees are also acceptable as small canopy trees where homeowners wish to maintain productive trees in their yards.

COMMON NAME	SCIENTIFIC NAME
Vine maple	*Acer circinatum*
Paperbark maple	*Acer griseum*
Japanese maple	*Acer palmatum*
Amur maple	*Acer tartaricum ssp. ginnala*
Autumn Brilliance Serviceberry	*Amelanchier x grandiflora*
Eastern redbud	*Cercis canadensis*
Chinese redbud	*Cercis chinensis*
Judas tree	*Cercis siliquastrum*
Kousa dogwood	*Cornus kousa*
Black hawthorn	*Crataegus douglasii*
Lavallei hybrid hawthorn	*Crataegus x lavellei*
Toba hawthorn	*Crataegus x mordensis*
Star magnolia	*Magnolia stellata*
Saucer magnolia	*Magnolia x soulangeana*
Japanese flowering crabapple	*Malus floribunda*
Southern beech	*Nothofagus antarctica*
Tanoak	*Notholithocarpus densiflorus*
Cherry plum	*Prunus cerasifera*
Japanese cherry	*Prunus serrulata*
Japanese stewartia	*Stewartia pseudocamellia*
Japanese snowbell	*Styrax japonicus*
Fragrant snowbell	*Styrax obassia*
Tree lilac	*Syringa reticulata*
Western yew	*Taxus brevifolia*

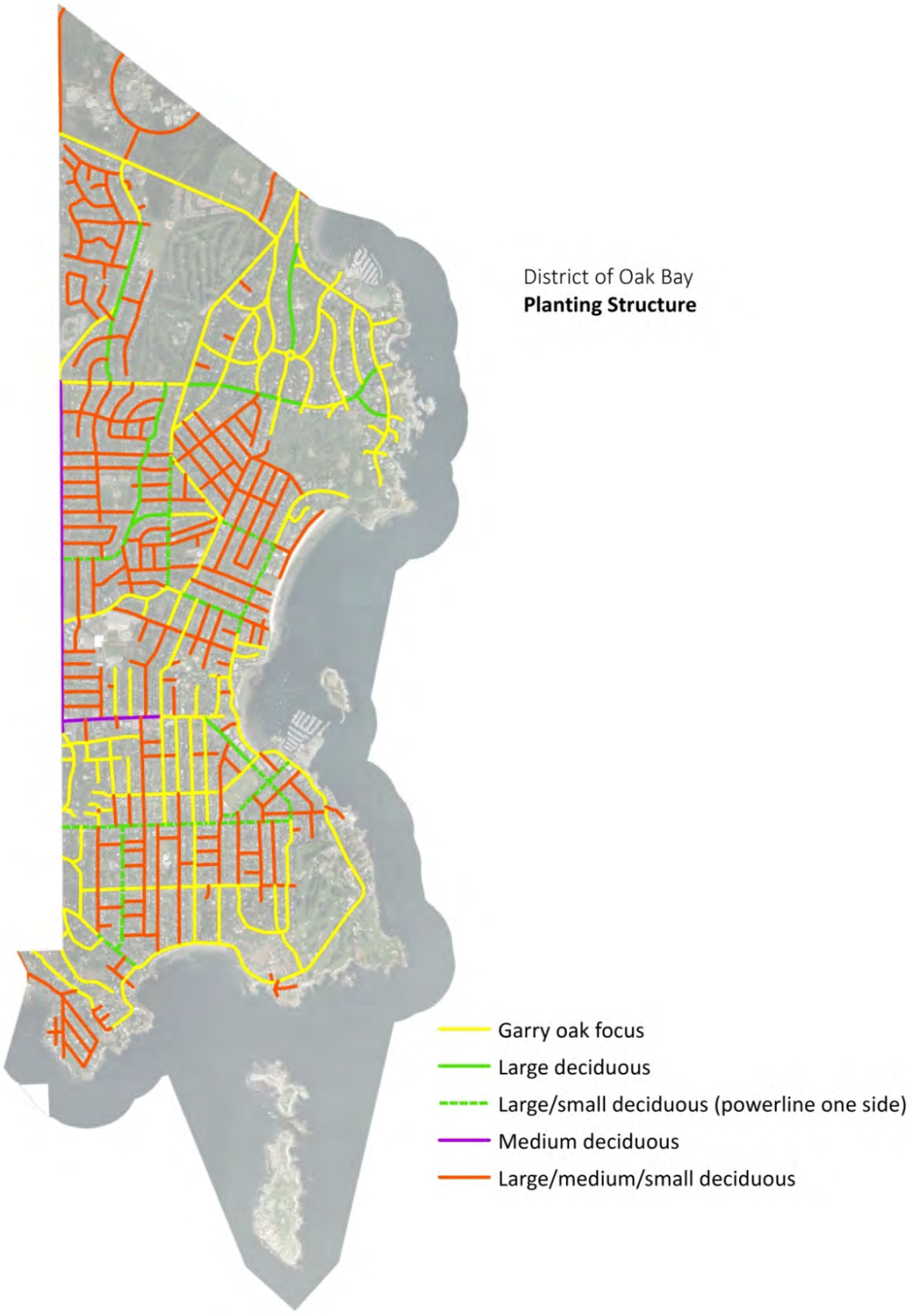
Appendix 6 - Public Realm Planting Guidelines and Standards

The planting program outlined is intended to guide the planting of 1,200 new trees on public right-of-way in Oak Bay. Opportunities for parks tree planting should be addressed through the parks planning process.

Principles

1) When selecting the tree species, consider:
    a. Neighbourhood character
    b. Place trees to frame, not obscure, views to the ocean and Mount Baker
    c. Connectivity or adjacency to natural areas
    d. Where Garry oak groves are present on adjacent park or private land, continuing that landscape character into the streetscape
    e. Streetscape objective (i.e., maximise future canopy while considering road users, pedestrians and urban design objectives)
    f. Species diversity:
        i. Use the Planting Structure map to broadly guide locations for Garry oak
        ii. Create homogeneity in texture, pattern, light and shade by planting the same species (or species of similar scale, form and texture) for 1-2 blocks at a time
        iii. Use asymmetrical treatments along some streets (e.g., streets where there are power lines on one side only so large trees may fit on one side and small ones, or none, on the other).
        iv. Select deciduous trees in streetscapes with building frontages to maintain winter solar access
    g. Planting site constraints (e.g., underground and above ground services, soil and moisture conditions etc.)
    h. Wind and salt exposure
    i. Biodiversity (if within an area prioritised for native vegetation or other driver of biodiversity objectives)
2) Plant trees in regularly spaced rows that define the pedestrian and roadway space
3) Plant trees close enough together to form a continuous, canopy ceiling
4) Plant trees curbside where possible to extend the canopy over the street
5) Select large trees that will cover and contain the pedestrian space rather than small trees that interrupt and fragment the pedestrian space, except where screening is needed or there are constraints like high-voltage power lines
6) Plant a second row, or grove of trees where boulevard space allows

7) Where planting opportunities are limited but road widths allow, consider creating plantable space in roadways (e.g., in road pits with parking in between, new nature strips etc.)
8) Create or exploit opportunities for large canopy ‘feature’ trees in unique urban locations (e.g., curb bulges, roundabouts, small green spaces)
9) Do not plant invasive trees


District of Oak Bay
Planting Structure
Garry oak focus
Large deciduous
Large/small deciduous (powerline one side)
Medium deciduous
Large/medium/small deciduous

The following are recommended as guidance only and site specific exceptions may be made by the District. In general, aim to maximize tree canopy cover while balancing the available soil volume and constraints for site lines, utilities or other relevant considerations.

Minimum Spacing and Soil Volume

Both soil volume and the permeability of the soil surface area around a planting site in hardscape (i.e., the "tree pit") influence urban tree growth. Where possible, soil volume should meet the specifications below and permeability should be maximized to support a tree reaching its size potential and optimal life span in an urban environment. While it is possible to plant a larger tree in less than the minimum soil volume, the trade-off is a shortened life span for the tree and an increased potential for infrastructure conflict as the resources within the provided planting site become inadequate to support tree growth.

Tree size category	**Average Spacing**	**Per-tree Minimum Soil Volume***
Large (>10 m canopy spread)	9 - 11 m	45 m3/30 m3 shared
Medium (~10 m canopy spread)	8 - 10 m	25 m3/20 m3 shared
Small (~6 m canopy spread)	6 - 10 m	10 m3/5 m3 shared
Very Small (~3 m spread)	3 – 6 m	5 m3

*Soil volume should be a depth of 1 m. The soil volumes quoted should be considered as minimums for the size categories listed and are based on a minimum of 0.3m^3 of soil per 1 m^2 of canopy area recommended by Lindsey, P. and Bassuk, N.L. 1992. Redesigning the Urban Forest from the Ground Below: A New Approach to Specifying Adequate Soil Volumes for Street Trees. Arboricultural Journal. 16(1) 25-39.

For options regarding meeting soil volume requirements in hardscape, refer to the District of Toronto's Tree Planting Solutions in Hard Boulevard Surfaces Best Practices Manual (https://www1.toronto.ca/city_of_toronto/parks_forestry__recreation/urban_forestry/files/pdf/TreePlantingSolutions_BestPracticesManual.pdf)

To increase root zone volume, engineered/structural soils under hardscape may sometimes be used, though they provide less actual soil volume than solutions that support quality soil under hard boulevard surfaces. The City of Vancouver's Street Tree Guidelines for the Public Realm (http://vancouver.ca/files/cov/StreetTreeGuidelines.pdf) provides specifications for Engineered Soils.

Distance from Services (refine in consultation with Engineering)

Lamp standards	1.5 – 4.5 m
Electrical/Communication/Trolley Poles	1.5 m
Driveways/Crossings	1.8 m
Fire Hydrants	1.8 m
Catch Basins/Valve Boxes	1.5 m
Corner Clearance	3 m
Stop Signs	6 m
Parking Meters	Clear of tree pit/surround
Buildings – spreading trees	3 m
Buildings – columnar trees	2 m
Gas	No root ball above intersection of main and lateral gas lines and within 2m of this intersection. Root ball can be placed above main and lateral lines outside of the 2m radial clearance zone
Back of curb	>0.5 m
Underground service locations (i.e., Gas, Hydro, Water, Sewer) to be determined prior to planting; tree locations shall avoid underground services and utilities where possible to prevent future conflicts. Where unavoidable, decisions to plant above services should be dependent on the depth of service (i.e., acceptable if service is below root zone) and the understanding that tree removal may be required for future service maintenance.	
Tree planting should, where possible, be offset to avoid overhead electrical conductors and/or species selection must consider required clearance distances from electrical conductors. Tree placement or species selection that would result in ongoing, long-term clearance pruning requirements should be avoided.	

Do not plant trees:

- **In sidewalk below overhead building encroachments or overpasses**
- **Under canopies, awnings or overhead signs**
- **In bus zones, except in bus bulges in line with other trees on block**
- **In loading or passenger zones**
- **In front of doorways, entrances, walkways**

Tree stock

For street trees, the District of Oak Bay should use the standards for trees described in Canadian Standards for Nursery stock 8th edition. The full description of which can be found at www.canadanursery.com/Page.asp?PageID=122&ContentID=868

Additionally, all trees must be:

1. nursery field grown (exception must be pre-approved)
2. be on a single leader, with the lowest branch being at least 2 metres high on the stem.
3. of 4 cm caliper or greater if deciduous
4. of 1.5 metres height or greater if coniferous
5. free of pest and disease

6. free of harmful weeds in the root ball
7. free of injury, or other defects
8. free of girdling roots

Where planting projects require more than 10 trees, the District reserves the right to select and tag optimal specimens at the source or wholesale nursery.

Tree Installation

Trees should be dug and moved during the dormant season, in a well-watered condition, and in accordance with the Canadian standards for Nursery Stock, current edition.

Tree roots should not be exposed to intense winter cold after they are lifted. Use mulch as protection. Excavation of the subgrade below shall be only as necessary to permit the bottom of the rootball to sit on undisturbed material or compacted fill such that the top of the rootball remains at the proper finished grade.

The tree should be installed such that the top of the root ball is even with the surrounding soil – after settlement. If there is a chance of some settling after planting, install such that the top of the root ball is 2 to 4 cm above the surrounding grade. Trees with bark buried beneath the soil line will not be accepted.

Wherever possible, the hole should be dug with sloping sides. Preferred angle is 45 degrees.

The tree should be lowered gently into position, not dropped. Trees should be as vertical as possible. If planting in a surround, the stem should be close enough to centre that at least some part of the tree is in dead centre.

Backfill should be a 50 /50 mixture of native soil and amending soil mix. The two mixes should be applied by shovel in alternating fashion, tamped gently with light boot pressure.

When the backfill has been placed up to about 2/3's of the rootball height, basket ties should be cut and the top 1/3 of the burlap and basket folded back downwards. No burlap or wire should be showing above the finished grade. Ties must be pushed back into the lower portion of the hole.

A 10 cm raised saucer, of inside diameter equal to the outside diameter of the root ball, should be constructed around the perimeter of the rootball to enhance water infiltration. A mulch of organic material (other than cedar) should be placed inside the berms of the saucer, to a depth of 7 – 9 cm.

Trees should be immediately and adequately watered after planting.

Trees should not be staked and tied unless planted in a high pedestrian traffic area where they are prone to being knocked. If staked, use one tie and ensure that it is firm but not tight in a manner that will prevent the tree from developing its own stabilizing roots and good taper.

Soil Mix

When it is not possible to preserve native soil for planting on site, imported soil mix should be commercially prepared soil, or be District approved material from the planting site. It should be virtually free of invasive plant seeds of viable plant parts, subsoil, non-composting materials, non-composted wood, insect or fungal pest organisms, or other extraneous materials.

Tree Protection for District Trees during Public Works

Boulevard trees can be damaged or destroyed during construction or demolition processes, and a number of measures should be undertaken to protect tree. Any drawings submitted for Development Permit (DP) or crossing permit applications should have all street trees marked on the site plan, as well as any street trees within 2 m of either side of the property line.

Tree Protection Barriers should be installed to protect Critical Root Zones and permeable surface surrounding protected trees. Before a person commences demolition, excavation, or construction on a site, the owner of the site should install a protection barrier around all boulevard trees between the extension of the two side property lines across the boulevard; or within two metres on either side of the two lines.

The location of all underground services should be marked on the DP drawings. Alignments should be outside of the required protection zone, and as far as possible from large trees.

Site access should be planned with consideration for avoiding conflict with street trees. Alternate access routes may be required to protect street trees.

Where work or demolition is undertaken, plants and the limits of their root systems should be identified and preserved. Plants and root systems must be protected from damage, compaction and contamination to the satisfaction of the District Arborist or designate prior to commencement of site activities.

Soil compaction reducing techniques such as weight displacement plates or thick wood mulch (20 – 30 cm) should be required by the District Arborist if the street tree rooting area is likely to be affected by vehicular movement.

Temporary storage sites of construction material or soil excavate should be as far from neighbouring trees as possible.

Boulevard trees should not be removed, pruned, moved or otherwise impaired, interfered with, or injured without prior approval from the District Arborist. Should there be any conflict with a street tree and the normal enjoyment of one's property, or a permitted activity, the District Arborist (or designate) should determine if corrective action is warranted. Only arborists authorized by the District Arborist should prune or remove street trees.

The City of Surrey's Parks Construction Standards and the City of Vancouver's Street Tree Guidelines provide useful guidance and standards. For more guidance for identifying and protecting trees during construction:

www.surrey.ca/files/Surrey_Parks_Construction_Standards_-_Winter_2010_11.24.pdf

http://vancouver.ca/files/cov/StreetTreeGuidelines.pdf

Ornamental Lights or Hanging Baskets in Trees

The fixation of wires to trees can kill branches, pre-empt tree care, or possibly create a risk of electrocution. If ornamental lights are fixed in trees, light strings must not be attached to tree

branches with wires, nails, tape or strapping of any kind, and should be placed near the centre of the tree, avoiding the ends of branches. Lights must be removed prior to pruning.

The City of Vancouver provides a useful example for regulation of ornamental lights in trees. For details on the City's program, refer to the Street Tree Guidelines: http://vancouver.ca/files/cov/StreetTreeGuidelines.pdf

Tree Care Topics and Related Homeowner Brochures

The International Society of Arboriculture provides a number of free brochures to help explain the benefits and management of trees:

www.treesaregood.com/treeowner/treeownerinformation.aspx

CAD Standards

The University of Florida provides a number of CAD standards for details and specifications that follow ANSI 300 or other arboriculture best management practices. Drawings listed include standards for planting, staking, irrigation, tree protection and inspection. These details can be found at:

http://hort.ifas.ufl.edu/woody/details-specs.shtml

Local municipalities may also be willing to share CAD standards already developed locally for these purposes.

Appendix 7 – Useful Life Expectancy

The Useful Life Expectancy (ULE) is an estimate of how long a tree is likely to be viable in the landscape based on health, amenity, environmental services contribution and risk to the community. Each tree shall be assigned one of the following ULE categories:

Useful life expectancy	**Typical characteristics**
< 1 year	Tree may be dead or mostly dead. Tree may exhibit major structural faults. Tree may be an imminent failure hazard.
1-5 years	Tree is exhibiting severe chronic decline. Crown is likely to be less than 50% typical density. Crown may be mostly epicormic growth. Dieback of large limbs is common (large deadwood may have been pruned out).
6-10 years	Tree is exhibiting chronic decline. Crown density will be less than typical and epicormic growth is likely to present. The crown may still be mostly entire, but some dieback is likely to be evident. Dieback may include large limbs.
11-20 years	Tree not showing symptoms of chronic decline, but growth characteristics are likely to be reduced (bud development, extension growth etc.). Tree may be over-mature and senescing.
21-30 years	Trees displaying normal growth characteristics. Tree may be growing in restricted environment (e.g. Streetscapes) or may be in late maturity.
31-60 years	Semi-mature and mature trees exhibiting normal growth characteristics. Juvenile trees in streetscapes.
61+ years	Juvenile and semi-mature trees exhibiting normal growth characteristics in parks or open space.