Metro Vancouver Tree Regulations Toolkit

Second Edition

March 2024

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Commissioned by Metro Vancouver

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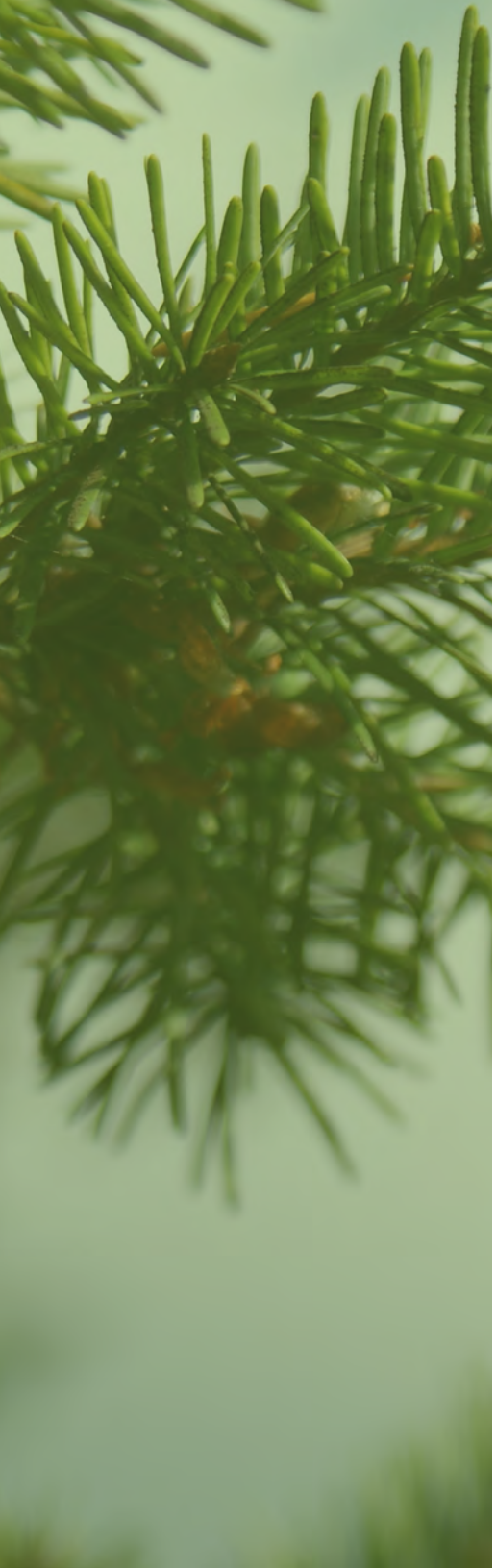
SERVICES AND SOLUTIONS FOR A LIVABLE REGION



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Acknowledgements

Thank you to all the municipal staff and consulting arborists who answered our surveys in the fall of 2020. Thank you also to Edward Nichol and Marcin Pachcinski of Metro Vancouver, and Dr. Julian Dunster for their thorough review and comments on this Toolkit. The *Metro Vancouver Tree Regulations Toolkit* benefited from your input, guidance, and care.

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RECOMMENDED CITATION

Metro Vancouver. (2024). *Tree Regulations Toolkit – Second Edition.* Contract report prepared by Diamond Head Consulting.

1.0 Introduction

Trees provide Metro Vancouver communities with shade and cooling, intercept stormwater, store carbon, create habitat, and make our cities beautiful. Healthy forests in both urban and natural areas are an essential component of regional livability and resilience to climate change. However, the area covered by trees in Metro Vancouver's urban areas (i.e., within the Urban Containment Boundary) is expected to decline from 32% to 28% over the next 20 to 30 years (Metro Vancouver, 2019). This canopy loss is anticipated due to development and lower density housing areas being re-developed as part of the region's planned growth. At the same time, the urban forest is vulnerable to climate change, and unexpected canopy loss could occur in the region because of heat, drought, extreme weather events or pest and disease outbreaks. As a result, approaches to preserve trees and grow canopy cover need to consider a wide range of factors, from the impact of land use on the availability of permeable land to grow trees to the future climate suitability of tree species.

The *Metro Vancouver Tree Regulations Toolkit* (Toolkit) provides guidance for Metro Vancouver member jurisdictions on how they can develop comprehensive policies and regulations to preserve trees and grow tree canopy within British Columbia's current legislative framework. Municipalities in British Columbia can use legislative tools to off-set or prevent canopy loss and contribute to achieving *Metro 2050*'s 40% tree canopy cover target by 2050.

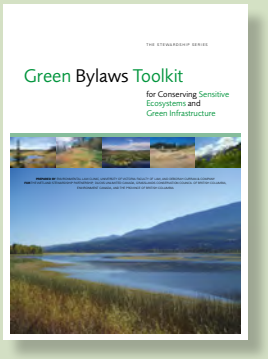
This Toolkit is a resource for municipal staff, decision makers and other practitioners, including planners, arborists, biologists, engineers and landscape architects, on using regulatory tools that influence the preservation and growth of trees and tree canopy. This Toolkit provides a framework for selecting regulatory tools to help achieve municipal tree preservation or canopy growth objectives.

No single best practices approach to regulating trees was identified during this review. The Toolkit therefore presents guidance based on best practices when available and recommends alternatives and options for consideration. Deciding on the most appropriate regulatory approach will require consideration of the community's values and canopy cover objectives, as well as the budgetary implications for local governments and permit applicants.

This Toolkit is not legal advice. Users must conduct their own legal review of any bylaws, regulations, or policies developed using this Toolkit.

ADDITIONAL TOOLKITS AND GUIDANCE DOCUMENTS

There are several other useful guides and toolkits that may help readers and inform the development of a comprehensive set of bylaws to manage natural assets, including:



- The **Green Bylaws Toolkit for Conserving Sensitive Ecosystems and Green Infrastructure** (Stewardship Centre BC, 2021) provides guidance on tools for local governments to protect green infrastructure (natural and engineered).

- **Environmental Development Permit Areas: In Practice and in Caselaw** (Britton-Foster, Grant, & Curran, 2016) provides information about using Environmental Development Permit Areas to protect riparian and terrestrial ecosystems. This report provides information about key components of environmental development permit areas (DPAs) and their judicial treatment in British Columbia.

- **Enhancing Climate Resilience of Subdivision and Development Servicing (SDS) Bylaws in the Columbia Basin: A Guidance Document** (Nelitz, Cooke, Curran, & Glotze, 2013) provides information to guide the update of subdivision and development servicing bylaws for the purpose of increasing climate resiliency and reducing the cost of building and operating infrastructure.

- The **Topsoil Bylaws Toolkit** (Curran, Dumont, Low, & Tesche, 2012) provides information and guidance for local governments to create effective topsoil policies that support rainwater management and reduce the impact of development.

1.1 STRUCTURE OF THE TOOLKIT

This Toolkit provides:

1. An overview of the available approaches to regulating trees in British Columbia
2. Considerations for selecting the right tools for your community
3. Descriptions of each tool including:
   - **a. Higher-level plans** that can support tree preservation or canopy growth through their vision and policy guidance (regional growth strategies and official community plans)
   - **b. Tools regulating land use** that influence the space available to retain or replace trees (land use bylaws and development permit areas and development, subdivision, and servicing bylaws)
     - i. The Toolkit provides information about:
       - Key components to retain or plant trees on private and public land
       - The core tool(s) commonly used and purpose of each component to achieve tree preservation and growth
   - **c. Tools regulating trees** as their primary purpose (environmental development permit areas, covenants, and tree bylaws)
     - i. The Toolkit provides detailed information about:
       - Key components listed in typical bylaw sections
       - The purpose of each component within the bylaw
       - Options for each component, either as a recommended best practice or a list of alternatives for readers to select from based on their community context

The majority of the content in this Toolkit is focused on tools regulating trees as their primary purpose because Metro Vancouver had identified a gap in regional guidance on this topic. In 2024, this Toolkit was updated to provide additional information about higher-level plans and tools regulating land use that provide the foundation for the long term preservation of trees and growth of tree canopy in the region. Readers seeking to preserve trees and grow canopy cover should begin with higher-level plans and tools regulating land use before selecting tools to regulate trees. Callout boxes throughout this Toolkit provide examples, external resources, and findings from the practitioner surveys conducted for the development of this Toolkit.

1.2 TOOLKIT DEVELOPMENT

The Toolkit was developed with input from a practitioner survey of municipal staff and consulting arborists in the region. In addition, the project team conducted a review of scientific literature, practitioner guides and bylaws from several regions across Canada and the United States to explore best practices for regulating trees and tree canopy.

In 2020, practitioners in Metro Vancouver were surveyed to better understand regional perceptions of the strengths and needs for improvement of tree regulations. Two practitioner surveys were sent, the first targeting municipal staff involved in tree bylaw implementation, and the second targeting consulting arborists who have experience working through the development process (listed on the International Society of Arboriculture's list of consulting arborists for municipalities in Metro Vancouver).

Fourteen staff from Metro Vancouver member jurisdictions with private tree bylaws answered the municipal survey. Twenty-nine consulting arborists (who have experience preparing arborist reports on development projects across Metro Vancouver) answered the consulting arborist survey. Appendix 1 contains the 2020 survey results. The project team conducted a review of academic literature and practitioner guides to identify components of successful tree regulations and key considerations for governance, planning and implementation supporting effective regulations. Appendix 2 contains the literature review.

Several Canadian tree bylaws were reviewed to inform the tree bylaws section. In Canada, only some provinces have legislation that explicitly enables the regulation of trees on private property. Municipalities in Ontario, Québec and British Columbia have private tree bylaws. Although bylaws from Ontario, Québec and the US were reviewed, British Columbia bylaws were selected for comparison in the Toolkit because of their legal compatibility with legislation in the Metro Vancouver region. Similarly, bylaws presented as examples in the land use section primarily come from British Columbia to ensure their applicability in the region, with a few examples from elsewhere included to provide inspiration from neighbouring jurisdictions.

2.0 British Columbia's Institutional Framework for Regulating Trees

British Columbia's institutional framework provides a range of policy and regulatory tools to preserve or grow trees in forest stands and urban areas. Figure 1 summarizes how tree and tree canopy considerations can be incorporated into British Columbia's available regulatory tools, including:

1. Higher-level plans:
   a. Regional Growth Strategy
   b. Official Community Plans and neighbourhood plans
2. Tools regulating land use and therefore the space available for tree retention and replacement:
   a. Land use bylaws and development permit areas, including zoning bylaws, screening and landscaping bylaws, development procedures bylaws, and form and character or energy efficiency development permit areas
   b. Development, subdivision, and servicing bylaws
3. Tools primarily regulating trees:
   a. Environmental development permit areas
   b. Covenants
   c. Tree bylaws

These tools provide opportunities to regulate trees in British Columbia but may not be applicable in all instances; the relevance of each tool depends on each jurisdiction's context and the trees that are the focus of regulation. Figure 1 includes examples for how each tool can be used to regulate trees growing on private (blue headings) and public (red headings) land for two types of canopy: naturalized stands and urban areas. Each column on the figure indicates if and how a tool would typically apply to this type of public or private tree canopy. For example, Figure 1 does not list content for 'Regional Growth Strategies' under private yard trees and private trees in a development because they are not typically addressed by that tool.

In addition to the regulations represented in Figure 1, some bylaws can stand alone or have their content addressed within zoning bylaws, subdivision and servicing bylaws or development permit areas. These bylaws include:

- **Runoff control bylaws** | Runoff control bylaws can establish maximum percentage areas covered by impermeable surfaces which vary by land use, zones, geography and size of paved areas

- **Soil removal and deposit bylaws** | Sometimes called sediment and erosion bylaws, these bylaws regulate grading, soil removal and deposition, soil storage and erosion control guidelines

- **Watercourse protection bylaws** | Watercourse protection bylaws can regulate specific activities and development in riparian setback areas

HOW REGULATORY TOOLS CAN BE USED TO PRESERVE TREES AND GROW TREE CANOPY IN THE REGION

	PRIVATE FOREST	MUNICIPAL FOREST
REGIONAL GROWTH STRATEGIES (OCP* must be consistent with RGS*)	Encourage development patterns that avoid urban sprawl, minimize risks from natural hazards, protect environmentally sensitive areas (ESAs) and water quality.	Encourage preserving, creating and linking urban and rural open spaces including parks and recreation areas.
OFFICIAL COMMUNITY PLANS & NEIGHBOURHOOD PLANS (Other bylaws must be consistent with OCP*)	Direct development away from ESAs* and environmental hazards. Policies supporting preservation, protection, and enhancement of tree stands and wildlife trees, clustering and density bonusing in exchange for conservation covenants.	Policies supporting the preservation, protection and enhancement of tree stands and wildlife trees. Policies that support clustering and density bonusing in exchange for parkland.
ZONING BYLAWS (Or contained in related land use bylaws for runoff control, parking, landscaping etc.)	Require setbacks from riparian areas and ESAs*, enable clustering and density bonusing, set out standards for preserving, protecting, enhancing and restoring ESAs.	At rezoning, parkland acquisitions can be negotiated through density bonusing.
DEVELOPMENT, SUBDIVISION, AND SERVICING BYLAWS	Sets standards for drainage and onsite stormwater management that can be made low impact.	Sets standards for drainage and onsite stormwater management that can be made low impact.
ENVIRONMENTAL DEVELOPMENT PERMIT AREAS	Establish riparian setbacks, ESA* soil and vegetation protection and restoration guidelines, environmental assessment requirements.	DPAs on private land can enhance connectivity, restoration and enhancement of natural areas adjacent to municipal forest.
COVENANTS	Protect natural areas and sensitive ecosystems on title and place maintenance or restoration requirements and restrict actions that could damage the protected features.	
TREE BYLAWS	Regulate all trees in ESAs*, on slopes and significant trees. Specify assessment, protection, replacement standards.	Regulate all municipal trees. Specify assessment, protection, compensation standards.

***Short forms:** ESA – Environmentally Sensitive Area | OCP – Official Community Plan | RGS – Regional Growth Strategy

Figure 1. The key regulatory tools in BC that can be used to protect or grow urban forest canopy types.

2 | Trees in Urban Areas

MUNICIPAL STREET & PARK TREES	PRIVATE YARD TREES	PRIVATE TREE IN A DEVELOPMENT
Develop settlement patterns that minimize the use of automobiles and encourage walking, cycling and the efficient use of public transit.		
Policies and targets supporting parkland amenity contributions, new parkland, expansion of the urban forest, treed character of streets and areas, integration with goals such as stormwater management, biodiversity, energy conservation and walkability.	Policies supporting the treed character of new landscaping in land uses and neighbourhoods.	Policies and targets supporting tree and canopy retention, protection and enhancement.
At rezoning, negotiate amenity contributions for new parkland. Require setbacks of above and below ground structures, signage and weather protection favourable for street trees.	Require lot sizes, trees per lot, impermeable/ permeable cover, off-street parking, screening | and landscaping, favourable to yard trees.	IMPORTANT: The tree bylaw may not apply to the extent necessary to allow a permitted use or density.
Set standards for boulevard trees, spacing, soil volume, planting standards, access, utilities favourable for street trees.	Set standards for access and utilities placement favourable to yard trees.	Set standards for access and utilities placement favourable to retaining private trees.
	Promote energy conservation, water conservation and reduction of greenhouse gas emissions using trees.	
		Protect trees or tree groups on developing properties, place maintenance requirements and restrict actions that could damage the protected features.
Regulate all municipal trees. Specify assessment, protection, compensation standards.	Regulate certain trees and require a minimum number of trees/canopy per lot. Specify assessment and replacement standards.	Regulate certain trees and require a minimum number of trees/canopy per lot. Specify assessment, protection, replacement standards.

Tree types: Forest stands and naturalized areas | Urban trees

Jurisdiction: Public | Private

***Short forms:** ESA – Environmentally Sensitive Area | OCP – Official Community Plan | RGS – Regional Growth Strategy

3.0 Selecting the Right Tools and Options for your Community

This Toolkit provides options for content that municipalities could include in policy and regulatory tools to preserve trees and grow tree canopy. For a municipality considering what tool(s) to select, an urban forest governance lens may be helpful to identify the decision-making factors. Urban forest governance refers to the processes, interactions, organizations, and decisions that lead to the establishment and maintenance of urban forest resources and benefits (Lawrence, De Vreese, Johnston, Konijnendijk, & Sanesi, 2013). Applying an urban forest governance lens means defining the governance approach used by a specific municipality and using that information to help inform decisions about which tool(s) are likely to be most successful.

The paper "*Urban forest governance: Towards a framework for comparing approaches*" (Lawrence, De Vreese, Johnston, Konijnendijk, & Sanesi, 2013) defines a set of variables for systematically analysing urban forest governance. This Toolkit poses a set of analysis questions related to urban forest governance; these questions can be used to help define the relevant focus, level of effort, extent of change, key actors, capacity, and processes for developing new tree regulations.

Urban forest governance analysis questions

1. **Community context:**
   - ◊ What are the urban forest canopy types that are the target of canopy preservation or growth: canopy in forest stands and naturalized areas, canopy in urban areas, or canopy in both naturalized forest stands and urban areas? Please refer to Figure 1 for the canopy types and how they might be regulated with different tools.
   - ◊ What level of administration and enforcement effort can be supported by the jurisdiction's population size and geographic area?
   - ◊ What level of regulation would align with community values?

2. **Institutional frameworks:**
   - ◊ What types of policies, plans and regulations are already in place and how could they be enhanced or complemented with updates or new regulations?
   - ◊ Will new policies or plans be required to support new regulations?
   - ◊ What urban forest canopy or tree targets exist in policies and plans, and how could new regulations be used to achieve them?

3. **Actors and coalitions:**
   - ◊ Who are the key internal and external stakeholders who need to be consulted?
   - ◊ Who needs to support the decision and who will make the final decision?

4. **Resources:**
   - ◊ Will funding and staffing need to increase to support the new regulation?
   - ◊ What new technical information will need to be provided to internal and external stakeholders?
   - ◊ Can other policies, programs or staff be used to implement the changes more effectively?

5. **Processes:**
   - ◊ What are the narratives, conflicts and framing that justify the changes being made?
   - ◊ What are the specific ways that actors and stakeholders will be consulted, engaged, involved, and empowered in decisions and implementation?
   - ◊ What are the performance targets[1] for the change? How will success be measured and reported in relation to targets?

Answering these questions will help choose the right tools and options for your community. Your answers will inform the selection and design of policy and regulatory tools that will be appropriate for the community's governance context; and help identify the engagement and resourcing required to support their effective implementation.

[1] Examples of measurable targets include metrics such as canopy cover, rate of tree removal and replacement, replacement tree survival rates, or pervious cover.

Higher-level plans are established for a regional, municipal or neighbourhood planning scale. The plans set goals, targets and policies that guide planning and development at that planning scale, making them an important driver for tools that regulate land use and trees.

4.0 Higher-level Plans

The higher-level plans described in this section include Regional Growth Strategies, Official Community Plans and Neighbourhood Plans. Regional Growth Strategies are an agreement across local governments on the future, population in the region and employment projections, and targets, policies and actions, for example for the reduction of greenhouse gas emissions (Local Government Act, RSBC 2015, c 1, 2015). A Regional Growth Strategy describes objectives for and ways to protect environmentally sensitive areas. Local governments are required to include a regional context statement within Official Community Plans (OCPs) to demonstrate consistency with matters in the regional growth strategy. Since the publication of the first edition of the Tree Regulations Toolkit, Metro Vancouver published *Metro 2050*, the new Regional Growth Strategy.

METRO 2050

In 2023, Metro Vancouver adopted its new Regional Growth Strategy, Metro 2050. The Strategy shares the vision for the region's projected growth in population, housing, and jobs for the next 30 years. Strategy 3.2 focuses on the protection, enhancement, restoration, and connection of ecosystems. It includes a target to increase tree canopy cover within the Urban Containment Boundary from 32% to 40% by 2050.

Official Community Plans are comprehensive plans that can include environmental protection policies. They provide the policy support for the bylaws adopted in the community. Official Community Plans can also define settlement patterns that guide development and avoid sprawl, map key areas, and designate development permit areas and guidelines for development permits responsible for tree protection and replacement (Stewardship Centre BC, 2016). Official Community Plans can establish goals and indicators related to the preservation and growth of a community's urban forest and support the implementation of community-supported bylaws and policies for that purpose. More specifically, Official Community Plans can set policies related to the natural environment with regard to the protection of stands of trees and ecosystems. They can also provide guidance on equity components to ensure access to all community members and to recognize and support the rights of Indigenous Peoples regarding urban forest resources. Official Community Plans should also guide land acquisition for the purpose of preserving and growing tree canopy and support the climate resilience of our communities through strategic use of tree canopy benefits and of urban forests in the face of changing growing conditions. Finally, they can guide the best use of trees for urban design and livability.

Neighbourhood Plans can be a helpful accompanying policy tool to set out targets for canopy cover. They can also and define policy objectives and character elements of importance for the urban forest and neighbourhood character. This smaller planning scale enables more consideration to be given to the local land use and unique context of each neighbourhood within a municipality. To supplement this section of the Toolkit, practitioners can refer to Appendix 3 for a worksheet that helps local governments assess their Official Community Plan and Neighbourhoods Plans.

LOOKING BEYOND BRITISH COLUMBIA: WASHINGTON STATE'S REGULATORY FRAMEWORK FOR NO NET LOSS OF HABITAT

Municipalities in Metro Vancouver follow the rules set by the Province of British Columbia. However, looking at other jurisdictions, including Washington State, could offer new ideas for urban forest management. Washington State's Growth Management Act requires all municipalities and counties to adopt critical areas' regulations for the protection of the natural environment, wildlife habitats, and sources of drinking water. The municipal and county regulations must first avoid, then minimize and mitigate development impacts on critical areas. The State requires a no net loss approach which requires local governments to maintain the same quantity and quality of critical areas over time. As a result, cities like Bellingham have adopted a Critical Areas Ordinance to implement the no net loss framework that applies to both public and private lands. These requirements have resulted in significant investments in restoration, including stream daylighting, forest and wetland restoration, and now the development of a mitigation bank to direct compensation funds towards ecologically appropriate and functional mitigation for impacts anticipated to occur over the next 10 years.

Land use regulations create the foundation for long-term protection and growth of trees. These regulations control where trees can exist and how much space is available for them to grow in a particular land use type as it develops.

It will be ineffective to implement a tree bylaw or an environmental development permit area to protect trees or grow tree canopy if land use regulations do not require adequate space to retain or grow trees post-development.

5.0 Tools Regulating Land Use

Land use regulations significantly impact tree preservation and growth because they influence the space available to retain or replace trees with development. As such, these tools will be critical to achieving Metro Vancouver's target to increase tree canopy cover to 40% within the Urban Containment Boundary (UCB) by 2050.

The availability of space to retain or replace trees varies widely across both public and private land uses. As urbanization and density increase in Metro Vancouver, the space available to grow trees tends to decrease. More specifically, studies have found that canopy cover declines significantly when median site coverage or housing density increases (Hilbert et al. 2019; Landry & Pu 2010; Troy et al. 2007). Local governments will need innovative land use policies to maintain and enhance tree canopy (where possible) and mitigate tree canopy loss in densely populated areas.

The land use bylaw components presented in this section contribute to tree preservation and growth because they influence the space available to retain or replace trees on private or public land. Practitioners can evaluate their current regulations to determine how much space they make for trees and how landscaping and tree retention mechanisms contribute to desired tree canopy cover outcomes.

Practitioners can use the following regulatory tools to address the components listed in this section:

- **Land use bylaws and development permit areas:** zoning bylaws can set rules for lot sizes, setbacks, building coverage, and how land can be used, which can, in turn, affect land cover and where tree canopy (and associated environmental benefits such as urban heat mitigation and stormwater interception) is distributed (Wilson, Clay, Martin, Stuckey, & Vedder-Risch, 2003). Zoning bylaws, screening bylaws, or 'form and character' and 'climate change' development permit areas can also regulate or provide guidelines for landscaping, retaining important trees, and promoting landscaping strategies for passive solar gain and cooling.

- **Development procedures bylaw:** can allow staff to approve minor variances to retain trees.

- **Development, subdivision and servicing bylaw:** can control the placement of trees and vegetation in streets and the landscaping design criteria and construction standards.

In a 2020 survey, the majority of municipal staff survey respondents indicated that they thought their zoning bylaws were not currently effective for preserving or growing canopy cover.

While some best practices for regulatory components influence tree canopy outcomes, others are more variable and context-specific. The following subsections provide detailed information about key bylaw components, including:

- Purpose of the bylaw component

- A recommendation for each component, either as:
  - ◊ Recommended components – central to the approach presented for tree retention or planting
  - ◊ Options – listed for every community's consideration based on the specific land use or context

- Examples of where those regulatory components are being implemented in existing regulations

Before providing an overview of the regulatory components, the toolkit includes context about how land use influences the region's tree canopy cover and impervious surface.

5.1 CURRENT LAND COVER AND CONSIDERATIONS FOR SETTING LAND USE CANOPY COVER TARGETS

This subsection presents information about the distribution of land uses in the Metro Vancouver region and their contributions to tree canopy and impervious surface cover. Land cover information provides context for which land uses have the greatest influence on tree canopy cover in Metro Vancouver.

Largest land uses in Metro Vancouver

Figure 2 illustrates the land use composition of the region's UCB in 2020. The most abundant land uses were low-rise housing (single detached and small-scale, multi-unit housing), parks and greenspaces, road rights-of-way, and commercial and industrial uses. Nearly 40% of the region's land area is in publicly managed parks and roads, while private land uses account for 60%. Therefore, when developing land use regulations to influence canopy cover, local governments must carefully consider how regulating their most extensive land uses can best support canopy preservation and growth.

Land uses across the region are not static and will continue to change. For instance, since 2014, the proportion of low-rise housing decreased as urban centres have densified. In addition, recently introduced Provincial regulations will result in all single-detached housing in the Urban Containment Boundary transitioning towards small-scale, multi-unit housing.

LAND USE AREA WITHIN THE URBAN CONTAINMENT BOUNDARY

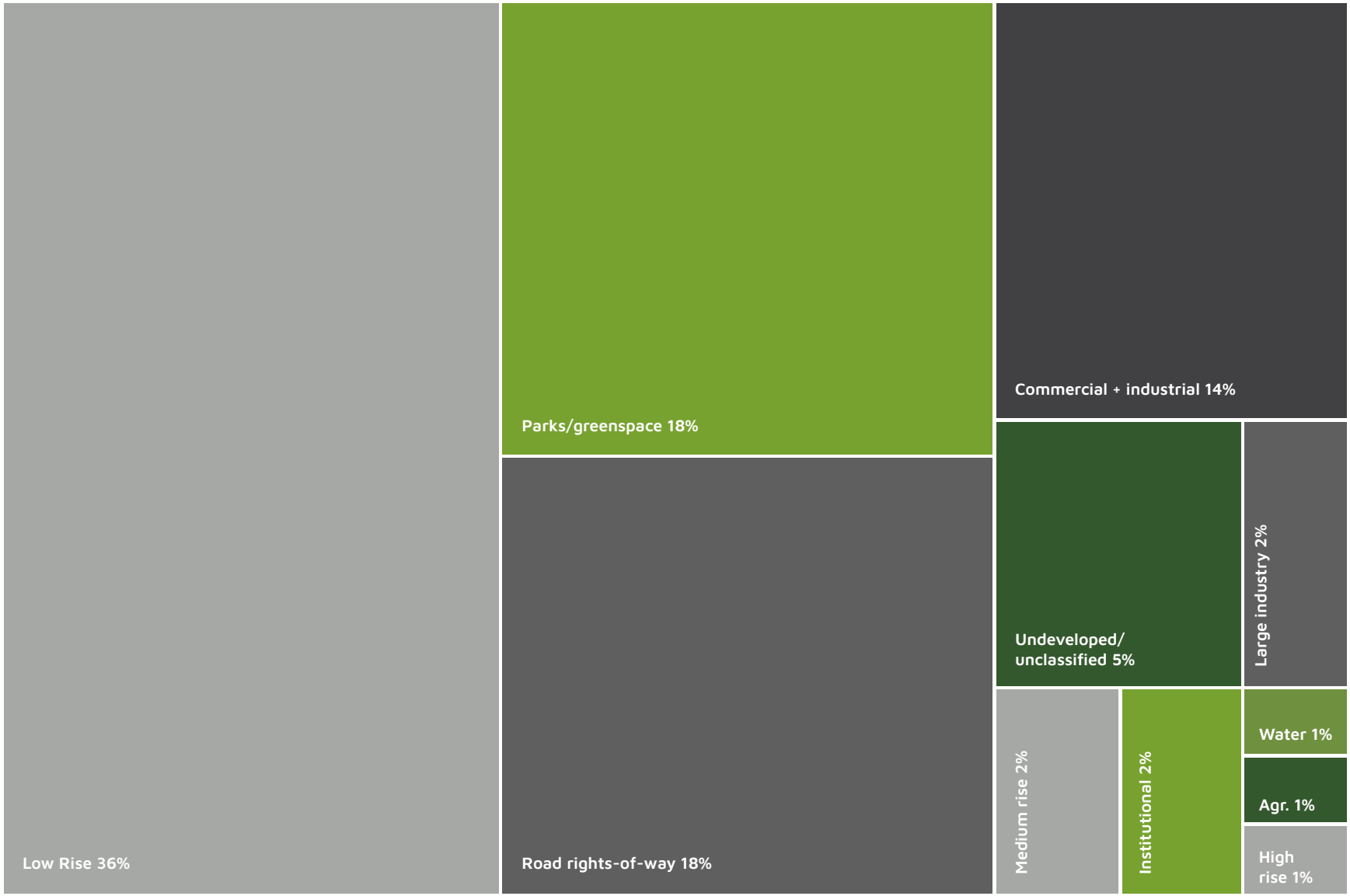


Figure 2. Approximate land uses contribution to Metro Vancouver's Urban Containment Boundary land base.

BC SMALL-SCALE, MULTI-UNIT HOUSING PROVINCIAL POLICY

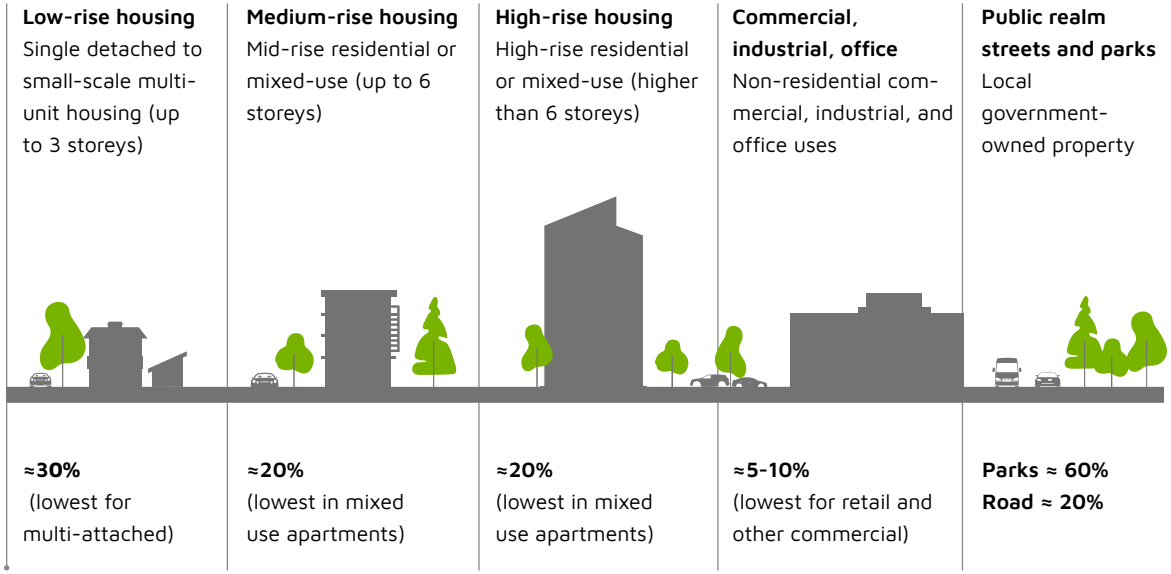
In 2023, the BC provincial government introduced changes to the *Local Government Act* and *Vancouver Charter*. It published a Policy Manual to guide the implementation of changes to single-detached dwelling or duplexes zones to allow Small-Scale, Multi-Unit Housing (SSMUH). The Transit-Oriented Development Areas legislation will also concentrate development in areas within 800 m of rapid transit nodes. The regulatory changes will replace single-detached and duplex zones across the region's Urban Containment Boundary to allow a minimum number of residential units ranging from a minimum of three to six units based on the lot size and their proximity to a frequent transit stop.

This section of the Toolkit uses icons to highlight the anticipated impacts and implications of the provincial regulatory changes on relevant bylaw components.

Where is most of the tree canopy in our region?

Metro Vancouver's 2024 Regional Tree Canopy Cover and Impervious Surfaces report (Metro Vancouver, 2024) found that in 2020 31% of the UCB was covered with tree canopy. Previous reporting concluded that low-density housing land uses had historically had the highest tree canopy (≈35%), but since the 1970s, that canopy has been declining (Metro Vancouver, 2019). Meanwhile, high-rise housing had its highest canopy cover in the 1980s (≈30%) and has been declining since. Today, low-density housing land uses have 1.5 times the canopy coverage found across higher-density housing areas. Commercial, industrial, and office land uses supported the least canopy cover of any land uses. Parks in the region contain approximately 60% canopy cover, while road rights-of-way supported approximately 20% canopy cover.

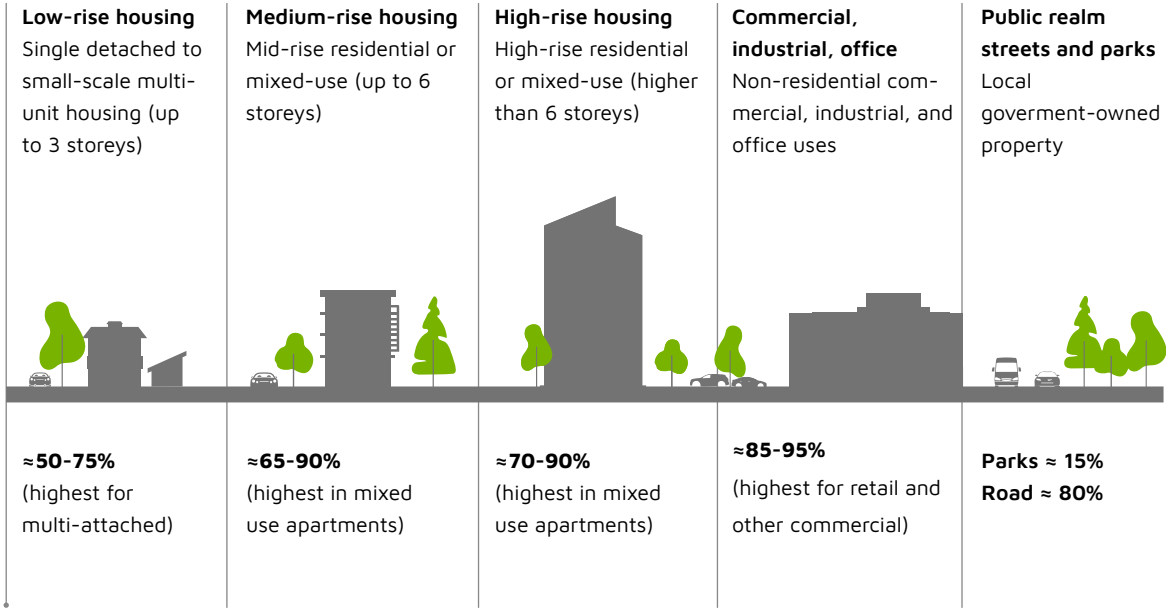
AVERAGE CANOPY COVER IN 2020



Where is most of the impervious cover in our region?

According to the Regional Tree Canopy Cover and Impervious Surface report (Metro Vancouver, 2024), in 2020 54% of land in the UCB was impervious, meaning it was covered by buildings or pavement. Commercial, industrial, and office land uses had the highest impervious surface of all land uses, reaching up to 94%. Housing land uses have seen comparable levels of impervious surface since the 1970s, with medium and high densities averaging around 75% impervious surface, because of larger site coverage and smaller lot sizes in lower density areas. In comparison, low density residential areas generally had lower impervious surface ranges from the 1970s to 2020 – 50% on average across the UCB. Recently adopted provincial government legislative changes promoting the transition in single-detached residential areas to small-scale, multi-unit housing are expected to increase site coverage and impervious surface further. Parks have the lowest impervious cover in the region at approximately 15%, while road rights-of-way have approximately 80% impervious cover.

AVERAGE IMPERVIOUS COVER IN 2020



IMPORTANT IMPERVIOUS COVER THRESHOLD FOR TREE CANOPY

Research and practitioner comments suggest a strong relationship exists between the proportion of tree canopy cover on a site and the extent of impervious cover (i.e., paved surfaces). Metro Vancouver's land cover data (2014) shows that once a city block reaches 60% impermeable cover, it becomes unlikely to reach more than 30% canopy cover.

Given the close relationship between impervious and canopy cover, local governments seeking to preserve or grow canopy cover need to ensure that their regulations result in adequate pervious surface and soil to grow trees in the land uses where the community wants to see tree canopy. **Local governments need to retain soil to grow trees close to where people live.**

5.1.1 Setting a Tree Canopy Cover Target

To reach the regional 40% canopy cover target within the UCB, local governments must implement practical solutions that minimize the loss of canopy and pervious area, and maximize opportunities to enhance landscapes and retain and plant trees in each land use. Parks and conservation areas, crucial for providing canopy cover and space for nature, should not be the sole source of tree canopy. Research underscores the importance of providing nearby tree canopy for public health, exemplified by the '3-30-300 rule', which advocates for the visibility of 3 trees from homes, schools, or workplaces, at least 30% canopy cover in each neighbourhood (a minimum suggested to ensure residents receive health and wellbeing benefits), and access to greenspace within 300 metres of residences (Konijnendijk, 2022). The BC Coroner Service's report on the 2021 heat dome event also highlighted the provision of tree canopy and pervious surfaces as one of four core strategies to combat extreme heat and mitigate future public health risks (British Columbia Coroners Service, 2022). While not all land uses will be able to accommodate the same canopy coverage, it is essential to continue making space for trees and greenspace close to where people live across the region. Setting up a local government canopy cover target is an important tool to direct efforts towards achieving adequate tree canopy and distribute those important benefits across communities and the region.

Metro Vancouver's tree canopy cover reporting has highlighted a concerning trend of declining space for trees across various land uses. This trend threatens the regional target of growing canopy cover to 40% within the UCB. Setting canopy cover targets at the local level by land use will help practitioners focus on aligning their land use bylaws with those goals. A review of land use regulations and rights-of-way standards will allow for a better understanding of what can be achieved on a parcel or city block level. Those parcel-level targets can be scaled to the land use and local government-wide scale to better understand how the local government will contribute to regional targets.

When choosing a suitable target for a specific land use, practitioners should consider its contribution to a local government-wide target, the regional UCB target (as required in *Metro 2050* Action 3.2.7a), and the provision of canopy close to where people live. Achieving 40% canopy cover across all land uses may not be feasible or appropriate.

To meet a canopy cover target, the number of trees and the necessary space required for planting must be allocated within each land use category. Table 1 presents the approximate tree density per hectare required to achieve various canopy cover targets. To achieve the targeted canopy cover with the tree density stated, the species planted should on average have a medium-size crown at maturity (mature crown spread 5 – 10 metres). The table also identifies that a certain percentage of each land parcel should be dedicated as a consolidated planting area (see inset) to accommodate tree growth. This percentage varies from around 5% to 30%, depending on the canopy cover target and parcel size. Ideally, each tree should have approximately 35 m^2 of pervious area; however, this can be reduced to 30 m^2 if shared with other trees (see Table 2 in section 5.3.2 for more details). If providing pervious area is not feasible, practitioners can employ engineered solutions such as soil cells or structural soil under impervious surfaces to achieve the desired outcome.

Table 1. Approximate tree density and percent of parcel area required to meet specific canopy cover targets at the parcel level

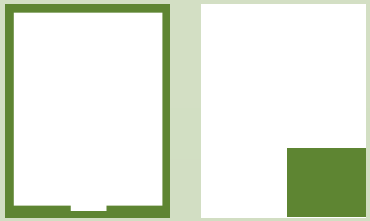
PERCENT CANOPY TARGET	TREE DENSITY PER HECTARE[1]	EXAMPLES OF PERCENT OF PARCEL REQUIRED FOR CONSOLIDATED PLANTING AREAS*[2]	
		2,000 SQUARE FEET PARCEL	9,000 SQUARE FEET PARCEL
60%	92	32% (space for 2 trees)	29% (space for 8 trees)
55%	85	32%	25%
50%	77	16%	22%
45%	69	16%	22%
40%	**62**	**16%**	**18% (space for 5 trees)**
35%	54	16%	18%
30%	46	16%	14%
25%	38	16%	11%
20%	31	16%	11%
15%	23	Less than 1 tree/lot needed	7%
10%	15	Less than 1 tree/lot needed	4%
5%	8	Less than 1 tree/lot needed	4%

[1] This tree density is based on the City of Vancouver's average canopy cover per tree of 65 m^2; Vancouver's tree population averages 35 cm diameter at breast height and young trees are most abundant. However, trees 30 cm and larger provide most of Vancouver's canopy area.

[2] To support a tree providing approximately 65 m^2 of canopy (8 m spread per tree), a minimum of 30 m^2 of consolidated pervious area should be provided. The examples of the percent of parcel required to provide the minimum planting area are based on parcel sizes of 2,000 and 9,000 sq. ft. (186 m^2 and 836 m^2).

WHAT IS A CONSOLIDATED PLANTING AREA?

Unlike pervious area cover, a consolidated planting area requires contiguous soil volume in an arrangement that would support the growth of a large-size tree.



Example of the same lot's pervious cover arranged in green slivers around a large grey impervious area (left) or in a consolidated form (right, preferred for tree planting)

For more details on implementing a consolidated planting area requirement in your land use bylaws, see section 5.3.2 on tree planting.

5.2 LAND USE BYLAWS AND DEVELOPMENT PERMIT AREAS

This subsection focuses on landscaping and site coverage guidelines, as well as regulations that create space to grow trees on private land. Practitioners may use various regulations to implement some of the components listed in this subsection based on local context and preferences. The regulatory tools are:

- **Zoning bylaws**, which set land use, density, building height and site coverage, and parking requirements
- **Form and character development permit areas**, which can regulate building design and landscaping
- **Climate change and energy conservation development permit areas**, which can promote landscaping solutions to reduce energy consumption
- **Screening and landscaping bylaws,** which can be used to preserve, protect, restore, and enhance the natural environment, screen or buffer land uses, and prevent hazardous conditions (e.g., require certain types of plants in wildfire hazard areas)
- **Development procedures bylaw,** which can define procedures to apply for variances to land use regulations, including application requirements and delegated minor variances

To supplement this section of the Toolkit, practitioners can refer to Appendix 4 for a worksheet that helps local governments assess their regulatory tools.

5.2.1 Landscaping Standards

Practitioners can use landscaping requirements or guidelines to meet canopy cover targets. These requirements can be used to encourage tree retention (given that retained trees help to achieve the landscaping requirements), but these requirements are primarily used to ensure that a consistent landscape standard is achieved post-development. The core component of the landscaping requirements that influences canopy cover growth is the tree planting requirements.

RECOMMENDED COMPONENT
Tree planting and retention requirements

PURPOSE | Landscaping and screening requirements can set tree planting or retention minimums and specify adequate planting standards in all or specific zones.

In practice, it might include the following components:

1. Number of trees:

- **Tree density requirement*** to consistently distribute canopy cover across a land use. A tree density requirement may be based on:

  - ◊ In residential land uses, the parcel or landscape area size

  - ◊ In commercial or industrial land uses, the number of parking stalls
- **Screening buffer** to use trees as a buffer between different land uses. The buffer should be at least 3 metres wide to allow the planting of larger tree species.

*Note on tree density: Practitioners can align tree density targets in landscaping requirements with a tree bylaw's tree density target requirement (see the tree bylaw subsection 6.3.6.2 Replacement Requirements – Achieving Canopy Growth). For example, the tree bylaw may use the tree density to cap replacement requirements while zoning uses the same density as a minimum landscaping standard. Over time, the combined use of those tools would equalize the distribution of tree canopy, with heavily forested properties reducing canopy, and sparsely forested properties increasing it after development.

2. Planting standards:

- **Size at maturity** is an important factor. To achieve the desired tree canopy target with the equivalent tree density requirement, trees must be mostly medium or large size at maturity, meaning that the species planted will reach a medium to large crown size. To achieve the targeted canopy cover with the tree density, local governments could require no more than 25% small trees at maturity, and no less than 50% large trees and medium trees at maturity to make up the difference.
- **Soil volume** minimums per tree are important to provide trees with sufficient growing space. They can be supplied with adequate pervious surface where trees are planted in the ground (see section 5.3.2 about planting area requirements) or with soil cells or structural soil if growing on structure or below impervious cover (see section 5.3.3 for recommended minimum soil volumes).
- **Installation and maintenance** requirements should reference the Canadian Landscape Standards, which provide industry best practices.
- **Tree species selection** should be guided by a list of climate-adapted and non-invasive species, as well as diversity guidelines. If it is not feasible to maintain a species list, practitioners should, at a minimum, require approval of the proposed species.

Examples of where this approach is used:

- Tree density requirements in zoning:
  - ◊ Coquitlam zoning landscaping requirements for development
  - ◊ Kelowna zoning landscaping standards (table 7.2; see inset)
  - ◊ Portland city code (11.50.050 On-Site tree density standards)
- Trees per parking stall requirements
  - ◊ Township of Langley parking lot landscaping (section 111.4)

TREE DENSITY REQUIREMENT FOR LANDSCAPING

The City of Kelowna's Zoning Bylaw includes landscaping requirements specific to four different types of land uses. The requirements include a minimum number of trees per hectare as well as a minimum growing medium area and soil volume.

Kelowna Zoning Bylaw – Section 7 Site Layout

ADDITIONAL OPTION | The recommended landscaping standards can be supported by development permit area (DPA) guidelines and other mechanisms to improve tree retention and planting:

Green standard/factor score or sustainability checklist: Local governments can use reporting standards that require applicants to report on their sustainability and greening efforts. Such tools can suggest a list of measures and their associated score, allowing applicants to select the tree retention or planting solutions that work best for their site. Sustainability report cards or green scores can be included in reports to Council and Committees for rezoning or development permit applications to demonstrate how well an application aligns with a local government's sustainability values. While they are sometimes used as a voluntary standard, sustainability scores can also be used as a requirement for amenity density bonusing, as described in section 5.2.3.

- Examples of where this approach is used:
  - ◊ Toronto green standard (see inset)
  - ◊ Port Moody sustainability report card

Form and character landscaping guidelines: Form and character DPAs are a common tool for local governments to implement requirements related to greenspace, planting, and character for new development. Form and character DPA guidelines can support landscaping requirements by encouraging retention of existing mature trees or forest stands, tree planting (including sufficient spacing and soil volume), and achievement of specific goals such as shading, place making, native plantings, stormwater management, or energy efficiency.

- Examples of where this approach is used:
  - ◊ Landscaping guidelines in Surrey's Form and Character DPA provide details on the type of tree retention, landscaping, and planting conditions required in different land uses to maximize benefits from trees and provide adequate conditions to support tree growth.

Climate change and energy conservation Development Permit Area: Under energy conservation, water conservation and greenhouse gas emissions reduction DPAs, some guidelines can contribute to preserving trees and growing tree canopy while increasing carbon storage and meeting goals for climate action. These components include landscaping strategies such as planting trees for passive solar gain and cooling to reduce energy consumption (British Columbia Ministry of Community, Sport and Cultural Development, 2011). Trees should be located to serve as a windbreak, and shade trees to cool buildings and impervious surfaces where possible. Tree species that require less watering should be selected to minimize irrigation needs.

TORONTO'S GREEN STANDARD

The Toronto Green Standard is the City of Toronto's sustainable design requirements for new private and City-owned developments. The Standard was introduced in 2006 as a voluntary standard for new development and has since been structured into a tiered program that offers a mix of mandatory and voluntary elements. Projects that demonstrate higher levels of performance may be eligible for a refund on development charges paid to the City. Design guidelines in the Toronto Green Standard address urban forestry, including:

- Soil volume required on the site and in the adjacent public boulevard
- Minimum soil volumes for each tree planting area (permeable area consolidation)
- Placement and spacing of trees
- Required watering and maintenance of trees after installation
- References to relevant bylaws and policies governing trees on public and private property

The Toronto Green Standard requires all new developments to increase tree canopy, soil volumes, and tree watering, while promoting the use of native species and exclusion of invasive species from landscaping. Additional tree planting or ecological restoration is voluntary and can be used to qualify for a development charge refund. The Toronto Green Standard is updated every four years to provide certainty and regularity to private landowners and the development industry. The urban forest is a crucial performance area for the Toronto Green Standard, which is a major implementation tool for the City's Climate Action Plan.

Another example of a similar approach:

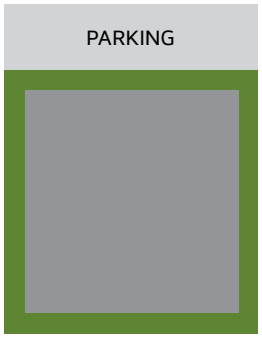
Seattle's Green Factor is another score-based approach to implementing greening requirements within the City's Municipal Code:

- Applicants must achieve a minimum number of credits
- Greening methods that earn credits: tree planting (highest for large species at maturity planted in adequate soil volume), pervious areas (highest for vegetated areas and greater depth of infiltration)

5.2.2 Planting Area Requirements

After establishing landscaping requirements aligned with their canopy cover targets, practitioners must ensure that site requirements provide adequate planting areas to sustain the desired canopy cover.

The additive impact of the regulatory components discussed in this section is shown on an example parcel where space to support trees on private property is initially insufficient:



RECOMMENDED COMPONENT
Planting area requirement

PURPOSE | The amount of pervious area provided on a parcel needs to be sufficient to support the landscaping requirements for tree retention and planting.

In practice, it might include the following bylaw components:

- **Minimum pervious area requirements (or maximum impervious area)** can support the provision of planting areas. Still, it may not be sufficient to achieve a consolidated tree planting area (e.g., narrow strips of grass surrounding a building).
- **Minimum consolidated planting (pervious) area** of at least 35 m^2 per tree (or 30 m^2 if the multiple trees share the soil volume) with minimum dimensions to create a shape large enough to support tree(s). The surface area requirements are based on the recommendation to provide at least 0.3 m^3 of soil and preferably 0.6 m^3 of soil per metre square of mature canopy area (Metro Vancouver, 2017).
- **Engineered solutions** to achieve soil volume under impervious surfaces.

A consolidated pervious area requirement will create an area large enough to support a tree: →

The table below summarizes the minimum surface area required to support a tree (assuming a 1 m soil depth).

Table 2. Surface area of soil per tree assuming 1 m depth

TREE SIZE	APPROXIMATE SURFACE AREA (M^2) OF SOIL REQUIRED PER TREE (ASSUMING 1 M SOIL DEPTH)		
	On ground	**Under hardscape – soil cells+**	**Under hardscape – structural soil++**
Small tree canopy spread is up to 6 m	8	x1.1	x5
Medium tree canopy spread is up to 10 m	20	x1.1	x5
Large tree canopy spread is greater than 10 m	35	x1.1	x5

+Soil cells are 92% soil, ++Structural soil is 20% soil.

Examples of where this approach is used: Victoria missing middle zoning; Ottawa missing middle; Portland City Code – Chapter 11.50 Trees in Development Situations

CONSOLIDATED PLANTING AREA

The City of Victoria recently adopted missing middle zoning that allows houseplexes (buildings with at least 3 and no more than 6 dwelling units), corner townhouses and heritage-conserving infill housing in areas previously limited to traditional residential zoning. Schedule P of the Zoning Bylaw lists new requirements for the missing middle zone, including requirements for open site space that the City developed to provide a minimum connected surface area of a size and shape that will enable tree planting:

Site coverage, open site requirement:

- Open site space (minimum): 45%
- A single space the greater of 35m^2 or 6.5% of the lot area:
  - ◊ That is landscaped and not paved,
  - ◊ That does not have above or below ground structures, and
  - ◊ **All sides of which are at least 4.5 m long**

City of Victoria Zoning Bylaw Schedule P – Missing Middle Regulations

5.2.2.1 Making Space for the Planting Area

To make space for the planting areas, practitioners need to consider site layout components that are competing for space on the parcels.

RECOMMENDED COMPONENT
Building setbacks to accommodate trees

PURPOSE | Trees require space from buildings and paved surfaces to grow to maturity without conflict with adjacent infrastructure. As such, local governments should be aware that setbacks will become limiting or altogether exclude tree planting once they get below the widths described below.

In practice, it might include the following bylaw components:

- **Front and rear setbacks:** at least 3 metres from foundations in the front or rear to allow tree planting more than 2 metres away from the building for medium-sized trees or 3 metres for large trees. Prioritize keeping the front setback larger to enable tree planting and cooling benefits, except where an existing forested area exists towards the rear of properties that could be preserved with a larger rear setback. Trees should be planted at least 1 metre from the property line.
- **Underground structures setbacks:** Setbacks often do not explicitly apply to underground structures in all zoning bylaws. Practitioners should note that if underground structures are permitted to reach the property line, it will result in tree impacts on and adjacent to that property. For instance, underground parkades that reach the property line may result in the removal of adjacent street trees and make it more difficult to replace trees. Being explicit about where zero setbacks for underground structures will be permitted would help to manage expectations about tree retention, planting, and canopy cover potential in adjacent streetscapes and sites as redevelopment occurs.

RECOMMENDED COMPONENT
Building setbacks to accommodate trees

A larger front setback will provide sufficient space from the building and soil volume to support trees that will grow to a larger size at maturity:

Where a 3-metre building and underground structure setback is not possible in the front or rear of the property, practitioners must review their Development Servicing standards for the rights-of-way to ensure that the boulevard width and placement make up for the lost opportunity for tree canopy – see section 5.3.1. Figure 2 below illustrates the relationship between front setbacks and boulevards for the provision of tree canopy.

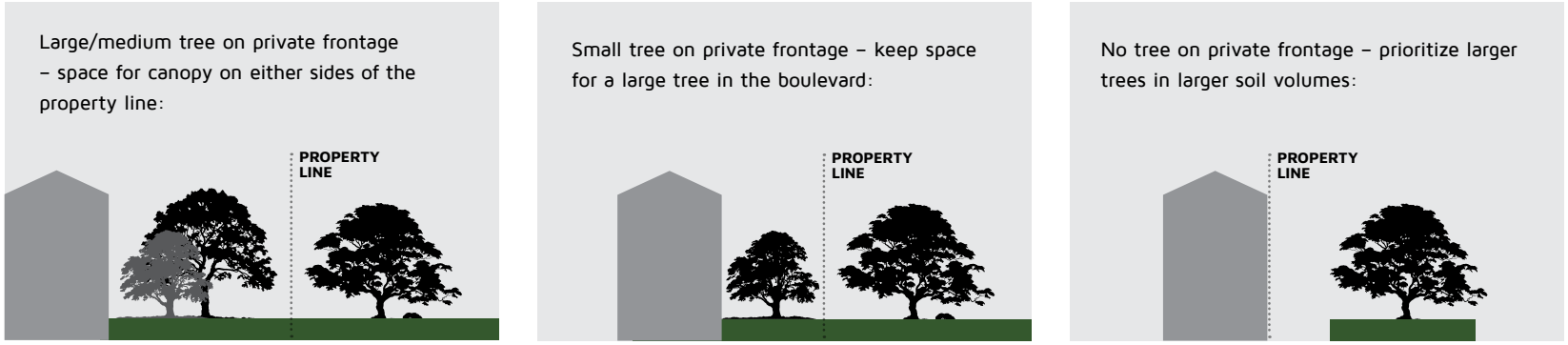


Figure 2. Relationship between front setbacks and boulevards for the provision of tree canopy.

The province's SSMUH Policy Manual recommends that local governments reduce building setbacks to improve the viability of more housing types. The Policy Manual recommends a range for front setbacks from 0-2m for lots with a minimum of 6 housing units to 5-6m for lots with a secondary suite or accessory dwelling. Recommended rear setbacks are as small as 1.5 m.

ADDITIONAL OPTION | Bylaw components to enable the provision of consolidated planting areas:

Site coverage: The maximum site coverage defines the proportion of a lot that can be occupied by structures. With the exception of landscaping grown on structures (discussed below), this represents an area that will not be available as pervious cover.

- The province's SSMUH Policy Manual recommends that local governments set a combination of maximum lot coverage with setbacks and maximum height requirements instead of floor area ratios. **Recommended maximum lot coverage** (i.e., proportion of the lot covered by a building footprint) ranges from approximately 30% for lots with only a secondary suite or accessory dwelling to 60% for lots with a minimum of 6 units.

- On mid- or higher-rise housing sites or other high-intensity land uses where full lot coverage cannot be avoided, tree planting will need to occur on structures. Tree planting on structures should still be supported by adequate minimum soil volumes (see section 5.3.3 for recommended minimum soil volumes).

Parking requirements: On site parking requirements increase impervious cover or the footprint of underground parkades. Numerous local governments have explored reducing or increasing the flexibility of parking requirements as a way to meet objectives for affordability or to reduce greenhouse gas emissions, and this flexibility would also increase the ability to retain or replace trees on a lot.

- The province's SSMUH Policy Manual recommends that local governments minimize or even remove parking requirements in some areas to retain space for buildable area and increase permeability.

Smaller site coverage and reduced parking requirements will further contribute to maintaining pervious coverage and space for trees:

GREEN ROOFS AND TREE PLANTING ON STRUCTURE

Green roofs may provide an opportunity to plant vegetation and small trees to offset canopy loss, and they can provide many benefits. However, trees growing on structure will provide less and shorter-lived canopy compared to trees planted in the ground because of the more limited soil volumes, and the need to remove trees periodically to repair membranes.

5.2.3 Negotiated Development

In addition to setting the parameters for landscaping standards and planting area requirements that will support achieving the selected canopy cover targets on as-of-right developments, local governments can use regulatory tools to improve tree canopy preservation and growth on negotiated developments.

OPTIONS | The following regulatory components can help improve tree retention and planting outcomes:

Amenity density bonusing: Local governments can use amenity density bonusing to preserve tree stands in exchange for additional density. For example, local governments may allow a higher floor space ratio (FSR) and a clustering of development away from the forested area. Conservation covenants in favour of the local government are often used to protect greenspace for the long term. Local governments may also acquire the area of interest as parkland beyond the 5% parkland dedication they can require at subdivision. Finally, local governments can use a green factor or report card scoring system that allows applicants to choose the most appropriate tree retention and planting actions for their site/project to gain additional density.

- Examples of where this approach is used:
    - ◊ Sammamish (WA) uses a points system to allow applicants to select the tree retention or planting interventions best adapted to their project *(see inset).*
    - ◊ The Green Bylaws Toolkit (2021) provides several examples of local governments in BC that used amenity density bonusing to protect sensitive ecosystems.
    - ◊ In the US, municipalities like Portland, Oregon use density transfer mechanisms to achieve goals similar to what amenity density bonusing can provide in BC. For example, Portland's City Code includes Floor Area Ratio transfer aimed at preserving existing affordable housing and trees/greenspace to other parcels in exchange for affordability or tree protection restrictions.

Comprehensive development: Local governments can use comprehensive development zones to drive landscape-level planning for larger parcels of land. Communities may find it helpful to achieve forest stand preservation goals or to enable innovative treatments on sites with particular constraints.

SAMAMISH LOW IMPACT DEVELOPMENT INCENTIVES

The City of Sammamish, Washington defines a set of techniques that can earn applicants 20% or 30% additional density on their development. The techniques listed in their Development Code include:

- Forest retention
- Restoration of vegetated areas
- Restoration of critical buffer areas
- Limited site disturbance, reforestation
- Reduced impervious surface
- Minimal foundation excavation

RECOMMENDED COMPONENT
Delegated minor variances for tree retention

PURPOSE | Local governments can use delegated minor variances to clarify how they expect permit applicants to modify their design to accommodate existing trees.

In practice, it might include the following bylaw components:

- **Significant trees** that are the target for retention. Most commonly, variances would be given for trees of high importance, such as heritage or significant trees (see tree bylaw section 6.3.1.1, additional options, for examples of typical categories of trees of high significance).
- **Delegated minor variances** that will be considered to enable tree retention. They commonly include variances to building setbacks, height, and parking.

The province's SSMUH Policy Manual recommends that local governments use delegated minor variances to expedite permitting where site conditions require variations to achieve the intended use, such as to retain trees or improve stormwater management outcomes.

Examples of where this approach is used:

- City of North Vancouver Development Procedures Bylaw section 2 – definition for minor development variance permit
- Seattle exceptional tree (*see the inset*)

5.2.4 Development Procedures

Practitioners can use their land use bylaws to provide flexibility for property owners and local governments to retain existing canopy with minor variances. Tree bylaws cannot prevent owners from achieving as-of-right development, meaning that tree removal will always be permitted where it is required to build a proposed development that conforms with the permitted use and zoning. Nonetheless, it is common for tree bylaws to require applicants to consider modifications to their proposed development to accommodate tree retention where possible (see tree bylaw section 6.3.4.2, conflict with buildings or structures).

5.2.4.1 Procedural Considerations

Land use bylaws should address the information required to support the application, such as a legal survey including trees, a tree inventory, and a site and landscaping plan that identifies retained and new trees. The bylaws should also define the appropriate professionals to undertake the inventories, design, and inspections (e.g., landscape architects, arborists, qualified environmental professionals). Practitioners should seek out information about trees and environmentally sensitive areas on site at the pre-application or first application stage to consider options for retention at the early design stage.

SEATTLE'S EXCEPTIONAL TREE PROTECTION ZONING

The City of Seattle, Washington defines exceptional trees as species of a certain size growing individually or in groves. The City has a defined process to vary building setbacks and height to retain exceptional trees. The process and development requirements vary based on the zone:

- **Single-family zones:** Applicants must take advantage of front and rear yard setback departures to enable the retention of exceptional trees.

- **Lowrise zones:** Where an exceptional tree is threatened, applicants must either follow a Streamlined Design Review process to make adjustments to enable tree retention, or they must consider increases in the permitted height detailed in the Tree Protection Code to achieve the same purpose. Additional departures to increase FAR and height or reduce the number and standard of required parking spaces may also be explored with applicants to enable the retention of exceptional trees.

- **Midrise and commercial zones:** Applicants must explore options such as departures from the land use code (as approved by a Design Review) or changes to parking plans to retain exceptional trees.

Seattle Department of Construction & Inspections (2019) – Tree Protection Regulations in Seattle.

BOULEVARD LOCATION

The City of Coquitlam's streetscape standards require the installation of boulevards between the street curb and sidewalks to urbanize its streets. Since 2018, the Frontage Works Program has required development or building permit holders in southwest Coquitlam to either make the rights-of-way upgrades or to pay a fee for the City to make the improvements. The examples below show streets in the same neighbourhood that were built before and after the standards and Frontage Works Program required installation of a boulevard between the street curb and sidewalk:

Boulevards adjacent to private land:

Boulevards located between the curb and sidewalk:

5.3 DEVELOPMENT, SUBDIVISION AND SERVICING BYLAW

This subsection focuses on development, subdivision and servicing bylaws that set the standards and specifications for works and services for land development in local governments. In most cases, these bylaws define the standards for landscaping in road rights-of-way that make up a significant proportion of public lands across Metro Vancouver. Road rights-of-way often need to accommodate multiple functions and services within a limited footprint both above and below ground, which adds complexity to tree planting. However, roads are also an important location to grow tree canopy and to deliver the benefits of tree canopy close to where people live and work. The options presented in this section can improve outcomes by ensuring sufficient space and soil are provided in the road rights-of-way to support tree canopy.

To supplement this section of the Toolkit, practitioners can refer to Appendix 5 for a worksheet built to help local governments assess their regulatory tools.

5.3.1 Procedural Considerations

As part of the development, subdivision and servicing process, procedures should address the information required to support the application (e.g., legal surveys including trees, tree inventories, site plans), securities that the local government will collect, documentation required for substantial completion, and the professionals (e.g., Landscape Architect) who will undertake the design, inspection, testing and record keeping of landscaping trail and street trees (unless installed by the local government).

5.3.2 Works and Services Standards for Trees in Boulevards

The first step to providing tree canopy in rights-of-way is for practitioners to ensure that the boulevard width and location are adequate to support the targeted tree canopy.

RECOMMENDED COMPONENT
Boulevard or median planting strip

PURPOSE | The boulevard designates the area between the private property line and the street curb that local governments generally use to plant trees and install street furniture like streetlamps or utilities. The boulevard excludes sidewalks, curbs, and driveways. The median is the strip of land between two lanes of opposing traffic. The works and services standards will generally define when a boulevard and landscaping are required by road classification and/or zone or land use. Local governments should require boulevard landscaping in their service standards/required service levels and provide the largest width possible for a boulevard or median tree planting strip.

In practice, it might include the following bylaw components:

- **Minimum boulevard width:** Where trees are planted in a median or a boulevard planting strip shared with utilities, a minimum width of 2 m is recommended. This width generally ensures enough space for trees to grow and allows for a setback from utilities or vehicles. However, if the utilities are not located in the boulevard area, trees can be planted in a space that is at least 1.5 m wide. Wider planting strips or access to additional soil volume either under the sidewalk or via root bridges to adjacent soil volume areas may be necessary to support medium- to large-sized trees.
- **Location of the boulevard:** Boulevard planting strips can either be located between the curb and the sidewalk or adjacent to the private frontage when there is a monolithic sidewalk (i.e., a sidewalk abutting a curb). While the planting strip adjacent to a private front yard can seem to provide a more continuous planting space, these locations are often perceived as an extension of private property where City tree planting may not be welcomed. Locating the boulevard between the curb and the sidewalk provides a clear distinction between public and private land, establishes a more continuous street tree canopy, and provides a more clearly dedicated space for trees in land uses with smaller front setbacks. Regardless of setbacks in the adjacent land use, locating boulevards between the street curb and the sidewalk should be prioritized where local governments seek to achieve more canopy closure above the street.

Examples of where this approach is used:

- The City of Coquitlam's streetscape standards and Frontage Works Program require boulevards located between the street curb and the sidewalk to achieve uniform tree planting (see inset).

5.3.3 Landscaping Design Criteria and Standard Specifications

After setting the location and width of the planting strips, practitioners should ensure that landscaping standards will support canopy growth.

RECOMMENDED COMPONENT
Landscaping criteria, standards, and specifications

PURPOSE | Landscaping standards are essential to ensure trees are planted in appropriate locations and are of a quality and size to survive and thrive. In most cases, local governments will use the Master Municipal Construction Documents (MMCD) as their base standard and then provide supplementary standards in a bylaw.

In practice, it might include the following bylaw components:

- **Plant spacing, location and type:** Design criteria should include minimum spacing to allow adequate space for trees of different sizes at maturity. Criteria should also guide location to avoid long-term conflicts. Local governments can incorporate species diversity guidance in the standards and provide a preferred species list to encourage planting climate-suitable and non-invasive species.
- **Stock size and quality:** Landscaping standards should refer to the Canadian Nursery Tree Stock Standard for stock size and quality.
- **Soil volume:** Soil volume minimums ensure that newly constructed streetscapes can accommodate trees (see Table 3 below). Soil volumes can be met either in the ground where native soils have been retained or with a combination of topsoil and soil cells or structural soil. Continuous, connected soil trenches should be encouraged. When adequate soil volumes are not achievable via planting strips, use soil cells to increase soil volumes and connect root zones of planting under paving. The soil volume provided for local street trees is one of the most significant ways these bylaws affect urban tree canopy.
- **Soil depth:** Soil depth is an important metric for accommodating adequate soil volume. Most tree roots grow within the top 0.6 m of soil and as deep as 1 m if there is adequate air and water to survive. Establishing a soil depth of up to 1,000 mm enables boulevards to hold more soil in the planting strip. It may also provide options for integrating stormwater into the lower depths of the boulevard. The installation of soil to these depths must be done to the correct specification to minimize settling that could result in tripping hazards and the need to add more soil in the future.
- **Soil solutions, surface treatments and root barriers:** Design criteria should enable the use of structural soils or soil cells to meet soil volume requirements. Standards should establish the quality of soil and installation for topsoil, structural soil and soil cells. Root barriers should be used whenever trees are planted within 2 metres of hardscape.
- **Standards for the landscape plan and bonding:** Typically, a warranty period is attached to the landscaping requirement where developers are responsible for installing and planting boulevards. Bonds should be of an amount that covers the cost of stock, installation, maintenance, and inspections. Where surface treatments are required to prevent tripping hazards, tree grates should be used sparingly (due to cost), and alternatives such as bonded gravel or compacted sand should be enabled.

RECOMMENDED COMPONENT

Landscaping criteria, standards, and specifications

- **Irrigation and drainage:** Design criteria can specify when the local government requires irrigation for street trees. Standards can provide specifications for installing irrigation infrastructure or drainage in tree planting spaces. Irrigation and drainage requirements are particularly important for planting sites with more limited soil volume or extensive hardscape that limits infiltration.
- **Utility and infrastructure setbacks:** Utility and infrastructure setbacks can result in trees being excluded from a streetscape or private yard. It is necessary to balance the potential for infrastructure conflict with the flexibility to include trees in spaces shared with utilities. Setbacks should be firm when a hazard could be created (e.g., intersection visibility, gas main connections) but allow for reasonable flexibility in other situations. Where there is inadequate space to achieve utility setbacks and a dedicated trench for trees, consideration should be given to making up the difference by extending the right-of-way onto private land.

The table below provides the recommended soil volume minimums for street trees (Metro Vancouver, 2017).

Table 3. Minimum recommended soil volume per tree

TREE SIZE	Min soil volume (m^3)[4]	Shared or irrigated soil volume (m^3)
Small tree canopy spread is up to 6 m	8	6
Medium tree canopy - spread is up to 10.0 m	20	15
Large tree canopy - spread is greater than 10.0 m	35	30

Credit soil volume according to the actual amount of soil:

- Soil: Volume of soil (Length x Width x Depth)
- Soil cells: Volume of soil cell installation (Length x Width x Depth) x 0. 92
- Structural soil: Volume of structural soil (Length x Width x Depth) x 0.2

- **ADDITIONAL OPTION** | Components that can support the street boulevard standards described above to achieve more tree canopy:

Perforated curbs: Directing water from our streets into boulevards can be a way to reduce stormwater runoff while improving water access for street trees.

- Examples of where this approach is used:

    ◊ The City of Coquitlam's streetscape standards make use of perforated curbs to direct stormwater from the roadway into boulevards.

Discrete solutions to expand tree planting space: Streetscape design standards define the standard location for streetscape components such as utilities, sidewalks, road lanes, bicycle lanes, boulevards, stormwater, trees and lighting in a streetscape. Standards should allow flexibility to adjust streetscape design when there are competing interests in the streetscape by establishing a hierarchy of preferred and alternative compliance methods for different streetscape components. They can also allow for discrete solutions that maximize tree planting space where space in the boulevard becomes limited, such as:

- **Curb bulges in the parking lane:** Curb bulges are commonly used to improve pedestrian safety at intersections but can also help stagger tree planting where space might be too limited in the boulevard.

- **Suspended slab sidewalks:** Suspended slabs can be used to achieve load-bearing requirements for sidewalks while retaining soil volume under sidewalks.

- **Permeable pavement:** Permeable sidewalks can allow for water infiltration through a sidewalk or bike lane.

- **Siting responsive to site condition:** Rights-of-way upgrades to improve action transportation can compromise tree retention or planting, yet tree canopy is also important to encourage those modes of transportation. Where healthy trees are already growing along a street, using atypical siting to install new bike lanes or sidewalks can help retain canopy.

    ◊ **Examples of where this approach is used:** The 10th Avenue bike lane near the Vancouver General Hospital was designed to retain as many mature trees as possible along the corridor. The bike lane width and alignment vary along the corridor to respond to pre-existing site conditions.

Environmental development permit areas, covenants, and tree bylaws can be effective tools to regulate the protection, restoration, and replacement of trees. They should be supported by higher-level plans and land use regulations to effectively preserve trees and grow tree canopy.

6.0 Tools Primarily Regulating Trees

This Toolkit provides detailed information about regulatory tools focused on preserving trees and growing tree canopy, specifically:

- **Environmental development permit areas,** which identify locations that need special treatment for certain purposes such as the protection of the natural environment, its ecosystems and biological diversity and typically include:
  - Identification of the development permit area
  - Development permit area guidelines

- **Covenants**, which can require that an amenity be protected, preserved, conserved, maintained, enhanced, restored or kept in its natural or existing state

- **Tree Bylaws**, which regulate the protection and replacement of individual trees and typically include:
  - Bylaw definitions
  - Prohibitions
  - Permitted removal reasons
  - Permit application information requirements
  - Requirements and incentives for tree retention and replacement
  - Replacement tree planting standards
  - Actions on site
  - Securities
  - Penalties
  - Tree bylaw implementation

The following sections provide the detailed information for each key component of the two regulations, including:

- Purpose of the component
- Recommendations for each element, either as:
  - Must have – a recommended best practice or list of alternatives that should be chosen based on the community context, values, goals and impacts
  - Recommended or additional options – listed for every community's consideration, where they may help achieve specific goals or manage impacts
- Examples of where each option is found in existing regulations

6.1 ENVIRONMENTAL DEVELOPMENT PERMIT AREAS

The Local Government Act allows land to be designated under a development permit area (DPA) for the protection of the natural environment that may "require protection measures, including that vegetation or trees be planted or retained" (section 491(1) of the *Local Government Act*).

Regional and community planning processes will often identify natural values and hazards related to forest stands that overlap with but are not adequately addressed by tree bylaws. Using development permit areas (DPAs) can define land with a specific management intent to align it with strategic objectives for protecting the natural environment. For example, in British Columbia, DPAs can be used for the (LGA, 2015):

- *Protection of the natural environment, its ecosystems and biological diversity;*
- *Protection of development from hazardous conditions;*
- *Establishment of objectives to promote energy conservation;*
- *Establishment of objectives to promote water conservation; or*
- *Establishment of objectives to promote the reduction of greenhouse gas emissions.*

DPAs can complement tree bylaws by providing protection, restoration or enhancement guidelines to achieve a broader range of objectives in these areas when development occurs.

> Practitioners surveyed emphasized the importance of environmentally sensitive areas, waterfront and riparian areas for protecting tree stands. Some communities have also found form and character DPAs and energy DPAs to be helpful in managing urban trees or tree stands.

Environmental DPAs are used to protect natural features from the impacts of construction or land alteration activities (Britton-Foster, Grant, & Curran, 2016). They are often used to protect environmentally sensitive areas including the marine foreshore, watercourses, wetlands and sensitive terrestrial ecosystems. Environmental DPAs can help protect trees from development activity by identifying significant forest stands and enforcing design guidelines to protect them. Environmental DPAs can be designed to require that identified forested areas be protected and, if degraded, restored or enhanced as a requirement of a development application. Environmental DPAs can be designed to work with, or independently of, a tree bylaw.

6.1.1 Identification of the Development Permit Area

PURPOSE | Identify the environmentally sensitive areas where the development permit applies and "describe the special conditions or objectives that justify the designation" (Local Government Act, 2015)

MUST HAVE: Mapping Environmentally Sensitive Areas

Environmentally sensitive areas must be defined in order to provide landowners with information on whether the development permit guidelines will apply to their development application.

EDPAs may use mapping of varying precision to designate areas where the development permit guidelines may apply. The designation of those areas is often done using external mapping data from regional or provincial sources. At a minimum, environmental DPAs should provide a principled basis for landowners to understand what falls within or does not fall within the approximate area boundary (Britton-Foster, Grant, & Curran, 2016).

Available technology and spatial information for mapping allows municipalities to provide relatively detailed locations of DPAs. The scale, precision and update frequency of mapping must be carefully considered, as environmental DPAs with precise but inaccurate mapping have been challenged.

ADDITIONAL OPTIONS | In addition to the mapping of environmentally sensitive areas, municipalities may wish to consider the mapping and protection of a network of ecosystems to preserve landscape level ecosystem connectivity. This network of ecosystems is called green infrastructure network mapping.

- **Green infrastructure network mapping**
  Green infrastructure networks seek to identify a network of interconnected natural areas that will conserve ecosystem values and functions as well as provide benefits to wildlife and people. A green infrastructure network consists of:
  - Core habitat areas that provide a home range for species
  - Natural corridors across urban areas that prevent the fragmentation of core habitat areas

  Once mapped, green infrastructure network areas can be included and protected within environmental DPAs. The mapping can also serve to inform Neighbourhood Plans and other landscape-level plans.

At the regional level, Metro Vancouver manages and updates the Sensitive Ecosystem Inventory. This inventory may be a good starting point for municipalities wishing to map environmentally sensitive areas. It would however need to be accompanied by a detailed assessment of environmentally sensitive areas to develop mapping at the municipal and neighbourhood scales.

PROTECTING TREES WITHIN DPAS

It is common for jurisdictions that have a tree bylaw and an environmental DPA to include trees within DPAs in the bylaw's definition of protected trees. The inclusion of trees within development permit areas in the tree bylaw strengthens their protection because of the enforcement mechanisms included in the tree bylaw. The tree bylaw can also ensure that, when the development permit is waived or not required, a suitable tree permitting and replacement process applies. If both an environmental development permit area and tree bylaw exist, consideration should be given to exempting applicants from a tree removal permit in cases where a development permit has been granted and ensuring that both policies are designed to have essentially the same requirements for tree protection, removal and replacement in DPAs.

In practice

The City of Surrey implements a sensitive ecosystems DPA that encompasses both a streamside protection DPA and green infrastructure network. It allows the City to protect habitat patches, to avoid the fragmentation of ecosystems, and to require habitat restoration with development.

6.1.2 Development Permit Area Guidelines

PURPOSE | Development guidelines inform landowners about what the requirements are for protecting DPAs when they develop adjacent lands.

OPTIONS

Many guidelines exist that can help preserve trees and grow tree canopy. The options highlighted in this Toolkit include tree protection within DPAs, the preservation and enhancement of forested ecosystems, restoration, and information requirements.

Tree protection within DPAs

Trees within EDPAs are usually protected unless deemed hazardous. Tree protection measures include:

- **Relocating** proposed buildings, structures, servicing or roads to prevent root impacts
- **Fencing** can be required during construction, or as a permanent fixture
- **Pruning** to carefully select branches for removal to reduce the wind load on trees (Stubbs et al., 2019)

Preservation or enhancement of forested ecosystems

Forested ecosystems can be preserved or enhanced with measures such as:

- **Tree species requirements** to maintain the composition and density of native species with replanting
- **Retention of wildlife** trees to provide habitat within forested stands
- **Preservation or enhancement of specific areas** to prevent fragmentation or maintain connectivity
- **Buffer zone planting** in the zone adjacent to the DPA. Natural landscaping may be required to provide a soft transition from the environmentally sensitive area to the development area

Restoration

Where existing ecosystems are degraded or damaged, environmental DPAs can require measures to return the environmentally sensitive area to its natural state:

- **Planting of native trees and plants** to restore the native plant community
- **Removal of invasive species** to prevent competition with native species and spread into adjacent natural areas

Information requirements

Environmental DPA guidelines can require applicants to provide reports from qualified professionals such as:

- **Site conditions and monitoring** from a qualified environmental professional (i.e., a person in good standing with a legislated self-regulating association in British Columbia who is acting within their area of expertise, such as a professional Biologist, Agrologist, Arborist, Forester, Geoscientist, Engineer, Architect, or Landscape Architect)
- **Riparian assessment to identify the Streamside Protection and Enhancement Area** per Provincial methods defined in the Riparian Areas Regulation
- **Stand prescriptions to reduce the likelihood of windthrow** along newly exposed forest edges
- **The identification of hazardous trees** by an ISA Certified Arborist who holds the Tree Risk Assessment Qualification (TRAQ)

6.1.3 Other Types of Development Permit Areas

Tree retention is often regulated within hazardous condition DPAs such as steep slopes DPAs to be helpful for tree retention. However, wildfire DPAs may conflict with tree preservation or replacement goals where trees pose a wildfire risk to structures. Where wildfire DPAs apply, it is important to ensure that the wildfire DPA and the tree bylaw are aligned to enable consistency with wildland urban interface management objectives. Alignment could involve permitting removals for wildfire risk reduction in the bylaw and ensuring that replacement trees and landscapes conform with FireSmart guidelines.

6.2 COVENANTS

Covenants are a tool local governments use to regulate trees on individual land parcels, usually with rezoning, subdivision, or development permits. The Province of British Columbia's Land Title Act, section 219 allows covenants (sometimes also called conservation covenants) to be registered on title. This toolkit section offers a brief description of the use of covenants to preserve trees and grow tree canopy but is not a comprehensive discussion of the legal and technical requirements of covenants in British Columbia.

Covenants registered under section 219 of the Land Title Act are a voluntary agreement between a property owner and a designated organization (government body or land trust organization) registered on the property title. Section 219 covenants can be both positive (require actions) and negative (prohibit actions) in nature (WCEL, 2005; LTA of BC, 2014). They can be used to protect, conserve, maintain, enhance, restore or keep amenities such as natural, environmental, wildlife or plant value in its natural or existing state (LTA, s.219). Conservation covenants can 'run with the land', binding all future owners of the property for the full term of the agreement, which can be perpetual.

Section 219 covenants can protect trees or sensitive ecosystems on developing properties, impose maintenance or restoration requirements and restrict actions that could damage the protected features. For example, covenants can require documentation such as tree protection and replanting plans or risk assessments prior to undertaking the subdivision of land. Covenants usually include a baseline report documenting the state of the land at the time of registering the covenant (NATEP, 2018). The report can describe special features and serves as a benchmark for future monitoring. Covenants can help to provide clarity around what is protected on a site; both to the municipality as the site moves through the development process, and to future owners so that they know what is protected on their property. Covenants can be amended or discharged and do not have to be perpetual agreements.

Working landscape covenants can also be developed to allow sustainable activities such as organic farming or sustainable forestry on land under a conservation covenant (WCEL, 2005). This type of conservation covenant is more complex than ones that protect land in its natural state. Working landscape covenants should clarify the priority for the management of the covenant area and require a management approach to be established in accordance with those priorities and the objectives of the covenant.

Statutory rights of way created under Section 218 of the *Land Title Act* are sometimes used to secure access to a property, such as for a public trail, in addition to a Section 219 covenant that specifies the positive (e.g., maintenance requirement) and negative (e.g., restricting tree removals) obligations of the owner granting the covenant.

6.3 Section Table of Contents Tree Bylaws

6.3 TREE BYLAWS

The *Community Charter* enables Council to "regulate, prohibit or impose requirements in relation to [...] trees" (sections 8(3)(c), 50 and 52). Regional and local planning processes increasingly identify tree protection and replacement as important community values. While environmental DPAs often provide adequate protection for tree stands and ecosystems, tree bylaws serve to regulate the protection or replacement of individual trees or groups of trees found across the municipal landscape.

While there are established best practices for some bylaw components, others are less well-defined. The alternatives and options available should be selected after consideration of a municipality's urban forest governance context.

The following sections are organized in typical bylaw sections or themes. Each section describes the key components that should be considered when developing tree bylaws and highlights when a best practice recommendation or an alternative option would be relevant. Examples of communities that have used any of the approaches presented are not exhaustive but provide readers with further opportunities to explore and adapt the options that are most appropriate for their local context.

6.3.1 Bylaw Definitions

Bylaw definitions set a common understanding for terminology used throughout the bylaw. Many bylaw definitions refer to established technical standards and clarify how to interpret other sections of the bylaw.

6.3.1.1. Protected Tree

PURPOSE | To define what trees the bylaw applies to. Public or private trees (or both), tree size and species are common criteria discussed. The definition itself does not drive the protection or replacement outcomes; tree protection rather depends on the acceptable reasons for removal and the replacement requirements.

MUST HAVE: PROTECTED TREE SIZE

Tree bylaws need to identify the size of trees that the bylaw will apply to:
* Option 1: Small trees
* Option 2: Medium trees
* Option 3: Large trees

OPTION 1: SMALL TREES (for example ≥6 cm DBH)

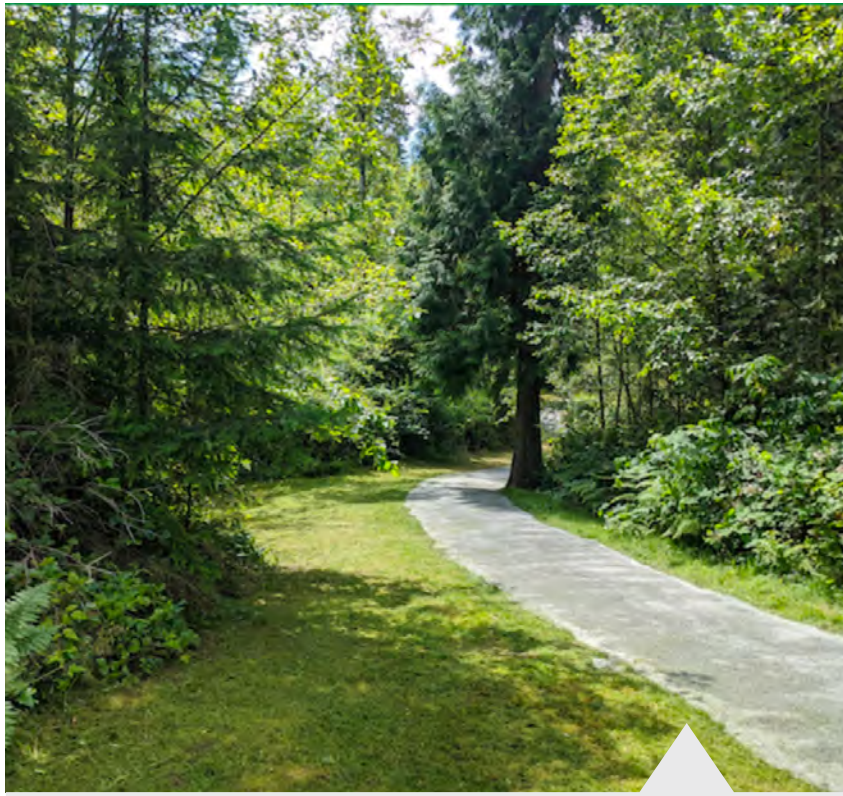
Communities may decide to regulate trees at a small size when the bylaw is less restrictive of tree removals and is using the permit system to track tree removals or is restrictive only under certain circumstances (e.g., limits removals in one year or when related to a subdivision). This could be used in conjunction with other categories of protected trees that have greater restrictions on their removal.

Context
This approach may be most relevant for municipalities interested in tracking tree removals and not placing too many restrictions on the removal of protected trees.
Found in Nanaimo, Anmore, Québec City (QC)

Pros
- Regulates most of the trees and canopy in a municipality
- Provides a good indication of the rate of tree removals
- Can identify and encourage retention of young trees that are more adaptable to development disturbances, with development

Cons
- Creates very high permit volume unless there are exemptions allowing removals in some circumstances (e.g., a certain number of trees being cut without a permit each year)
- May not be supported by the community without allowances to remove some trees
- Creates higher costs for development related applications to survey many trees and prepare management plans
- It is not usually practical to restrict removals or require replacements for small trees, so often the bylaw functions more as a permit to track removals

This option may be best implemented with additional protected tree definition options, to restrict the removal of specific trees of importance.



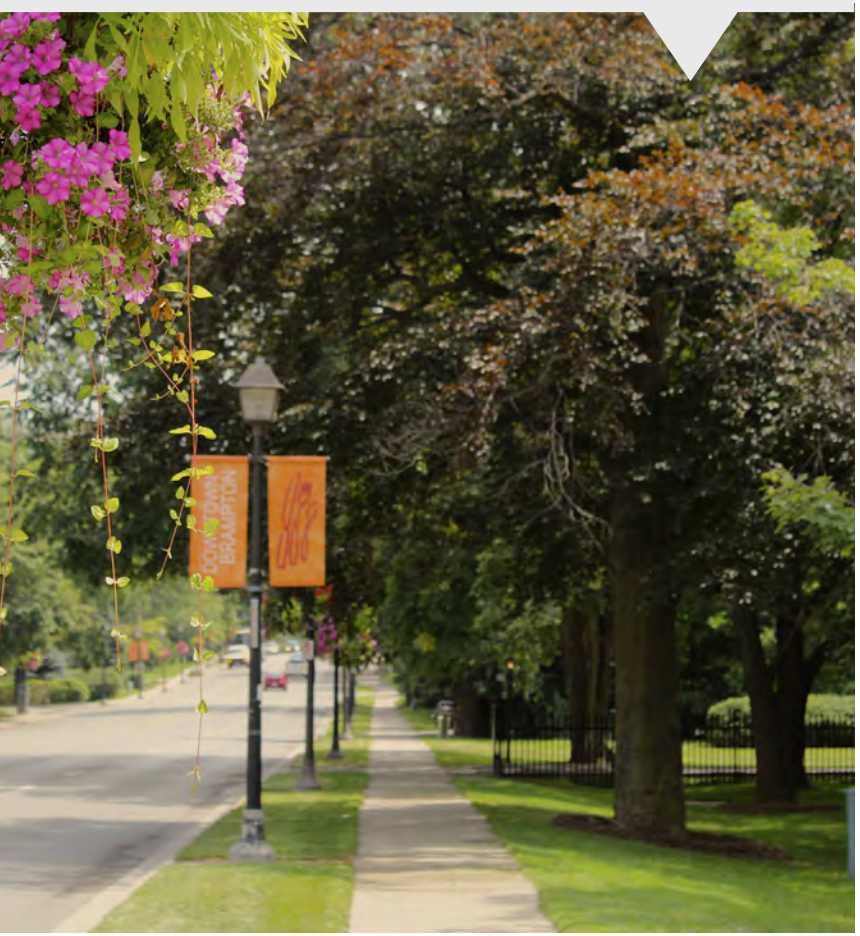
In practice

The Village of Anmore requires a tree cutting permit for all trees 10 cm or larger in DBH if the number removed is greater than annual allowable cut and not in direct hazard or conflict with infrastructure.

Hedges, alder and cottonwood are exempt from the definition.

In practice

Brampton does not require permits for trees with a DBH less than 30 cm.



OPTION 2: MEDIUM TREES (for example ≥20 cm DBH)

The tree bylaw applies to medium-sized trees, which enables municipalities to regulate reasons for removal and replacement requirements for those trees.

Context

Medium-size protected trees are the most common in Lower Mainland tree bylaws. This size class may be most appropriate for communities that are fairly urban and where most properties have few trees. Alternatively, it may be appropriate in communities that have many trees and where the bylaw is not restricting tree removal but is using the permit system to track removals.

Most commonly 20 cm DBH *found in Burnaby, Delta, Richmond, Port Coquitlam, Vancouver, New Westminster, Maple Ridge, Abbotsford, Courtenay, Squamish*
30 cm DBH *found in Surrey, White Rock, Victoria, Brampton (ON)*

Pros

- Typically regulates more than half of the trees and canopy in a municipality
- Seems to be a practical size for the number of trees brought into regulation based on the large number of municipalities using either 20 cm or 30 cm DBH
- Results in more tree replacement in the landscape than a larger protected tree size, if tied to a replacement requirement

Cons

- Creates relatively high permit volume unless there are exemptions allowing removals in some circumstances (e.g., a certain number of trees being cut without a permit each year)
- Increases regulation on private property. Tree replacement requirements also tend to be higher, which is a cost to applicants and may not receive broad community support.

For communities using this protected tree size to monitor removals, this would be best implemented with other categories of protected tree that have greater restrictions on their removal. Municipalities choosing this protected tree size should also consider defining hedges and whether they are protected under the bylaw.

OPTION 3: LARGE TREES (for example ≥50 cm DBH)

The tree bylaw applies to large-sized trees, which enables municipalities to regulate reasons for removal and replacement requirements only for mature specimens of larger species.

Context
This approach may be most appropriate for communities with limited resources and low development pressure that want to prioritize protecting the largest, oldest trees.
Found in the District of North Vancouver, West Vancouver

Pros
- Typically regulates the large canopy trees in a municipality
- Associated with a low volume of permits, and generally easy for the community to support because few trees are regulated

Cons
- Most of the urban forest is unregulated and can be cut without a permit
- Only regulates large trees that are relatively rare on properties, so may be perceived as a disincentive for having a larger tree on a property

In addition to defining the protected tree size, municipalities that require replacement trees as a bylaw requirement should protect replacement trees regardless of their size.

In practice

The District of North Vancouver defines large-diameter trees as 75 cm or greater.

In practice

Courtenay protects 6 species 0.5 m and taller in size.

ADDITIONAL OPTIONS | In addition to defining protected trees with a diameter size, several municipalities adopt tree protection or replacement requirements for other types of individual trees or tree stands of interest. These options become particularly relevant when a tree bylaw is permissive of removals because they offer a more targeted way to protect trees of special interest. Common categories of trees included in protected tree definitions are municipal trees, species of interest, trees on sensitive land, heritage or significant trees and hedges.

Municipal trees: Municipal trees must be protected and many communities choose to protect trees on public land through their tree bylaw, although they can also be protected under different bylaws. Regulating the protection of municipal trees in a tree bylaw can offer consistency and ease of access to information about tree protection on public and private land. However, some communities protect them in other bylaws such as a street and traffic bylaw or a parks and boulevard bylaw supported by a municipal tree policy.

***Places where this approach is found**: Surrey, White Rock, Saanich, Victoria, Courtenay and many others*

Species of interest: Communities that want to maintain habitat value with tree species important to the local ecology may decide to include smaller trees of specific species to their protected tree definition. In these cases, the potential impacts of climate change on these species should be considered so that regulations enable replacement with species suitable to the future climate when necessary.

Trees on sensitive land: Communities may choose to protect trees located on sensitive lands defined by a mapped boundary or descriptive criteria, such as lands that:

- Are susceptible to flooding or erosion, or have unstable slopes or poor drainage
- Have special significance for animal, bird or plant life, including wetlands, forests and nesting areas
- Have cultural or historical significance
- Foster connectivity and biodiversity for flora and fauna
- Are adjacent to waterways

***Places where this approach is found**: Saanich, Courtenay, Squamish, Mississauga (ON)*

Heritage or Significant trees: A municipality might choose to protect a specific list of trees when:

- Heritage trees have been identified in the community and owners have allowed trees to be placed on a register
- Specific qualities have been defined for trees (e.g., size, health, age, heritage, endangered, uniqueness) that will require a higher standard to be met to remove the tree – a set of criteria, nomination process and community board would typically be required to assess whether trees are significant

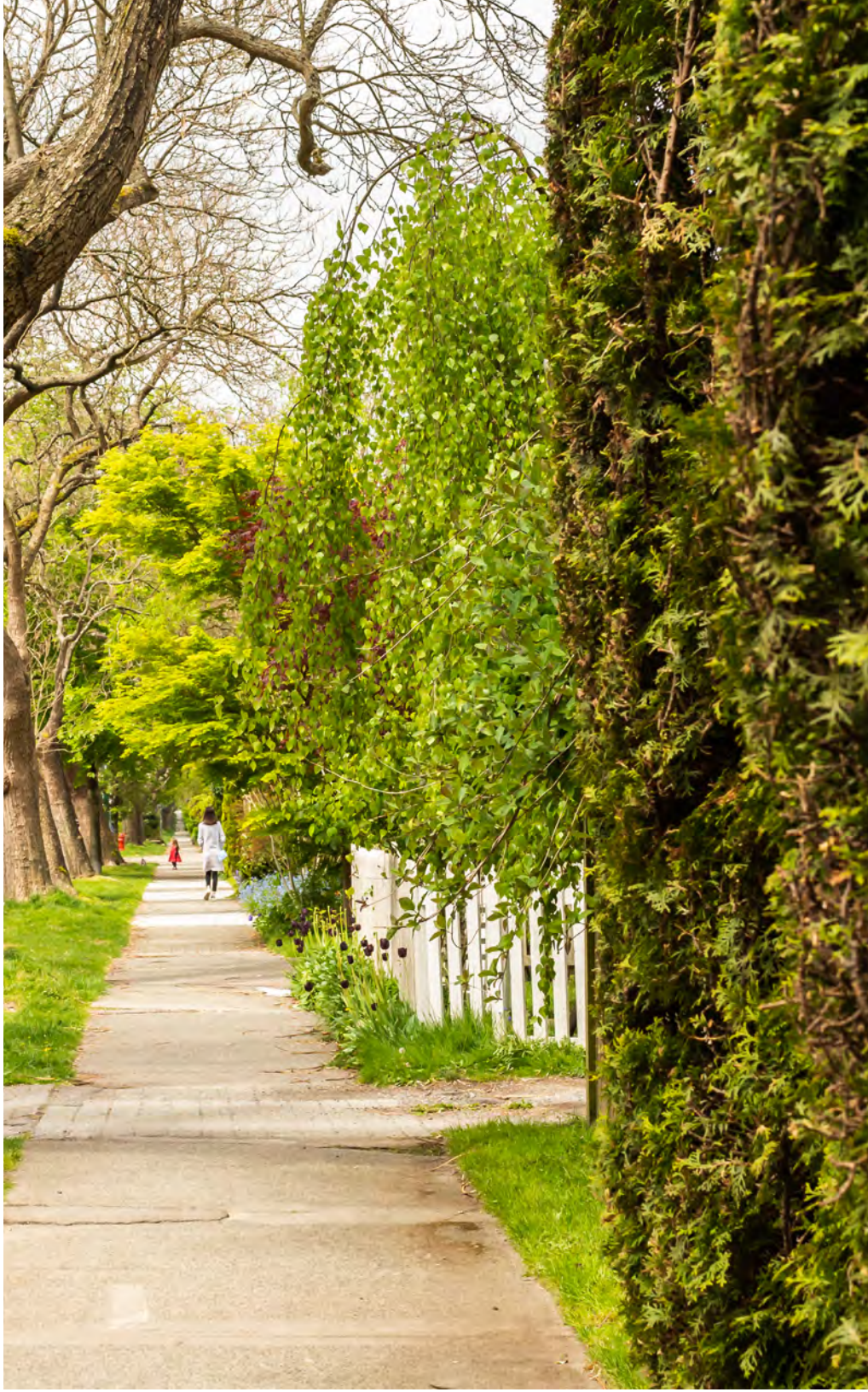
***Places where this approach is found**: Maple Ridge, New Westminster, Surrey, Mississauga (ON)*

Hedges: Hedges can be challenging to regulate when they contain trees that meet the protected tree size definition because:

- All trees in a hedge grow up together and it may be appropriate to retain them or remove them as a group even if only one or some of the trees meet acceptable reasons for removal
- Hedges can contain many protected trees that, if approved for removal under a bylaw with a high replacement ratio, would have unreasonably high tree replacement requirements
- Hedges are often sheared and pruned in a way that would be considered damaging to a regular tree and so it can be necessary to distinguish regular maintenance of hedges from tree damaging activities that would be a violation of a bylaw

Once a hedge is defined, it can either be protected or exempted under the bylaw as a hedge, rather than as individual protected trees.

***Places where this approach is found**: New Westminster*



6.3.1.2. Diameter at Breast Height

PURPOSE | A diameter at breast height (DBH) definition is typically used to indicate how to measure a tree and determine if it is a protected tree, to calculate the tree protection zone (see below) and sometimes to calculate replacement requirements.

MUST HAVE: Diameter at Breast Height Measurement

A measurable definition is a must have to consistently determine the DBH of a tree.

BEST PRACTICES FOR MEASURING DBH

The International Society of Arboriculture defines best practices for measuring DBH (Bond, 2013):

- For a 'typical' single trunk, DBH is found by measuring the diameter at 1.4 m above the ground[2]
- For a tree that branches out at or below 1.4 m, so that the diameter is smaller below 1.4 m, then the diameter is measured at the smallest point below the branching point
- For a multi-stemmed tree that branches between 1 and 1.5 metres, measure either:
  - The smallest point below the fork (Magarik, Roman, & Henning, 2020) or
  - Measure each stem 30 cm above the branching point and sum the result

Recent research recommends measuring multi-stemmed urban trees by taking the diameter measurement at 30 cm, or below the fork (Magarik, Roman, & Henning, 2020). The research found no significant differences between these and other multi-stemmed measurement methods, and that this approach was an improvement over other methods because of the ease of measurement, simplicity and repeatability.

[2] It is standard practice in forestry to measure DBH at 1.3 m (Husch, Beers, & Kershaw, 2003; Avery & Burkhart, 2002) and some bylaws use this height as the standard for measuring DBH.

6.3.1.3 Tree Protection Zone

PURPOSE | To define the area around a tree that must be protected to prevent damage to roots so that the tree can be successfully retained during construction, or to determine when a tree cannot be retained successfully.

MUST HAVE: Tree Protection Zone

A measurable definition is a must have to consistently determine the tree protection zone.

The International Society of Arboriculture's (ISA) best management practices for Managing Trees During Construction (Fite & Smiley, 2016) defines the tree protection zone as an arborist-defined area surrounding the trunk. It is intended to protect roots and soil within the critical root zone and beyond, to maximize future tree health and stability.

Typically, the tree protection zone is calculated using either a trunk diameter method or a dripline method. The ISA's best management practices and the American National Standards Institute A300 (Part 5) Standards refer to tree protection zone multiplication factors of between 6 x and 18 x DBH dependent on relative tree age and tolerance (based on Matheny and Clark, 1998, and the British Standards Institute) (Fite & Smiley, 2016). The American National Standards Institute A300 (Part 5) Standards state that the tree protection zone should not be less than 6 x DBH without mitigation measures. Australian and British Standards use a multiplier of 12 x DBH as standard. Best management practices for the Pacific Northwest recommend using both 12 x DBH and dripline plus 1 m and selecting whichever is larger to define the tree protection zone (Oregon State University, 2009).

Based on the available best management practices guidance, it is recommended that municipalities consider defining the tree protection zone as:

- The area, on an approved plan prepared by an arborist, that shows the land surrounding the trunk of a protected tree expected to contain the bulk of the critical root zone of the tree, or
- In the absence of an approved plan, the area of land surrounding the trunk of a protected tree contained within a circle having a radius calculated by multiplying the diameter at breast height of the tree by 12 or dripline plus 1 m, whichever is larger

TREE PROTECTION ZONE VS. CRITICAL ROOT ZONE

The International Society of Arboriculture (ISA) defines the tree protection zone as an arborist-defined area intended to protect roots and soil within the critical root zone and beyond, whereas the critical root zone is the area immediately adjacent to the trunk where roots essential for tree health and stability are located.

The tree protection zone is used to inform the area around the tree that should be fenced during construction and should always be larger than the critical root zone; however, the final fence location is informed by professional judgment, species tolerances and site constraints that reflect where most of the roots are believed to be located on a site. For example, fencing would not block a sidewalk, or if a building existed within the tree protection zone, then the roots are less likely to be growing under the foundation and the fencing would be adjusted accordingly. If the tree protection zone is reduced on one or more sides, then increasing the tree protection zone on the opposite side may be appropriate (Fite & Smiley, 2016).

The ISA's best management practices for Managing Trees During Construction (Fite & Smiley, 2016) note that the critical root zone is subjective, they also note that regulations may choose to define it (e.g., the City of New Westminster defines the critical root zone as 6 x DBH). In the event that the tree protection zone needs to be temporarily reduced for a construction activity, the ISA's best management practices note that the tree protection zone should not be reduced to an area smaller than the critical root zone.

While cutting roots within the critical root zone should always be avoided, there are instances when cuts may be required (e.g., sidewalk or utility repair). The ISA BMPs note that stability is compromised for some species when roots are cut at a distance of 3 x DBH (Fite & Smiley, 2016). However, an arborist must judge the proximity of cuts that can be tolerated and still allow the tree to remain stable.

6.3.1.4 Applicant or Application Type

PURPOSE | A definition of different types of applicants or applications is used when the requirements of the bylaw need to be differentiated.

RECOMMENDATION | Application types can be differentiated if a community wants to vary requirements such as the information required to assess the permit application (e.g., arborist report, tree survey, replacement plan, etc.), permit fees, replacement requirements, securities or cash-in-lieu according to the scale and complexity of the permit type.

DEVELOPMENT REQUIREMENTS IN LAND USE REGULATIONS AND DPAS

Requirements specific to development can instead be addressed separately in land use regulations or development permit area guidelines, in which case a tree bylaw would typically exempt tree cutting and removal approved under subdivision or development permits. It should be noted that regulating trees under multiple bylaws creates parallel processes that are usually administered by different departments; this approach requires careful coordination to ensure that the outcomes of each regulation are consistent with municipal objectives for the preservation of trees and growth of tree canopy.

6.3.1.5 Pruning

PURPOSE | To define acceptable pruning that can be carried out on a protected tree with or without a permit.

MUST HAVE: Acceptable Pruning

Describing acceptable pruning clarifies both enforcement and the public's understanding of what type of pruning is acceptable. The pruning definition should be in accordance with the most current version of the American National Standards Institute Publication "American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management – Standard Practices" and the companion "Best Management Practices" Series of the International Society of Arboriculture. Explicitly defining tree damaging activities, such as topping and excessive crown reduction, helps to clarify what is not acceptable pruning.

Bylaws do not always require a permit for acceptable pruning; however, if pruning is being regulated, then the pruning definition should define the size of limb requiring a tree permit, and only require that permit for protected trees.

PRUNING BEST MANAGEMENT PRACTICES

The ISA's Best Management Practices for Pruning (Lilley, Gillman, & Smiley, 2002) note that pruning dose is guided by the objectives of the pruning, and the tolerance of tree to loss of foliage. Objectives listed in the Best Management Practices include:

- Improving structure
- Risk mitigation
- Clearance
- Maintaining health
- Restoration
- Size management
- Improving a view
- Improving aesthetics
- Managing wildlife habitat
- Reduce density

Pruning systems described in the best management practices include natural, pollard, topiary, hedge, espalier, pleach and fruit (Lilley, Gillman, & Smiley, 2002).

6.3.1.6 Other Best Practices Definitions

Other definitions that may be useful to include are:

- **Arborist:** means a person holding a current certification of ISA Certified Arborist issued by the International Society of Arboriculture
- **Tree risk assessor:** means a person who holds the International Society of Arboriculture's Tree Risk Assessment Qualification (TRAQ)
- **Arboricultural best practices:** means practices in accordance with the most current version of the American National Standards Institute Publication, "American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices" and the companion "Best Management Practices" Series of the International Society of Arboriculture
- **High or extreme risk tree:** means a tree that has, in the opinion of a Tree Risk Assessor, a high or extreme TRAQ risk rating
- **Qualified Environmental Professional:** means a person in good standing with a legislated self-regulating association in British Columbia who is acting within the individual's area of expertise and includes a professional Biologist, Agrologist, Arborist, Forester, Geoscientist, Engineer or Technologist

6.3.2 Exemptions

PURPOSE | Exemptions are used to enable certain groups or activities to proceed without a tree permit. Exemptions are needed when it would be impractical for a group to apply for tree permits given the frequency or volume of their work, or when other statutes give them the power to cut or remove trees. Exemption may include tree cutting or removal:

- For farming use
- Pursuant to the Hydro and Power Authority Act
- For Survey lines work pursuant to the Land Surveyors Act
- By the Government of Canada, the Province of British Columbia or Regional Governments on their own properties
- By a public utility for the purpose of safety, maintenance or operation of the utility's service or infrastructure on their own properties
- By the municipality for works undertaken by the municipality on its own property

Some municipalities exempt their operations from the tree bylaw to enable a more efficient and adapted process to take place internally. Municipalities that exempt their operations from the bylaw should develop an internal policy that details the process to be followed by staff. This process should meet or exceed bylaw requirements. Research has shown that for local governments to be successful in preserving trees and growing canopy cover, they need to address those issues with good interdepartmental coordination (Ordonez & Livesley, 2020).

6.3.3 Prohibitions

PURPOSE | Prohibitions describe what is prohibited except when permitted in the bylaw and in accordance with the terms of a tree permit. Prohibitions typically include cutting, removal and damage, and often address requirements for compliance and accurate information.

RECOMMENDED: Damaging activities

Describing tree damaging activities provides clarity both for enforcement and for the public to understand what activities constitute damage. Just as with cutting or removal, there may be circumstances when tree damage is permitted in accordance with the bylaw and a tree permit. For example, cutting tree roots and altering the grade within a tree protection zone does damage the tree but may be required to accommodate a pathway. If the tree can tolerate the damage and still be safe to retain, then that damage could be allowed with a tree permit.

The definition of damage should be broad (e.g., any action that is likely to cause negative impacts to the health or structural integrity of a tree), but prohibitions, while not limiting that definition, can elaborate to include actions that could cause a tree to die or become hazardous such as:

- Pruning in a manner not in accordance with arboricultural best practice, including:
  - removal of more than 25% of the tree's total live foliage or bud bearing branches or limbs in any 12 month period
  - lift pruning where the lower branches of the live crown (green branches) of the tree are removed to reduce the live crown to less than 50 percent of the total tree height
  - topping, unless the tree in question has been previously topped and regenerative growth has a high likelihood of failure due to weak branch attachment, excessive branch elongation and end weight, or the formation of extensive decay or cavities that cannot be mitigated other than by re-topping the tree
- Poisoning or burning a tree
- Raising or lowering the grade within the tree protection zone
- Shearing, harming or undermining the roots of the tree growing within the tree protection zone
- Placing fill, building materials, asphalt, a building or structure or storing or stockpiling of material within a tree protection zone
- Operating, staging or parking trucks, backhoes, excavators, mini-excavators, hydro-excavators, mechanical trenchers or other heavy equipment within a tree protection zone
- Denting, gouging, drilling, harming or affixing anything to the branches or the trunk of a tree
- Removing bark from a tree
- Depositing concrete, washout or other liquid or chemical substances harmful to the health of a tree in a tree protection zone
- Removing soil from a tree protection zone
- Conducting blasting operations within a tree protection zone
- Conducting blasting or excavating operations outside of a protected root zone that would harm roots or disturb soil inside a tree protection zone

Describing tree damaging activities can improve enforcement by defining specific actions that would be considered a bylaw violation unless permitted in the terms of an approved tree permit.

6.3.4 Permitted Removal Reasons

PURPOSE | To define why a permit will or will not be issued to remove a tree. Describing the acceptable reasons for removal enables transparent and consistent decision-making by staff issuing tree permits. These reasons listed determine the strength of the bylaw in terms of protecting trees from removal.

6.3.4.1. Risk, Dead and Dying trees

PURPOSE | To define why a permit will or will not be issued to remove a tree. Describing the acceptable reasons for removal enables transparent and consistent decision-making by staff issuing tree permits. The reasons listed determine the strength of the bylaw in terms of protecting trees from removal.

MUST HAVE: Dead, dying or high or extreme risk trees

The following reasons for removal must be enabled:

- Tree is high or extreme risk or has an imminent likelihood of failure and the risk or failure cannot be mitigated other than by cutting or removing the tree
- Tree is dead, or more than 50% of its crown is dead (or an alternative threshold that indicates when a tree would be accepted to be dying)

6.3.4.2. Conflict with Buildings or Structures

PURPOSE | To avoid conflicts that would sterilize development rights.

MUST HAVE:Conflict with principal or accessory buildings, off-street parking and utilities

A tree bylaw cannot sterilize development rights by preventing development to permitted use or density according to zoning. However, the extent to which applicants must modify designs or construction to retain trees can be controlled by reasons to permit removal. There are two ways in which communities choose to allow removals to enable permitted use.

- Option 1: **Tree can be removed to accommodate design**
- Option 2: **Design must be changed to accommodate trees if possible**

Option 1: Tree can be removed to accommodate design

Tree removal is permitted whenever protected trees are in conflict with buildings, parking or utilities proposed.

Context

This approach may be most suitable for municipalities with undeveloped/rural land within the Urban Containment Boundary where heavily treed lots are being subdivided in the wildland urban interface.

Pros

- Enables communities to focus on planting replacement trees in appropriate locations following development
- Reduces the potential impacts on development
- Is less resource intensive to implement than the alternative

Cons

- Will not often require trees to be retained during development

Option 2: Design must be changed to accommodate trees if possible

Tree removal is permitted only if it is not possible to retain the tree. Applicants may be required to make changes to their design to accommodate the retention of protected trees while still building to the current zoning.

Context

This approach may be most suitable for already developed and densifying municipalities and where the community places a high value on the preservation of protected trees. Communities using this approach should provide staff with additional guidance on what trees this would apply to and how to determine when it is not possible to retain the tree. This guidance may include criteria related to tree health and condition or safe useful life expectancy in the new site conditions.

Pros

- More often requires the retention of existing trees

Cons

- Results in greater impacts to development projects to accommodate tree retention
- Is more resource intensive for the municipality (longer applications review and interactions with applicants expected)

Note

Bylaws may distinguish between principal buildings and accessory buildings, off-street parking and utilities to require design changes only for some of those items.

TREE REMOVALS ON AGRICULTURAL LANDS

Municipalities in British Columbia cannot regulate tree removals that take place for farming use. However, some municipalities require affidavits from landowners to attest that the removals are for the purpose of farming. A tree bylaw can still apply to agricultural land when trees are being removed for non-farming uses, such as development.

Given the limitations for municipalities to regulate trees on agricultural land, communities with large proportions of agricultural land may instead consider implementing or promoting incentive and stewardship programs.

ADDITIONAL OPTIONS | Other common reasons to permit tree removals include wildfire risk, invasive species, yearly removal allowances, proximity to building foundations, infrastructure damage, construction access and trees on structures that require upgrades or replacement.

- **Wildfire:** Communities within the wildland-urban interface that manage wildfire risk through a Development Permit Area should ensure that the tree bylaw is consistent with FireSmart requirements, as detailed in their wildfire DPA. To ensure that wildfire risk management measures are appropriate, they should be guided by a Community Wildfire Protection Plan that defines high-risk areas, and a DPA that provides development guidelines for reducing risk in those areas. Measures to reduce risk may include conifer tree removal or pruning and FireSmart landscaping requirements.

- **Invasive species:** Communities may wish to enable the removal of invasive tree species that would otherwise be protected by their tree bylaw. Enabling the removal of invasive tree species may provide more consistency in municipalities that regulate or have policy related to invasive species. It should refer to specific lists or species from credible sources, such as the province of British Columbia or the Invasive Species Council.

- **Construction access:** Communities may consider allowing tree removals for trees located within the required construction access path, if the construction access cannot be modified to retain or avoid cutting the protected tree(s).

- **Proximity to building foundation:** Some communities choose to enable the removal of trees near building foundations. Enabling this can allow for poorly located trees to be removed and replaced by an appropriate species planted in a more suitable location. However, it could also lead to the removal of healthy trees that are not causing issues in some cases.

- **Infrastructure damage:** Some communities choose to enable the removal of trees that are causing or will imminently cause structure or infrastructure damage that cannot be mitigated other than by cutting or removing the protected tree. Implementing this option can allow for trees causing damage to be removed and replaced by an appropriate species planted in a more suitable location. However, staff will need additional guidance on determining when damage cannot be mitigated and the bylaw should enable the option to require a qualified environmental professional (e.g., professional engineer) or arborist to provide an opinion on whether or not the damage can be mitigated other than by cutting or removing the tree.

- **Yearly removal allowance:** Communities sometimes elect to include an annual allowance of trees that can be removed for any reason. If considering such an allowance, it should be limited by factors such as tree density, tree size, zoning, lot size or a combination of them; those limits would prevent progressive clear cutting while providing flexibility to manage numerous trees on forested lots.

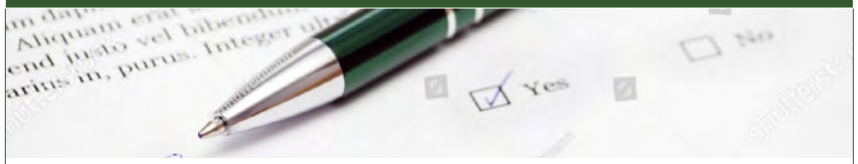
- **Trees on structures:** Communities that have trees planted on structures (i.e., above parkades or on roof-tops) may consider enabling the removal of trees for repairs to the structure.

6.3.5 Permit Application Information Requirements

PURPOSE | To enable staff to determine whether a permit application meets the bylaw requirements to issue a tree permit.

MUST HAVES | At a minimum, basic information should be required with every permit application.

BASIC PERMIT INFORMATION REQUIREMENTS



All permit applications must be accompanied by:

- The address and legal description of the lot/s
- Proof that the owner, or an authorized owner's agent, is submitting the application
- Written consent from the adjacent property owner that they support the application, where a tree shared between two properties is proposed for removal
- Reasons why the applicant is applying to cut or remove a protected tree
- A description and map/plan drawing of the protected trees included in the application

RECOMMENDED FOR DEVELOPMENT: Information requirements for all applications related to development*

Tree bylaws should provide clear information requirements, particularly for applications related to development. They should require sufficient and consistent information to enable staff to review permit applications efficiently.

Development-related applications are complex. Accurate information about trees is needed to understand which trees can be safely and effectively retained, and which trees need to be removed. Non-development-related permit applications can also sometimes require more information, for example, when a tree is proposed for removal because of risk and a tree risk assessor's opinion is needed. For these reasons, it is recommended that the bylaw enable staff to request when needed:

- A legal survey identifying the location of existing trees accurately.
- An arborist report and inventory detailing the location and condition of protected trees and trees proposed for removal.
- A risk assessment report from a tree risk assessor confirming that a tree is high risk if the application entails removal or cutting of a high risk tree.
- A tree management plan mapping the location of protected trees, their tree protection zones, recommended protection measures, location of tree protection fencing and trees proposed for removal.
- A replacement tree plan mapping the location and species of replacement trees to be planted. Build in the need to have these reflected in all landscape plans or at least cross referenced in the landscape plans.
- Additional information from qualified environmental professionals when sensitive lands are involved, for example, to assess the impacts of removing trees in riparian areas or steep slope areas.
- A tree fencing confirmation letter from an arborist confirming that protective fencing has been installed per an approved tree management plan.
- A letter of assurance from an arborist, signed by the owner, to specify construction activities requiring arborist supervision to prevent and mitigate damage.

Terms of reference for these information requirements can be included in schedules or standard operating procedures.

***Tree bylaws should also enable staff to require or relax some of these additional requirements on an as needed basis.**

Municipalities can ask for a confirmation that a permit application is consistent with provincial and federal laws, for example require a Bird Nesting Survey for tree removals proposed during the nesting season.

6.3.6 Requirements and Incentives for Tree Retention and Replacement

Replacement requirements determine how protected trees are replaced when they are removed. There are numerous approaches to tree replacement. The appropriate choice should be tied to meeting the community's goals for tree preservation and growth.

6.3.6.1. Replacement Requirements – Achieving Successional Replacement

PURPOSE | To achieve successional replacement by defining the number of replacement trees required for every protected tree removed. Ratios are not generally effective for increasing the number of trees and growing tree canopy in low-canopy areas because they only require planting on properties that already have trees.

MUST HAVE: Replacement ratio

A replacement ratio can be consistently applied to require that each tree removed is replaced. This approach would require applicants to replace every protected tree removed with one or more replacement trees.

- Option 1: **1:1 or 2:1 replacement ratio**
- Option 2: **1:many replacement ratios based on diameter of tree removed**

Option 1: 1:1 replacement ratio with large trees (2:1 if small trees)

Context

A municipality might choose 1:1 or 2:1 replacement ratio when:

- Properties have limited space for additional trees and a higher replacement ratio would typically result in over-crowding
- The bylaw incorporates requirements to meet soil volume and spacing standards that will maximize the survival and growth of replacement trees
- The bylaw prioritizes replacement with a large tree species but provides flexibility to replace with smaller trees if the site is constrained
- It is coupled with other approaches to encourage or require canopy growth

Found in: *Vancouver, Victoria*

Pros

- Encourages large tree species replacement and healthy growing environments
- Enables most properties to replace a tree in the space created by the tree removed
- Does not penalize properties that already have trees by requiring even more trees as replacements when a tree is removed

Cons

- Does not replace tree canopy removed as quickly as a higher replacement ratio.
- Does not increase the number of trees or grow tree canopy in low-canopy areas. It cannot be used to meet canopy cover targets.

Option 2: 1:many replacement ratios based on diameter of tree removed

This approach would require applicants to replace every protected tree removed with multiple replacement trees.

Context
The 1:many replacement ratio would be most appropriate for communities that have lots of space for more tree planting.

Found in: *White Rock (ranges from 2:1 to 6:1), Courtenay (3:1 if below density target), Saanich (2:1 or 3:1 removals for roads/services), Squamish (2:1 to 6:1 for significant trees, up to density target), Abbotsford (2:1 or 3:1), Oakville (1:1 to 1:12 based on size of tree removed)*

Pros
- Enables instant replacement of more of the tree canopy removed

Cons
- To properly compensate for the canopy removed, many more trees may be required than would be practical or reasonable to require as a replacement ratio (Nowak & Aevermann, 2019).
- Urban properties are often unable to fit multiple replacement trees without overcrowding and poor planting location choices, likely leading to more failures and removals in the future.
- Creates an incentive for people to plant small trees or hedges to try and fit replacements on their property, which is at odds with canopy cover goals.
- Penalizes properties that have more trees by requiring them to replace even more trees on their properties, while having few requirements for properties with few or no trees.
- Does not increase the number of trees and grow canopy in low-canopy areas. It cannot be used to meet canopy cover targets.

USING 1:MANY REPLACEMENT RATIOS TO ACHIEVE CANOPY GROWTH

While tree bylaws may attempt to achieve canopy growth through the implementation of higher replacement ratios, this practice is not recommended. When replacement ratios are high, either the trees are disadvantaged by being crowded into inadequate growing space and never reaching healthy maturity, or the applicant is disadvantaged by paying a large sum in cash-in-lieu. Another unintended consequence of high replacement ratios is that they penalize properties with more trees by requiring high replacement or cash-in-lieu and reward properties with few or no trees by imposing few requirements when they re-develop.

6.3.6.2 Replacement Requirements – Achieving Canopy Growth

PURPOSE | To require that every property meets a minimum tree or canopy cover target.

MUST HAVE: Minimum Target

A target can be measured and consistently applied to each property. There are two main approaches to growing tree canopy using tree bylaws in Canada and tree ordinances in the United States:

- Option 1: **Tree density target**
- Option 2: **Canopy cover target**

Option 1: Tree density target

The tree density target approach establishes a target number of trees per unit area that applicants are required to achieve after the tree removal takes place.

Context

A municipality might choose a tree density target when:

- The density of trees is targeted towards meeting a canopy cover goal that has been established for the community
- The municipality wants to increase canopy in low canopy locations by requiring properties with few or no trees to meet the density target with development
- The municipality is rural and is allowing some tree removals but wants to limit the extent of removals permitted per property (e.g., under an annual removal allowance)

Found in: *Maple Ridge, Courtenay, Gatineau (QC)*

Pros

- Effectively increases the rate of tree planting across the community, even on properties that have few or no trees
- Evens out the requirements across the community so that all properties have to contribute to meeting the target
- Neutralizes the perception of a penalty for having trees on a property that occurs when tree bylaws only include replacement ratios for trees removed.
- Can establish a relationship between tree density and canopy using tree canopy data

Cons

- Adds another replacement requirement to calculate on top of a ratio
- Must be calculated, which is simple when an arborist report is required with development, but staff may otherwise have to assist applicants when non-development applications allow tree removals down to a minimum tree density

Best implemented with differentiation for meeting the requirements during development versus non-development contexts. If an annual removal allowance is in place, it may be necessary to protect trees that are of particular importance to the community such as species of special interest, significant or specimen trees to prevent their removal under the allowance.

Option 2: Canopy cover target

The canopy cover approach establishes a canopy cover target that applicants must achieve on the lot after the tree removal takes place. The canopy area retained on site is measured and if the canopy target is not met then the shortfall is met by planting replacement trees. A replacement tree list defines a canopy area credit for small/medium/large tree species. Applicants plant the number of replacement trees that add up to the canopy area required to meet the target on site. The canopy cover target approach is used in Oak Bay and in several tree ordinances in the US to calculate replacement requirements.

Context

A municipality might choose a minimum tree canopy cover target when:

- The canopy cover target(s) set in the tree bylaw can work towards meeting a canopy cover goal that has been established for the community
- The municipality wants to increase canopy in low canopy locations by requiring properties with few or no trees to meet the canopy target with development
- The municipality is rural and is allowing some tree removals but wants to limit the extent of removals permitted per property (e.g., under an annual removal allowance)
- The community has many existing large canopy trees that overhang properties and wants to provide incentives to protect and maintain offsite trees

***Found in**: Oak Bay, Anmore, and various US municipalities (e.g., Baltimore MD, Lake Forest Park WA, Fort Worth TX)*

Pros

- Effectively increases the rate of tree planting across the community, even on properties that have few or no trees
- Evens out the requirements across the community so that all properties have to contribute to meeting the target
- Neutralizes the perception of a penalty for having trees on a property that occurs when tree bylaws only include replacement ratios for trees removed.
- Relates directly to meeting canopy cover goals
- Reduces an owner's replacement requirements when canopy overhangs their property, which provides incentives to retain and protect offsite trees during development

Cons

- Adds another replacement requirement on top of a ratio
- Must be calculated and is more complex to calculate than tree density
- Must assume a relationship between species and typical canopy outcomes to simplify calculations for replacement requirements, so that replacement species can be credited for a certain amount of tree canopy at maturity

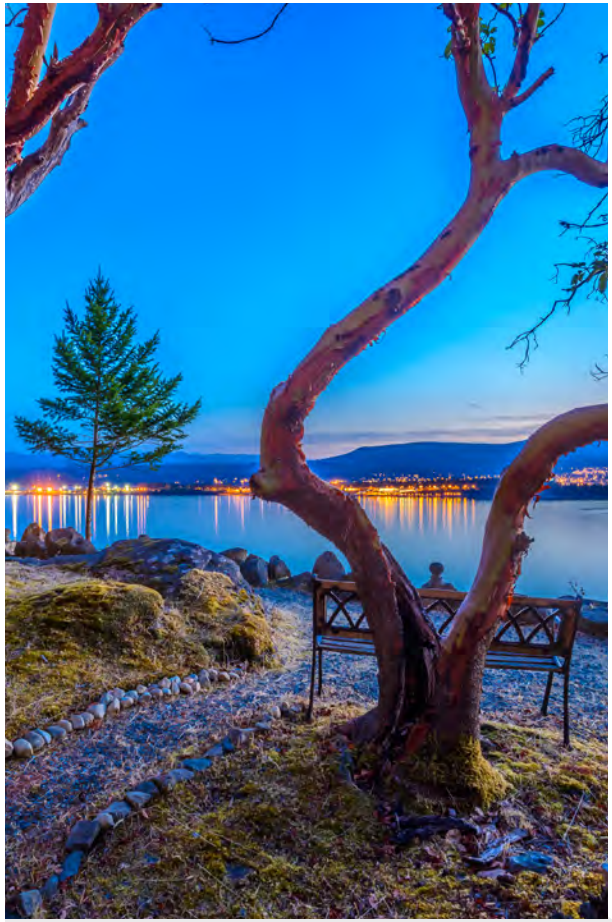
Best implemented with differentiation for meeting the requirements during development versus non-development contexts. If an annual removal allowance is in place, it may be necessary to protect trees that are of particular importance to the community such as species of special interest, significant or specimen trees to prevent their removal under the allowance.

In practice

The City of Courtenay implements a tree density target of 50 trees per net developable hectare. This means most single-family properties require 3-4 trees.

In practice

The District of Oak Bay uses a canopy cover target approach when the owner of a parcel applies for a building permit. The canopy target varies by zone and ranges from 50% for Community Institutional Zoning to 20% for Multi Unit Residential.



In practice

In Nanaimo, cash-in-lieu is capped at a maximum per hectare value.

6.3.6.3 Cash-in-Lieu

PURPOSE | To fund tree planting elsewhere on public or private property.

MUST HAVE: Cash-in-lieu

A dollar amount that applies consistently and is adequate to cover the cost of planting and establishing trees.

Cash-in-lieu enables municipalities to collect funding to plant replacement trees. To be effective, cash-in-lieu should cover the cost of replacing the trees.

Context

A municipality might choose to have a cash-in-lieu option when:

- Properties have limited space for replacement trees
- Infill development or higher site coverage development is limiting opportunities for tree planting on site post development
- If coupled with a minimum tree density or canopy target, it is used as a means of every property contributing to a canopy cover goal either by planting trees on site or by funding planting elsewhere

***Commonly Found in**: Bylaws that implement replacement requirements, for example in White Rock, Surrey, Vancouver, Township of Langley, Nanaimo, Oakville (ON)*

Pros

- Funds tree planting or enhancement towards growing canopy cover in the municipality
- Can fund stewardship efforts to encourage private land planting and tree maintenance

Cons

- Can become very costly if a 1:many replacement ratio is in place and effectively penalizes properties with more existing trees
- If set too low, or enabled as a choice, then people may opt for cash-in-lieu instead of replacing trees

ADDITIONAL OPTIONS | Municipalities may wish to consider the additional options for managing replacement requirements that are species- or location-based, for dead or high or extreme risk trees, or credits to reduce the requirements.

Species based replacement*

A municipality might choose to add species-specific replacement requirements to:

- Require specific species of trees for the replacements of species of interest or native species in sensitive areas (e.g., like for like replacement)
- Reduce replacement requirements for fast growing species that tend to volunteer (e.g., alder or cottonwood) when a 1:Many ratio applies otherwise

*Future species suitability as a result of climate change should be considered when setting species-specific replacement requirements.

Location based replacement

A municipality might choose to define location based replacement requirements to:

- Require specific species of trees or replacement ratios for sensitive lands
- Require different replacement requirements for municipal trees

Exclusion of dead or high or extreme risk trees

- A municipality might choose to exclude dead or high or extreme risk trees to avoid discouraging owners from applying for a removal permit

Incentives for tree retention

A municipality might choose to reduce an applicant's replacement requirements if they retain certain trees on site (e.g., large, healthy trees). Credits can function as an incentive for tree retention when they meaningfully reduce the number of additional trees that must be planted on site. Some bylaws allow non-protected trees to be counted as replacement trees.

Other incentives such as a reduction in permit fees could help incentivize tree retention, or a reduction in securities could help incentivize redesign or implementing protection measures around retained trees.

In practice

The City of New Westminster reduces the retained tree securities by 50% for applicants that agree to modify a design to retain protected trees.

STEWARDSHIP AND INCENTIVES

In addition to or as an alternative to replacement tree planting for successional replacement or canopy growth, communities should consider stewardship and incentive programs to encourage tree planting and stewardship on private land.

- **Subsidised tree sales:** many municipalities in the region hold subsidised tree sales for their residents to encourage tree planting.
- **Adopt-a-tree programs:** some municipalities implement programs where residents are invited to water new street trees.
- **Citizen science programs:** such programs can support data collection for urban forest management. For example, the City of Melbourne's Citizen Forester Program recruits volunteer community members to help collect data on many urban forest components. The City has also led a genetic sampling program to learn about the genetic diversity of elm populations in the city, collect observations on pollinator species or carry out habitat planting.
- **Stormwater utility:** The City of Victoria charges a stormwater utility to property owners that offers incentives for properties that manage a stormwater more sustainably. The utility's rainwater rewards program credits on-site rainwater management installations that enable rainwater storage or infiltration.

6.3.7 Replacement Tree Planting Standards

Planting standards serve to guide applicants in the planting of replacement trees to maximize the establishment success of those trees.

6.3.7.1 Species List

PURPOSE | A species list can be used to encourage climate and site appropriate species choices.

RECOMMENDED: Species List

Species lists should:

- Be a list of approved species that is a schedule of the bylaw, or a list published online, but that allows flexibility for updates and for professionals to submit an alternative for approval
- Be large enough to support meeting diversity targets for urban tree species
- Include proven species (native and non-native) that are suitable for current and future climate

6.3.7.2 Spacing and Soil Volume

PURPOSE | Prescribing minimum spacing and soil volume requirements will ensure that trees have adequate space to grow.

RECOMMENDED: Spacing and soil volume

Requirements should include:

- Replacement trees should be planted at least 2 m away from a building foundation wall (or more for larger tree species), at least 1 m away from any property line of a lot, above and at least 1 m away from an underground utility, driveway or other paved surface, and in an approved location
- Minimum spacing from existing trees and other replacement trees should be set at 2 m for small trees, 4 m for medium trees and 6 m for large trees
- Soil volume required for replacement trees should be estimated based on canopy size at maturity

BEST PRACTICE TO CALCULATE SOIL VOLUME

TREE SIZE	Min soil volume (m^3)[4]	Shared or irrigated soil volume (m^3)
Small tree canopy spread is up to 6 m	8	6
Medium tree canopy - spread is up to 10.0 m	20	15
Large tree canopy - spread is greater than 10.0 m	35	30

Credit soil volume according to actual content of soil:

- Soil: Volume of soil (Length x Width x Depth)
- Soil cells: Volume of soil cell installation (Length x Width x Depth) x 0. 92
- Structural soil: Volume of structural soil (Length x Width x Depth) x 0.2

[4]0.3 m^3 minimum soil per 1 m^2 of crown projection based on Lindsey and Bassuk (1990).

6.3.7.3 Stock and Planting Standards

PURPOSE | Stock and planting standards are meant to maximize the chance of survival of replacement trees to maturity.

RECOMMENDED: Stock and planting standards

Requirements should include:

- Replacement trees must meet requirements set out in the latest edition the Canadian Nursery Trades Association "Canadian Standards for Nursery Stock"
- Define the size of planting stock that is acceptable (often 6 cm caliper for deciduous and 2 m height for conifer) but may be smaller for non-development tree permit applicants
- Define the acceptable timing of planting based on local planting season

6.3.8 Actions on Site

Actions on site are steps that applicants must take as a condition of a tree permit.

6.3.8.1 Tree Protection Measures

PURPOSE | To prevent damage when a tree permit is being issued with a development related permit where trees are being retained.

RECOMMENDED: Fencing measures

Fencing requirements should include:

- A standard tree protecting fencing detail as a schedule in the bylaw.
- Signage indicating that the fencing is for tree protection. Signage could include contact information for the project arborist and a dollar value associated with the tree to indicate the cost of damage.
- Fencing should remain in place for the duration of the construction work.
- Removing fencing should be a violation of the bylaw except when part of an activity approved by the tree permit and under the supervision of an arborist.

RECOMMENDED: Supervision measures

If activities are occurring close to trees such that fencing needs to be removed or absent, then arborist supervision of the activities is an alternative method to prevent or minimize damage. Supervision requirements should include:

- A letter of assurance from the owner and arborist to define activities that will be supervised by an arborist, and supervision should be documented
- Documented supervision by the arborist of any planned works within the tree protection zone, pre-construction tree pruning, post-construction assessment or any other activities defined as requiring supervision

RECOMMENDED: Alternative measures

When tree protection fencing cannot be installed or maintained at the recommended distance, alternative tree protection measures (Fite and Smiley, 2016) may include:

- Mulching (15-30 cm)
- Laying minimum ¾ inch (2 cm) plywood, beams, commercial logging or road mats, on the ground or over a 10 cm layer of mulch (on fabric to enable easier removal)
- Applying 10 – 15 cm of gravel over a taut, staked, geotextile fabric
- Protecting the trunk with wood planks on a closed-cell foam pad bound with straps or wire (no fasteners into the tree)
- Irrigation
- Any other measures defined to protect trees on site

6.3.8.2 Notification and Marking

PURPOSE | Posting a notice of impending tree removals and marking trees to be removed lets the public know that an approved tree removal is taking place.

RECOMMENDED: Notification and marking

Requirements should include:

- A notice to post, similar other permits types (e.g., building permits), provided with the approved permit
- Trees to be removed be marked with flagging tape or survey paint

6.3.9 Securities

Securities are used as refundable deposits to guarantee that an applicant will follow through with actions required by a tree permit.

6.3.9.1 Securities for Tree Retention

PURPOSE | To guarantee that an applicant will follow through with tree protection measures which are conditions of the tree permit obtained for a development application.

RECOMMENDED: Tree retention securities

Securities must be determined using a method that can consistently calculate the security amount and be of a sufficient amount to deter bylaw infractions while still being affordable in the context of the project being undertaken.

It is recommended that securities:

- Be a set value for trees or categories of trees (e.g., value by diameter class)
- Be capped at a maximum value to avoid securities being unaffordable
- Incorporate flexibility to waive the security for on site trees that are not at risk of damage
- If applied to municipal trees, incorporate flexibility to be valued according to the Council of Tree and Landscape Appraisal Formula in addition to the cost of removal and planting
- Be returned upon final completion and confirmation by an arborist that the tree was protected as required in the permit, and supported by documentation of arborist supervision of any activities described in a letter of assurance
- Be transferred to a dedicated reserve fund for tree planting if forfeited, as opposed to general revenues

Context

Any community requiring tree protection measures may benefit from retention securities. However, municipalities will require sufficient staffing to manage securities.

***Found in**: Surrey, New Westminster, White Rock, Courtenay (at Director's discretion)*

Pros

- Functions to guarantee the applicant and arborist follow through on protection and supervision measures for retained trees
- Requires evidence of compliance from the project arborist to reduce staff enforcement
- Provides another compliance tool in addition to penalties

Cons

- Increases the administration requirements of tree bylaws, with securities having to be calculated, held and then returned pending approval of documentation provided
- Requires applicants to provide cash or a letter of credit for the duration of the project

Variation

- **Amenity value-based** replacement securities, where trees are valued according to the Council of Tree and Landscape Appraisal Formula
- **Applicant/application type-based** tree retention securities typically require large sums to be held for larger development contexts in order to encourage compliance while avoiding burdening applicants for smaller works permits

Securities are best implemented with a requirement for arborist supervision and letters of assurance that can provide staff with evidence that work was carried out according to the requirements.

In practice

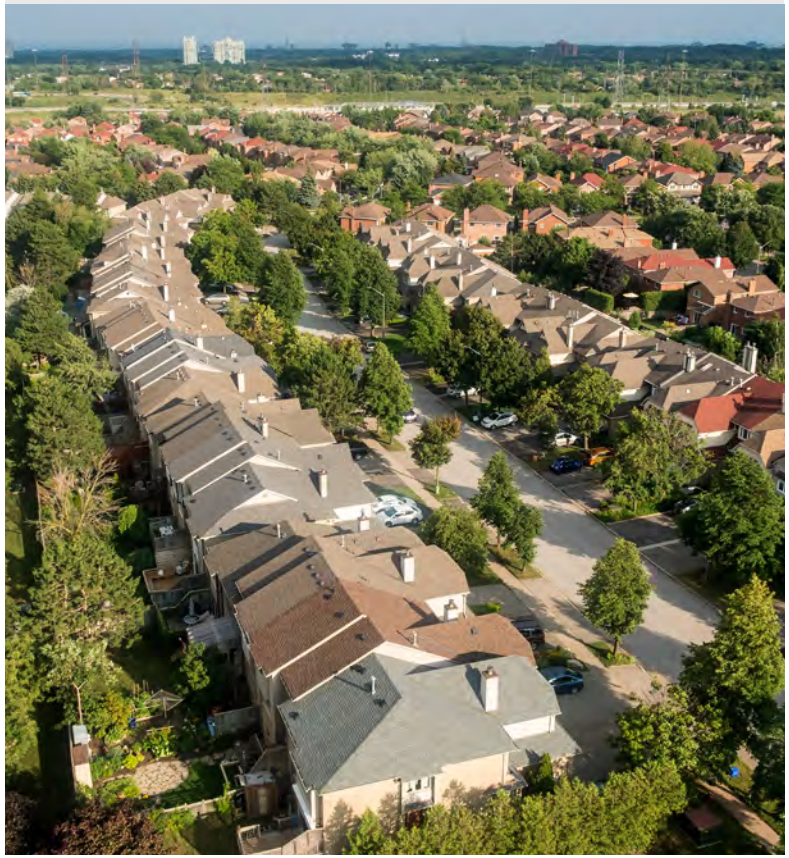
New Westminster's retained tree securities vary by size; the security for a protected tree is $2500 and greatly increases for a retained specimen tree, which is set at $10,000.

6.3.9.2 Securities for Tree Replacement

PURPOSE | To guarantee that an applicant plants and maintains replacement trees that are conditions of the tree permit.

In practice

In Mississauga, a tree replacement security deposit is determined on a case-by-case basis by the City.



RECOMMENDED: Replacement securities

Securities must be determined using a method that can consistently calculate the security amount and be of sufficient value to incentivize the planting of replacement trees.

It is recommended that securities:

- Be set at an amount that covers the cost of replacing a tree and maintaining it to establishment
- If cash-in-lieu is enabled, be set at an equivalent value for applications related to development
- Despite the previous points, if there is a 1:many replacement ratio or the cash-in-lieu amount is high, replacement securities can be modified to a type of applicant or application to avoid burdening non-development applicants
- Be returned once a tree has been planted and has survived for a set period of time

Context

Any community requiring tree protection measures may benefit from retention securities. However, municipalities will require sufficient staffing to administer securities.

Found in: *Delta, Surrey, Vancouver, Abbotsford, Victoria, Mississauga (ON)*

Pros

- Incentivizes the applicant to follow through with planting and maintaining replacement trees
- Provides another compliance tool in addition to penalties

Cons

- Increases the administration requirements of tree bylaws, with money having to be calculated, held and then returned pending approval of documentation provided
- May require an additional inspection point at the end of the security period

Cash-in-lieu and replacement securities should be equivalent amounts to simplify enforcement by enabling the municipality to retain securities without having to fine applicants to recover the balance amount for cash-in-lieu.

COMPLIANCE WITH REPLACEMENT TREE PLANTING

A recent report from the University of Toronto (Conway, Khatib, Tetreault, & Almas, 2021) reviewed the level of compliance for replacement tree planting requirements in the City of Toronto. A survey sent to homeowners who received a tree removal permit found that 70% of respondents had complied with their permit's replacement tree planting requirement. The researchers conducted site visits and found a very high short-term survival rate for trees planted. The highest survival rate was for trees planted by professionals. The species planted where not all adequate for the local climate and were occasionally misreported to the City. Researchers concluded that an inspection would increase compliance and improve documentation on the replacement trees planted. They also suggested that species guidance and professional tree planting would improve the replacement planting outcomes. Authors also noted the importance of tracking and record keeping systems at the municipal level to enable adequate follow-up and the promotion of compliance.

ADDITIONAL OPTIONS | In order to ensure that replacement plantings take place, municipalities may wish to consider additional options to encourage tree replacement:

1. Enforcement is used as an alternative to securities in some municipalities such as Richmond in order to ensure that replacement planting is carried out as intended. To be as effective as securities, enforcement requires sufficient resources to carry out proactive inspections.

2. Stewardship measures can be used to encourage the planting of replacement trees, such as the municipality providing a free or low-cost replacement tree. Stewardship measures are usually perceived in a more positive light by the public and make replacement tree planting more accessible to applicants with lower incomes. However, such measures come at a cost to the municipality and should be supported by adequate budgets.

   Note: bylaw fees, cash-in-lieu or transferred securities collected in a reserve fund could be set up to support residents with tree care and planting on private land.

6.3.10 Penalties

PURPOSE | Penalties seek to deter bylaw infractions and require remedial measures.

MUST HAVES: Long form prosecution

Tree bylaws should enable municipalities to make use of the Offence Act and fines to penalize bylaw infractions.

Municipalities can enforce their tree bylaws with the long form information process under the provincial Offence Act. The Act provides municipalities with the ability to enforce penalties up to $50,000 if they do not have established penalties (as described under municipal ticketing) or for enforcing major bylaw contraventions.

MUST HAVES: Municipal ticketing

Municipalities can set up fines for tree bylaw infractions for specific minor to medium contraventions. **The Municipal Ticket Information system** enables municipalities to enforce and prosecute contraventions to tree bylaws through infractions listed in a Municipal Ticketing Bylaw. Penalties cannot exceed $1,000 but multiple fines can be issued for damaging a single tree if multiple infractions apply.. Tickets that are disputed go to provincial court.

The Bylaw Notice Adjudication System enables municipalities to establish an administrative system as an alternative to the provincial court for resolving minor local government bylaw contraventions. Local governments may join together to administer a bylaw notice system jointly to cover a broader geographic area more cost-effectively. Penalties cannot exceed $500.

ADDITIONAL OPTIONS | In addition to enabling the use of available enforcement mechanisms, municipalities may wish to consider additional measures to provide themselves with further options to enforce their tree bylaw, including stop work orders, securities transfer and replacement tree requirements.

Stop work orders
Municipalities can use stop work orders to interrupt work that is causing damage to retained trees until remediation measures are taken. This measure should only be used in situations where irremediable damage is being caused, where it may offer an effective solution to stop such damage when it is occurring.

Securities transfer
Municipalities could consider including provisions within their tree bylaws to automatically transfer unclaimed securities to their reserve funds after a set period of time. Including such a provision may offer more clarity and transparency to staff and applicants as to the expected process and timeline to comply with permit conditions before securities are transferred.

Requiring replacement trees
Some municipalities require people found to be in violation of their bylaws to plant replacement trees as a means of enforcement. This approach may be helpful in cases where applicants removed trees without knowledge or understanding of the tree bylaw requirements. It may however prove challenging to enforce in cases where applicants are purposefully trying to evade the bylaw and are not interested in planting trees on their properties. In such cases, fines may be a better way to recover funds to plant elsewhere in the municipality.

6.3.11 Tree Bylaw Implementation

Practitioners surveyed for this project in the fall of 2020 highlighted the importance of the implementation process for creating an effective regulatory environment that balance canopy preservation and growth with competing priorities. Findings of the literature review further emphasize the importance of several factors beyond the bylaw content that will significantly impact urban forest outcomes.

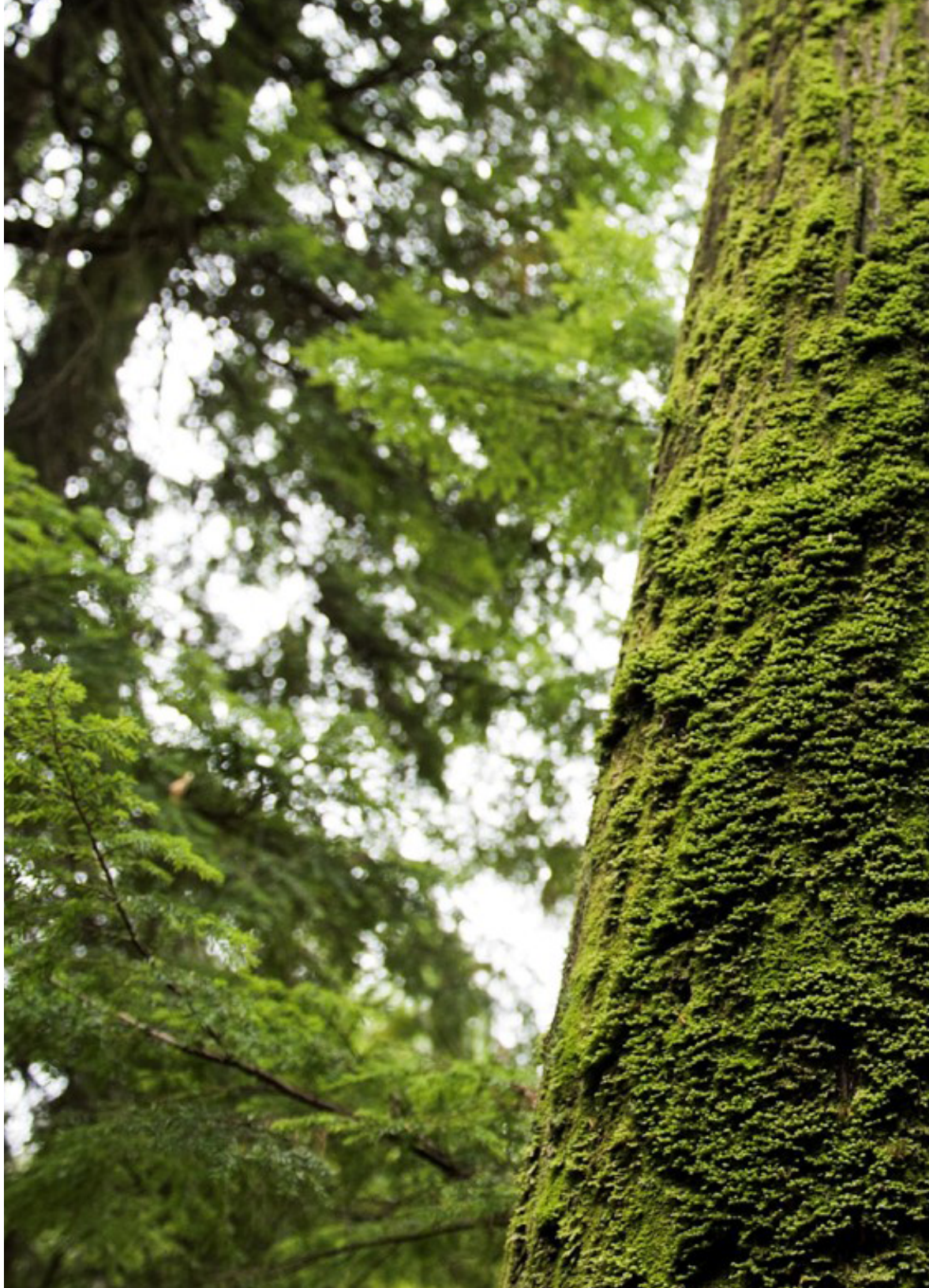
Bernhardt and Nichols propose seven implementation criteria for effective tree ordinances (Bernhardt & Swiecki, 2001; Nichols, 2007). These criteria are discussed in detail in the literature review and align closely to many of the comments compiled in the practitioner survey. The criteria include:

- **Clearly stated goals:** Describe the capacity of the bylaw to achieve certain goals with a clear connection to any wider management strategies. Goals are essential to interpret the bylaw and evaluate its effectiveness.
- **Designated responsibility:** Assign authority to a single person responsible for bylaw implementation.
- **Basic performance standards:** Designate best management practices and standards to guide the bylaw whenever possible.
- **Flexibility:** Allow for site-specific decisions to be made by arborists and qualified environmental professionals on a case-by-case basis when appropriate. An appeal process is recommended to ensure decision-making is based on the technical merit of applications.
- **Enforcement:** Employ a variety of penalties consistently.
- **Comprehensive management strategy:** Develop a comprehensive management strategy alongside the bylaw to align goals and integrate them throughout community resources.
- **Developed with community support:** Align with community values and priorities that citizens are willing to comply with, and support.

7.0 Conclusion

The benefits of trees are widely recognised and valued by communities across Metro Vancouver and around the world, particularly in the context of climate change adaptation. Local governments are showing an increasing interest in developing or improving regulations to preserve trees and grow tree canopy. Yet, a limited number of resources exist to inform the design and implementation of regulatory tools for this purpose.

The *Metro Vancouver Tree Regulations Toolkit* provides readers with practical information about how they can develop comprehensive policies and regulations to preserve trees and grow tree canopy within British Columbia's current legislative framework. It is intended to offer information about the options available and important components to consider for each regulatory tool to allow readers to make decisions about the most appropriate options for their local context. This document will need to be periodically reviewed and updated as legislation and best practices in the region evolve.



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Appendix 1. Practitioner Survey Results (2020)

Detailed Results – Practitioners Surveys

Observations about municipalities in Metro Vancouver

Canopy loss: In Figure 1, staff indicated that:

- Most tree canopy loss in their community was due to:
  - Single-family/townhome subdivision development into greenfield (80% said moderate to high loss)
  - Higher density/commercial development into green field or already developed areas (40 to 50% said moderate to high loss)
  - Single-family/duplex/triplex infill into already developed urban areas (40% said moderate to high loss)
- Least tree canopy loss in their communities was due to:
  - Minor development (90% said low loss)
  - Municipal development and capital infrastructure upgrades (90% said low or not applicable)
  - Dying or high-risk trees needing to be removed (80% said low)
  - Industrial development (80% said low or not applicable)
  - Homeowners cutting trees for perceived nuisance (65% said low)

In addition to the causes for canopy loss listed in the survey, staff mentioned off-site infrastructure upgrades for development, climate change, wildfire and forest management, climate change impacts and tree management on other jurisdictions (e.g. School Districts) as causes of canopy loss.

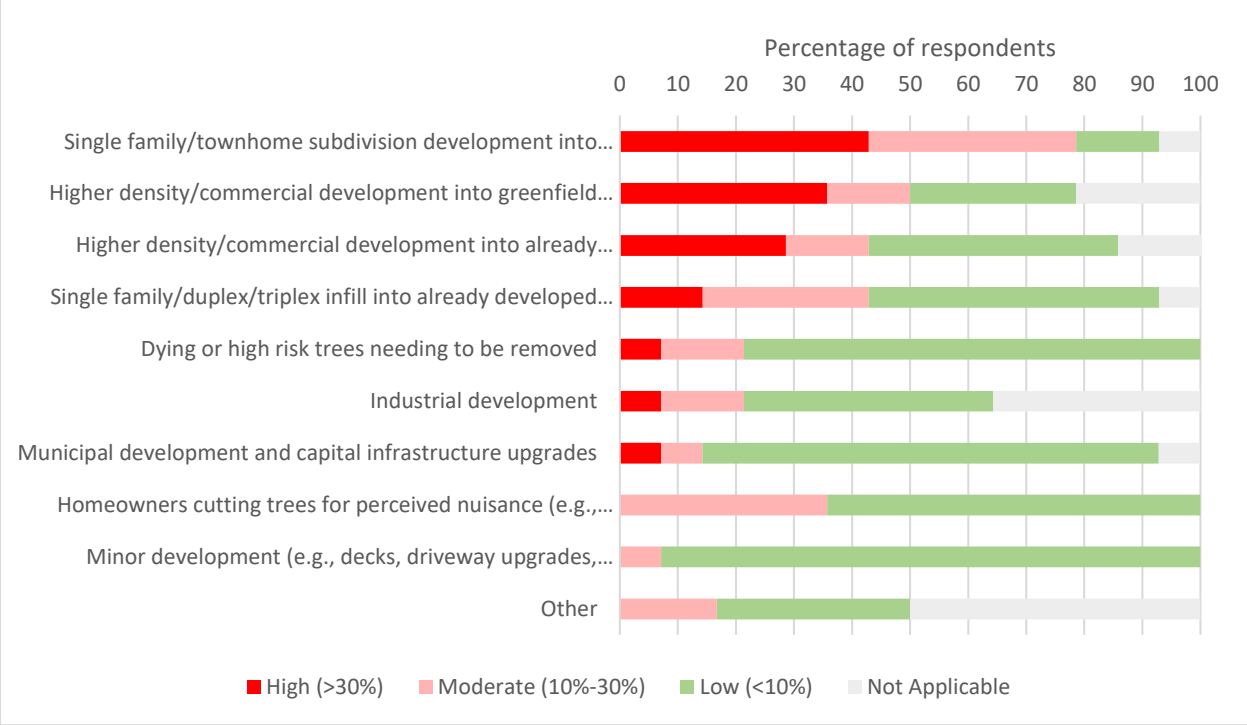

Figure 1. Municipal staff's perceived reasons for canopy loss in their jurisdiction (from survey responses).

Effectiveness of regulations: Municipal staff respondents identified Environmental Development Permit Areas (Environmental DPA), Public and Private tree bylaws as the most effective regulatory tools currently in their municipality (see Figure 2). Zoning and Subdivision and Servicing Bylaws were seen as least effective. Reasons cited included a lack of language to support urban forest objectives and landscaping and street tree requirements, and the inadequate regulation on the amount of impervious cover or building envelope size permitted. These reasons cited suggest that opportunities exist to improve those regulations for canopy preservation or growth. Staff also pointed to a lack of staffing and resourcing to implement regulations and ensure compliance and enforcement and fluctuating political will to implement regulations to their full extent.

In addition to the tools listed in the survey, staff highlighted the Watercourse Protection and Steep Slope Protection Development Permit Areas and guidelines as being effective for tree canopy regulation. Staff also commented on additional tools to sustain or grow canopy cover, including a donor tree program, carbon sequestration and biodiversity initiatives for public tree planting and Urban Forest Management Plans.

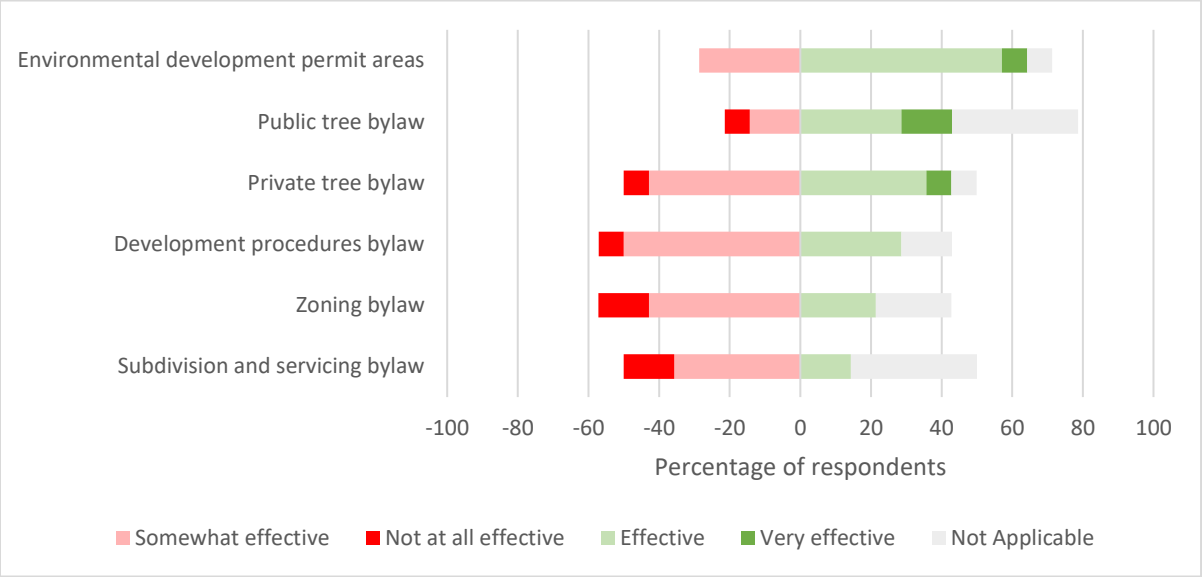

Figure 2. Current effectiveness of regulatory tools to preserve or grow canopy in municipal staff's jurisdictions (from survey responses).

Effectiveness of regulatory tools to achieve specific outcomes: Municipal staff and consulting arborists were asked to comment on the effectiveness of regulatory tools at achieving specific urban forest preservation and growth outcomes (see Figure 3 and Figure 4). Both municipal and consulting arborist survey respondents thought that the regulatory tools were effective for achieving tree protection during construction and retention of existing trees where reasonably possible. Both sets of respondents were also consistent in the finding that regulatory tools did not achieve protection and reuse of native soil, increased tree canopy in locations that previously had little canopy, or protection of permeable areas or future planting sites. Consulting arborists were more critical than municipal staff respondents on the effectiveness of those tools to achieve the selection of climate suitable species for the site and replacement planting of medium to large canopy trees. In general, the results indicated there was room for improvement in the region's regulations to achieve most of the outcomes listed.

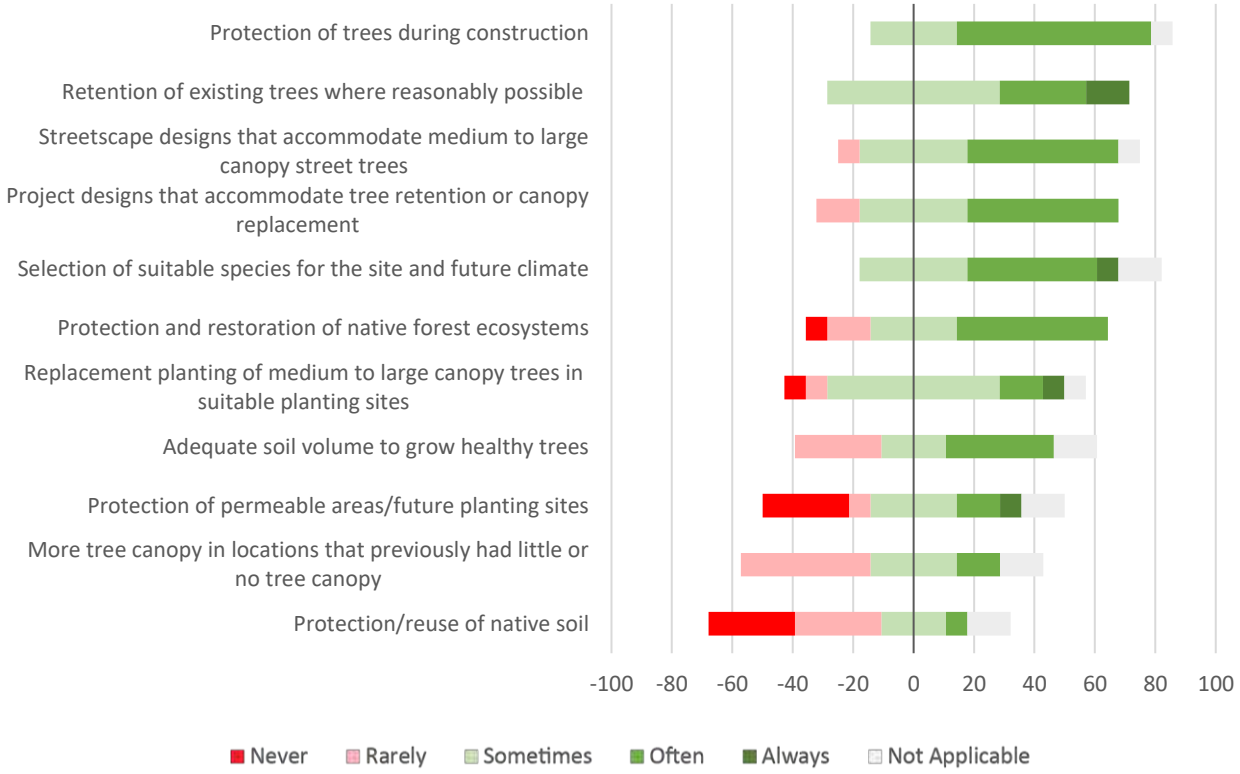

Figure 3. Effectiveness of regulatory tools to achieve specific outcomes according to municipal staff (from survey responses) (above).

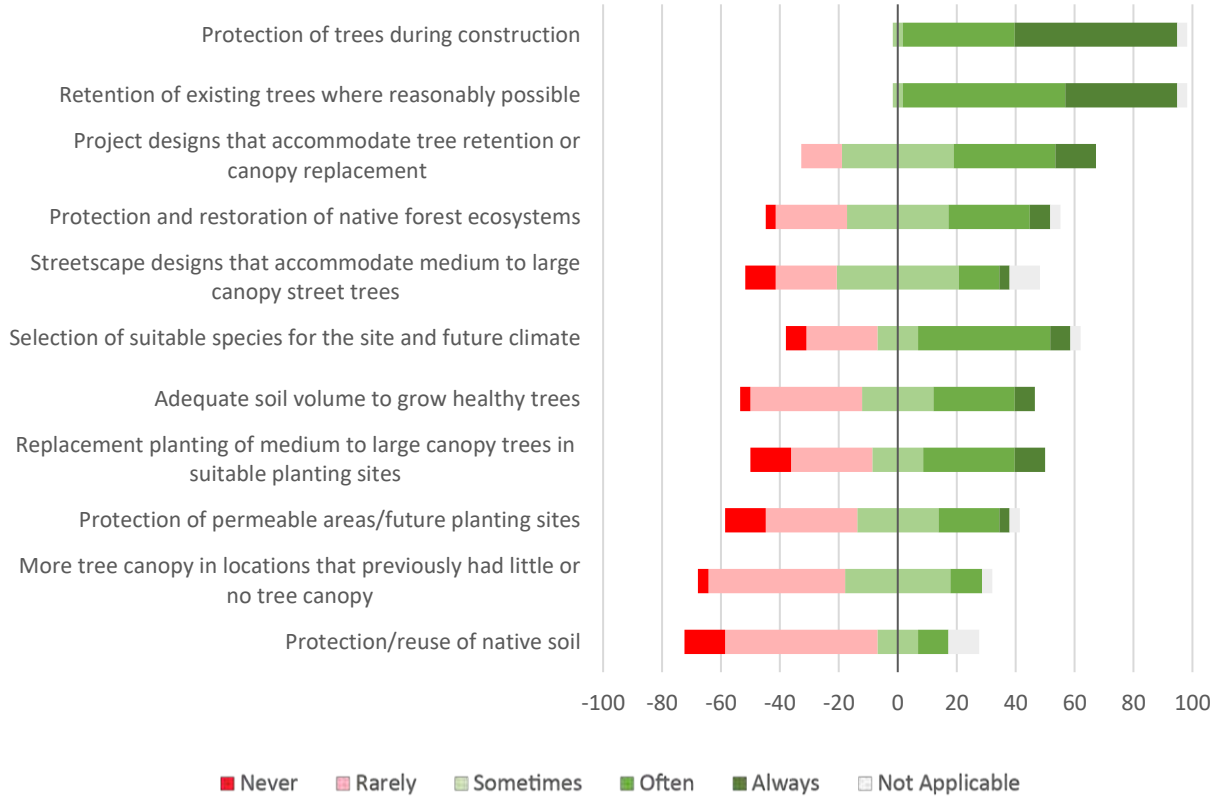

Figure 4. Effectiveness of regulatory tools to achieve specific outcomes according to consulting arborists (from survey responses) (above)

Most important objectives for introducing regulations: Municipal staff respondents clearly consider maximizing tree retention to be the most important objective guiding the introduction of regulations in their municipality, followed by increase new tree canopy in low canopy areas and maximizing canopy replacement (see Figure 5). The administrative metrics listed were not ranked as high. However, minimizing staffing required to administer the bylaw and costs to permit applicants were considered significant to a few municipalities, particularly those of a smaller size. It is worth noting that while increasing canopy cover in low canopy neighbourhoods ranked high in the priorities of municipal staff, many of them also noted that their current regulations rarely achieve that outcome currently.

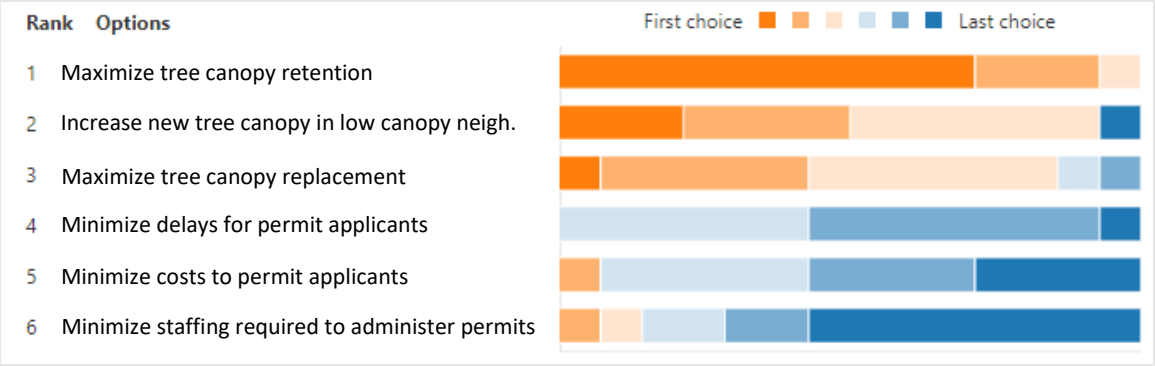

Figure 5. Objectives ranked from most to least important when introducing regulations in their jurisdiction, according to municipal staff (from survey responses).

Staff noted the following objectives as additional to the ones listed in the survey:

- Increase staffing for tree care on public land
- Protect available space for retention or replacement on urban infill lots (including rooftops/decks on high-rises) and off-site locations (neighbourhood shared spaces areas, community open spaces/facilities)
- Fiscal incentive for agricultural land tree planting + retention where land isn't used for farming
- Climate change resiliency targets (site, neighbourhood and municipal level)
- Access to green spaces (community health)
- Urban forest health & diversity (vs. simply coverage)
- Room to mature for replacement trees
- Wildfire management
- Public safety
- OCP/neighbourhood plans/parks plans

Finally, municipal staff highlighted the challenges of competing priorities (utilities, TOD, active transportation, parking), an interest in learning about tree retention and re-planting initiatives in the Pacific Northwest including carbon credit programs to support re-planting, and the fact that administrative procedure metrics are far less critical than sound canopy objectives and decision-making for canopy cover outcomes.

Perceptions on bylaw best practices

Zoning: Municipal staff highlighted maximum lot coverage and maximum impervious cover in the Zoning Bylaw as having the most potential to sustain or grow canopy cover (see Figure 6). Environmental setbacks and landscaping were also considered by staff from more urbanized municipalities to have a large impact, while smaller and more suburban communities found setbacks to be less impactful. This perception may partially be explained by there often being larger green spaces in the smaller communities that are found adjacent to Provincial land whereas in the denser and more developed communities, the environmental setbacks, outside of the major parks, are often the largest green spaces outside of major parks. Less urbanized municipalities that are seeing increased development pressures may need to consider the protection of large setbacks of a sufficient size to either preserve tree stands of value or future planting sites.

Additional zoning components of importance highlighted by respondents included buildings (accessory buildings and infill housing), utilities and stormwater management, other constructions (pools, patios, retaining walls) and re-grading. Respondents also mentioned the importance of tree canopy and vegetation cover treatment options, landscaping guidelines and greening guidelines on structure for higher density/larger footprint developments.

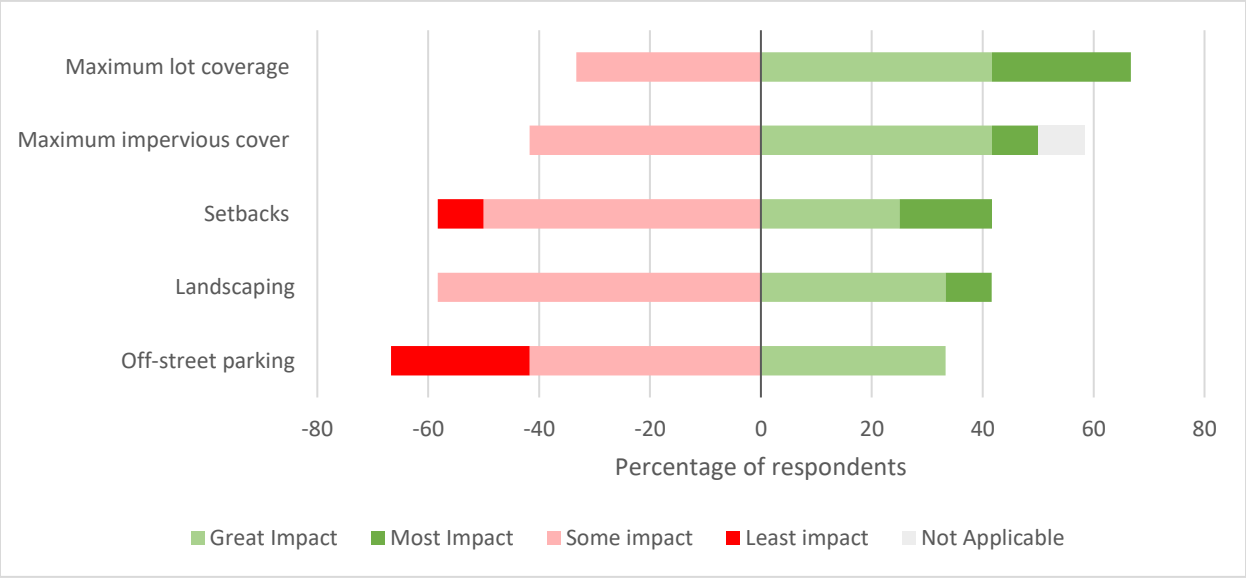

Figure 6. Impact of zoning bylaw components on canopy cover preservation or growth according to municipal staff (from survey responses).

Development Permit Areas: With regards to Development Permit Areas (DPAs), municipal respondents felt that the protection of the natural environment has an significant impact on sustaining and growing canopy, while most staff didn't find hazardous conditions DPAs to have a great impact. Other DPAs mentioned included Waterfront, Watercourses, Slopes, Form and Character and Energy.

Subdivision and Servicing Bylaw: Staff highlighted soil volume requirements as the most impactful component of this bylaw for sustaining and growing canopy. Boulevard width and tree spacing and setbacks were also found to have some or a great impact on canopy.

Respondents listed the following additional components as impactful for sustaining or growing canopy: servicing and trenching, private tree plantings (at the front and rear of buildings), street tree requirements and standards for planting and maintenance, and bio-filtration requirements that account for canopy cover. A few respondents pointed out implementation challenges with getting the requested soil volumes or the lack of involvement of urban forestry staff in the development process.

Tree bylaw: Replacement requirements and tree protection standards were found to be the components with the most impact to the greatest number of municipal staff respondents (see Figure 7). All respondents thought that securities had a great impact on sustaining and growing canopy cover. There was less agreement on the impact of components such as the permitted removal reasons and penalties.

Although information requirements were ranked as having less impact on sustaining or growing canopy, standardized arborist reports were noted as a component with a significant impact in the comments. Additional items related to securities and replacement requirements. Forest edge effects (trees blowing over) and wildfire management concerns were also highlighted in municipalities with large urban-wildland interfaces.

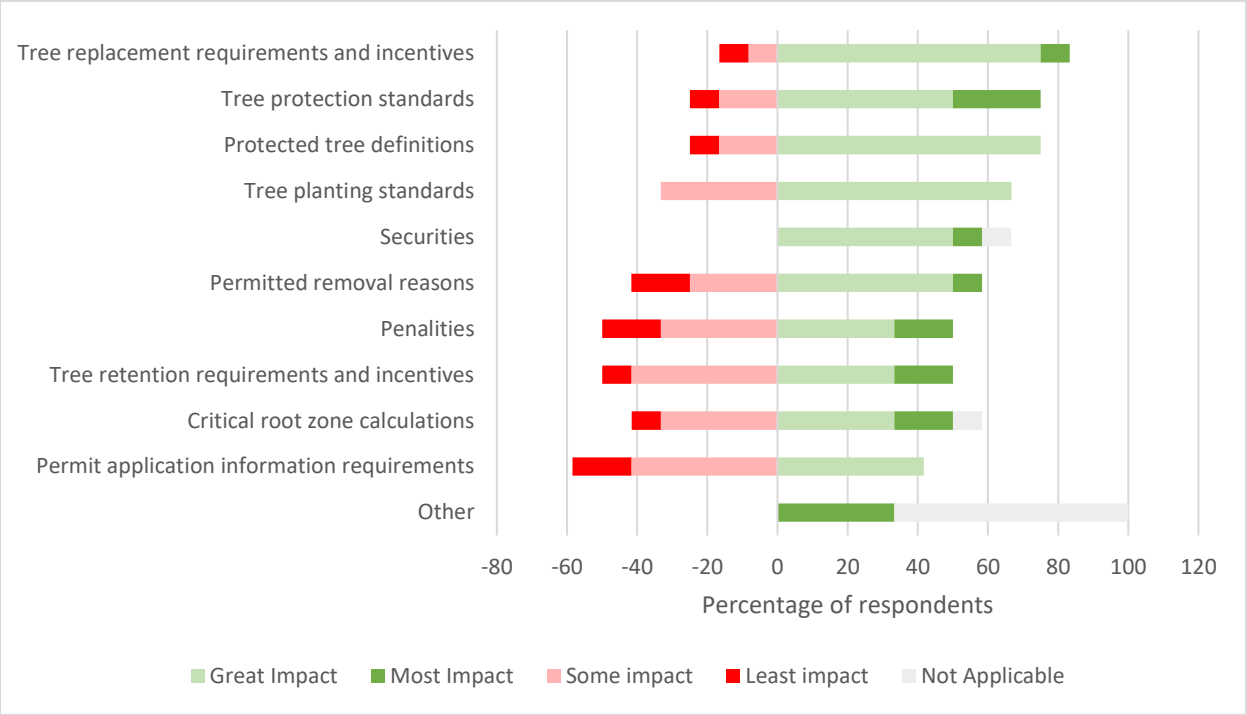

Figure 7. Impact of tree bylaw components on preserving or growing canopy cover according to municipal staff (from survey responses).

Appendix 2. Literature Review

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1.0 Introduction

Many jurisdictions in Canada and elsewhere use laws or policy, including comprehensive plans, zoning, tree bylaws/ordinances, and subdivision regulations, to influence urban tree canopy on private land. **Tree bylaws, ordinances or policies** are often used by municipalities to directly regulate or guide the protection, removal, and replacement of trees in urban and peri-urban forests. **Land use bylaws and planning overlays** (land use regulations) also influence urban tree canopy by controlling how and where land development can occur, what permeable space will remain to plant trees, specifying landscaping outcomes, and prioritizing the protection of or requiring restoration of environmentally sensitive or significant areas. Typically, **land use regulations**, and an owner's right to develop their property according to those regulations, **will override tree regulations**, therefore, **tree regulations and land use regulations need to be aligned to achieve a municipality's urban tree canopy goals**.

Approaches to regulating tree protection vary significantly between jurisdictions even within the same region. This literature review draws on scientific research and practitioner guides to explore best practices for regulating urban tree canopy and ultimately to inform a conceptual model for comprehensive canopy regulation that could be used in the context of British Columbia. Specifically, this literature review will explore:

- The role of urban forest governance
- Methods to incorporate tree canopy into land use regulations
- Guidance for effective tree regulation and the key elements that need to be in place, and pitfalls to avoid, to effectively regulate urban tree canopy
- Approaches to private tree protection in Canada and the United States
- The tools available to municipalities in British Columbia to regulate urban tree canopy
- A conceptual model for comprehensive canopy regulation in British Columbia

Tree and land use regulations are referred to using different terminology depending on the country. There are multiple words used throughout the literature review in reference to tree governance that are important to define. Generally, ***bylaw*** (also spelled by-law) is used in a Canadian context and ***ordinance*** is used in the United States. General definitions for key terms include:

- **Bylaw** – Laws passed by municipal councils and regional district boards to exercise their statutory authority. Bylaws may be used for a variety of different purposes, including establishing meeting procedures, regulating services, prohibiting an activity, or requiring certain actions (The Government of British Columbia, 2020).
- **Ordinance** – Law enacted by a municipal body, such as a city council or county commission. Ordinances govern matters not already covered by state or federal laws such as zoning, safety and building regulations (Lectric Law Library's Lexicon, 2020).
- **Policy** – Law, regulation, procedure, administrative action, incentive, or voluntary practice of governments and other institutions (Centers for Disease Control and Prevention, 2020).

- **Regulation** – An official rule. In the Government, certain administrative agencies have a narrow authority to control conduct, within their areas of responsibility. These agencies have been delegated legislative power to create and apply the rules, or "regulations" (Cornell Law School, 2020).
- **Standard –** Written limit, definition or rule that is approved and monitored by an agency as the minimum benchmark acceptable (Black's Law Dictionary Free Online Legal Dictionary 2nd Ed., 2020).

2.0 The Role of Urban Forest Governance

Urban forest governance refers to the processes, interactions, organizations, and decisions that lead to the establishment and maintenance of the urban forest. It is important to acknowledge, even though a local government may have the authority to regulate trees, that not every municipality may choose to exercise that power. In a study of urban forest governance in Australian cities, Ordonez (2019) found that central and inner urban centres face different challenges and prioritize issues differently than outer and regional centres. FitzGibbon and Summers (2002) state that tree regulations tend to be stronger in more populated areas in the US and Canada. In other words, tree regulations strengthen as communities become more urbanized. Ordonez et al. (2019) note that variation in urban forest governance may reflect differences among urban areas such as level of development, population density, and population growth. Hill et al. (2010) suggest that when a community is aware of the inhibitors to maintaining tree canopy cover – including insufficient budget, insufficient staff and equipment, competing priorities, lack of public support and political will, and lack of community recognition concerning the importance of tree management – it is an indication that the community is making efforts to acquire resources and protect trees to increase canopy cover. By contrast, if protecting or growing the urban forest is not a concern for the community, it will not identify any inhibitors and will not make efforts to maintain tree canopy (Hill et al. 2010).

Mincey et al. (2013a) observe that urban forest management is influenced across multiple scales by operational, policymaking, and constitutional rules that determine policy creation. The organization of urban forestry programs within governmental structures and communities is influenced by social systems and institutions. Lawrence et al. (2013) offer a comparative model of integrated urban forest governance which describes:

- **Context:** urban trees, forests, population size
- **Institutional frameworks:** policies, plans and regulations, ownership, and access
- **Actors and coalitions:** land managers, citizens and NGOs, partnerships, and power analysis
- **Resources:** funding, knowledge, delivery mechanisms
- **Processes:** discourses, participation, monitoring, and evaluation

This model is proposed as a method of mapping the whole picture of urban forest governance, that can help disentangle the complexity of the urban forest and enable comparison of urban forest governance

between jurisdictions. Such a model may provide insight into the type of urban forest governance frameworks that support adequate funding, political will, public pressure, and municipal capacity to enact and enforce effective tree regulation.

Issues of environmental equity and justice in urban forest governance are also coming to the forefront but are not yet well represented in the literature on regulating urban tree canopy. The U.S. Environmental Protection Agency defines environmental justice as:

"the fair treatment of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws and policies and their meaningful involvement in the decision-making processes of the government."

Decisions made in urban forestry practice are not always equitable – for example, research found that resident associations involved in urban forest stewardship activities are more likely to be active in high income communities (Conway et al. 2011). Different stakeholders have varying levels of influence , with some urban forestry stakeholders such as municipal managers more connected to strategic planning and therefore more capable of influencing resource allocations (Campbell, 2016; Ordonez et al. 2020). Nesbitt et al. (2019) define urban green equity as equitable access to urban forests and governance. They present two practice-based models for urban green equity that practitioners can apply to recognize and overcome barriers to inequity in practice: recognitional equity and distributional equity. Recognitional equity describes the representation of stakeholders involved in urban forest decision making, stewardship, and representation in the profession (Nesbitt et al., 2019).

Distributional equity is focused on fair access to ecosystem services, which in urban forestry often relates to the proximity and extent of vegetation cover. The distribution of ecological attributes in cities, such as tree canopy, urban heat island, and environmental hazards are frequently driven by social inequity (Schell et al. 2020). Studies examining predictors of vegetation cover have proposed three social theories (Troy et al., 2007; Grove et al., 2006):

1. **Population density:** drives vegetation change through development.
2. **Social stratification:** predicts vegetation cover based on relative power, income and race differences among neighbourhoods, and the subsequent levels of public and private investment in greening.
3. **Lifestyle behaviour:** suggests increases in vegetation cover based on household patterns of consumption and expenditure motivated by social status resulting in a 'luxury effect', where groups with adequate discretional income outwardly express prestige and neighbourhood belonging through their landscaping.

Affluent residential neighbourhoods often have greater vegetation cover, canopy cover, and plant diversity (Schell et al. 2020). Housing age and race have also been associated with trends in canopy cover (Troy et al., 2007; Watkins & Gerrish, 2018). A study of potential plantable areas on private land found that potential planting areas were limited in locations with high lot cover and density, which also

tended to be in neighbourhoods characterized by high population density with often lower incomes and higher proportions of minority households (Troy et al., 2007). This indicates that increasing canopy cover in underserved neighbourhoods may not be a matter of just increasing tree planting but increasing available plantable areas.

Studies find significant correlations between tree ordinance provisions and community urban forest characteristics related to wealth and education (Dickerson et al., 2001; Conway et al., 2011). Residents with a higher mean income and education level are more likely to live in areas that have ordinances with provisions biased toward protection and maintenance of existing community trees whereas residents with a lower education and income level are more likely to live in areas with ordinances focused on community aesthetics and safety (Dickerson et al., 2001). Understanding how current practices and policies contribute to environmental inequity and increasing diverse representation in decision making are important steps towards identifying policy outcomes that will improve environmental equity. When developing tree regulations, it is important to apply an environmental justice lens to ensure policies are not disproportionately impacting or penalizing minority or low-income populations.

3.0 Guidance for Effective Tree Regulation

Increasing or maintaining the number of trees and the extent of tree canopy cover in a city is an indication of effective tree regulation (Landry & Pu, 2010; Sung, 2012 in Clark et al., 2020). Tree regulations are commonly enacted by local governments to regulate tree removal, regulate the planting and maintenance of trees, and control landscaping and tree protection for new development sites (Yung, 2018). Beyond these direct control outcomes, tree bylaws serve broader urban forestry goals including watershed health, stormwater management, habitat, sustainability, canopy, aesthetics, and access to greenspace (Baur et al., 2016). Federal and provincial acts are often critical to provide local governments with the authority and guidelines to create bylaws. For example, BC's Community Charter delegates broad power to municipalities to regulate trees (on both public and private land), whereas Alberta's Municipal Government Act does not. Federal or provincial acts can also provide 'blanket' protection of the urban forest, such as for riparian areas or for species at risk, though this is not always the case (Fong, n.d.). The literature provides various insights into effective urban forest governance and implementation of tree bylaws and ordinances. This review focuses predominantly on private tree regulation because the majority of urban tree canopy loss occurs on private land, which is a more controversial space to regulate trees than on public land.

Given the complexity of urban forest governance, efforts to preserve trees must be trans-disciplinary and reach all the relevant actors. Much of the urban forest is owned and managed by private landowners (Clark et al., 1997). As a result, calibrating policy prescriptions (ordinances, standards) to community attitudes is important. There are significant differences between communities within and between regions which present challenges for recommending general best practices (Mincey et al., 2013a). Examples are common where bylaws not supported by a community fail to be adopted, are ignored, spark retaliatory actions, or detract from the community perception of the urban forest as a

public good (Mincey et al., 2013a; Treiman & Gartner, 2005; Nesse, 2020). Copying generic bylaw templates prevents a city from meeting the specific needs of the community and misses an opportunity to work with property owners and developers in the process to strengthen connections (Schwab, 2009).

Bernhardt and Nichols propose seven criteria for effective tree bylaws (Bernhardt & Swiecki, 1991; Nichols, 2007). These criteria will be discussed in the following sections and include:

- **Clearly stated goals:** Essential for interpretation of the bylaw and evaluation of effectiveness. The goals should describe the capacity of the tool to achieve certain goals with clear connection to any wider management strategies.
- **Designated responsibility:** Assign authority of a single person responsible or when resources are limited, split between city staff and tree commissions as needed.
- **Basic performance standards:** Indicate best management practices and standards that address the overall urban forest.
- **Flexibility:** Allows for site-specific decisions in the variety of circumstances that may arise and supports staff to use their discretion in a fair, reasonable and transparent manner. An appeal process is recommended to ensure decision making based on technical merit.
- **Enforcement:** Adequate staffing to administer the bylaw and provide enforcement, and effective penalties to deter violations.
- **Comprehensive management strategy:** Development alongside a Comprehensive Management strategy ensures goals align and are integrated with other community policy.
- **Developed with community support:** Align with community values and priorities that citizens are willing to comply and support.

3.1 Defining Goals for Tree Regulation

Much of the literature highlights the establishment of clear goals and purpose as integral to developing a successful tree bylaw or ordinance (Bernhardt & Swiecki, 1991; Heaviland, 2007; Nichols, 2007; NC State University Cooperative Extension, n.d.). Ideally, these goals should be driven by a higher- level plan, such as an urban forest strategy with established community-supported urban forest goals. Having data about forest cover change and tree protection issues of the community is also important to inform tree regulations (Forest Conservation By-law & Lower Tier Advisory Group, 2013). The literature describes a wide range of goals that could be used to guide the development of bylaws and potentially evaluate their success including:

- **Goals that focus on preservation**
  - Preserve beneficial stands of multiple trees
  - Preserve trees in sensitive ecosystems or on steep slopes
  - Preserve significant trees
  - Preserve mature trees
  - Preserve trees along roadways and vegetation roadway buffers
  - Prevent loss of tree canopy

- **Goals that focus on growth or replacement**
  - Establish trees in non-forested areas
  - Preserve space and soil for new trees
  - Increase canopy cover equitably
- **Goals that focus on quality and character of retained or replaced trees**
  - Maintain trees in a healthy condition through good cultural practices
  - Maintain aesthetics associated with existing trees
  - Maintain habitat values
  - Maintain species diversity
  - Maintain age diversity
  - Conserve local genetic resources
- **Goals that focus on ecosystem services**
  - Maximize the environmental, economic and social benefits provided by trees
  - Reduce the urban heat island effect and building energy use
  - Improve air quality
  - Reduced water pollution
  - Beautify neighborhoods

No single, best practice set of goals was found in the literature. It is evident that goals will vary depending on the regional context and values of each community. Larson et al. (2020) reviewed 156 landscape related ordinances (not just tree ordinances) across six US cities to capture their goals for conservation and environmental management, aesthetics and nuisance avoidance, and health and wellbeing. They found variation in the goals of ordinances based on climate and contexts. For example, wetter climates tended to emphasize stormwater management and flood mitigation, while drier regions emphasized water conservation (Larson et al., 2020). Some regions prioritized environmental services such as biological conservation and water quality protection, while others prioritized aesthetic 'neatness and order' over naturalized landscapes (Larson et al., 2020). They also found contradicting regulatory goals were common within regions and ordinances tended to overlook contradictions or trade-offs between goals; for example, emphasizing water conservation in one place but requiring irrigation to maintain healthy vegetation in another. Overall, Larson et al. (2020) concluded that coordinated, multi-objective planning with key stakeholders is important to develop ordinances with cohesive objectives and explicitly defined trade-offs.

3.2 Designated responsibility

Assigning administrative responsibility for the bylaw or ordinance is critical. Communities may designate specific positions responsible, or a citizen tree advisory board to share responsibilities (NC Cooperative Extension Service, n.d.; Nichols, 2007). In British Columbia, Councils can delegate powers, duties, and functions to a council committee, an officer or employee or another body established by Council. Specifying responsibility is especially important for a successful permitting program where it is crucial to have staff that can approve criteria, supply a permit, and enforce any mechanisms. While context specific, an agency or official must have expertise and support for the bylaw goals, and should be available throughout the process (Nichols, 2007).

3.3 Performance standards

Performance standards specify standards to be met by permit applicants and are an important aspect of effective tree bylaws (Bernhardt, 2001). Performance standards often address acceptable practices for activities such as arborist inventories and reports, tree protection, pruning, tree compensation, replacement tree planting, and maintenance (NC Cooperative Extension Service, n.d.). Municipalities should have a strategic plan for tree planting to ensure there are suitable locations to plant trees funded by cash-in-lieu (i.e., money provided by applicants in lieu of planting a replacement tree), which is when the value of a tree replacement is collected and used for a more suitable site then the original replacement site. Bernhardt (2001) identifies performance standards not aligned to goals can be a limitation to ordinances. For example, ordinances may require tree planting but do not set standards for the eventual amount of canopy to be achieved or may have more permit requirements for removing native vegetation but do not ultimately limit the maximum amount of native tree canopy that can be removed (Bernhardt, 2001). Instead, establishing standards based on a percentage of existing tree density or canopy cover can provide objective standards for assessing whether projects comply with tree regulation and will meet defined goals (Bernhardt, 2001).

Performance standards are also important for ensuring appropriate professionals are engaged by applicants. Professional qualifications for arborists can be addressed through standards such as requiring tree assessments and specification of tree protection measures that can be factored into the design process. Arborists must work with planners, architects, engineers, and contractors to ensure grading, trenching, and pruning will be compatible with preserved trees (Matheny& Clark, 1998). To meet tree management goals, consistent, professionally qualified follow-through is found throughout the literature to be a key success factor (Matheny & Clark, 1998; Nesse, 2020; Oregon State University Extension, 2009; APWA n.d.).

Most jurisdictions have standards documents that guide performance standards for tree regulations and complement professional experience. In the US and Canada, the American National Standard for Tree Care Operations (A300 standards) and the accompanying ISA best practices documents provide various standards for tree work, including for tree protection during construction (Accredited Standards Committee, 2007). Washington's Department of Natural Resources has published a best management practices guidebook for tree protection on construction and development sites for the Pacific Northwest based on these standards (Oregon State University, 2009). Other references commonly used in Canadian tree regulations include in Canada include the Canadian Landscape Standard and the Council of Tree and Landscape Appraisers Guides to Plant Appraisals.

Despite the existence of these standards, they are often voluntary, and in practice there is substantial variability in the performance standards used in tree regulations. For example, many British Columbia bylaws use a multiplier with diameter at breast height to calculate root protection areas, which is a standard practice. However, one bylaw may define the radius of a root protection area for a 50 cm tree as being 6 times DBH, or 3 metres, while another defines it as 18 times DBH, or 9 metres. The ISA provides general guidelines for the critical root zone (CRZ) calculated in metres or centimetres as 6 to 18

x DBH, with a medium tolerance, mature trees having a 12 x DBH multiplication factor. Another common rule is dripline plus 1 m. The BMPs for the Pacific Northwest recommend using both 12 x DBH and dripline plus 1 m and selecting whichever is larger to define the root protection area (Oregon State University, 2009). Consistency in the application of performance standards at a regional scale could improve clarity for applicants and project arborists who work across multiple municipalities. While standards are helpful as a baseline, it is still important to build in flexibility to enable site/tree specific decision-making by professionals within the bounds of best practices guidance.

Several industry standards and best practices are relevant to consider when developing performance standards for Canadian tree bylaws, including:

Publisher	Standard	Detail
International Society of Arboriculture (ISA)	Best Management Practices	The ISA publishes best management practices on many subjects in tree care, maintenance, and urban forestry applications. Certified arborists are encouraged by the ISA to follow all applicable best management practices.
American National Standards Institute	Z133, A300	The American National Standards Institute releases and updates the accepted industry standards for safety in arboriculture operations (Z133) and tree care (A300). ANSI Z133 covers criteria in general safety, electrical hazard, use of vehicles and mobile equipment, power tools, hand tools, climbing, and other procedures for workers engaged in arboriculture. A300 contains ten parts addressing the major aspects of arboriculture planning and practice, including pruning, soil management, tree planting and establishment, protection during construction, tree risk assessment, and integrated pest management.
Council of Tree and Landscape Appraisers	The Guide for Plant Appraisal	The Guide, now in its 10th edition, presents a widely accepted protocol for tree appraisal. Winnipeg applies the Guide when requests to remove significant trees are made under the City's Tree Removal Guidelines.
Canadian Nursery Landscape Association	Canadian Landscape Standard, Canadian Nursery Stock Standard	The Association publishes standards in common use for landscape construction and nursery stock. Winnipeg incorporates the Canadian Nursery Stock Standard into its Tree Planting and Maintenance Specification.

3.4 Flexibility

Along with performance standards, flexibility is also important to cover the variety of circumstances that may arise and support staff to use their discretion in a fair, reasonable, and transparent manner. Flexibility is important for maintaining community support for tree regulation (Nichols, 2007; Nesse, 2020). Discretion is the ability to make a choice among one or more different possible courses of action that comply with applicable legislation (BC Ombudsperson, n.d.). To avoid inconsistent use of discretion, vague terms such as 'reasonably' and 'minimal' should be avoided when creating performance

standards, and standards should not be undefined and left to the discretion of the delegated authority (NC Cooperative Extension Service, n.d.; Schwab, 2009). An example of a flexible ordinance policy is in Fulton County, Georgia which provides the permit-issuing arborist discretion to determine the location and species of replacement trees based on site-specific physical and biological factors (Nichols, 2007). Another aspect of maintaining flexibility is keeping the bylaw or ordinance as brief as possible and housing performance standards and specifications in a separate document or appendix that is also approved by council but is easier to change (Dickerson et al., 2001; NCC Cooperative Extension Service, n.d.).

3.5 Enforcement

Tree regulations need to be supported by enforcement in order to ensure compliance (Bernhardt, 2001; Yung, 2018; Schwab, 2009; NC Cooperative Extension Service, n.d.). Enforcement is authorized by the regulation but it also depends on adequate staff resources assigned to enforce the regulations (Bernhardt, 2001; Nichols, 2007; Schwab, 2009). Staff resources include the staff who administer the bylaw (e.g., landscape review, city arborists), staff who inspect site conditions (e.g., city arborists, building inspectors) and staff who are dedicated to bylaw enforcement. Broadening the range of staff who can assist with enforcement, for example swearing in urban forestry staff to issue tickets, is one way to overcome resourcing challenges (Nichols, 2007). Nichols provides a unique example to address challenges with resourcing tree enforcement from Chapel Hill, North Carolina where localities train a developer's employee to designate a person responsible for enforcement (Nichols, 2007).

Regulations can further support enforceability by including provisions that provide opportunities for oversight either by staff or qualified professionals. For example, the regulation may require staff or project arborists to provide items such as monitoring reports, inspections for tree barriers, and replacement trees (Nichols, 2007).

Penalties such as fines, forfeiture of securities, and stop work orders are often used as deterrents or punishments for violations (Bernhardt, 2001; Nichols, 2007). Penalties can also include requiring replacement trees or monetary charges for restoration. While rare and not recommended, some jurisdictions in the US allow for criminal penalties including jail terms (Nichols, 2007).

Private stewardship is also key when resources are lacking for enforcement. In the paper by Clark, Ordonez, and Livesley, the authors find private tree retention can be improved with tougher penalties alongside stronger enforcement – this can be supported by community education through stewardship engagement activities (Clark, Ordonez & Livesley, 2020). Nesse (2020) observed that laws alone cannot protect trees. The stakeholders such as developers, property owners, renters, politicians, and the public require awareness, understanding, and a willingness to participate in order to accomplish long term success.

3.6 Integration into a Comprehensive Strategy and Urban Forest Program

One common theme throughout the literature is the importance of implementing a tree bylaw alongside a comprehensive strategy such as an Urban Forest Strategy (UFS) or at minimum, alongside a community plan, such as an Official Community Plan (OCP) in British Columbia. Comprehensive plans often represent a long-term (10-20 year) vision and strategy for a community by providing a framework

for implementation of land-use regulations including zoning and subdivision codes (Schwab, n.d.). These plans help provide strategic management direction to resource managers and serve to guide the intention of bylaws that are established. Fongar et al. (2019) found that municipalities in Norway with an adopted greenspace management strategy (including urban forest strategies) have significantly higher funding allocation to these resources than municipalities with no strategy.

Clark et al. (1997) describe a model for urban forest sustainability as a means of evaluating urban forest management in three elements:

1. **Vegetation resource:** dynamic systems providing continuity of services over time.
2. **Community framework:** public and private players and institutions to govern and steer urban forest management.
3. **Resource management:** plans, policies, funding, staffing, and implementation to realize established goals.

This model is helpful in identifying gaps and the strategic actions for a sustainable urban forest strategy. Nesse (2020) observe that the implementation of comprehensive strategies is dependent on key players or champions, especially in smaller municipalities. Management may hinge on the competency and initiative of individual staff members. In larger municipalities there is greater organizational separation from managers and decisionmakers. In either case, improving knowledge of the urban forest as a vegetation resource, building an understanding of urban forestry across the community, and integrating urban forests into resource management across the organization will help to shift urban forest policy and management towards more optimal sustainable urban forest management goals (Clark et al., 1997; Fongar, 2019; Nesse, 2020). Adaptive management can be used to integrate new opportunities for participation, science, and evolving community dynamics such as environmental justice movements into a responsive management system (Lawrence et al., 2013).

3.7 Community Support

In her approach to local ordinances, Sandra Nichols explains a successful ordinance must reflect the goals and needs of the community, therefore a variety of approaches to policy formation should be undertaken (Nichols, 2007). In recent years, the literature has addressed public response and attitudes to tree bylaws. One study, conducted across four neighborhoods of Mississauga (Ontario, Canada) by Tenley Conway, examined residential attitudes toward trees and level of support for various tree policies (Conway, n.d.). The study found that while nearly all residents appreciated trees, there were lower levels of support for municipal policies that encouraged planting and restricted the removal of trees (Conway, n.d.). People were more likely to support tree policies in areas where children were present, there was higher property-level tree density, people recently planted a tree, or where people had shorter residencies. Areas with older residents had lower support for tree policies because of the perceived maintenance required. Ordonez et al. (2019) found that strategies will fail if they focus solely on increasing tree numbers and urban tree-canopy, and do not address issues of interdepartmental coordination, risk aversion, and public engagement.

Weber et al. (2020) found that residents were willing to be active participants in tree preservation and management programs, but this engagement must be meaningful. Kangas et al. (2014) find that community participatory planning processes have been most successful when complex, 'wicked' problems affecting the urban forest, like climate change, are acknowledged up front and participants from different stakeholder groups are engaged in finding reasonable solutions such as through interdepartmental coordination. A participatory process in Finland (**Error! Reference source not found.**) r educed conflict between different stakeholder groups, and a pragmatic approach (that acknowledged differing values and perspectives) reduced miscommunications in discussions (Kangas et al. 2014).

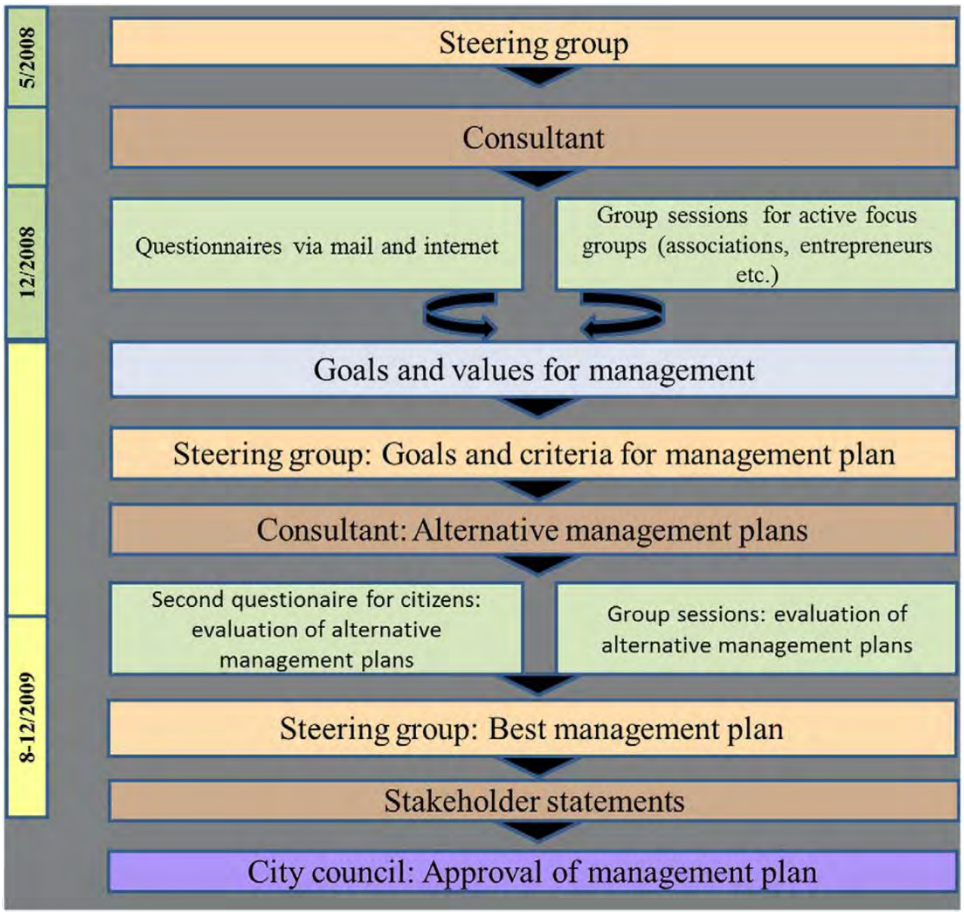


Figure 1. Participatory planning process from Kangas et al. 2014

In general, encouraging support for the urban forest may be possible using marketing, where planners and managers ''sell'' greener neighborhoods to different neighborhood-based consumer markets, building upon different groups' needs, sense of social status and group identity (Troy et al., 2007). Careful consideration must be taken to prevent community exclusion using this method, where canopy marketing could have the potential to favour affluent communities, therefore, canopy cover proportion must not be the predominant driver. It is proposed this method could involve using market segmentation to measure different lifestyle groups' preferences and motivations for various environmental behaviors, and then matching communication strategies to those preferences and

motivations in a spatially explicit context (Troy et al., 2007).

3.8 Methods of Assessing Performance

Upon implementation of a tree bylaw, Bernhardt (2001) stresses the importance of evaluating Urban Forest bylaw performance by sampling populations, using photogrammetry/remote sensing, and ground surveys. Clark et al. (1997) also specify GIS and remote sensing, along with tree inventories and urban tree canopy assessments within their performance indicators for vegetation resources. Indicators may include canopy cover, age distribution, species composition, and specific biological characteristics affecting population sustainability (McPherson, 2013; Clark, 1997). Performance assessment and monitoring are ongoing measures for adaptively managing a sustainable urban forest.

A 2010 canopy cover study in Tampa, Florida, presented a method for assessing ordinance performance using an IKONOS imagery analysis. In the study, residential areas were assessed to quantify tree loss in areas lacking regulation. The study found greater tree canopy cover on parcels with homes built post tree protection than prior to (Landry & Pu, 2010). They concluded municipalities could implement scientific knowledge to guide future bylaw creation. Baur et al. (2016) found that residents tend to support science-based management.

Qualitative assessment can be used to assess public sentiment for policies (Lawrence et al., 2013; Baur et al., 2016) using surveys, town hall meetings, and committees. However, Fongar et al. (2019) found that related or partner organizations may tend to focus on their own interests, which may not be representative of the broader community. Considering recognitional equity by reducing barriers to participation ensures a diversity of voices are heard which is important from an environmental justice perspective.

4.0 Incorporating Urban Tree Canopy into Land Use Regulation

Tree bylaws and ordinances are typically considered the most direct way to regulate trees. However, land use regulations have a significant effect on influencing canopy cover outcomes in new developments (Mincey et al., 2013b; Troy et al., 2007; Wilson et al., 2003). Hill et al. (2010) evaluated the impact of land use policies on tree canopy cover and found that tree ordinance clauses, zoning ordinances, and sustainable development practices, when implemented together, were most effective for preserving canopy cover in a community. Where tree bylaws and ordinances tend to focus specifically on regulating trees, other forms of land use regulation tend to be focused on outcomes for biodiversity, connectivity, and managing natural hazards, which are often particularly important for peri-urban forests.

4.1 Regional and Community Plans

There are various policies and tools that regulate tree protection noted throughout the literature, dependent on location. In Canada, Regional Plans and Community Plans guide the vision for land use, which is then implemented through municipal zoning and planning overlays at the finer scale. In the United States, Comprehensive Plans guide land use, which is then implemented by zoning and other ordinances.

At the regional scale, addressing ecosystem concerns can help to protect larger shared resources such as water and air quality as well as set regional canopy goals that are compatible with local canopy goals (Schwab, 2009). In BC, a Regional Growth Strategy (RGS) is an agreement across member municipalities and regional districts that aims to develop priority actions for social, economic, and environmental goals. Section 428(1) of the *Local Government Act* defines the purpose of an RGS is "to promote human settlement that is socially, economically and environmentally healthy and that makes efficient use of public facilities and services, land and other resources" (Local Government Act, 2015). While the overall goal of a RGS is to guide growth and development, goals include protecting environmentally sensitive areas and preserving, creating, and linking urban and rural open spaces including parks and recreation areas (Stewardship Centre BC, 2016). Local governments are required to include a regional context statement within their Official Community Plan (OCP) to demonstrate consistency with the RGS. As defined in Section 471(1) under the *Local Government Act,* an OCP is "a statement of objectives and policies to guide decisions on planning and land use management, within the area covered by the plan, respecting the purposes of local government." Within the OCP, policy statement(s) can be included to further address components of the natural environment (Local Government Act, 2015). Below are examples of policy provisions that can be included in an OCP to support tree protection (Columbia Basin Trust, 2015):

- Integrate green infrastructure such as urban forests throughout the community to preserve existing ecological resources, support biodiversity and reduce climate risks
- Recognize and enhance ecosystem services provided by parks and open spaces and promote planning and design that enhances biodiversity, carbon sequestration and air and water quality

- Work with adjacent municipalities, regional, provincial and federal governments, First Nations and community groups to create a network of regional parks, trails, services, and facilities
- Include parks as secondary floor areas in stormwater management planning and flood plain mapping
- Ensure new park acquisitions maximize opportunities for biodiversity protection, stormwater management, flood control, and/or other functions that increase climate resilience
- Conserve water by improving efficiency of existing irrigation systems, improving park construction standards, designing for water conservation, using non-potable water, and converting park and civic building landscapes to reduce the amount of irrigated turf where appropriate

4.2 Zoning to Preserve and Grow Urban Tree Canopy

Zoning is the most common form of regulating land use and ultimately land cover. Zoning bylaws may indirectly influence urban tree canopy through land use rules, or directly by requiring maintenance of percentage canopy cover by zone (Mincey et al., 2013b). Different zones have rules for lot sizes, setbacks, building coverage, and how land can be used, which can in turn affect land cover and where tree canopy, and environmental benefits such as urban heat mitigation and stormwater interception are distributed (Wilson et al., 2003). Planners typically administer zoning bylaws and are often in the position of having to balance demands for growth while mitigating negative environmental impacts (Wilson et al., 2003). The conversion of land from a pervious, vegetated condition into urban materials such as concrete and asphalt has numerous environmental implications including increasing surface runoff, increased heat absorption and storage, biodiversity and biomass loss, and reduction in air and water quality, which in turn have negative effects on landscape aesthetics, energy efficiency, human health, and quality of life (Wilson et al., 2003).

Studies have found that canopy cover declines significantly when median building lot coverage or housing density increases (Hilbert et al., 2019; Landry & Pu, 2010; Troy et al., 2007). Wilson et al. (2003) used remote sensing to explore the relationship between zoning and density, radiant surface temperature and normalized difference vegetation index (NDVI – presence of live green vegetation). The study found that zoning characterized by low density development had the lowest impact on surface temperatures and vegetation cover. However, since urban sprawl is considered undesirable by many urban planners, Wilson et al. (2003) used the data to make the case against spawl and located examples of lower impact development in high density zones, such as multifamily housing. Multifamily housing included developments with retained tree cover near the parcel edges and parking incorporated into the building footprint so the only impermeable cover in addition to the building parcel were access roads (Wilson et al., 2003). Despite these studies, understanding of the relationship between urban tree canopy and zoning is still not well enough understood to inform fine scale land use planning (Mincey et al., 2013b).

Recent work by Metro Vancouver found that most of the tree canopy cover in the urban areas is in “Residential – single-family detached with no secondary unit” (Metro Vancouver, 2019). “Parking” and

"Retail and other commercial" areas have the least canopy cover at 5% and most impervious surface at more than 90% (Metro Vancouver, 2019). The study also found a relationship between tree canopy cover and age since development. High density housing stock actually showed gains in canopy cover from the 1940s to 1980s. Low density housing canopy cover was relatively steady until the 1970s and then shows a declining trend up to 2000. This decline indicated that fewer, or smaller, trees were being retained or planted during construction of low density housing over time as lot sizes shrunk and demand for bigger homes increased, resulting in increased lot coverage (Metro Vancouver, 2019). The high density canopy cover trend was attributed to the 'skyscraper' boom in 1960s, 1970s, and 1980s that was characterized by tall and slender buildings with low Floor to Area Ratio (FAR), and enough space between them to preserve view corridors (Metro Vancouver, 2019). Similar to the example of multifamily housing developments highlighted by Wilson et al. (2003), this "Vancouverism" architectural model featured residential buildings that used up little lot coverage and allowed abundant greenspace, street trees and other public space at ground level (Metro Vancouver 2019). However, average canopy cover has been declining in both high density and low density housing stock in Metro Vancouver between 1980 and 2000.

Zoning is an important tool for tree preservation because it determines development type by land cover, including the permeable space that will remain on a site post-development. Additionally, zoning can independently, or in combination with overlays such as development permit areas, regulate landscaping post-development, establish requirements and guidelines for the preservation of environmentally sensitive areas, encourage the clustering or transferring of density to preserve environmentally sensitive areas, and require setbacks or buffers form other land uses (Cullington et al., 2008). These tools often determine if a tree or stand of trees can be retained with development. While a tree bylaw can strengthen tree protection, it cannot prevent development to permitted use or density according to zoning. Landscaping regulations can also be incorporated directly into zoning, subdivision regulations, and site plan regulations and cover a variety of tree measures including tree planting, preservation of trees, plantable area, required tree canopy cover, maintenance, and enforcement.

In the United States, some cities instead choose to adopt overall landscaping ordinances that support a Comprehensive Plan which includes five provisioning components including site landscaping, buffering and screening, street trees, parking lot landscaping, and tree preservation. Under the landscaping ordinance, the urban canopy can be enhanced through the site landscaping provision which requires tree cover to fulfill a city-adopted canopy cover percentage or to meet an established number of trees per dwelling unit. Trees can also be planted under parking lot provisions, typically including multi-family residential, and non-residential use – for example in Des Plaines, Illinois one shade tree must be planted for every 100 square feet of landscaped area (Bowen, 2004). Similarly, in BC, municipalities can incorporate landscaping requirements into zoning and subdivision bylaws to regulate urban tree canopy during development without enacting a tree bylaw. However, this means that trees are not generally regulated and protected except during development.

4.3 Planning for values and hazards in urban and peri-urban forest stands

Regional and community planning processes will often identify natural values and hazards related to forest stands that overlap with, but are not adequately addressed by, urban forest strategies, tree bylaws and ordinances. In the US, zoning overlays identify areas where special provisions will apply; they can be used to protect natural resources or to preserve forestry integrity. Overlays incorporated into policies such as the OCP and other strategic plans can create policies that are more targeted to managing values and hazards in urban and peri-urban forest stands than tree bylaws.

Biodiversity, and the protection of environmentally sensitive areas, is a value of forests and other ecosystems that warrants dedicated strategies and policies in order to guide its preservation and enhancement. Regional conservation strategies can be used to inform the RGS, OCP, and other government processes on enhancement strategies and goals for protection and restoring diversity in ecological areas; they can also directly impact the urban forest by setting goals to map biodiversity, acquire forest, and protect green infrastructure (Stewardship Centre BC, 2016). One example from British Columbia of a Regional conservation strategy is the Comox Valley Land Trust Regional Conservation Strategy, which outlines priority ecological and recreation areas to provide recommendations applicable to all participating local governments (Fyfe, 2008). At the municipal level, biodiversity or green infrastructure strategies can achieve similar outcomes. An urban forest strategy helps to integrate the management and protection of tree resources into the municipal policy framework, biodiversity strategies integrate green infrastructure. These strategies set environmental targets that can be integrated into community plans, zoning, stormwater management plans, and other various bylaws and legal documents (Schwab, 2009).

Wildfire is a hazard of forest fuels. In British Columbia, and in other Canadian and US municipalities, many communities have developed or are developing community wildfire protection plans. Municipalities in BC and the US can have development permit areas or overlays that are specific to FireSmart or Firewise development in the wildland urban interface (WUI). With the increasing incidence of severe wildfire and its direct impact on lives, homes, and infrastructure, management of fire and fuels within the WUI is driving many policy decisions (Barrett, 2019). Fire resilience strategies such as Firewise USA and the Community Planning Assistance for Wildfire project focus on proactive strategies to reduce flammable materials including vegetation in proximity to structures (Mockrin, 2020). Within the WUI, correlation of population density within proximity to vegetation/forest type can be used to assess fire risk (Miranda, 2019). Canopy cover and tree preservation goals in this context may conflict with fire risk reduction goals, since contiguous fuels are a pathway for fire spread. In these instances, bylaws and ordinances need to enable consistency with WUI management, through permitting removals for that purpose and ensuring that replacement trees and landscapes conform with FireSmart guidance.

Layered on top of zoning, cities can adopt planning overlays to identify land with specific management intent to align with strategic objectives for protection of the natural environment (Ordonez & Livesley, 2020). For example, in BC development permit areas can be for the:

- Protection of the natural environment, its ecosystems and biological diversity
- Protection of development from hazardous conditions
- Establishment of objectives to promote energy conservation
- Establishment of objectives to promote water conservation
- Establishment of objectives to promote the reduction of greenhouse gas emissions

Such overlays can complement tree bylaws by providing guidelines to achieve specific objectives in these areas when development occurs. It is worth noting that, while land use zones, schedules, overlays, and local laws can equate to regulatory policy mechanisms toward private tree protection, effectiveness is still limited to the capacity and resourcing of the organization (Ordonez & Livesely, 2020).

5.0 Private Tree Protection in Canada and the US

In municipalities across North America, trends suggest the majority of tree canopy falls on private property (Clark et al., 2020). In Canada, the ability of local governments to regulate tree removal and replacement is controlled by provincial legislation. As regulating private trees becomes more commonplace, municipalities are increasing the restriction of residential tree removal, with initial evidence suggesting their effectiveness at increasing and protecting canopy cover (Conway, 2010). The degree of protections provided to trees on private property varies widely by jurisdiction and local bylaws which reflect community attitudes towards associated local bylaws. The following sections describe private tree protection approaches in Canada, the United States and Australia.

5.1 Private Tree Protection in Canada

Canada's urban tree canopy declined by 1.5% between 1991-2011 – however while the national average decreased, the prairies have seen an increase in tree canopy cover on land previously lacking trees (Webber et al., 2020). It is expected that communities in forested ecoregions see a net loss of trees as forests are cleared and fewer trees are replanted with development, while prairie ecoregions see a net gain of tree cover from developer plantings in what was previously grassland.

Across Canada, the literature revealed a variety of private tree bylaws in place at the municipal level in British Columbia, Ontario, Québec, and Prince Edward Island. Provincial legislation is the acting authority that regulates tree bylaws in Canada and only some provinces have legislation explicitly regulating trees on private land.

British Columbia

In British Columbia (BC), tree bylaws are variable in their approach to tree regulation, with many applying to specific species and diameter, some applying to only heritage trees, others applying to trees 10 cm or greater but not restricting their removal, and still others applying to only certain areas within a municipality (Cullington et al., 2008). The presence of tree bylaws in BC appears to be related to population size. A review by Diamond Head Consulting looked at BC municipalities with a population of 2,000 people or more and found that approximately half of the municipalities had some form of private

tree bylaw, and municipalities over 25,000 people had a private tree bylaw almost 80% of the time. It is important to note that, despite a tree bylaw being in place, a tree is not protected if it would prevent a permitted use or development density enabled under a zoning bylaw. Limited literature exists on the effectiveness of BC's tree bylaws. Dunster (1994) examined several bylaws in BC relatively soon after provincial legislation enabled their enactment. At that time, Dunster highlighted several issues including:

- Public and political desire for strong tree protection and the potential for liability issues being created when forest trees retained were vulnerable to windthrow
- Inadequate protection during construction and maintenance after the development to ensure retention is successful
- Hazard assessments being performed by professions other than ISA Certified Arborists
- A need for post-development hazard assessments
- Lack of evidence to assess their effectiveness

Ontario

Ontario is unique in that is in the only province that explicitly identifies urban forestry in legislation through the Professional Foresters Act, Municipal Act, and Planning Act; while these policies succeed in acknowledging urban forests, they lack weight in placing significant authority onto municipalities (Barker & Kenney, 2012). Barker and Kenney in their 2012 study found that community residents are critical to elevate the quality of urban forestry programming in small communities and the public must be engaged. A study by Dr. John FitzGibbon and Sylvia Summers found that for over 50 years, the municipalities in Ontario have had authority to enact tree conservation bylaws, but penalties and enforcement of these bylaws is limited (FitzGibbon & Summers, 2002). Yung (2018) found bylaws in Ontario were fragmented across municipalities due to the scattering of urban forestry practice across public and private land. He noted several key problems, the most crucial being the variety of bylaws and non-legally binding policy, and the discretion of the municipalities to implementing a tree bylaw.

Quebec

In Quebec, the Act Respecting Land Use Planning and Development enables municipalities to regulate or restrict the planting or felling of trees in their zoning bylaw to ensure the "protection of the forest cover and promote the sustainable development of private forests" (*Loi sur l'aménagement et l'urbanisme*, chapter 19.1, section 79.1). Cities such as Quebec City regulate the removal of trees on a lot frontage or back and require the protection or replanting of trees for development projects. No literature was found that studied the effectiveness of Quebec's tree bylaws.

Prince Edward Island

On Prince Edward Island (PEI), municipalities are enabled by the Municipal Government Act to pass bylaws for "tree preservation and protection" as well as the "development and implementation of maintenance standards for trees". The municipality of Charlottetown updated its Tree Protection Bylaw

in 2019, which focuses on the protection of public trees as well as private heritage trees (>100 cm DBH). No literature was found that studied the effectiveness of PEI's tree bylaws.

5.2 Private Tree Protection in the United States

The United States loses over 70,000 hectares of urban tree canopy per year (Koeser, 2020). Multiple forms of assessment have been undertaken to evaluate current standards of tree bylaws in the United States. The most comprehensive study was completed in 2014 by Richard Hauer which analyzed over 667 communities across the United States (Hauer, 2014). The results of the study showed over 90% of municipalities had some form of tree ordinance with the five most common ordinances as follows:

- 80% have defining authority
- 77% have regulated removal of dead and diseased trees
- 70% have an approved tree list for public tree planting
- 68% required tree planting in new developments
- 60% require tree planting around new parking lots

Hilbert et al. (2019) found that heritage tree ordinances, which protect large diameter trees, were a significant predictor of higher urban tree canopy and important for canopy retention.
Additionally, the study identified that 54% of municipalities surveyed require tree preservation during development. Only 25% restrict cutting on private property and 31% identify heritage/significant trees for preservation. These numbers illustrate the patchwork of protections for trees on private property. Communities that have established canopy goals may be in a better position to influence private tree canopy as a community resource (Haur, 2014).

Ordinances differ widely between communities. State and Federal laws generally do not impact local municipal urban forestry ordinances. Some exceptions include state level requirements for stormwater retention facilities (bioswales) and trees in new hardscape installations, invasive species regulations (eg. USDA Animal and Plant Health Inspection Service (APHIS)), and the Migratory Bird Act. Natural or undeveloped areas (especially on waterways) and the peri-urban forest fall more often under state and federal regulations. Tree removal or development in these areas may be prohibited under water quality permits (EPA), the Endangered Species Act (US Fish and Wildlife Service), or archaeological/cultural preservation laws (eg., Washington Forest Practices Act).

The United States administers urban forestry policy at the federal, state, and municipal level. The US Department of Agriculture administers the US Forest Service (USFS) which delivers the Urban and Community Forestry (UCF) program throughout the US in a multi-stakeholder framework through agencies – however this does not benefit all municipalities equally as the centralization of the urban forest program does not guarantee small municipalities will be equipped to meet challenges (Barker & Kenney, 2012). Federal UCF serves largely to support individual state programs, administered by various state agencies (Colorado State Forest Service, Oregon Department of Forestry, Washington Department of Natural Resources, Massachusetts Department of Conservation and Recreation). University Extension

Services and regional urban forestry councils (e.g., Texas) comprise another level of support for communities. Research partnerships between USFS and universities or extension services are found in nine geographic regions. Private research partners include the Arbor Day Foundation, Bartlett Tree Experts, and Davey Tree Experts.

In many cases, state efforts draw on the resources of the Arbor Day Foundation for outreach and incentives. The Tree City USA program is a common thread for communities engaged in UCF at any level. Four standards of the TCUSA program offer low barrier entry with minimal requirements including:

1. Tree Board or Department
2. Tree Care Ordinance
3. Community Forest program with annual budget of, at minimum, $2 per capita
4. Arbor Day observance and proclamation

State employees tasked with UCF typically work with communities who wish to attain or maintain TCUSA status and offer support in developing tree ordinances. No specific requirements are defined for what the ordinance shall include, however a brochure is available from the Arbor Day Foundation with a framework for content (Fazio, 2017).

In summary, tree ordinances at the local level have the most impact on a community's urban forest. A multitude of guidelines, Best Management Practices, and templates are available which policymakers and managers at the local level can tailor to meet community needs. Private tree protection in the US, as elsewhere, is a sensitive subject, fraught with pitfalls if not implemented with community support. In the policy context, canopy loss can be attributed to increased development, densification, lack of understanding of trees, and lack of integrated planning and development processes. To illustrate the variety of regulatory approaches across the United States, several jurisdictions are discussed in detail below:

Florida

A particular study by Andrew Koeser evaluated the impact of Florida's recent state statute which significantly limits local government oversight of trees on private property (Koeser, 2020). Florida leads in annual tree canopy loss in the United States and is second only to Texas in impervious surface area – this is in part because opponents of tree protection and regulation see unnecessary taxation as adversarial to economic growth. While Florida was an early leader in creating provisions to oversee private tree removals (twice as likely to regulate trees on private property compared to other cities prior to new law), it is now the first state to have local oversight removed. At the time of the study, very few cities had moved to comply with Florida's new state statute. As a result, the full impact to private tree regulation had not yet been observed (Koeser, 2020).

Massachusetts

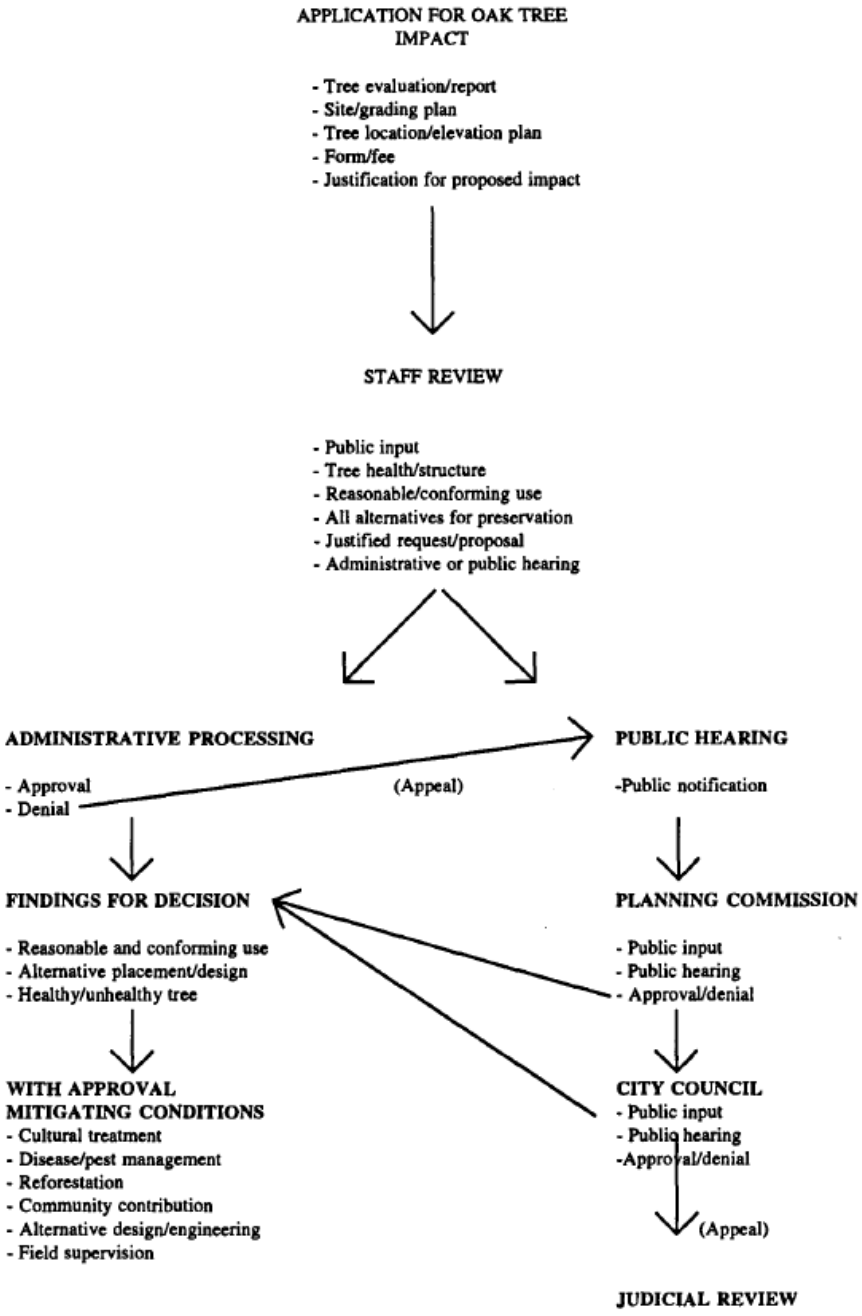
Massachusetts adopts a unique and historical approach to tree regulation through the implementation of Tree Wardens under state law (Steiner, 2010). Driven by early community support for trees, the Public Shade Tree Act was posed in 1899; the act places complete authority over maintenance, trimming, and tree removal at the hands of the wardens, requiring every municipality to have a position. The tree warden role (elected or appointed) has evolved over the years from a tree conservation focus to hazardous tree removal. The requirement of public hearings for tree alteration (except for six exemptions) has created issues and conflicts over tree damage and hazards. Adopted in 1973, the Scenic Roads Act overlaps responsibility and is implemented by the town planning board, however, this overlap can cause conflict between the controlling authorities (Steiner, 2010). Steiner recommends three advances to the Public Shade Tree Act to adapt to modern practice:

- Clarify authoritative control in the event of conflict between warden and planning board
- Clarify if trees may be removed to support efficiency of home energy systems
- Clarify appropriate level of training for wardens

California

Starting in 1972, the City of Thousand Oaks, California adopted the Oak Tree Ordinance as an Emergency City Council Proclamation – the toughest tree preservation ordinance enacted in California (Elmendorf, 1991). The ordinance was implemented following a public outcry when large valley oak trees were uprooted in an unapproved development. Citizens in Thousand Oaks demanded that oak trees were incorporated into new commercial construction and development designs. Having both staff and community on board with key objectives and a clear tree removal application system has enabled the City to protect trees. A key component to the success is the City's belief that private and public sector costs associated with enforcement and administration of the ordinance is insignificant compared to its benefits. Figure 2 below shows the method for evaluation of proposed Oak tree impact for the City of Thousand Oaks (Elmendorf, 1991).

Figure 2. Method of Evaluation of proposed oak tree impact, City of Thousand Oaks



6.0 Tools Available to Municipalities in British Columbia

There are a variety of tools available to municipalities in British Columbia for regulating urban tree canopy. The list below summarizes key tools that support tree regulation available for practitioners in British Columbia:

6.1 Acts

Local Government Act - Previously the Municipal Act, the Local Government Act recognizes the importance of all local governments including municipalities and regional districts and enables the creation of the Community Charter (BC Ministry of Municipal Affairs, n.d.).

Community Charter - Responsible for enabling municipalities to establish the below tools, the Community Charter enables Council to "regulate, prohibit or impose requirements in relation to […] trees" (sections 8(3)(c), 50 and 52). The Community Charter provides municipalities with the rights to provide services and develop bylaws including the development of Tree Bylaws and Official Community Plans, however, it does not include the City of Vancouver which has its own legislation *Vancouver Charter* (Government of British Columbia, 2020).

6.2 Regional Level Tools

Regional Growth Strategies (RGS) – Regional Growth Strategies are an agreement across municipalities on the future region, population and employment projects, actions proposed, and targets, policies, and actions for the reduction of greenhouse gas emissions (Local Government Act, RSBC 2015, c 1, 2015). The RGS aims to protect environmentally sensitive areas by detailing the means of green infrastructure protection and as defined in Section 429 of the *Local Government Act*, must cover a period of at least 20 years. The RGS can also include regional visions, raise the profile of regional issues to initiate discussion, and provide mechanisms for coordinating regional action through mapping sensitive ecosystems, committing to acquiring sensitive ecosystems, and designating urban containment boundaries (Stewardship Centre BC, 2016).

Regional Conservation Strategies (RCS) - Governed by the Local Government Act, the Regional Conservation Strategy (RCS) aims to enhance biological diversity in a region and protect and/or restore ecologically significant areas through establishing mapping frameworks to identify goals for protection. The RCS can be part of the Regional Growth Strategy or Official Community Plan (Stewardship Centre BC, 2016).

6.3 Municipal Tools

Official Community Plans (OCP) - The Official Community Plan (OCP) is a comprehensive plan that can include environmental protection policies. They can also define settlement patterns to guide development and avoid sprawl, map key areas, and designate Development Permit Areas and guidelines for Development Permits responsible for tree protection and replacement (Stewardship Centre BC,

2016). OCPs can establish goals and indicators related to preserving and growing a community's urban forest and support the implementation of community-supported bylaws and policies for that purpose.

Neighbourhood Plan – Adopted as an amendment to the Official Community Plan, the Neighbourhood Plan is a helpful accompanying policy tool to set targets for canopy cover, policy objectives, and character elements of importance. This scale enables additional consideration to local land use and neighbourhood context. Neighbourhood Plans can further define Development Permit Areas for protection of sensitive ecosystems and identifies green corridors (Stewardship Centre BC, 2016).

Development Permit Areas (DPAs) – Development Permit Areas (DPAs) can define land with a specific management intent to align with strategic objectives for protection of the natural environment. They can also provide local governments with site control over layout and design with the intent of limiting development for protection of the natural environment. Land must not be subdivided, or construction started unless a development permit is obtained (Columbia Basin Trust, 2015). Environmental Development Permit Areas (EDPAs) are permit areas specifically to protect sensitive ecosystems and prohibit disturbance activities to trees during development (Stewardship Centre BC, 2016).

Tax Exemptions and Conservation Funds – Supported through the Tax Exemption and Conservation Funds Community Charters, the funds can encourage landowners to protect and maintain natural areas (Stewardship Centre BC, 2016).

Security and Covenants – To prevent developers from damaging Environmentally Sensitive Areas (ESAs), a security deposit can be held and used to restore trees and damaged landscaping. Security and covenants are often managed through the Community Charter, under the Local Government Act, and Land Title Act (Stewardship Centre BC, 2016).

6.4 Bylaws

Zoning Bylaws –Allow for development to be directed away from sensitive ecosystems to help maintain green infrastructure by setting lot sizes and requiring buffers between new development; they can also allow a developer to seek a density bonus in return for protection of green infrastructure (Stewardship Centre BC, 2016). Zoning bylaws also enable the removal of trees to allow for permitted use and drive the extent of impervious cover.

Landscaping Bylaw- Regulates larger scale activities across different scales to specify planting and native species requirements. Tree and watercourse protection are often included in standalone bylaws and in Environmental Development Permit Area (EDPA) guidelines (Stewardship Centre BC, 2016).

Tree Bylaw – Sets standards for homeowners and developers for tree protection and replacement with a general goal to regenerate and enhance the urban forest. Can be a pathway to public education and is the most direct way to administer tree protection (Stewardship Centre BC, 2016). The Community Charter (Division 7 - Authority in Relation to Trees) places certain restrictions in relation to the authority

to regulate trees. Notably, a tree bylaw would not typically apply to a parcel (or part of it) if it would prevent permitted uses or development density under the applicable zoning bylaw.

Watercourse Protection Bylaw – Regulates specific activities and development in riparian setback areas directly related to water quality and can provide protection of these trees to manage infiltration requirements (Stewardship Centre BC, 2016).

Rainwater Management Bylaw – Can support the planting of trees and bioswales as an infiltration strategy that can require developers to minimize changes to water flow during construction, often through the protection of vegetation (Stewardship Centre BC, 2016).

Screening and landscape Bylaw – Can require the use of screening or landscaping to preserve, protect, restore, and enhance the natural environment. They can also prevent hazardous conditions for example, requiring specific plant types in a wildfire hazard area.

Soil Removal and Deposit Bylaw - Often called sediment and erosion bylaws, these bylaws regulate grading, soil removal and deposition, soil storage, and erosion control guidelines during development which can impact trees (Stewardship Centre BC, 2016).

Pesticide Use Bylaw - Controls pollution from pesticides into sensitive ecosystems (Stewardship Centre BC, 2016).

Invasive Species Bylaw – Maintains sensitive ecosystems and controls noxious plans that may impact urban forest stands and plantings (Stewardship Centre BC, 2016).

6.5 Urban Forestry Specific Tools

Urban Forest Management Plans (UFMP) - A UFMP is a defining document that outlines the vision, criteria, and actions for the management of the urban forest. They can address themes such as tree maintenance, planting, climate change, social and educational opportunities, policy and administration, economics, and temporal-spatial time frames (Ordonez, 2013).

Stewardship Programs – Stewardship programs are an educational outreach tool that can include initiatives and groups dedicated to care of the urban forest. Stewardship groups can focus on aspects of tree maintenance, planting, and community education (Schwab, n.d.).

7.0 Conceptual Model for Comprehensive Canopy Regulation for Municipalities in British Columbia

The graphic on the following pages describes how the regulatory tools enabled by BC's institutional frameworks that can be used to protect or grow different types of urban forest canopy.

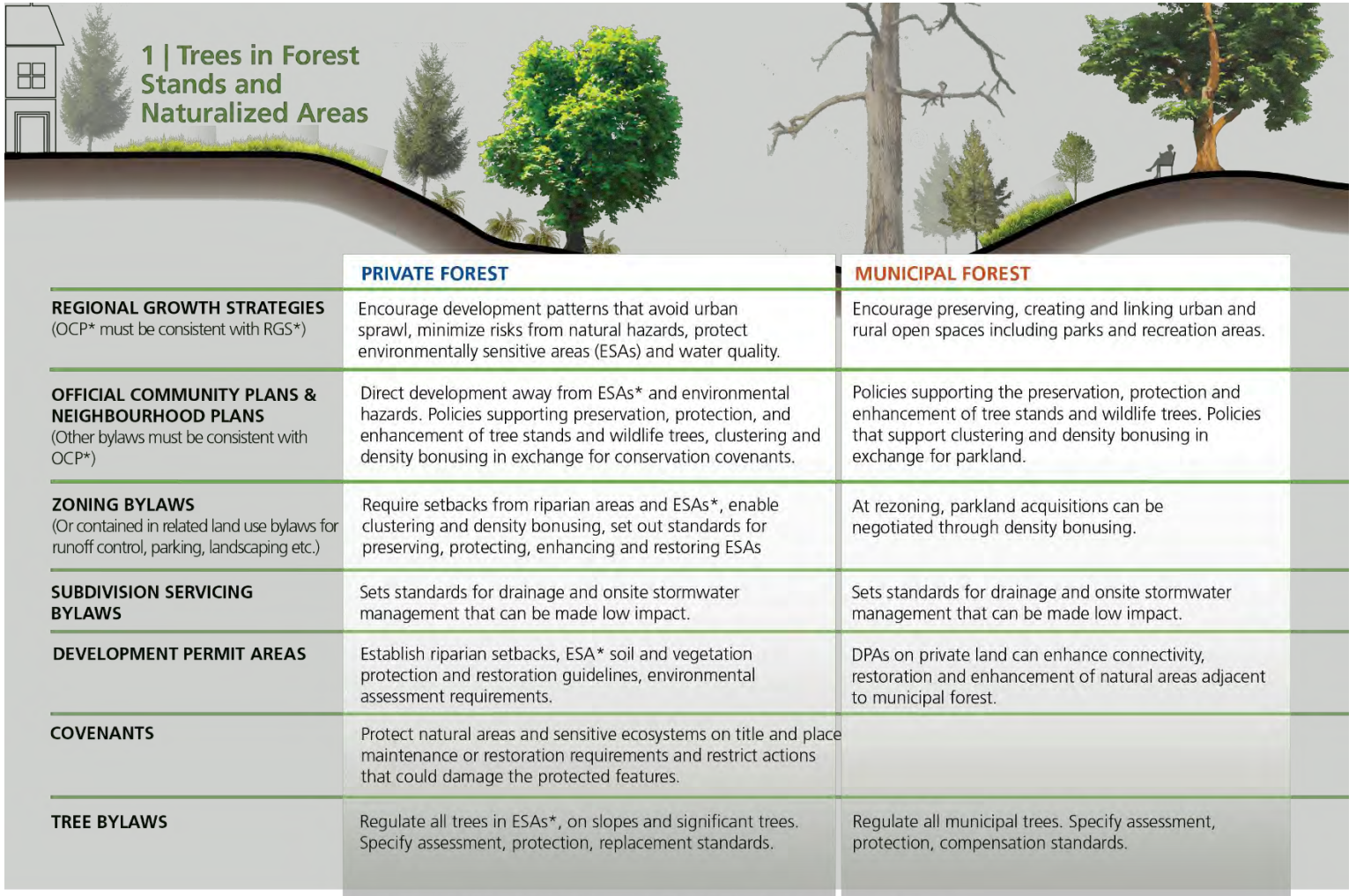


Figure 3. Key regulatory tools in BC that can be used to protect or grow urban forest canopy types (con't on the next page).

MUNICIPAL STREET & PARK TREES	PRIVATE YARD TREES	PRIVATE TREE IN A DEVELOPMENT
Develop settlement patterns that minimize the use of automobiles and encourage walking, cycling and the efficient use of public transit.		
Policies and targets supporting parkland amenity contributions, new parkland, expansion of the urban forest, treed character of streets and areas, integration with goals such as stormwater management, biodiversity, energy conservation and walkability.	Policies supporting the treed character of new landscaping in land uses and neighbourhoods.	Policies and targets supporting tree and canopy retention, protection and enhancement.
At rezoning, negotiate amenity contributions for new parkland. Require setbacks of above and below ground structures, signage and weather protection favourable for street trees.	Require lot sizes, trees per lot, impermeable/ permeable cover, off-street parking, screening | and landscaping, favourable to yard trees.	IMPORTANT: The tree bylaw may not apply to the extent necessary to allow a permitted use or density.
Set standards for boulevard trees, spacing, soil volume, planting standards, access, utilities favourable for street trees.	Set standards for access and utilities placement favourable to yard trees.	Set standards for access and utilities placement favourable to retaining private trees.
	Promote energy conservation, water conservation and reduction of greenhouse gas emissions using trees.	
		Protect trees or tree groups on developing properties, place maintenance requirements and restrict actions that could damage the protected features.
Regulate all municipal trees. Specify assessment, protection, compensation standards.	Regulate certain trees and require a minimum number of trees/canopy per lot. Specify assessment and replacement standards.	Regulate certain trees and require a minimum number of trees/canopy per lot. Specify assessment, protection, replacement standards.
Tree types: Forest stands and naturalized areas | Urban trees		**Jurisdiction:** Public | Private

For a municipality considering the appropriate regulatory tool/s to select, the Lawrence et al. (2013) model of integrated urban forest governance provides a helpful framework for identifying factors that are important to the decision:

1. **Context:**
    - What are the urban forest canopy types (see Figure 3 on previous page) that are the target of canopy preservation or growth?
    - What level of administration and enforcement effort can be supported by the population size?
    - What level of regulation would align with community values?
2. **Institutional frameworks:**
    - What types of policies, plans and regulations are already in place and how could they be enhanced or complemented with updates or new regulation?
    - Are new policies or plans required to support new regulation?
    - What urban forest canopy or tree targets exist in policies and plans, and can the new regulation be used to achieve them?
3. **Actors and coalitions:**
    - Who are the key stakeholders who need to be consulted?
    - Who needs to support the decision and who will make the final decision?
4. **Resources:**
    - Will funding and staffing need to increase to support the new regulation?
    - What new technical information need to be provided to internal and external stakeholders?
    - Can other policies, programs or staff be able to support implementation of the changes?
5. **Processes:**
    - What are the narratives, conflicts and framing that justify the changes being made?
    - What are the specific ways that actors and stakeholders will be consulted, engaged, involved and empowered in decisions and implementation?
    - How will success be measured and reported in relation to targets?

8.0 Conclusion

A review of the available literature has provided insight into the variety of tree protection methods and their successes and limitations. The literature provides guidance for creating effective tree regulations, including the importance of supporting bylaws with adequate resources for compliance and enforcement, as well as implementing tree bylaws alongside comprehensive plans and strategies, and other regulatory tools and stewardship programs. While there is no one size fits all approach, there are best practices that could improve performance standards. Community engagement is key both to support tree protection efforts, and to develop a bylaw that meets the needs of each local community.

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Appendix 3. Worksheet to Review Higher-Level Plans

Higher Level Planning Tools: Official Community Plan (may also include neighbourhood plans and urban design guidelines)

Does your plan contain a policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
A clearly defined vision that, at the highest level, supports the importance of trees and forests to the community						
The connection between human health and well-being and forests and trees						
Aligning urban forest strategies with transportation, park, and climate plans						
Supporting development and implementation of urban forest and biodiversity conservation strategies						
Natural Environment						
Strategies that support urban forest goals and operational targets including tree canopy extent, planting targets, condition, and distribution, ecosystem services and urban forest system vulnerabilities						
Best management practices for the planting, establishment, maintenance, protection, risk management, and removal of trees						
Protection of significant trees or stands of trees						
Maintaining or enhancing the ecological viability of the urban forest, including supporting a diversity of forest types and a minimum widths/size of retention areas						

Does your plan contain a policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Maximizing the retention of existing vegetation and soils through development and infrastructure projects						
Design of new developments to prioritize protection of environmentally sensitive areas identified in a Natural Environment Development Permit area						
Maximizing the retention of existing native vegetation and restoring native vegetation wherever possible during site development in environmentally sensitive areas identified in a Natural Environment Development Permit area						
Provincial or regional conservation planning and priority-setting efforts to conserve biological diversity and protect threatened and endangered species and ecosystems						
An ecosystem-level approach to ecological planning and management to ensure the ongoing function of environmentally sensitive areas, establishment and/or retention of ecosystem connectivity corridors and the preservation of species at risk						
Strategies to manage and protect rivers, streams, lakes, wetlands, other water bodies, and riparian areas, and to manage stormwater						
Strategies to maintain and improve biodiversity through the establishment and preservation of ecosystem connectivity corridors						

Does your plan contain a policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Integrated management options where appropriate, such as prescribed fire, rotational grazing, and natural regeneration to increase forest health and vitality						
Strategies to restore critical habitat and culturally significant vegetation						
Incentives for voluntary environmentally sensitive area protection including allowing increased height and density on the balance of the subject property, transferring density to another property, trading land, purchasing land, offering grants-in-aid, or granting tax exemptions						
Requiring land use and development projects to have "no net loss" of natural ecosystems and their functions as determined through environmental assessment for properties identified in a Natural Environment Development Permit Area, and pursuing net gain overall						
Mitigation sequencing of management actions that could harm trees or habitats by first trying to avoid impacts through siting and design, mitigate impacts where possible, or compensating if the loss is unavoidable						
Compensation requirements for unavoidable losses of trees or habitat						

Does your plan contain a policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Stewardship of environmentally sensitive areas on private property through conservation tools such as conservation covenants, land trusts and eco-gifting						
Tools to protect environmentally sensitive areas including dedicating land, returning to Crown Land, covenants, density bonusing, cluster housing, amenity contributions and adequate setbacks						
Initiatives, policies, outreach, or public assistance strategies that encourage private landowners to replace trees that have died or been removed						
Equity						
Equity in planning decisions and resource allocation in the community to ensure that forests and trees are preserved and protected in all neighbourhoods regardless of social, ethnic, or economic demographics						
Strategies to ensure equitable distribution, access and utilization of urban forests, parks and greenspaces						
A commitment to recognize and respect the rights of Indigenous Peoples, including the use of available resources and information to identify the Indigenous Peoples whose rights may be affected by the organization's urban forest management activities,						

Does your plan contain a policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
recognition of the established framework of legal, customary, and traditional rights such as the Calls to Action from the Truth and Reconciliation Commission and the United Nations Declaration on the Rights of Indigenous Peoples						
Inclusive community engagement, diverse partnerships, equitable protocols, and targeted programming to ensure that forests and trees are planted, preserved, and protected in all neighbourhoods regardless of social, ethnic, or economic demographics						
Land Acquisition						
The acquisition of new parks and protected areas						
Connectivity between parks and public spaces						
Partnerships to acquire and deliver parks and public spaces						
Climate Resilience						
Designing the community to be more resilient to a changing climate including protecting natural areas and habitats, increasing park space and tree canopy cover, and reducing energy consumption by building energy-efficient neighbourhoods						

Does your plan contain a policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Green infrastructure strategies to mitigate the effects of urban heat islands, ecological disruption, and social/economic disruption due to climate change						
Encouraging collaboration with Indigenous Peoples to incorporate Indigenous knowledge into climate action						
Encouraging the community to take action to mitigate and adapt to climate change						
Investing in trees and green infrastructure to mitigate and adapt to a changing climate on public land, in urban centres, and in new development						
Encouraging the use of adaptive management strategies in municipal operations to cope with uncertain climate conditions						
Reducing the risk of invasive species and diseases in sensitive ecosystems and where they threaten public health, the economy and the environment						
Urban Design						
Land use-specific guidance protecting and integrating nature and greening, including tree planting in both the public and private realm						
Form and character development permit areas that provide guidelines for incorporating high-quality landscape, and streetscape design to support livability, sustainability, and a sense of place						

Does your plan contain a policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Form and character development permit areas that provide guidelines for the design of streets and open spaces, create visual interest, comfort, and safety for pedestrians, and positively contribute to urban ecology and stormwater management (see Toolkit section 5.2.1 for more details on the use of form and character landscaping guidelines)						
Form and character development permit areas that provide guidelines to ensure the provision of adequate servicing, vehicle access, and parking while minimizing adverse impacts on the comfort, safety and attractiveness of the public realm						
Neighbourhood or area plans that guide future development in an area, including the locations of parks and public spaces and development standards to provide a link between the high-level planning found in an Official Community Plan and the regulatory detail of a zoning bylaw						
Public realm design guidelines that describe outcomes expected for urban centres, including public realm typologies, streetscape components, and expectations for the standard of trees, soils and materials installed in the public realm						

Appendix 4. Worksheet to Review Land Use Bylaws and Development Permit Areas

Planning Tools: Zoning bylaw, landscape and screening bylaw, form and character development permit areas, climate change and energy conservation development permit areas, and development procedures bylaw

Does your plan contain policy directions that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Landscaping Standards[1] (Toolkit section 5.2.1)						
RECOMMENDED COMPONENTS – Number of trees:						
Tree density requirement by zone or development type, aligned with selected canopy cover targets						
In surface parking lots associated with commercial, industrial, or office uses, a planting requirement of 1 tree per number of parking spaces (e.g., one tree for every 5-6 parking stalls)						
Between land uses, landscape and screening buffers 3 m or larger to accommodate larger tree species						
RECOMMENDED COMPONENTS – Planting standards:						
Tree size requirements establishing no more than 25% small trees at maturity, no less than 50% large trees and medium trees at maturity to make up the difference						

1 These outcomes could be required in zoning or included as guidelines in a development permit area.

Does your plan contain policy directions that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
A minimum soil volume per tree that is adequate to support its growth to a healthy, mature size, -- modified for single tree soil volume versus shared tree soil volume						
Reference to meeting or exceeding the Canadian Landscape Standard for installation and maintenance						
Trees species selection from an approved list, and/or reviewed and approved by the local government						
ADDITIONAL OPTIONS:						
Green standard/factor score or sustainability checklist that promotes tree retention (particularly trees of high value to the community or growing in sensitive ecosystems) or planting						
Form and character development permit area landscaping guidelines that support mature trees and forest stand retention and tree planting to achieve community goals (e.g., native plantings, placemaking, shade, energy efficiency, stormwater management) and grow healthy trees						
Guidelines for tree planting for passive solar gain and cooling to reduce energy consumption						
Pervious Surface and Lot Layout Requirements (required in zoning; Toolkit section 5.2.2)						
RECOMMENDED COMPONENTS – Planting area requirement:						
Consolidated pervious areas required by zone or development type aligned with selected canopy cover targets						

Does your plan contain policy directions that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Or, in low-rise housing zones, a minimum pervious area requirement of a size sufficient to provide 35 m^2 per tree as aligned with the selected canopy cover targets						
In zones or land uses with high surface coverage, engineered solutions (i.e., soil cells, structural soil) to achieve soil volume under impervious surfaces or above a structure						
RECOMMENDED COMPONENTS – Building setback for trees:						
At least one setback larger than 3 metres, (preferably larger) in the front or rear to make space for tree planting in the ground, except where smaller setbacks are the preferred design outcome, and the public realm frontage will accommodate large trees (see Toolkit section 5.3.2)						
In zones other than low-rise housing, consider applying setbacks to underground structures, except if boulevard width and location compensate for smaller setbacks (see Toolkit section 5.3.2)						
ADDITIONAL OPTIONS:						
The maximum site coverage retains sufficient pervious surface to support the target tree density						
Parking requirements minimized to allow sufficient pervious surface or parking is built with pervious materials to allow soil volume under the surface						

Does your plan contain policy directions that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Negotiated Development (Toolkit section 5.2.3)						
Use of amenity density bonusing to protect environmentally sensitive areas, supported by a sustainability checklist or green factor incentive that provides credits based on desirable tree retention or planting in exchange for additional development floor area or density (see section 5.2.1 for examples of green factor scoring systems)						
Comprehensive development zones integrate the relevant requirements to maximize the retention of existing environmental assets, such as setbacks, site coverage, and clustering						
Development Procedures (Toolkit section 5.2.4)						
RECOMMENDED COMPONENTS – Delegated minor variances						
Delegated minor variances are enabled and define the setback, height, and parking variances that applicants must consider retaining significant trees						
PROCEDURAL CONSIDERATIONS						
A requirement for a survey by a BC Land Surveyor that includes the location of existing trees, protected areas, or natural areas, water bodies and water courses as part of an initial application						

Appendix 5. Worksheet to Review Development, Subdivision, and Servicing Bylaws

Planning Tools: Development, subdivision and servicing bylaw

Does your plan contain policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Procedural Considerations (Toolkit section 5.3.1)						
A requirement for a survey by a BC Land Surveyor that includes the location of existing trees, protected areas, or natural areas, water bodies and water courses as part of an initial application						
Security or bonding for works and services including landscaping, with return subject to local government verification of total performance of works and services						
Option for the applicant to provide a cash payment alternative for the local government to perform the works and services including boulevard construction and tree planting as part of a broader frontage works construction program						
Requirement of a Landscape Architect to undertake the design, inspection, testing and record keeping of landscaping requirements						

Does your plan contain policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Procedural Considerations (Toolkit section 5.3.1)						
RECOMMENDED COMPONENT – Minimum boulevard width for trees:						
Works and service level requirements, and supporting schedules, that require boulevards of sufficient width to support tree planting (>1.5 m without utilities in boulevard, >2.0 m with utilities sharing boulevard), landscaping and trees as standard for most road classifications						
Boulevard located between the curb and sidewalk if seeking canopy closure above the street						
Landscaping Criteria, Standards, and Specifications (Toolkit section 5.3.3)						
RECOMMENDED COMPONENT – Landscaping:						
Requiring a minimum number of street trees based on species size and spacing per linear frontage, encouraging preferred tree size/canopy cover target outcomes by road classification						
Selection and siting of urban trees in pavement to eliminate long term above-ground and below ground conflicts with utilities, buildings and structures, and pedestrian and vehicular traffic						
Tree planting setback distances from intersections, streetlights, utilities, etc. do not prohibit tree planting in most streetscapes						

Does your plan contain policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Requiring a minimum soil volume per tree that is adequate to support its growth to a healthy, mature size						
Specifying the basic sod boulevard and median treatments and defining where treatments will be varied based on location (e.g., adjacent to commercial properties, urban centre development permit areas, streetscape improvement plan areas) to provide hard surface materials, soil cells to extend soil volume under hard surfaces, or other landscaping						
Trees and plant species selection from an approved list, and/or reviewed and approved by the local government						
Continuous tree planting trenches encouraged						
Root barriers used when tree pit or boulevard opening width is less than 2 metres						
Irrigation installed where needed and when boulevards are covered with hard surface materials that are not permeable						
Alternatives to tree grates are provided (e.g., bonded gravel, compacted sand)						

Does your plan contain policy direction that addresses the following?	Yes	No	Partially	N/A	Priority to Update?	Notes for update:
Construction standards require at least 1 year of maintenance post-planting and a landscape completion certificate prior to acceptance by the municipality						
Supplemental standards to MMCD detail growing medium composition and depth (minimum 0.6 m to preferred 1 m), options for reuse of native topsoil, compost, structural soil, soil cells, planting standards for landscape trees, riparian and restoration planting, stock quality and irrigation systems						
Encourages underground utilities to be aligned and buried to provide a continuous 1 m deep utility-free trench beneath tree planting locations. When the distance from the property line to utilities is insufficient to accommodate a utility-free trench, the difference should be provided as a statutory right-of-way on the adjacent property						
ADDITIONAL OPTIONS:						
Provides standards to enable solutions to maximize retention potential, planting space and quality for tree health, such as perforated curbs curb bulges, suspended slab sidewalks or bike lanes, permeable pavement, and siting responsive to site conditions						