4 The Future of the Public Urban Forest

This section covers the challenges and opportunities that will shape the future of Richmond's public trees, and describes how the City's management practices can be adapted in response.

4.1 Climate Change and Forest Health

Climate change projections for the Metro Vancouver Region predict an average annual temperature increase of 3°C in the 2080s (Metro Vancouver, 2016). As climate changes, the management of Richmond's public trees will have to be altered and adapt to the new reality.

Several conditions important for future tree growth are presented in the table below. The values reported are averages for Metro Vancouver but are similar for Richmond, which has lower average precipitation and warmer average temperatures than other parts of the region.

Climate variable	Past (1971 - 2000)	2080s projected* (2071 - 2100)
Extreme maximum temperature	30°C	37°C
Duration of dry spells	21 days	29 days
Summer precipitation	206 mm	147 mm
Frost days	79 days	17 days
Growing season length	252 days	331 days

* Projected change is based on modelling for Metro Vancouver using the Intergovernmental Panel on Climate Change's Representative Concentration Pathway 8.5 scenario (RCP8.5), which assumes there is no coordinated effort to reduce global greenhouse gas emissions by the end of this century (or "Business as Usual"). In producing its Climate Action Plan, Richmond used RCP2.6, which assumes global greenhouse gas emissions will peak by 2020 and decline thereafter.

What does this mean for Richmond's trees?

Based on work completed to assess the risk and vulnerability of the region's urban forest (Metro Vancouver, 2017), Richmond's urban forest is likely to experience:

1. Reduced growth and increased mortality due to...

- Reduced water availability and increased length of drought in summer.
- Waterlogging of soils and localized freshwater flooding within City parks in fall, winter and spring.
- Longer wildfire seasons and an increased frequency and duration of wildfires.
- More hot days that exceed species specific growth optimums.
- More frequent and severe pest outbreaks and variety of pests.
- Ongoing windstorms and severe weather events.

2. Increasing diversity of species tolerant of Metro Vancouver's climate due to...

- Longer growing season, milder winters and fewer damaging frosts.

Most tree species that occur in Richmond today are expected to be able to persist in a changing climate. However, climate change will place more stress on trees.

How can we adapt trees in Richmond's urban areas?

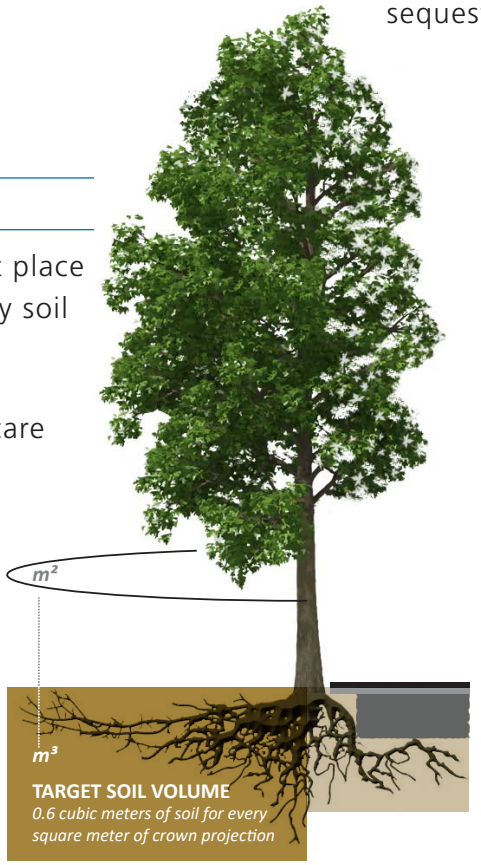
Richmond's urban forest will be less vulnerable to climate change if the following recommendations are implemented:

- Plant species well suited to both site and future climate, and trial new species.
- Provide planting sites that maximize permeability, soil volume and quality.
- Provide adequate water to young trees and, where possible, irrigation of street trees adjacent to new development sites.
- Promote strong branch structure by pruning trees when young and regularly throughout their lives.
- Protect public trees from the impacts of construction activities.
- Mitigate impacts to and from private utilities and civic infrastructure.
- Monitor and adapt management to changes in urban trees, natural forests and peat bogs.

Implementing these adaptation measures will create more resilient urban forest population. A healthy urban forest will complement the City's adaptation efforts by providing cooling refuges, absorbing rainwater and preventing erosion, reducing air pollution, buffering severe wind and sequestering carbon.

Low vulnerability

- Right species and right place
- Adequate, good quality soil volume
- High permeability
- Adequate young tree care and proactive pruning
- Tree protection



High vulnerability

- Wrong species or wrong place
- Above and below ground conflicts
- Low soil volume or compacted soil
- Low permeability
- Inadequate maintenance
- Inadequate tree protection

Tree graphic from Metro Vancouver's Urban Forest Climate Adaptation Framework (Metro Vancouver, 2017)

4.2 Parks and the Ecological Network

Parks and Open Space

Development and management of Richmond's park and open space system is guided by the 2022 Parks and Open Space Strategy (POSS). This Strategy can support POSS outcomes by:

- Managing a high value and resilient urban forest in parks to maximize ecosystem services.
- Connecting the City's green network to create a healthy and resilient city-scape.
- Protecting and enhancing soils, trees and green infrastructure to improve the City's sustainability.
- Diversifying and transforming the management of resources.

In turn, parks and open spaces play an important role for implementing this Strategy by providing space to plant more trees, room to grow large trees, and provide a more stable environment for trees to reach maturity. Parks also provide more opportunities for habitat and biodiversity where shrubby understories, downed wood and snags, and mostly native species can be supported. In natural areas ecosystem processes like nutrient cycling, windthrow and vegetation succession can often be left to occur with limited management intervention.

Ecological Network

Ecologically valuable areas in Richmond have been defined as part of the Ecological Network (EN). This includes larger areas such as Richmond Nature Park, Terra Nova Rural Park, Sturgeon Bank, South Arm Islands, and smaller areas such as parks, school yards, fields and meadows. These areas support habitat for birds, insects and wildlife, including migratory shorebirds and waterfowl, and salmon.

This system of natural areas, as well as developed parks and greenways and green infrastructure, are the basis of the Ecological Network (EN). The connectivity of each area is a key success factor to creating a healthy and viable corridor for habitat health and vitality.

The protection and enhancement of the EN enriches the health and livability of Richmond and provides access to nature within increasingly urban neighbourhoods. The EN also plays an important role in increasing Richmond's resilience to climate change by providing ecosystem services like flood mitigation, carbon storage, supporting biodiversity and enabling natural processes to occur. Along with mature trees, understory plants and soils

The components of the EN are defined below and on the map as:

Hubs: natural areas greater than 10 hectares. Capable of supporting entire and diverse populations of animals and plants associated with ecological functions.

Sites: smaller, non-linear areas of natural ecosystems providing "stepping stones' as connections between hubs.

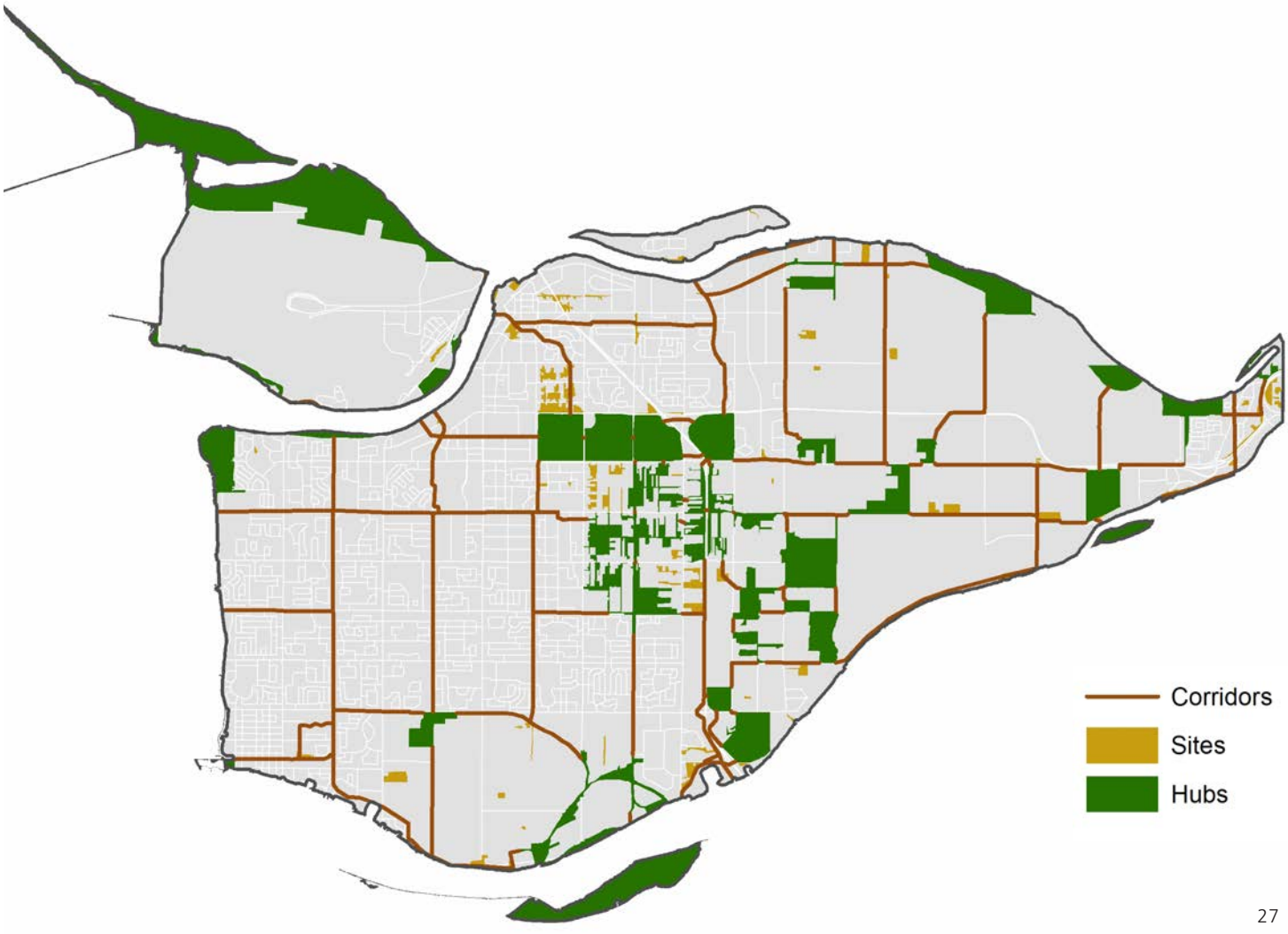
Corridors: linkages that facilitate movement of species, water, nutrients and energy between hubs and sites. Urban forest canopies add to the connectivity of corridors.

Additionally, Riparian Management Areas (RMA) are a critical component of Richmond's Ecological Network. These sites are often located in setback areas straddling both public and private land in and around watercourses, where trees form a major portion of the structure of valuable habitats.

The urban forest occurs in and around the Ecological Network, and the Public Tree Management Strategy can integrate the goals and objectives of the Ecological Network on public land by:

- Increasing tree cover along corridors and buffering the edges of hubs, sites and City-owned lands generally to enhance ecological connectivity and habitat.
- Increasing the use of green infrastructure on boulevards in developing and redeveloping neighbourhoods to reduce runoff, improve water quality, and encourage the use of native plants.
- Retaining and enhancing tree cover and vegetation.
- Retaining and enhancing permeability and soils for water filtration and storage.
- Encouraging restoration and enhancement of vegetation and wildlife habitat and features.
- Enabling urban forest stewardship initiatives.

Map of Ecological Network Components



4.3 Integrated Rainwater Management and Flood Protection

Lulu Island, being relatively flat and on average one metre above sea level, relies on dikes to prevent flooding. Runoff is managed by either draining water with gravity or pumping it out during high tides. Richmond's drainage system has been carefully engineered and includes channelized watercourses, sloughs and ditches. The dike system prevents flooding during high water levels and will be upgraded to adapt to projected sea-level rise. Three key documents guide the management of stormwater and flood protection in Richmond:

1. The Flood Protection Management Strategy.
2. Dike Master Plans.
3. The Integrated Rainwater Resource Management Strategy.

Flood Protection Management Strategy

Under the City's Flood Plain Designation and Protection Bylaw, construction grades are raised to protect habitable space from flooding. Grade changes often have adverse impacts on existing tree health as a result of construction impacts and changed groundwater behavior. Planning for public tree planting must also avoid, where possible, locations subject to future grade changes.

Dike Master Plans

Council adopted Dike Master Plan Phases 1, 2, 3 and 5. The City is currently developing Dike Master Plan Phase 4. Trees are not recommended for planting within the dikes structure, as they compromise the structural integrity of the dike and restrict access for maintenance. The Strategy acknowledges that some trees will likely need to be removed for dike upgrades and that trees will not be planted within the dike structure. Any tree removals associated with dike upgrade projects will be replaced elsewhere in the city.

Integrated Rainwater Management

Richmond's Integrated Rainwater Resource Management Strategy (IRRMS) is focused on minimizing the negative impacts of future development on drainage infrastructure and ecological health, reducing potable water use, addressing sedimentation issues, and supporting the City's Ecological Network. The IRRMS goals and strategies are closely aligned with those of the Public Tree Management Strategy in that they address habitat quality, impervious surfaces and enhancement of green infrastructure to increase ecosystem services and rainwater infiltration.

This Strategy can complement implementation of the IRRMS goals and strategies by:

- Encouraging rainwater harvesting and reuse as alternatives to potable water use for irrigation of trees and vegetated landscapes.
- Selecting trees with drought tolerance traits.
- Prioritizing tree planting and forest restoration within the Ecological Network.
- Encouraging use of green infrastructure for rainwater management on public lands.

4.4 City Trees Operations

City trees need management to maintain a healthy and safe urban forest that benefits the community. Operational costs are higher in the first few years of a tree's life and decrease as trees mature. Costs increase again when trees become stressed or over-mature. As illustrated in the graphic below, maximizing tree health and life expectancy is important for two main reasons:

1. The longer a tree stays healthy in the landscape, the less often the City incurs the high costs of removal and replanting.
2. Ecosystem services benefits grow as trees mature. The longer a tree lives, the longer it produces maximum benefits.

Maximizing both the establishment success of young trees and the healthy life-span of mature trees is the best way to delay removal and replanting.

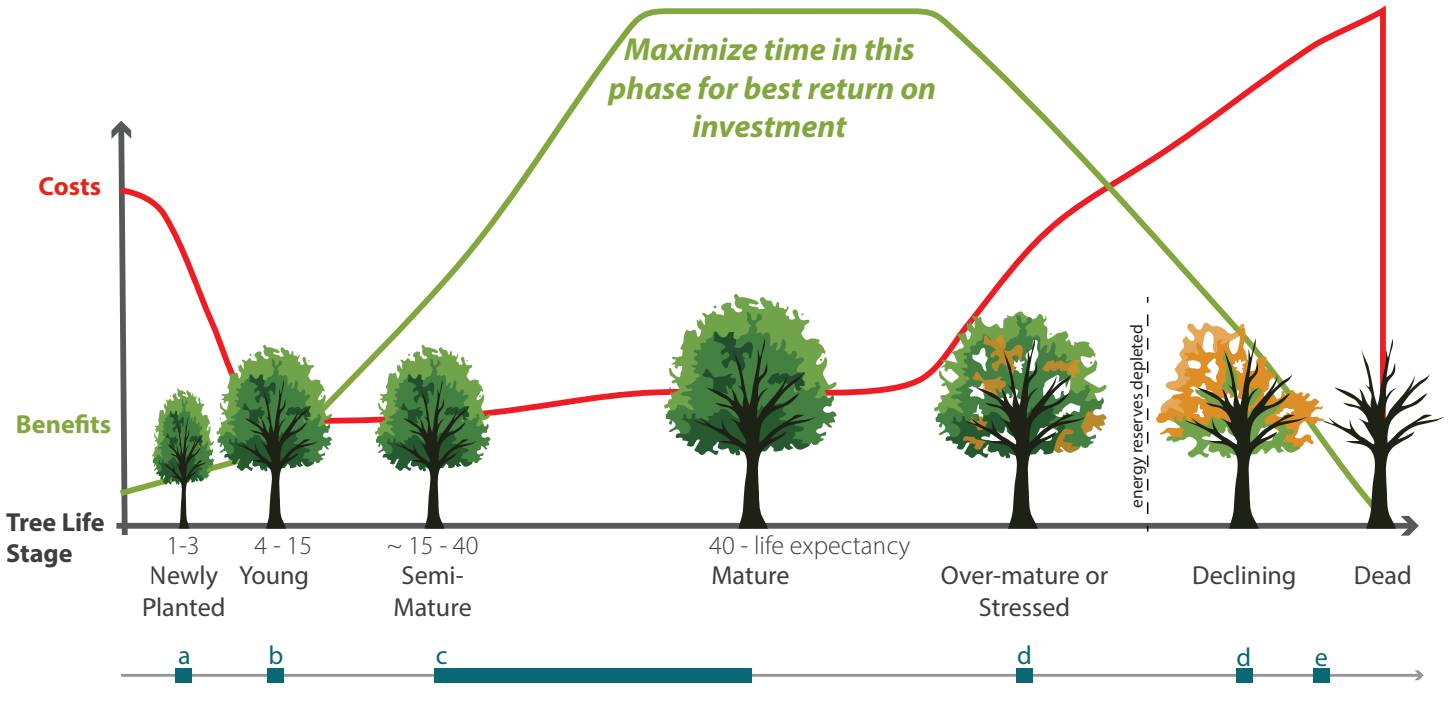
Richmond has developed a City Tree Policy and Public Tree Operations Manual (PTOM) to establish the standards, practices and processes the City uses to manage public trees under Community Services - Parks jurisdiction.

The policy and PTOM address:

- Planning and design for tree planting.
- Planting including soil volume and technical standards for planting.
- Maintenance and plant health care.
- Inventory and risk management.
- Succession planning and removal management.

This Strategy, the policy and PTOM provide the guidance to shift the City's tree management from the current program of demand driven management towards a planned, preventative approach that will improve the life expectancy of and benefits from City trees.

Magnitude of Life Cycle Costs per Tree for Maintenance Activities



Tree Management Best Practices

a. Planting and young tree watering

b. Young tree pruning

c. Proactive inspection and pruning cycle

d. Tree health and risk management treatments

e. Removal & stump grinding

Planting the Future Urban Forest

The City has been planting an average of 850 public shade trees per year in addition to hundreds of smaller trees planted in parks for forest restoration. These trees are a combination of new and replacement street and park trees planted by City crews and through development activities or stewardship volunteers. Funding sources for tree planting include City capital budgets, Tree Compensation Fund, and grants. Presently, the rate of planting exceeds the rate of removals.

An analysis of potential planting areas on public land has identified approximately 30,000 individual sites for shade tree planting. Further analysis is needed to filter out locations with constraints such as utilities and land use plans and it is likely the total sites will be fewer.

New planting sites are also created with developments when parks or streetscapes are upgraded, new parks are built, or when areas are retrofitted with green infrastructure to manage rainwater.

By setting a target to plant **850 new trees per year**, in addition to replacement trees and restoration plantings in parks, public canopy cover should increase from 20% to 30% by 2045. Based on present tree removal numbers, the planting program (City and developer planted trees) would require a net increase of approximately 300 trees per year above current levels; this figure may vary with removal rates. The canopy forecast assumes that Richmond's canopy area will grow by 1.5% (7 hectares) each year on public land to reach the target by 2045. This canopy increase is forecasted from both the growth of existing trees as well as from planned new plantings and the replacement of every tree lost.

Planting out all available sites is one of the main ways Richmond can maximize ecosystem services from the urban forest. To ensure that new tree plantings are successful, the City will:

- Plant the right tree in the right place.
- Plant from a diversity of species using high quality planting stock.
- Consider the suitability of species and stock to future climate in all planting decisions. This may include altering the balance of native tree species composition or sourcing seed from warmer, drier climates.
- Provide good soil, growing conditions and water for young trees.
- Partner with and educate residents and community groups to plant and care for young trees.

City Tree Planting Prioritization

Richmond's data on canopy cover, street tree density and population density was used to prioritize blocks where public tree planting is a priority. Areas in and around 'Ecological Network' are a priority for planting to meet the objectives of the Ecological Network Strategy regardless of low, moderate or high priority ratings defined below. In these areas, the focus will be on native plant species and connecting green spaces to enhance habitat.

Areas that rated as 'Low' priority are census blocks with any one of:

- Fewer than 10 people per hectare.
- More than 6 street trees per 100 metres.
- Canopy cover greater than 30%.

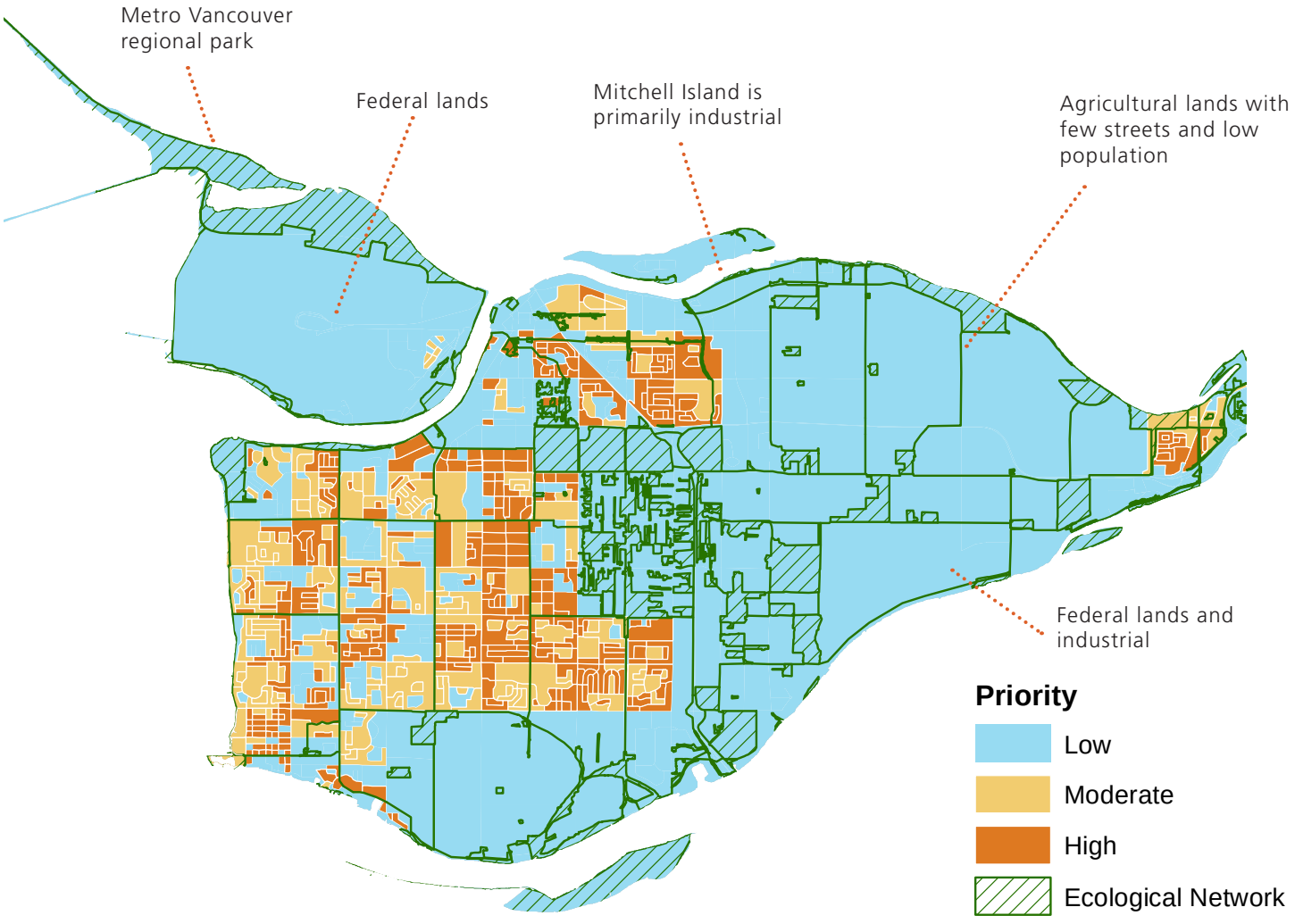
Areas that rated as 'Moderate' priority are census blocks with:

- Fewer than 100 people per hectare.
- Fewer than 6 street trees per 100 metres.
- Canopy cover less than or equal to 30%.

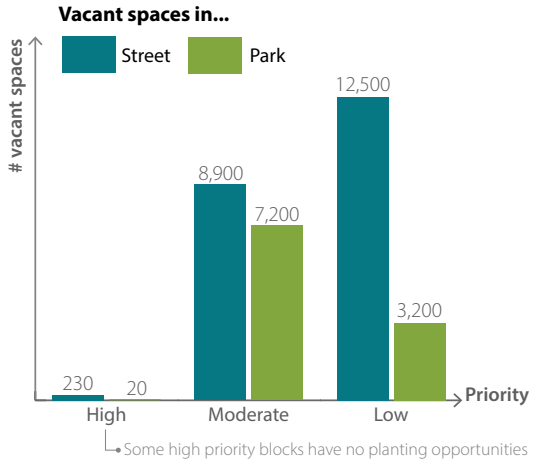
Areas that rated as 'High' priority are census blocks with:

- More than 100 people per hectare.
- Fewer than 6 street trees per 100 metres.
- Canopy cover less than or equal to 30%.

Map of Priority Planting Areas



In total, approximately 30,000 potential public planting opportunities have been identified:



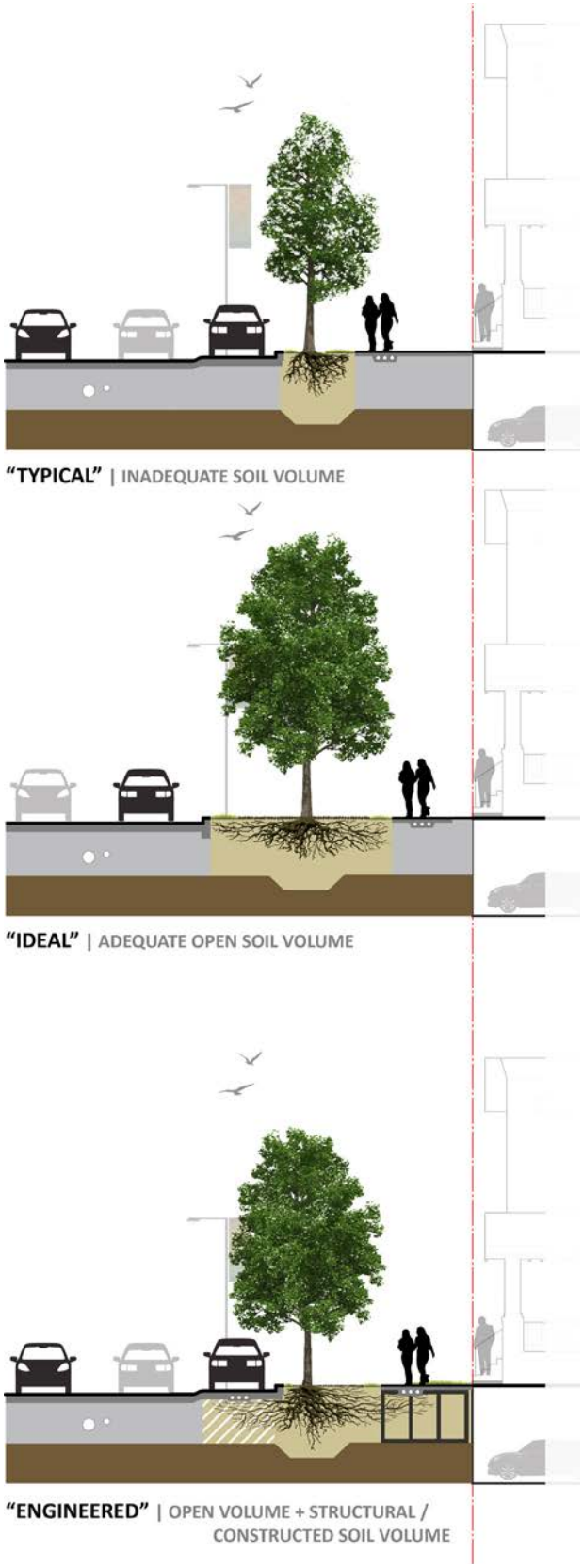
Creating New Planting Opportunities

The graphic at right illustrates "typical", "ideal", and "engineered" planting scenarios. Many high priority areas have high impermeability because of extensively paved sidewalks and roadways. Increasing canopy cover in these locations will require the creation of "engineered" planting sites using innovative approaches such as structural soil or soil cells. As planting technologies and best practices evolve, the City will look to test and implement new methods to grow more trees successfully in these challenging urban environments.

In Metro Vancouver's climate, it is recommended that between 0.3 and 0.6 cubic metres of soil be provided for every 1 square metre of tree canopy, though this can be reduced when multiple trees share the same volume or when sites are irrigated.

Supporting New Tree Plantings under Servicing Agreements

When trees are planted on public property as part of development Servicing Agreements, they are maintained by the Agreement holder for the first year. The City ensures trees are planted per applicable landscape best management practices, with approved soil volumes, and with irrigation systems connected to private water connections. Upon completion of the maintenance period, City staff again inspect the trees and any dead or deficient trees are replaced prior to final acceptance by the City. Once accepted as a new city asset, the trees are inventoried into the City's geographic information system and then maintained by the City. Irrigation systems remain the maintenance responsibility of the landowner.



Streetscape soil volume illustration from Metro Vancouver's Urban Forest Climate Adaptation Framework (Metro Vancouver, 2017)

Maintenance

Maintenance needs differ for trees throughout their life-cycle (see page 30 for a graphic summary):

- Young trees need water to establish their root systems and structural pruning to set up good branch structure.
- Once trees reach 15 years of age, they can move onto a preventative pruning cycle that involves periodic inspection and pruning when required. Trees stay on this pruning cycle as long as they are healthy and safe.
- As they near the end of their lives, or become stressed for other reasons, trees need more intensive care until they return to health or the decision is made to remove them.

Demand versus Preventative Model

Richmond's urban forest currently is managed primarily on a demand basis. This means trees are maintained as they come to the attention of staff through service requests initiated primarily by residents or staff that identify issues.

Recognizing that preventative maintenance would be a more sustainable and financially responsible approach, the City is beginning to transition its operations to a scheduled pruning cycle. Each year, City crews will work through a section of Richmond inspecting trees and pruning (when needed). Each full cycle will take five years to complete for streets and about ten years in parks. That means every inventoried public tree will be visited by City crews in that period. As well, some high-use areas will be inspected more frequently.

A demand system will still operate alongside so that crews can respond to emergency pruning or tree health issues as they arise (for example, storm damage or tree failure).

The transition to preventative maintenance will initially increase the cost of the City's urban forest operations. However, once the first cycle is complete, the frequency of demand pruning requests is expected to drop.

With climate change, tasks related to drought and pest management are expected to become a larger operational cost. Presently, City trees are in good health and few trees require watering once established except during extreme drought. Several pests, such as Asian Longhorn Beetle, Japanese Beetle (currently quarantined in Vancouver), Gypsy Moth and Emerald Ash Borer are potential threats to Richmond's forest; however, none of these pests have yet been detected in the City.

Priorities for maintaining a healthy and resilient tree resource are to:

- Transition to preventative maintenance including a block pruning cycle and young tree pruning to promote good structure at maturity.
- Water young trees until they are established (at least the first three years after planting).
- Monitor plant pest threats.

Tree Protection and Removal

Trees are civic assets, just like roads, sidewalks and sewers. As such the City conserves and protects its trees to the greatest extent possible. City tree protection and removal are regulated by Tree Protection Bylaw No. 8057, the Public Parks and School Grounds Regulation Bylaw No. 8771 and are further guided by the City Tree Policy. Staff, as authorized and guided by these policies and bylaws, must make a decision to protect or remove a City tree whenever development or City works are planned in their vicinity. Tree removal should be viewed as a last resort.

Priorities for improving tree protection and providing staff with the tools to make transparent decisions about removals are to:

- Implement the Council adopted City Tree Policy to guide protection and removal decisions and processes.
- Quantify and share the value of trees according to their appraised amenity value, role in carbon sequestration, stormwater capture and water quality improvement and providing building energy savings.
- Improve referral procedures, information sharing systems and tree protection standards internally so that City trees and potential conflicts are consistently identified and managed.

Inventory

Currently, the City inventories the trees it maintains to record the species, size, location, condition and work history of City trees. It is an essential tool for all aspects of urban forest operations but particularly for enabling preventative maintenance and monitoring health and risks. The inventory will be continuously updated and improved over the course of the pruning cycle by City crews using geospatial-enabled mobile technology. Inventory methods will be updated as technology evolves. To further inform urban forest operations, the inventory will be used to:

- Monitor mortality and failure rates to identify problem planting sites, health issues or species to avoid.
- Monitor tree condition to inform succession planning for tree replacement.
- Track progress towards meeting Strategy targets.
- Communicate tree locations, benefits and health information internally and externally.

Inspection and Risk Management

Inspections are used to identify and assess the health and condition of City trees. Inspection programs are one way to mitigate risk by ensuring the trees are providing maximum enjoyment and safety to the City and residents. Inspections are also a way for the City to identify appropriate pruning requirements, tree health and where, a risk is suspected or identified, the additional actions to investigate, monitor and/or mitigate risk. Tree removal is considered only as a 'last resort' to risk management; arboricultural best practices will be implemented first before outright removal is considered.

City trees will now be inspected in coordination with the pruning cycle. Inspections will be done by staff qualified to conduct Tree Risk Assessments. The appropriate allocation of resources for staffing and training will be required to support this enhanced risk management approach.

Typical risks from City trees include limb or tree failures and root damage. Damage to private property or individuals could result in increased costs to the City. A preventative maintenance program is expected to reduce the City's exposure to claims. Priorities to reduce risk exposure are to:

- Inspect trees periodically in coordination with the pruning cycle.
- Inspect and assess a tree when a service request is received.
- Document inspection procedures to support the City Tree Policy.
- Document actions to investigate, monitor and/or mitigate risk.

4.5 Community Stewardship

Community stewardship supports urban forest management in Richmond's parks and enables residents to learn about the urban forest and its value. Occasionally, public trees are intentionally or accidentally harmed by people. Stewardship programs help to educate the public about the important role trees play and how to properly care for them. Richmond runs urban forestry volunteer stewardship, community outreach and public education through Parks Programs.

Volunteer stewardship is focused on engaging individuals and groups in specific activities such as tree planting and invasive plant removal, as well as forming partnerships for managing specific areas. For example, Paulik Park is maintained in partnership with the Richmond Garden Club.

Community outreach programs include Adopt-a-Tree, which allows groups to take ownership of a planting program to beautify a public space. The City identifies the locations, develops the planting plan and provides the plant materials, equipment, tools and Parks staff support to plant the trees and assist in their care.

Public education involves sharing information about the urban forest, its benefits and how to care for it in a manner which engages and empowers volunteers with little to no training in tree care.

These programs extend the work of urban forest operations to provide both environmental and social benefits to the community. Priorities for community stewardship are to:

- Share information and data about the urban forest's critical role in community health and wellness.
- Educate the public to avoid activities that harm trees.
- Educate the public about how to properly care for trees and partner in stewardship activities.
- Support people to connect with nature through urban forest stewardship.

Stewardship programs also serve to communicate the importance of preserving trees on private properties, particularly mature trees and trees located in Environmentally Sensitive Areas.