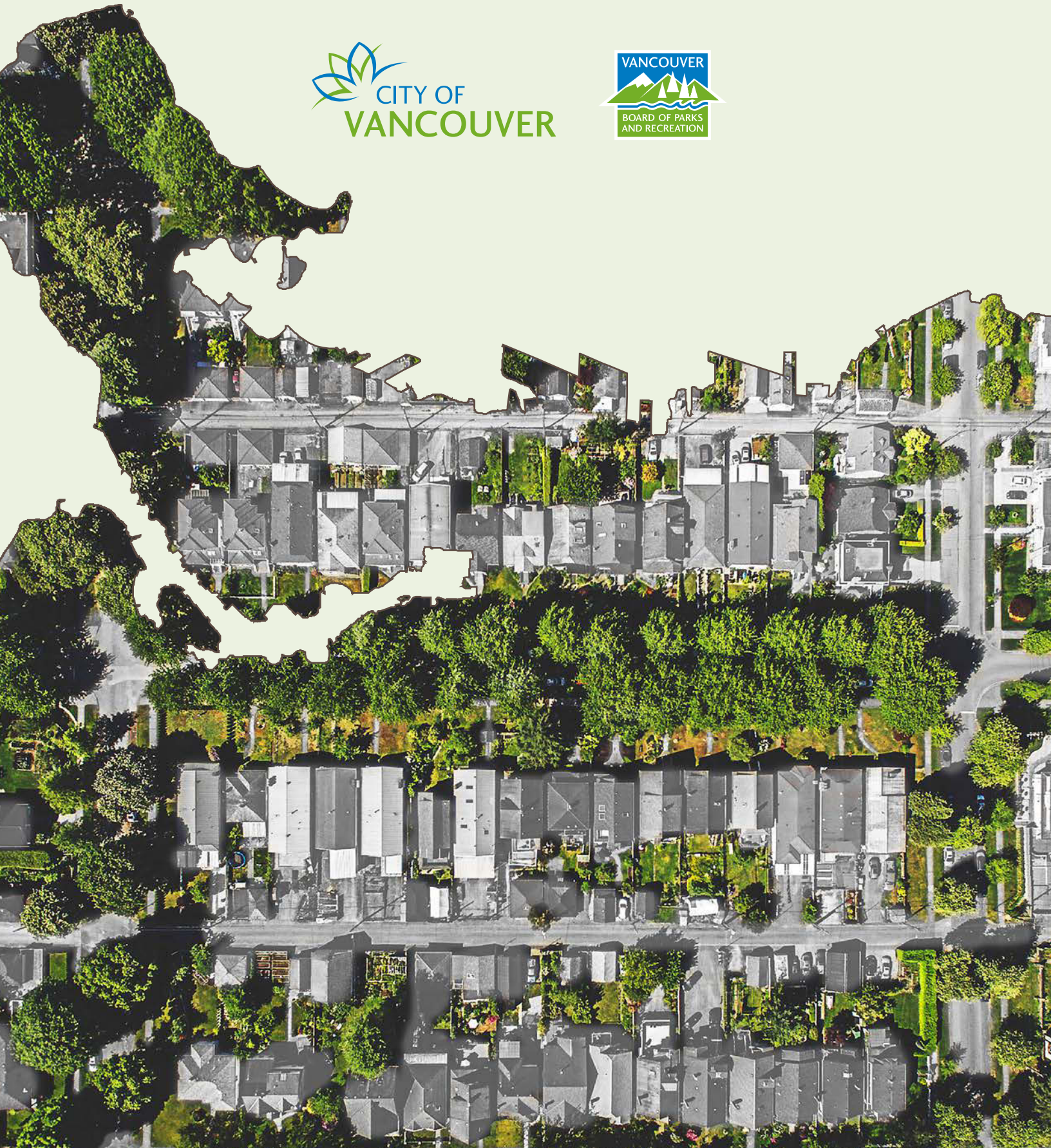


URBAN FOREST STRATEGY

2018 UPDATE



Acknowledgments

This strategy was developed by Diamond Head Consulting Ltd. (Amelia Needoba, Camille Lefrançois, Lucy Foley, Trevor Cox, Maddy MacDonald and Mike Coulthard) with content contribution and direction from a staff working group composed of:

Vancouver Park Board

Nick Page
Bill Stephen
Erin Embley
Amit Gandha
Dana McDonald
Joe McLeod

City of Vancouver

Katherine Isaac
Lee Beaulieu
Cameron Owen
Angela Danyluk
Ben Mulhall

Recommended citation: City of Vancouver and Vancouver Park Board. 2018. Urban Forest Strategy: 2018 Update. 60 pp.

Cover photo: 'Vancouver Special' by Jon West © 2016. Original image modified for cover.

CONTENTS

1	EXECUTIVE SUMMARY.....	IV
2	INTRODUCTION.....	1
3	THE VALUE OF VANCOUVER’S URBAN FOREST.....	4
4	HISTORY OF THE URBAN FOREST.....	12
5	STATUS AND TRENDS.....	16
6	EMERGING DIRECTIONS.....	26
7	PRINCIPLES.....	42
8	GOALS, STRATEGIES & ACTIONS.....	43
9	CONCLUSION.....	49

1 EXECUTIVE SUMMARY

This update to Vancouver's Urban Forest Strategy expands on the key policies that were presented to City Council and Park Board in 2014. It provides new information on the status of the urban forest, and sets goals, targets, and actions to protect and enhance Vancouver's urban forest. The update provides Park Board and City staff, as well as members of the public and the development community, with a foundation for how Vancouver manages the urban forest.

The vision of the Urban Forest Strategy is to protect, plant, and manage trees to create a diverse, resilient, and beautiful urban forest on public and private lands across the city.

Vancouver's urban forest includes all trees within the city: native forests in Stanley Park and other large parks, ornamental park trees, fruit trees in community gardens and orchards, street trees, trees on school grounds, and trees on private property. The urban forest is an essential part of Vancouver's character and identity as a green city at the foot of the mountains and the edge of the sea.

Vancouver's urban forest canopy covers about 18% of the city but has declined due to urban development. A key pillar of this strategy is to protect the existing urban forest through planning, regulation, education, and enforcement.

In 2010, Vancouver's Greenest City Action Plan set an ambitious target of planting 150,000 trees by 2020 to improve access to nature. This target galvanized our collective efforts to support tree planting on private lands, restore native forests in large parks, and replace aging street trees. As of the end of 2017, about 102,000 trees have been planted towards the target.

The urban forest is not equally distributed across the city and this strategy identifies priority neighbourhoods for tree planting such as the Downtown Eastside and Marpole. Tree planting is an effective way of improving the quality of green space

in dense, urban neighbourhoods, and improving community health by lowering summer temperatures and reducing air pollution.

PRINCIPLES

Twelve principles underpin the strategy:

1. Protect our existing urban forest
2. Create beautiful urban landscapes
3. Enhance habitat & support biodiversity
4. Select the right tree for the right place
5. Distribute ecosystem services equitably
6. Mitigate & adapt to climate change
7. Support healthy & safe trees
8. Contribute to a healthy city
9. Celebrate Vancouver's cultural & natural identity
10. Collaborate with a broad range of partners
11. Use sound science
12. Measure progress

URBAN FOREST GOALS

Strategic actions are structured around five goals:

PROTECT the urban forest during development.

PLANT trees to grow the urban forest.

MANAGE trees for health and safety.

ENGAGE citizens in the urban forest.

MONITOR the status and condition of the urban forest.

TARGETS

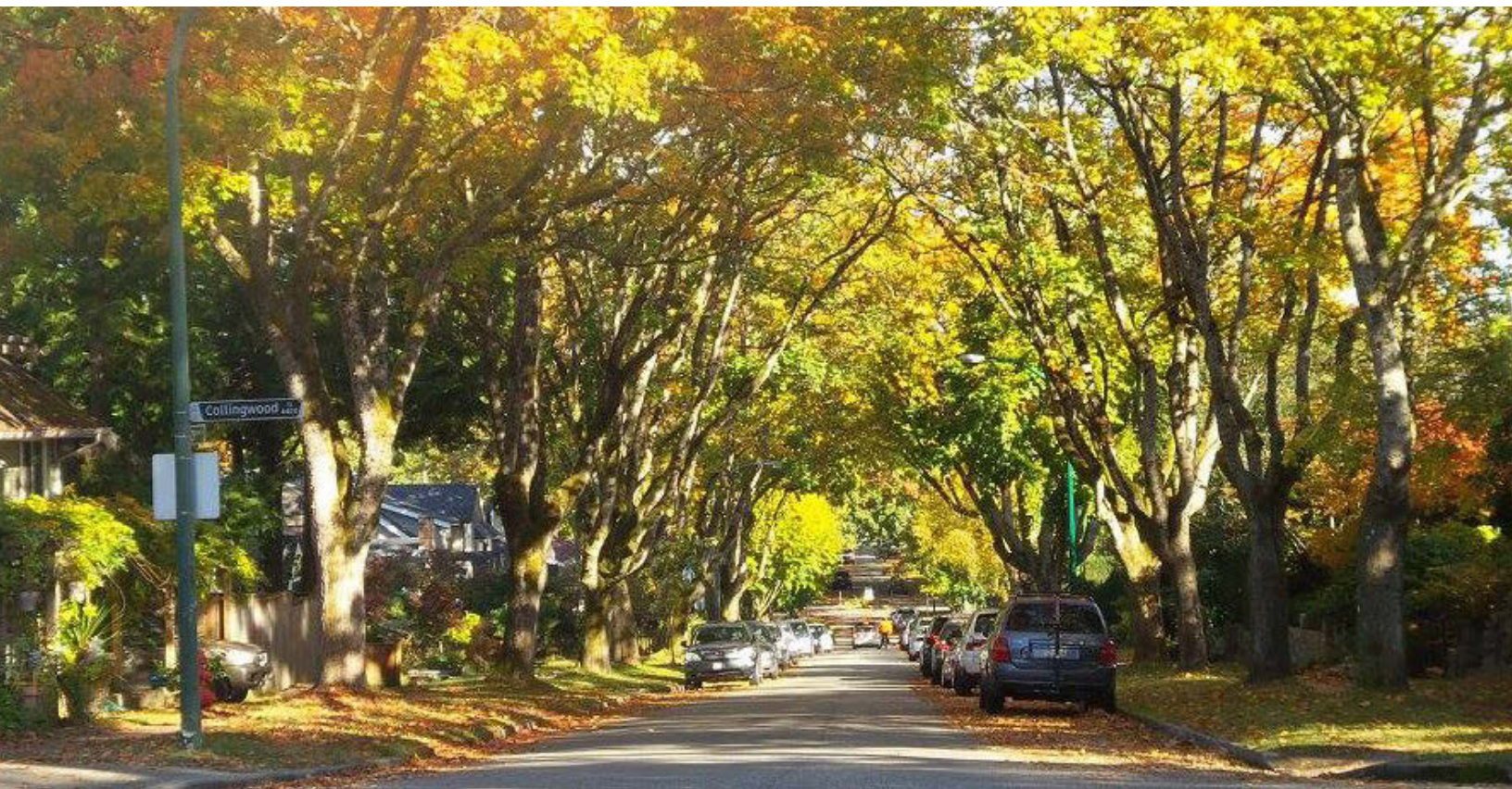
Four targets have been set to measure success:

1. Plant 150,000 trees between 2010 and 2020.
2. Increase the urban forest canopy to 22% by 2050.
3. Restore or enhance 25 ha of natural areas, including forests, by 2020.
4. Double street tree density in below average blocks of the Downtown Eastside and Marpole by 2030.

PRIORITY ACTIONS

Below is a summary of the highest priority actions from the Urban Forest Strategy.

- Update policies and standards to enable proactive design for retaining healthy, mature trees.
- Update policies and procedures to enable securities to be taken for tree protection and replacements.
- Update the *“Street Tree Guidelines for the Public Realm”* to reflect best practices and set targets for soil volume to support healthy mature trees.
- Increase street tree planting in the Downtown Eastside, Marpole, False Creek Flats, and other priority neighbourhoods with below average urban forest cover.
- Enhance natural forests in Stanley, Jericho, Musqueam, Everett Crowley, Renfrew Ravine, and other large parks as critical parts of Vancouver’s ecological network.
- Create a *“Public Tree Management Guidebook”* to guide staff in tree planting, maintenance, inspection, protection, and other operational tasks.
- Replace the Vantree inventory and work order management software with a GIS-based public tree information system.
- Expand the Park Stewards program to support volunteer- and school-based stewardship of urban forests in parks.
- Provide funding, staff support, and resources for stewardship organizations to undertake urban forest projects.
- Work together with local First Nations and the urban Aboriginal community to identify opportunities to develop culturally appropriate forest stewardship practices.
- Measure Vancouver’s urban forest canopy every 5 years using LiDAR and i-Tree methods.
- Support knowledge sharing and advocacy, including hosting events such as the Canadian Urban Forest Conference in 2018.





Urban forestry is the art, science and technology of managing trees and forests in and around urban areas for benefits that contribute to the health, happiness and comfort of our communities.

2 INTRODUCTION

Trees and forests are an essential part of Vancouver’s character and identity. They are interwoven into the city’s history and culture, and continue to define our parks, neighbourhoods, and streets. What would Vancouver look like without the tall evergreen forests of Stanley Park? Or the blossoms of cherries, plums, and magnolias that define spring in many of our neighbourhoods? Trees are waypoints that mark the changing of the seasons, enhance the physical and mental health of city residents, provide food in our gardens, and support biodiversity.

Urban forests are increasingly recognized as a critical part of a healthy and sustainable city. They form part of Vancouver’s “green infrastructure” that intercepts rainfall before it enters storm drains, filters airborne pollutants, shades streets and buildings during heat waves, and supports birds and other wildlife. These ecosystem services are as important as the water, sewer, and street systems that sustain the city. The urban forest will become even more important as the impacts of climate change increase.

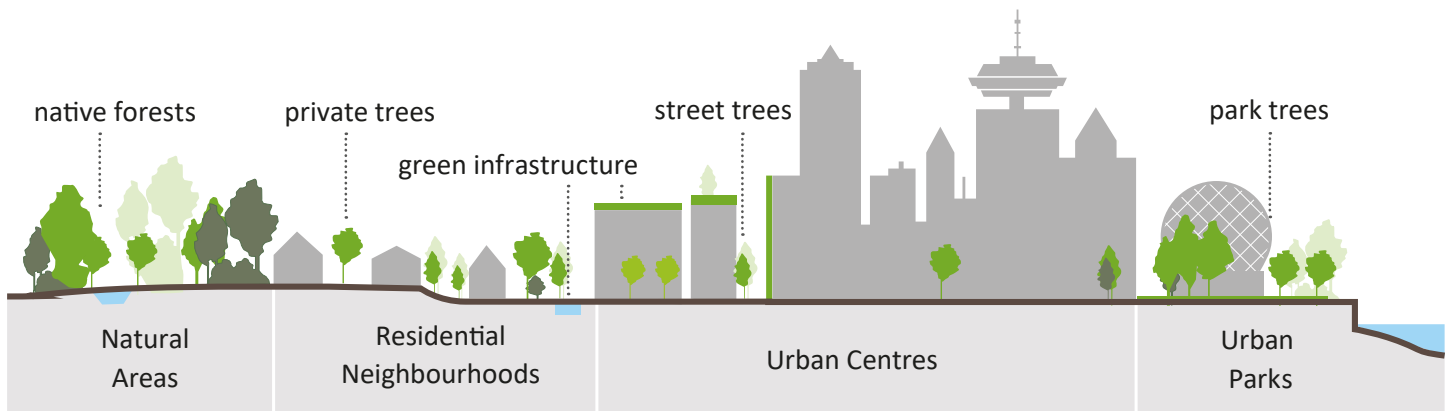
Vancouver is a rapidly changing city with high land values and physical constraints to expansion. The city’s neighbourhoods and communities face significant challenges from population growth, urban development, and climate change. The urban forest will play an increasingly important role in Vancouver’s resilience through its contributions to both human and environmental health and well-being.

When implemented together, the Urban Forest Strategy, Biodiversity Strategy, Integrated Rainwater Management Strategy, Vancouver Bird Strategy and Vancouver’s Playbook (parks and recreation master plan) will establish a comprehensive network of green infrastructure throughout the city.

STRUCTURE OF THE STRATEGY

This strategy is divided into eight sections:

1. An Introduction to the strategy and the history of Vancouver’s urban forest.
2. Context and Policies that are the foundation of the strategy.
3. The Values of Vancouver’s urban forest including ecosystem services and cultural values.
4. The Status and Trends that show how much urban forest Vancouver has, where it is, and how it is changing.
5. Emerging Directions for urban forest management.
6. Principles to guide urban forest management.
7. Goals and Actions that guide future work to protect, plant, manage, and monitor the urban forest, and to engage residents in this effort.
8. Conclusion to the strategy.



COMPONENTS OF THE URBAN FOREST

WHO MANAGES THE URBAN FOREST?

The City of Vancouver and the Vancouver Park Board work together to protect, manage, and enhance Vancouver's urban forest. The City's Planning, Urban Design, and Sustainability and Engineering departments regulate trees and urban forest on private lands and the City's street network. The Park Board manages and maintains trees in parks, as well as in all publicly-owned lands including streets. Landowners, developers, and design professionals have a critical role in protecting trees on private property and helping grow the urban forest through planting. Park stewards and other volunteers also assist in forest management in parks.

DEVELOPMENT OF THE URBAN FOREST STRATEGY

Vancouver's Greenest City 2020 Action Plan (2010) included the goal of creating the world's most spectacular urban forest and planting 150,000 new trees by 2020.

In 2012, Council and Park Board directed staff to develop an Urban Forest Strategy. The City possessed plans, bylaws, and policies governing trees across different departments but a coordinated and long-term approach was needed to sustain the urban forest, and to align with emerging technology and best practices.

Three key action areas were identified:

PROTECT: Find ways to protect and enhance a healthy, mature canopy.

- Retain more trees during development.
- Create a Public Tree Retention Framework.

PLANT: Plant strategically.

- Expand private property planting and stewardship programs.
- Expand Park Planting Programs.
- Create Street Tree Cooling Networks.

MANAGE: Better manage the urban forest.

- Establish Street Tree Soil Volume Standards.
- Create a Coordinated Street and Park Tree Management Plan.
- Update Public Tree Inventory Systems and Data.
- Create Monitoring and Adaptation Frameworks.

In April of 2014, Park Board and Council voted to endorse these Urban Forest Strategy Action Areas and objectives, in addition to an update to the Protection of Trees By-law, which addressed 45% of the loss of trees on private property. In 2015, an update on action items was provided to the Park Board and Council, and additional key action areas were added: engage and monitor.

OTHER POLICIES & STRATEGIES

Broad strategies for regional growth, climate adaptation and resilience set the tone and vision for where and how the urban forest and other community assets and programs can best serve the city. More immediately, Vancouver's sustainability initiatives are driven by the 10-year Greenest City Action Plan that sets goals and multiple targets for becoming the greenest city in the world by 2020.

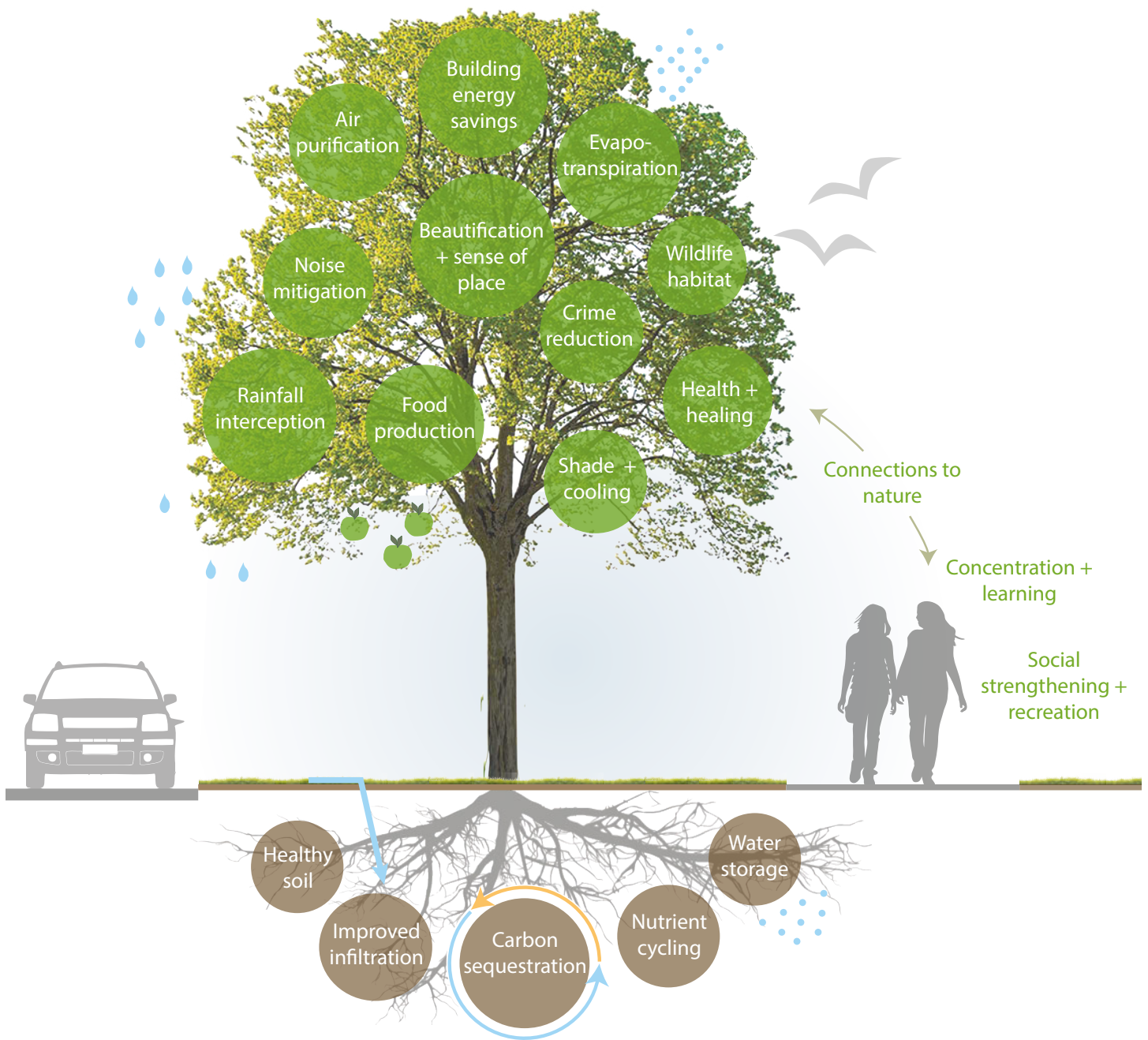
The Urban Forest Strategy is one of several city-wide strategies that guide planning and implementation of sustainability initiatives. Complementary plans closely related to the Urban Forest Strategy are the Biodiversity Strategy (2016), Integrated Rainwater Management Strategy (2016), and the Vancouver Bird Strategy (2015). The Vancouver Park Board is also developing Vancouver's Playbook (the parks and recreation master plan), a new plan to guide parks and recreation over the next 25 years.

VANCOUVER'S URBAN FOREST STRATEGY CONTEXT



Implementing the Urban Forest Strategy will benefit our community in ways that touch on the objectives of numerous City strategies.

3 THE VALUE OF VANCOUVER'S URBAN FOREST



Vancouver's goal is to become the greenest city in the world by 2020: a city that uses resources wisely, reduces its overall ecological footprint, and is resilient to a changing climate and other future risks. Strengthening the urban forest throughout the city will help to achieve Vancouver's Greenest City goals.

This section summarizes the values of the urban forest. It includes cultural and aesthetic values that support beautiful and liveable neighbourhoods, as well as ecosystem services which provide essential functions on which the city depends.

CONNECTIONS TO PLACE

Vancouver's identity is closely connected to its natural landscape: as a city of parks, beaches, and shorelines surrounded by Burrard Inlet, the Fraser River and the Coast Mountains. Urban forests are an essential part of Vancouver's identity.

The character of Vancouver's urban landscape, beyond its dramatic natural setting, is influenced by its streets and parks accented with big trees and lush vegetation. The urban forest connects the city's streets, parks and neighbourhoods, creating coherent patterns and comfortable spaces for people to enjoy.

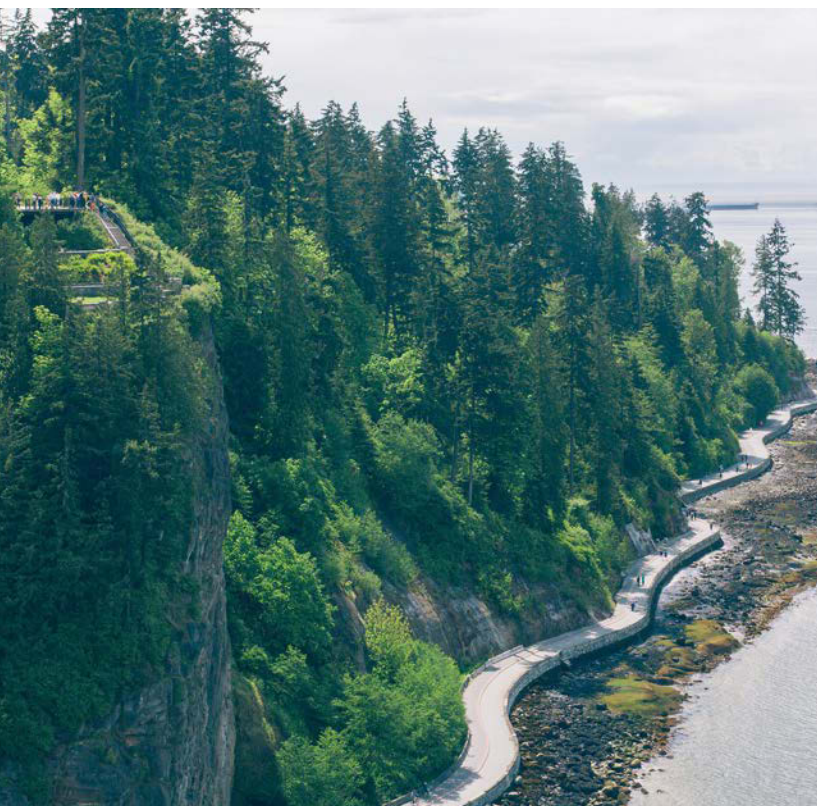
Places like Stanley Park, VanDusen Botanical Garden and Queen Elizabeth Park are iconic urban forests in Vancouver but even individual trees and neighbourhood greenspaces have a significant impact on people's connection to place.

CONNECTIONS TO NATURE

The urban forest is a foundation of Vancouver's ecological network. It contributes to the goals of Vancouver's Biodiversity Strategy by providing habitat for plants and wildlife. For example, the abundance and diversity of birds in urban areas is closely linked to the richness of trees and other vegetation. Migrating songbirds, resident raptors such as Cooper's hawk, and woodpeckers like Northern Flicker are found throughout Vancouver because of the health of the urban forest.

For children, daily access to nature improves cognitive function and fosters activities and experiences that are important for healthy development [1]. These experiences also foster positive attitudes towards nature that can contribute to a strong commitment to stewardship of the natural environment as adults [2].

For adults, greener neighbourhoods provide a positive social setting and encourage social bonding with neighbours [3]. Easy access and attachment to green places can also encourage stewardship and a community that values nature [4].





Vancouver once supported some of the tallest trees on Earth. Settlers logged and then cleared the vast majority of old-growth forests, except parts of Stanley Park, UBC, and the North Shore Mountains. However, the region's native tree species grow tall quickly. In one hundred years, a Douglas-fir in Vancouver can grow to an incredible 60 m (200 feet) tall. Given that the Douglas-fir can live to be more than 1,000 years old, these trees have much growing left to do. They are the future giants of Vancouver.

— Ira Sutherland, Big Tree Hunter

CONNECTIONS TO CULTURE

Vancouver's people are diverse in culture and ethnicity. Research suggests that people feel more at ease and less stressed if the landscapes reflect settings where they feel at home [5]. The design and structure of the urban forest in many parts of Vancouver reflects the city's recent history of forest clearing and replanting in European landscape traditions.

For the Musqueam (xʷməθkʷiʔəm), Squamish (Sḵw̓x̓ wú7mesh), and Tsleil-Waututh (səlilwətaʔt) people whose unceded territory includes Vancouver, connection to land is inherent to culture. One example of the cultural importance of Vancouver's forests comes from the xʷməθkʷiʔəm people for whom the single most important plant species is traditionally western redcedar because of its many uses [6]. The xʷməθkʷiʔəm are skilled carvers and periodically harvested large, old cedars to carve canoes. Today, there are no big cedar available for harvest in xʷməθkʷiʔəm territory.

While some ecosystem services are delivered soon after a tree is planted, others require centuries to become available. Vancouver's urban forest today reflects the cultural landscape and ecosystem services prioritized by colonizers. Working together with local First Nations, urban aboriginal people and the diverse cultures within our community, we can nurture an urban forest that strengthens connections to culture.

SUPPORTING A HEALTHY CITY

The urban forest contributes to Vancouver's Healthy City Strategy goal of healthier people, healthier places and a healthier planet by creating environments that benefit physical and mental health.

Research has shown that trees and greening enhance the quality of parks and outdoor spaces, and encourage physical activity [7]. People are more likely to walk to get their coffee or do errands when there are trees or other natural features along the route. People who use parks and open spaces are three times more likely to reach recommended levels of physical activity, reducing their health risks [8].

ENVIRONMENTS FOR HEALTH AND HEALING

The more time spent in green spaces, the greater the restorative effect and lower the stress levels [9]. In Japan, Shinrin-yoku or 'forest bathing' is practiced for preventative health and healing [10], and programs are offered for forest therapy in designated 'forest medicine bases' throughout the country.

Having plants or nature visible nearby has improved people's coping and healing strategies for a range of illnesses. Studies have found that surgical patients who had a view of trees from their rooms had shorter stays in hospital [11], and children with Attention Deficit Disorder have less severe symptoms after activities in green settings [12].



ADAPTING TO CLIMATE CHANGE

Scientists predict that Vancouver will experience hotter, drier summers, more frequent and intense rainfall events, and rising sea levels because of climate change [13]. Vancouver's Climate Change Adaptation Strategy identifies impacts from storm damage, heat-related illness, water shortages, and overland flooding as significant concerns.

The urban forest is one of the city's climate adaptation tools because of the many climate mitigation and adaptation benefits provided by urban trees. Trees, plants and associated soils absorb carbon, keep the city cooler in summer, reduce air pollution, buffer winds and increase the amount of rainwater interception and groundwater recharge, thereby lowering flood risk from intense rainstorms. Natural areas can also be used to collect and treat stormwater or buffer residential neighbourhoods against storm surges and flooding.

Urban forests are also susceptible to impacts from summer drought, windstorms, and new pests and diseases. The summer droughts in 2015 and 2017 increased mortality of young and old trees, particularly in developed areas with poor or shallow soils. Some species such as western redcedar will be less suited to Vancouver's future climate.

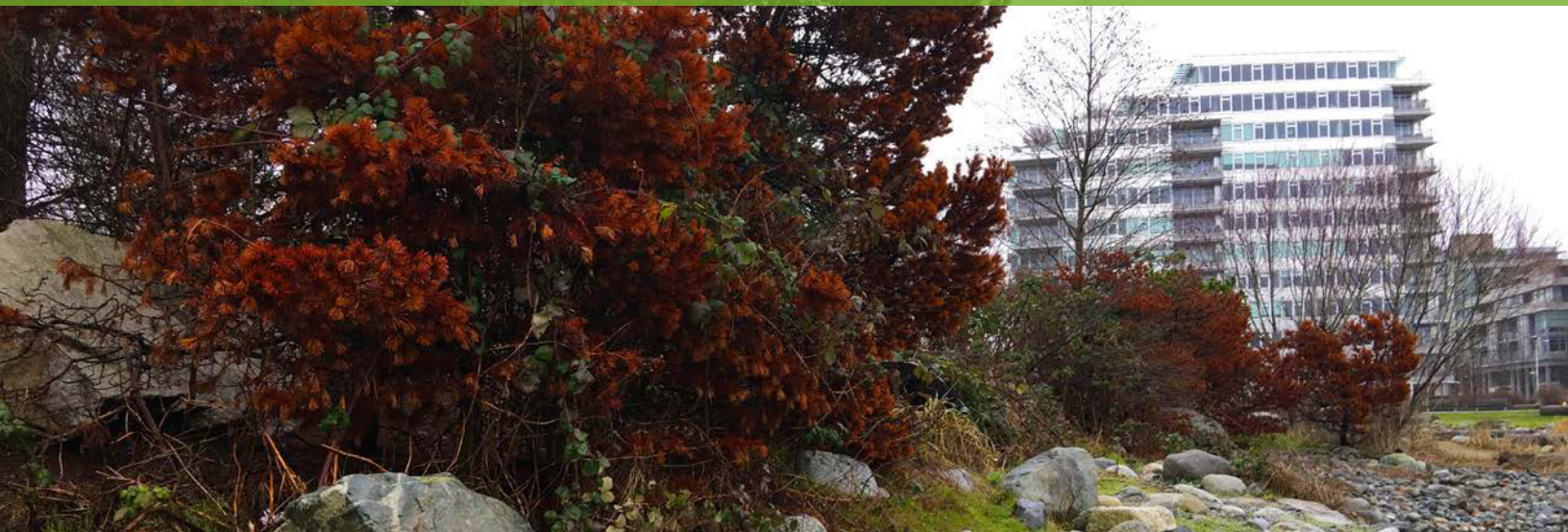
REDUCING HEAT EXPOSURE

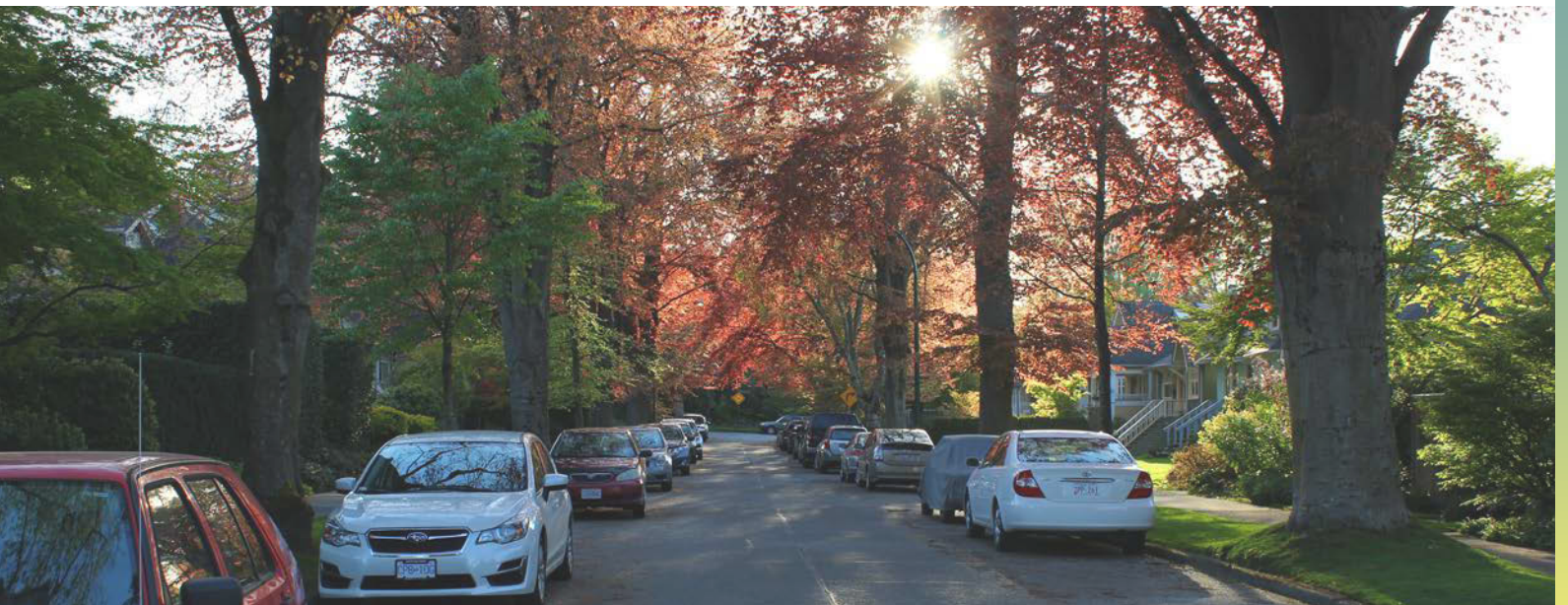
Climate change is also expected to increase the number of extreme heat days across Canada. In Vancouver, regional climate models predict twice as many summer days above 25°C in the 2050s than today (from 18 days to 43 days) [13]. By the 2050s, an extreme heat event that happened once every 25 years will occur three times as frequently.

Large urban centres are especially susceptible to extreme heat due to the urban heat island effect; a phenomenon where temperatures in urban and suburban areas are elevated on average compared to surrounding rural areas. Higher urban temperatures result from lower tree canopy coverage and the higher amounts of roads and buildings that absorb and store heat.

Vancouverites, particularly those who are socially vulnerable, are at risk from extreme heat [14]. Air conditioning is not standard in many homes so it can heat up indoors during extreme heat events. Trees and green spaces provide shade and cooling that can keep buildings cooler and provide refuge during extreme heat events [15].

Climate change will bring warmer, drier summers to our region. Many of our urban trees are vulnerable to drought stress, particularly in developed areas with poor or shallow soils.





A thermal image flown on a summer day in Vancouver showed that average land surface temperature varied by more than 20 °C between the coolest and hottest city blocks.

Urban heat mapping by researchers at Simon Fraser University identified several hotspots in Vancouver where, when coupled with vulnerable populations, the risk of heat-related illness and mortality is higher [14]. The city's hottest areas also tend to have the lowest tree canopy. Increasing tree canopy in these areas is one way to reduce vulnerability to heat in these locations.

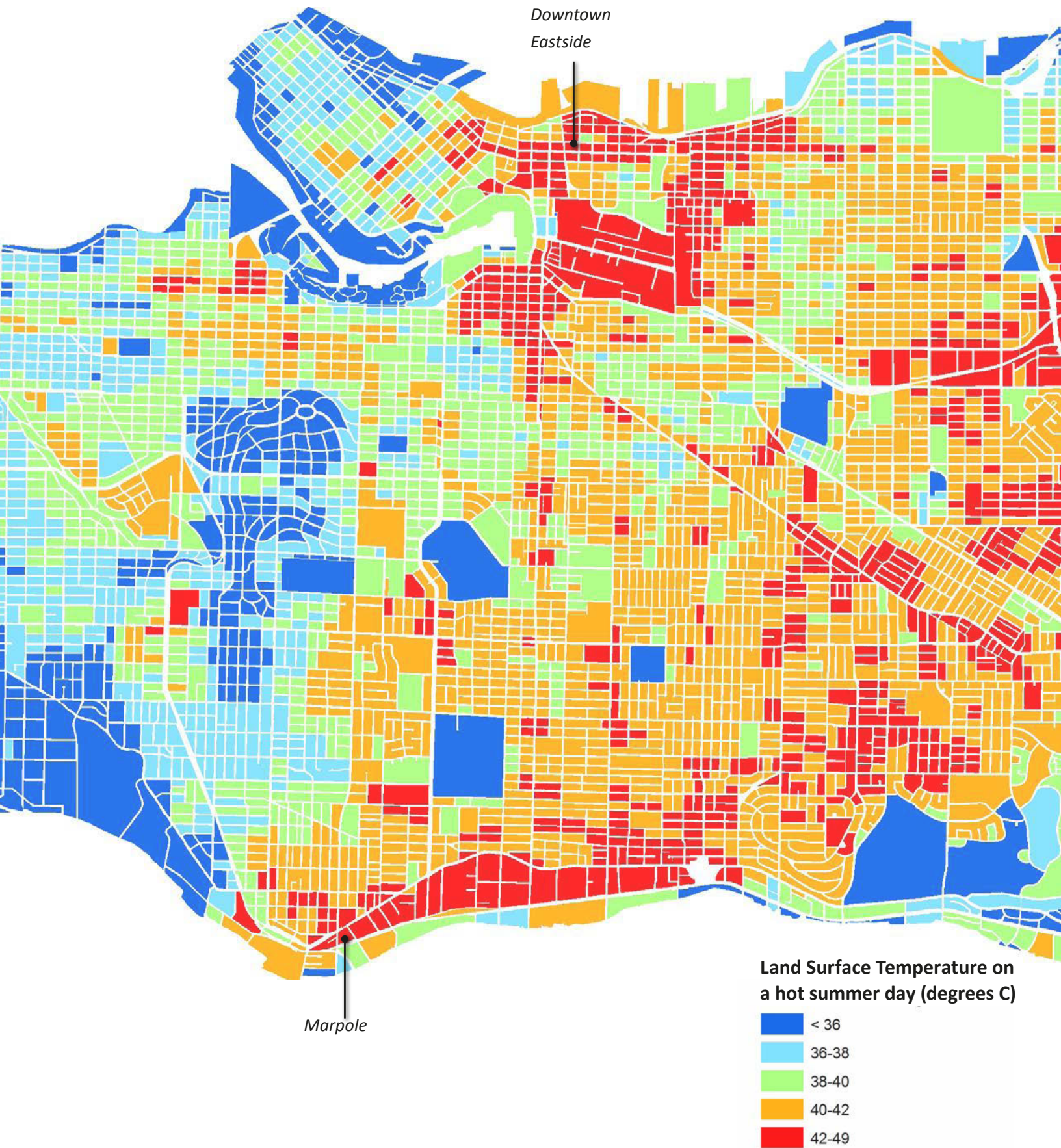
Researchers also investigated the connection between land surface temperature and factors that contribute to Vancouverites' vulnerability to extreme heat. Those factors include isolation, mental illness, homelessness, substance addiction, physical disability, and developmental disability. The study focused on four vulnerable groups: citizens of the Downtown Eastside, seniors, infants and those with chronic illnesses. The majority of these citizens can be found in three areas of the City of Vancouver where urban heat island effect is high – the Downtown Eastside, Marpole and parts of southeast Vancouver. False Creek Flats also shows an urban heat island effect but the limited residential land use meant it was not a priority area.

As well as having plenty of trees and parks in the city to help with climate adaptation, the urban forest must also respond to climate change. The Urban Forest Strategy will ensure that Vancouver's trees and ecosystems remain healthy and resilient to climate change by improving growing conditions and maintenance, and by selecting a higher diversity of tree species that are adapted to the future climate.



The map shows the relative difference in land surface temperature between different parts of the city recorded on a single summer day aerial flight. The average land surface temperature is 39°C (the temperature the surface feels to the touch).

MAPPING URBAN HEAT



4 HISTORY OF THE URBAN FOREST

Vancouver has one of the mildest climates in Canada: low elevation and proximity to the ocean result in mild winters, cool summers, and prodigious winter rainfall. Vancouver's native forest cover consists of lush temperate rainforest dominated by western redcedar, Sitka spruce, Douglas-fir, western hemlock, and bigleaf maple.

Vancouver's forests have been used and managed by the Musqueam (x^wməθk^wəy^{əm}), Squamish (S^kw^xwú7mesh), and Tsleil-Waututh (səlilwətaʔt) people for thousand of years. The forests provide building materials, food, and cultural and spiritual resources.

When European and Asian settlers arrived in the 1860s, extensive land clearing and burning began. Commercial logging rapidly altered the landscape. Some of the world's tallest and largest trees were felled in Vancouver to be milled in Hastings Mill and exported around the world.

The preservation of 400 ha of forest in what is now Stanley Park as a naval reserve in the 1860s was an important moment for Vancouver's urban forest. The park was selectively logged before being designated as Vancouver's first park in 1888. Several significant windstorms have disturbed extensive areas of Stanley Park since then. The forest's recovery from extensive logging and disturbance is a testament to the resilience of the temperate rainforest. The Vancouver Board of Parks and Recreation was established in 1890 to manage the park and, since that time, has been responsible for managing the urban forest.

With an initial focus on land clearing, it was some time before street tree planting became a priority for the Park Board. Bigleaf maple figured prominently in early Vancouver. A place in the Gastown area was known as K'emk'emelá'y, or place of Maple Trees, in the Squamish language and other references are made to beautiful groves of trees in that area. Maple Tree Square, in Gastown, was home to a

large remnant maple that was destroyed during the Great Vancouver Fire (1886). One of the city's oldest maples is located in nearby Victory Square and is thought to have been planted in 1897. Maples were planted as the city's first street trees.

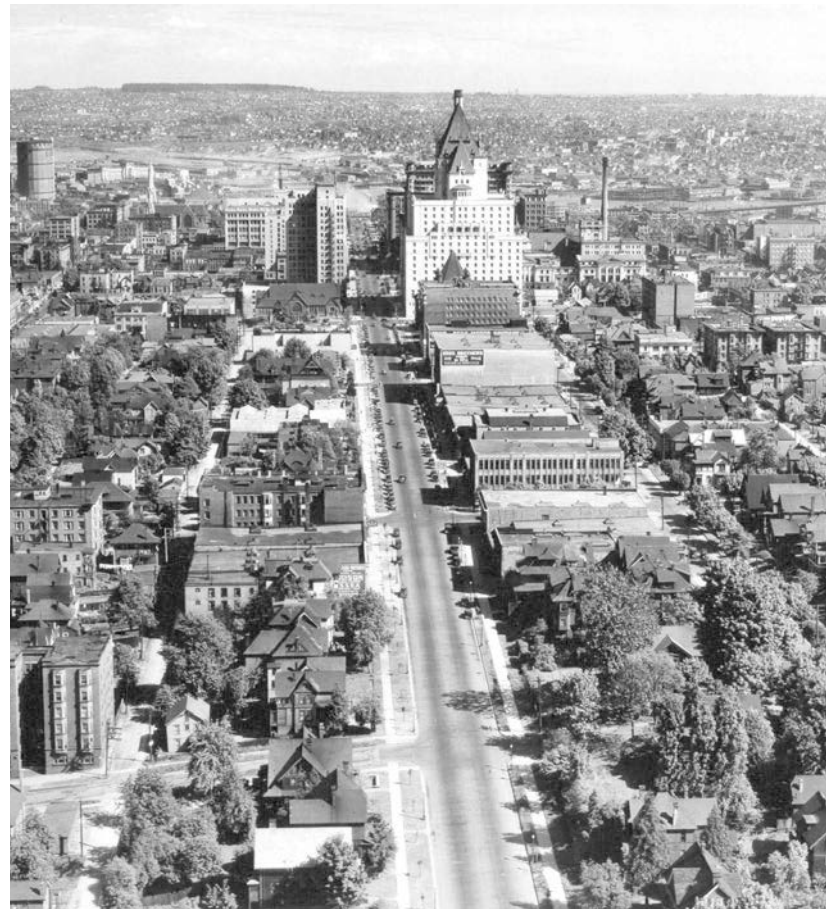
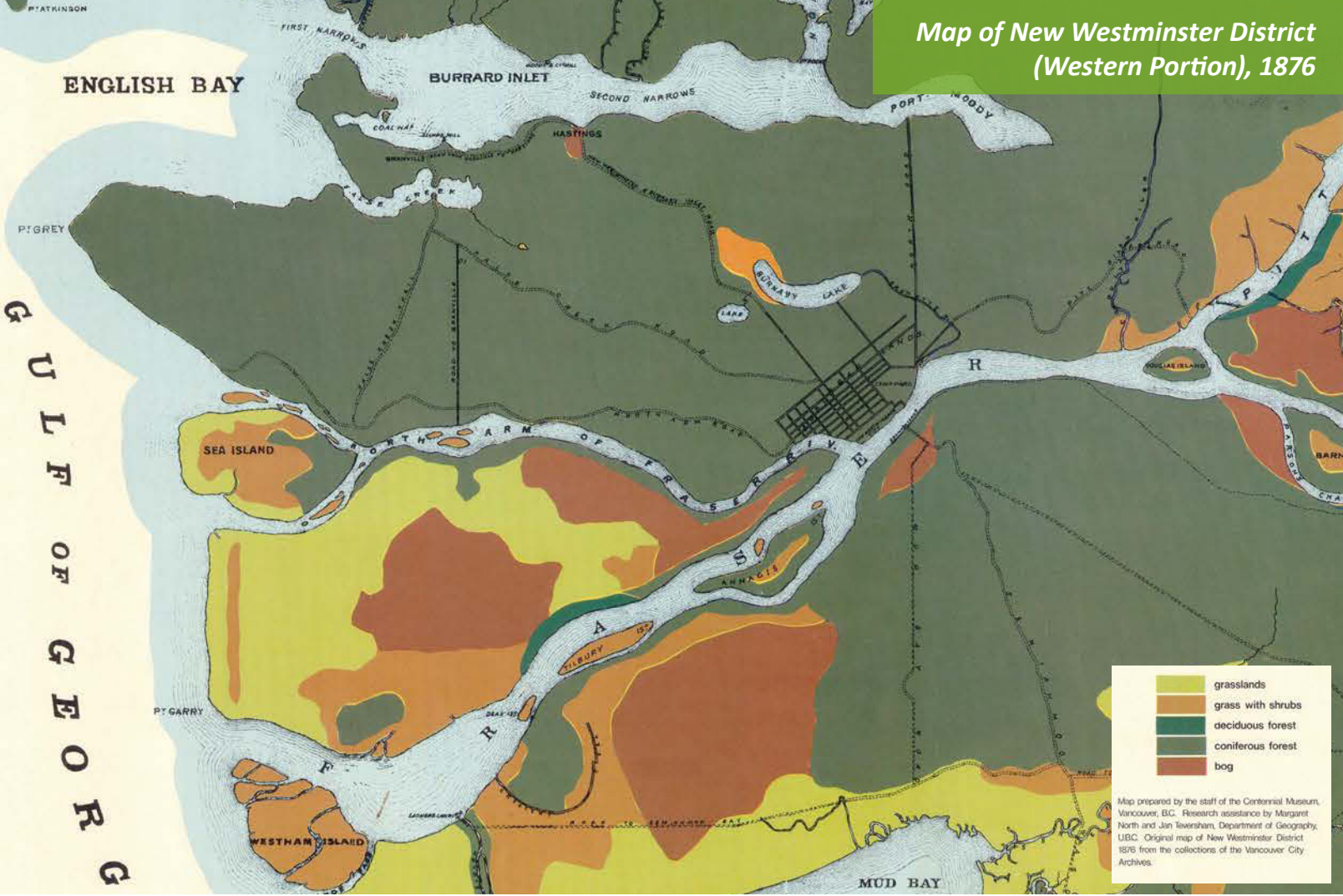
Vancouver's parks incorporate native trees, as well as a range of introduced ornamental trees. Trees were planted to delineate spaces, frame buildings, shield unsightly views, provide shade, or simply to bring a focus onto beauty. Neighbourhood parks such as Clark, West Memorial, Oppenheimer, and Maple Grove still have many trees planted in the early 1900s.

A strong horticulturist influence on parks enabled enhanced tree collections to develop and Queen Elizabeth Park was designated as an arboretum. Vancouver established a street tree bylaw in 1917. Seeds of large deciduous trees were imported from Europe in the early 20th century with elms, maples, oak, London plane and horse-chestnut being popular species. These large, deciduous trees were favoured for street trees and many are still in the landscape today because of their long life-spans.

Trees were one of a few structures typically found in early streetscapes. Over time, the street trees grew and streets became host to powerlines, traffic lights, signage and underground utilities. As the size of the trees and the number of conflicts increased, a decision was made to plant smaller trees with ornamental flowering habits. Cultivated clones were planted; mostly from flowering cherry, plum, crabapple, and hawthorn selections. Springtime flower shows were eagerly awaited and still are today. However, many of the small trees were short-lived and prone to disease. In recent decades, a greater diversity of tree types and sizes have been planted in streets.

The patterns of street and park trees across the city today reflect the tree planting fashions of different periods in Vancouver's development history.

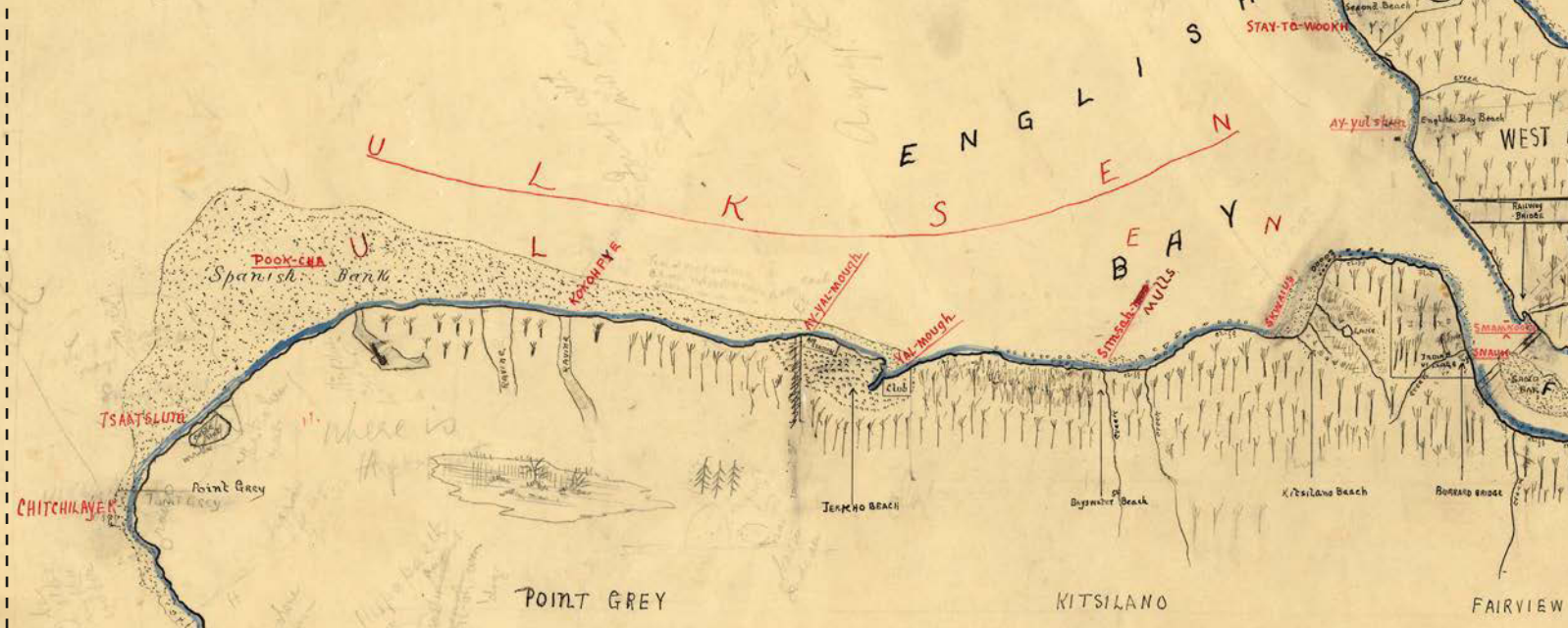
**Map of New Westminster District
(Western Portion), 1876**



Granville Street, 1895

Georgia Street, 1931, looking east

The place now known as Vancouver sits on the unceded territories of the xʷməθkʷəy̓əm (Musqueam), Skwxwú7mesh (Squamish) and səliłwətaʔt (Tsleil-Waututh) people.

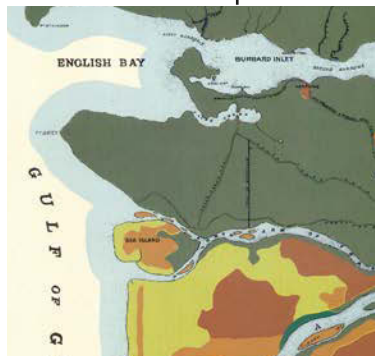


LOCAL FIRST NATIONS HAVE BEEN CARETAKERS OF THIS LAND SINCE TIME IMMEMORIAL

First Nations communities in Vancouver today have had continuous connection to their territories for countless generations



- 10,000+
Glacial till deposited over much of Vancouver. Scattered deposits of beach sand, sandstone, peat and Volcanic rock (Queen Elizabeth Park)



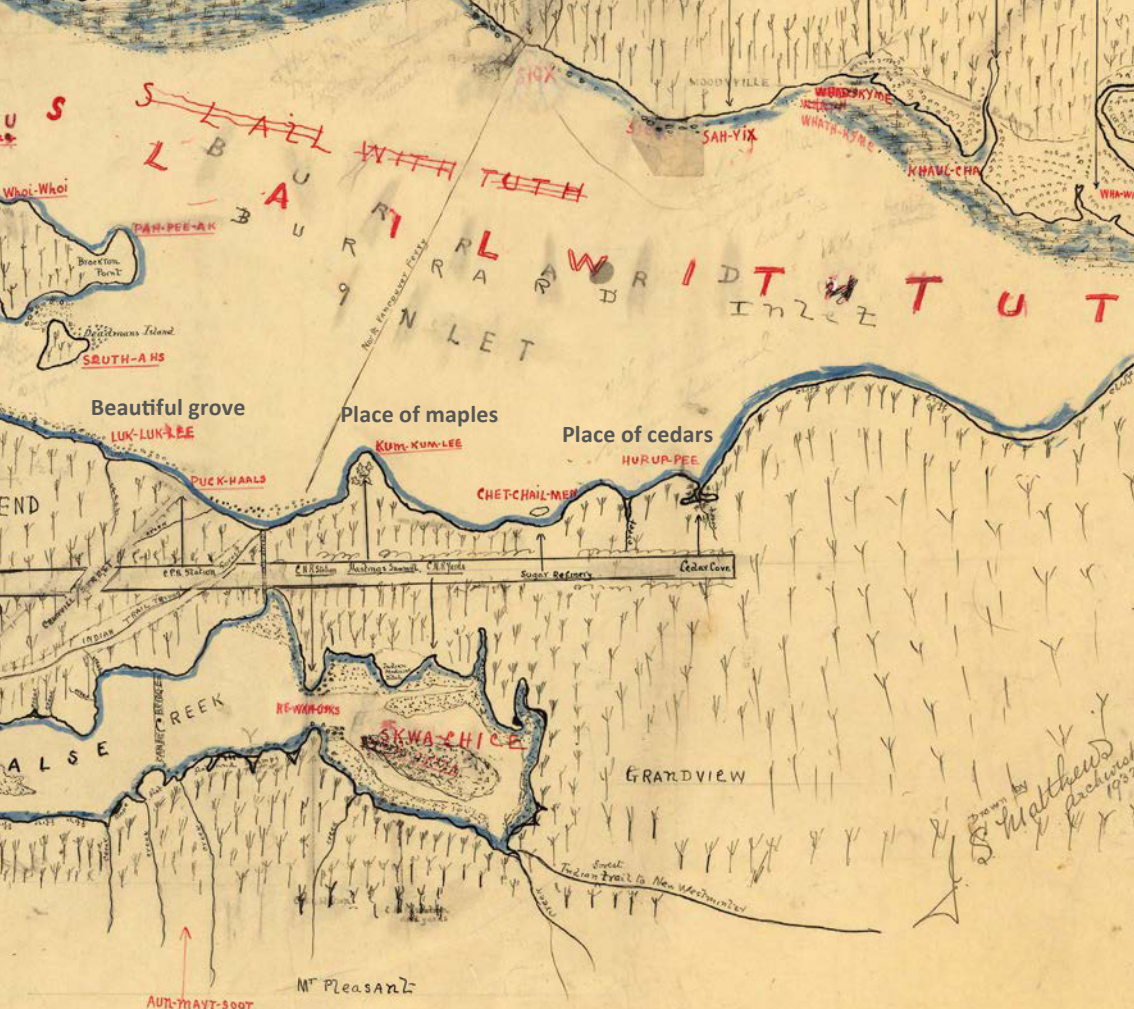
- 4,000 to - 7,000
Modern coastal temperate rainforest ecosystems established



- 4,000 to - 5,000
čəsnaʔəm, Musqueam ancestral village, founded in the area now known as Marpole

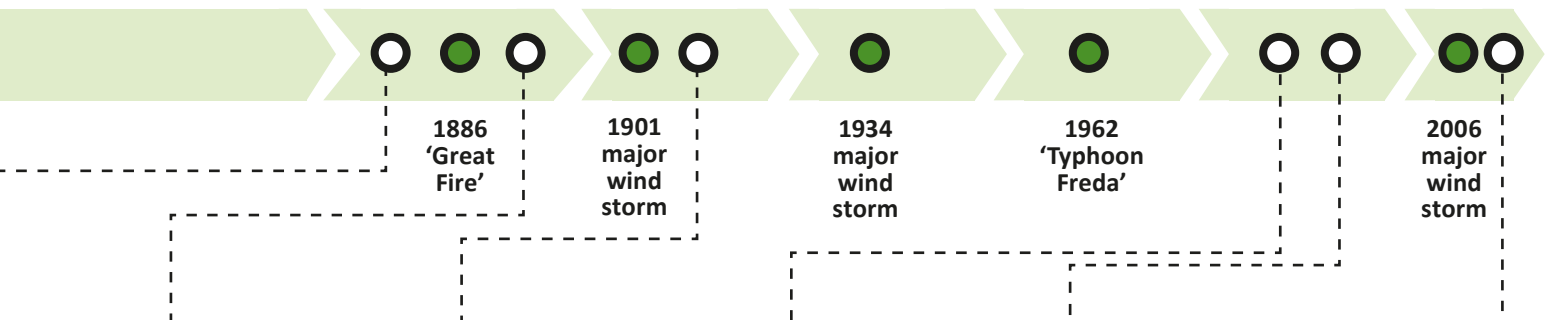


1860 +
Colonial settlement of Granville, now Vancouver, land clearing for development and commercial logging



This map represents First Nations and European place names. The map was made by J.S. Matthews (Vancouver City Archivist), in 1932 using knowledge provided by August Jack Haatsalano [sic] and contributors listed in "Early Vancouver, Volume 2". The spelling of these place names is not accurate in the Skwxwu7mesh Snichim (Squamish language) or Hən̓q̓əmin̓əm (Downriver Halkomelem) written languages today; current resources for place names can be found from x^wməθk^wəy̓əm, Skwxwú7mesh and səliłwətaʔ sources.

CITY OF VANCOUVER'S URBAN FOREST MANAGEMENT HISTORY



1886
'Great Fire'

1901
major wind storm

1934
major wind storm

1962
'Typhoon Freda'

2006
major wind storm



1888
Stanley Park officially opens



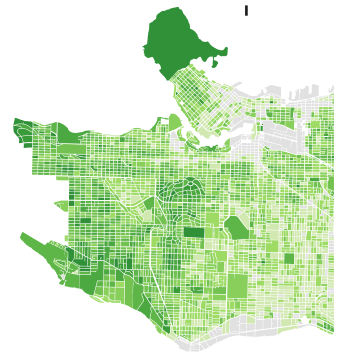
1917
First Street Tree bylaw established protection, and assigns care and custody to the Vancouver Park Board



1990
Street Tree Management Plan is adopted



1994
Private Tree Bylaw introduced (updated in 2009 and 2014)



2013
Work begins to measure Vancouver's urban forest resource and develop a strategy

5 STATUS AND TRENDS

This section describes the status and trends of Vancouver’s urban forest: how much the city has, where it is and how it is changing.

Canopy cover is a measure cities commonly use to describe the amount or size of their urban forest. Canopy cover measures the area occupied by tree crowns (upper leafy surface) and provides an indicator of the ecosystem services provided by the urban forest. It is often expressed as a percent compared to the total area of the city.

There are several ways to measure canopy cover. It can be mapped from air photos, or using new technologies such as LiDAR¹, satellite imagery, and even Google Streetview images. All can be used to measure the urban forest and improve people’s understanding of patterns and changes of forest cover in the city.

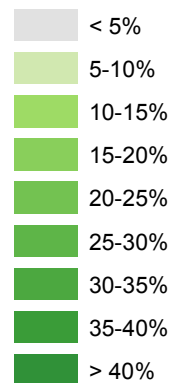
HOW MUCH URBAN FOREST DOES VANCOUVER HAVE?

Canopy Cover

Vancouver’s canopy cover was estimated at 18% (2,063 ha) in 2013. This was determined using Light Detection and Ranging, or LiDAR, data collected in February 2013. LiDAR points are collected from aircraft using a sensor that sends down laser pulses. Each LiDAR point has an elevation creating a 3D representation of the surface.

Canopy cover is extracted from LiDAR data by outlining the points classified as trees. LiDAR is very precise when a high density of points is collected, providing tree height, stem diameter, canopy width and volume data.

The USDA’s (United States Department of Agriculture) i-Tree² program was also used to estimate canopy cover using 2015 air photos; it was estimated to be 19% which is not significantly different from 2013 LiDAR-based estimate (the two methods are expected to provide slightly different results).

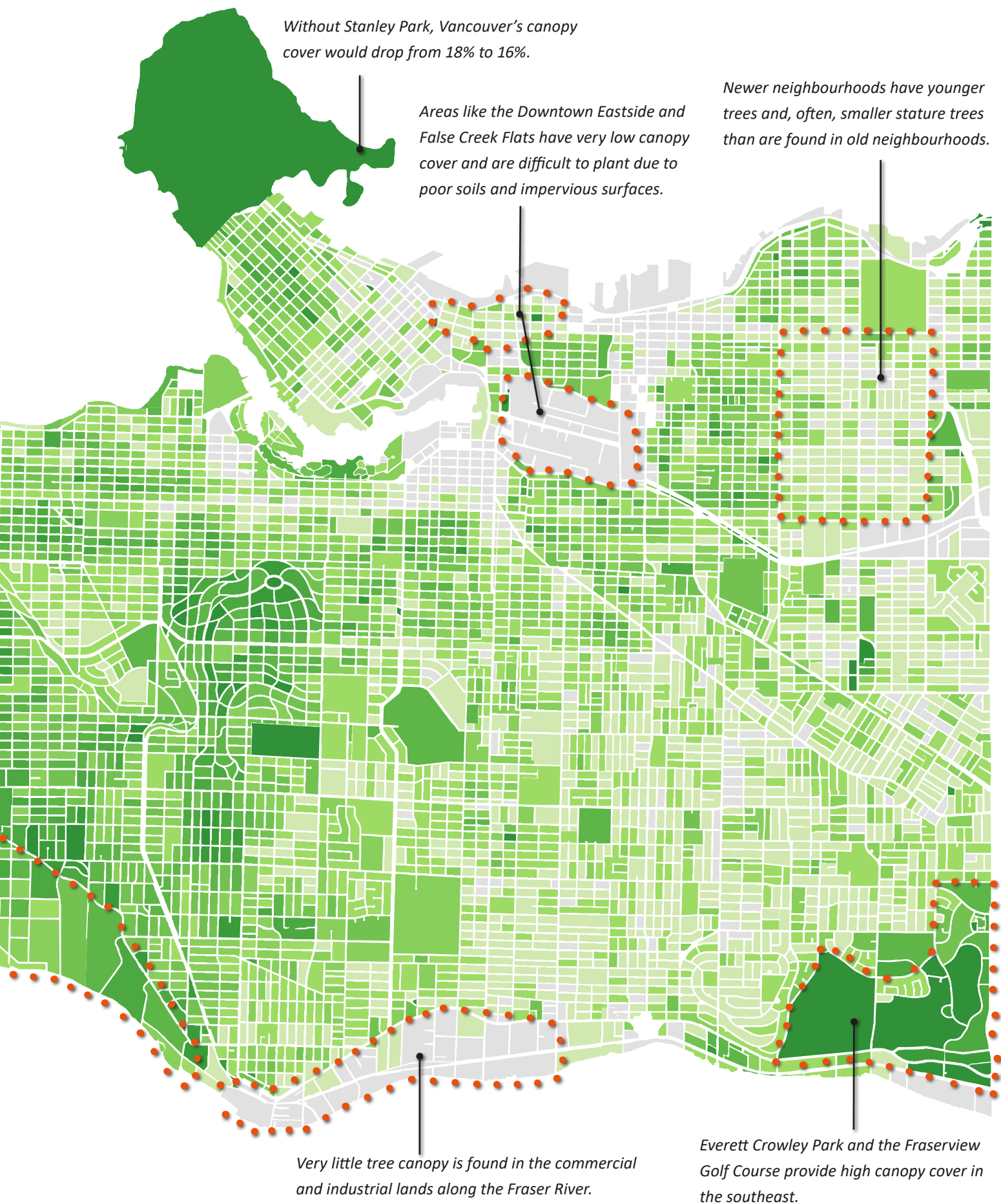


Older neighbourhoods have more large, old trees and native forests that were retained or planted with development.

Private land canopy cover is higher in the southwest than in other parts of the city.

¹ LiDAR - Light Detection and Ranging

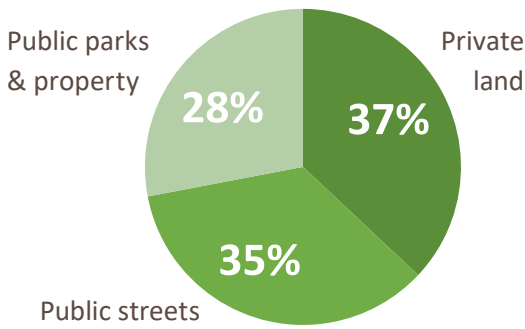
² i-Tree estimates canopy cover based on the presence or absence of tree canopy in orthophotos assessed at random points across the city.



WHERE IS VANCOUVER'S URBAN FOREST CANOPY DISTRIBUTED?

Vancouver's canopy cover is evenly distributed between public parks, public roads and private land. Most of the canopy is over public land but this includes private trees overhanging streets and parks.

CANOPY COVER BY OWNERSHIP



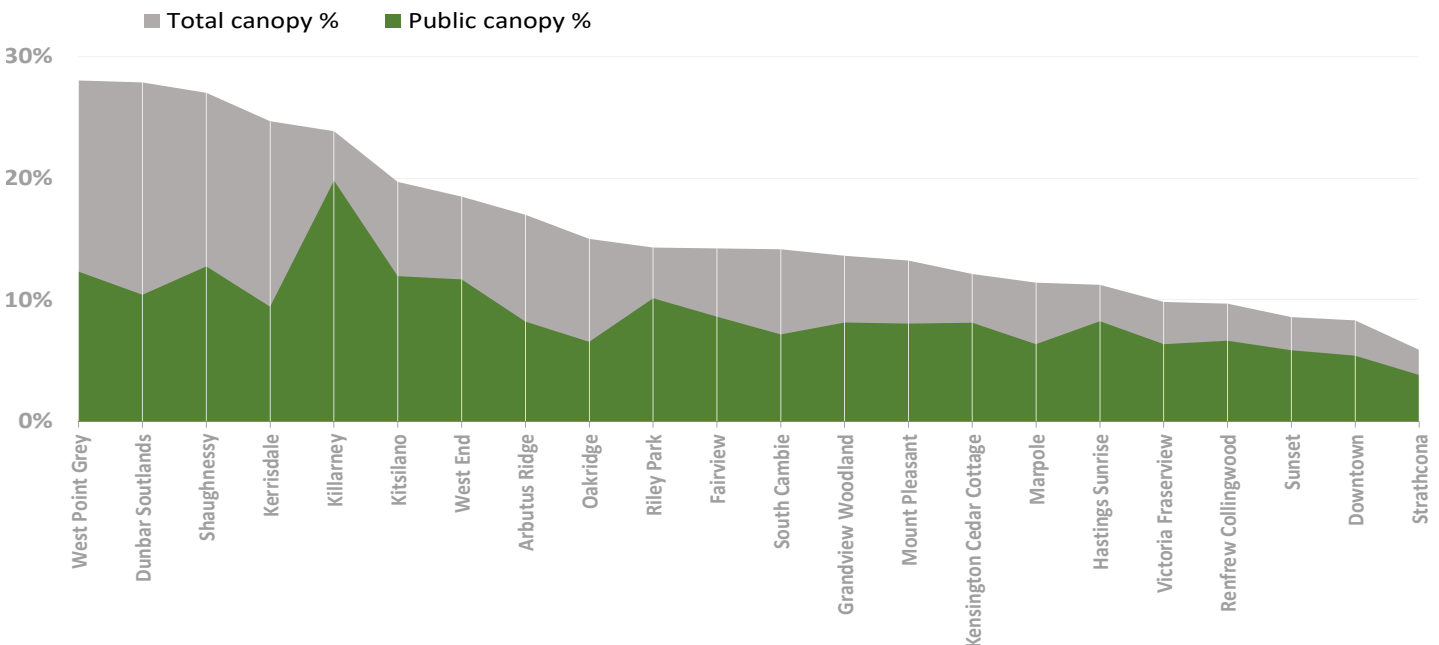
On public land, canopy cover averages 26% and is distributed over roads, parks, golf courses and other city-owned properties.

Private land canopy cover averages just 12% but because private land makes up 57% of the land base, it encompasses a large proportion of Vancouver's urban forest. Vancouver's west and southwest neighbourhoods, six of which exceed the city average canopy cover of 18%, contain most of the private land canopy.

CANOPY COVER BY NEIGHBOURHOOD

NEIGHBOURHOOD	CANOPY COVER	MOST CANOPY IS...
WEST POINT GREY	28%	PRIVATE
DUNBAR SOUTHLANDS	28%	PRIVATE
SHAUGHNESSY	27%	PRIVATE
KERRISDALE	25%	PRIVATE
KILLARNEY	24%	PUBLIC
KITSILANO	20%	PUBLIC
WEST END	18%	PUBLIC
ARBUTUS RIDGE	17%	PRIVATE
OAKRIDGE	15%	PRIVATE
RILEY PARK	14%	PUBLIC
FAIRVIEW	14%	PUBLIC
SOUTH CAMBIE	14%	EQUAL
GRANDVIEW WOODLAND	14%	PUBLIC
MOUNT PLEASANT	13%	PUBLIC
KENSINGTON CEDAR COTTAGE	12%	PUBLIC
MARPOLE	11%	PUBLIC
HASTINGS SUNRISE	11%	PUBLIC
VICTORIA FRASERVIEW	10%	PUBLIC
RENFREW COLLINGWOOD	10%	PUBLIC
SUNSET	9%	PUBLIC
DOWNTOWN	8%	PUBLIC
STRATHCONA	6%	PUBLIC

CANOPY COVER BY NEIGHBOURHOOD AND OWNERSHIP



CANOPY COVER TREND

Vancouver was heavily forested prior to the 1860s but logging, land clearing, and burning almost entirely destroyed the original native forest. Aside from remnants in Stanley Park, Vancouver's urban forest is composed of trees that are less than 120 years old.

To better understand how canopy cover has changed, the USDA's i-Tree Canopy assessment tool was used with Vancouver's earliest digital orthophotography to estimate canopy cover changes since 1995.

Work done in 2014 to compare the 1995 i-Tree canopy cover with the 2013 LiDAR canopy cover found that Vancouver had lost significant canopy cover over the last 20 years; it estimated a change from 22% to 18%. However, the 1995 orthophoto has low resolution and high distortion. Careful re-interpretation using both the LiDAR data to check for distortion of existing canopy and Google Earth™ historical imagery to improve tree loss detection refined the 1995 canopy cover estimate to 20%. This refined estimate indicates that Vancouver has lost canopy cover over the last 20 years (18% in 2014 from 20% in 1995) but fortunately the rate of loss has not been as rapid as first reported.

On public land, canopy cover is growing. For example, the street tree population increased from 80,000 in 1990 to 147,000 in 2017. More trees have been planted on public land than have been removed over the last two decades.

On private land, canopy cover has been declining. Between 1996 and 2013, almost 50,000 trees were removed under permits from the City of Vancouver. Half of those qualified for a former tree bylaw exemption allowing property owners to remove one tree per year. That exemption was removed in 2014, however removals related to poor tree health or development still occur at a significant pace. Replacements are required wherever possible.

In the future, there should be a stabilizing effect from the City's tree bylaw update and changes to the development process, as well as the City's Greenest City Action Plan target to plant 150,000 trees by 2020. Over the term of the strategy, canopy should increase due to these efforts. Trees take decades to establish and reach maturity; improvements to canopy cover occur slowly.



An example of a street tree that required removal due to advanced decay. When trees become hazardous due to disease or decay, or cannot be safely retained with development, they are typically removed to manage risk.

REGIONAL FOREST COVER TRENDS

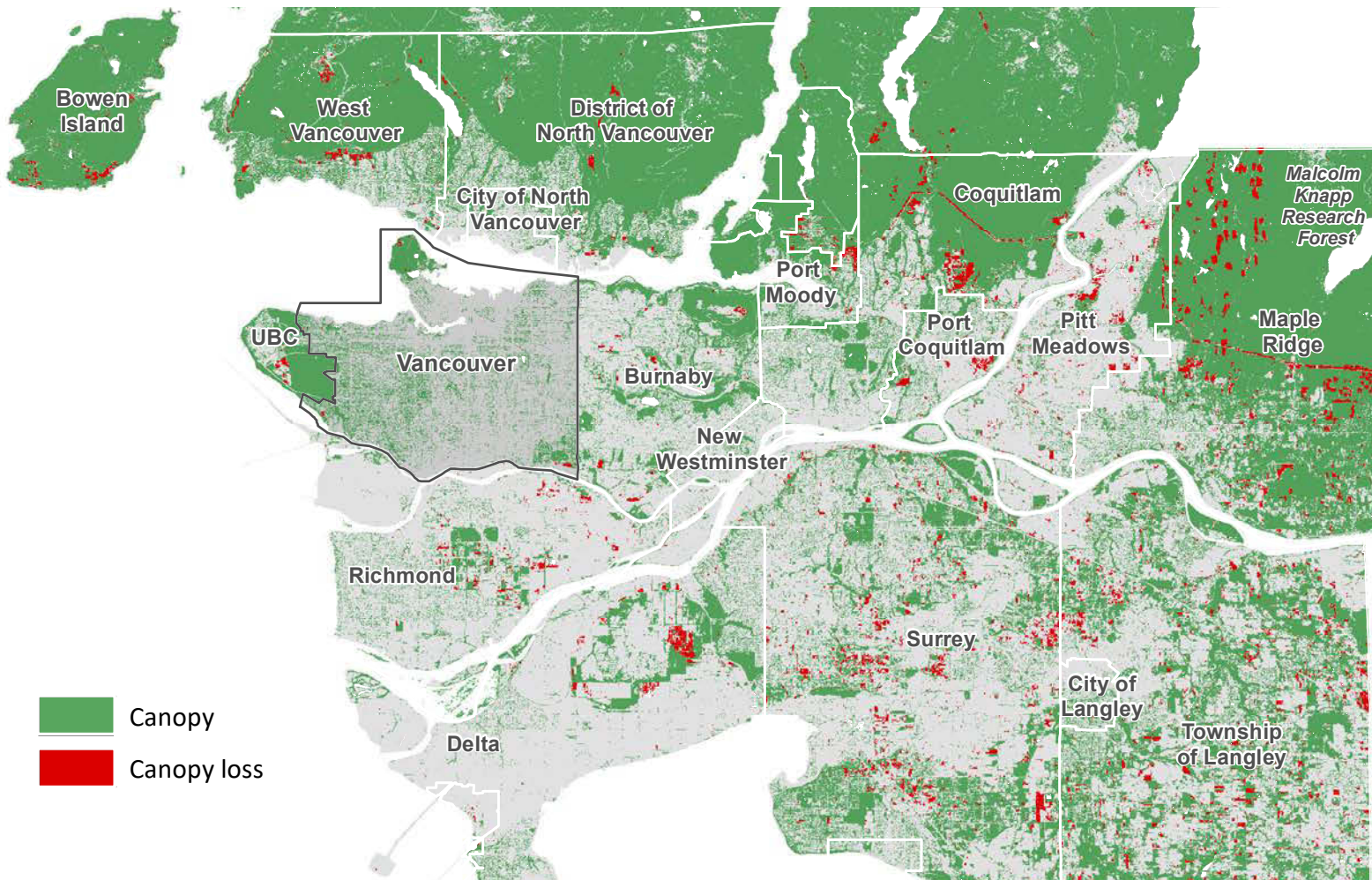
Changes in forest cover globally between 2000 and 2014 were measured by University of Maryland scientists using satellite images [16]. While this is a relatively coarse dataset that doesn't show small scale changes, it is useful for examining larger scale forest cover loss across Metro Vancouver. The red canopy loss shown on the map below is sourced from the University of Maryland dataset. The green canopy cover data is sourced from Metro Vancouver's land cover classification data.

Vancouver's forest cover losses since 2000 are mostly explained by many scattered removals on private land, too small to be captured on the map below. This contrasts with some parts of the region that have experienced large scale canopy loss due to land clearing. Vancouver's largest recent losses of forest were from the 2006 Stanley Park windstorm damage and large developments such as the River District in southeast Vancouver.

In Metro Vancouver, large urban forest losses are often associated with urban development (e.g., British Properties, UBC South Campus, south Surrey, SFU University, and new residential subdivisions in outer municipalities). Large losses are also visible as a result of forest harvesting in the UBC's Malcolm Knapp Research Forest, the 2005 wildfire in Delta's Burns Bog, and the construction of the Seymour-Capilano Filtration Plant in the Seymour River valley in North Vancouver.

Forest cover gains from reforestation and development planting are also occurring across Metro Vancouver but take time to show up in satellite imagery. Overall, the Maryland data set indicates that forest cover loss exceeded gain in Metro Vancouver between 2000 and 2014.

REGIONAL CANOPY LOSS BETWEEN 2000 AND 2014



HOW DOES VANCOUVER COMPARE TO OTHER CITIES?

Comparisons of total canopy cover between different cities can be misleading because of differences in land use composition and natural vegetation type. For example, if one city is entirely urbanized, while the other is still developing, direct comparisons do not accurately reflect how each city is managing its urban forest.

If measurement methods and ecoregions (e.g., forest, grassland, desert, etc.) are equivalent, comparisons of similar land uses between cities can better reflect urban forest performance than total canopy cover comparisons between cities.

A recent project by the MIT Senseable City Lab [17] compared the canopy cover people experience in streets. Their method applied a Green View Index (GVI) using Google Street View panoramas to measure the percent of the image obstructed by tree canopies. Vancouver's GVI is among the highest of the 23 global cities measured, exceeded only by Singapore. Using this visual method, Vancouver's urban forest seems to be performing well in streets compared to many other large cities around the world, which is good news for delivering urban forest benefits to Vancouver's public. However, this analysis doesn't measure the urban forest canopy in areas away from streets.

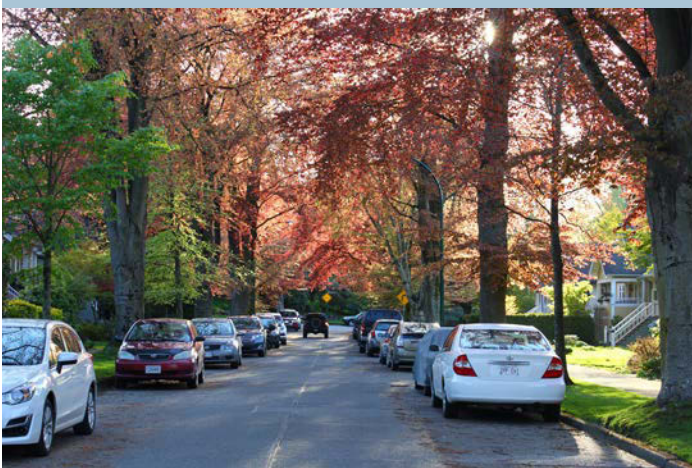
Toronto, GVI 20%



Seattle, GVI 20%



Vancouver, GVI 26%



Singapore, GVI 29%



MEETING THE 150,000 TREE PLANTING TARGET

In 2010, Vancouver’s Greenest City Action Plan set an ambitious target to plant 150,000 trees by 2020 as part of the Access to Nature goal. As of the end of 2017, just over 102,000 trees have been planted. About 55% of the new trees have been planted on public lands (streets and parks) while 45% have been planted on private lands including backyards and development sites.

Public Land Tree Planting

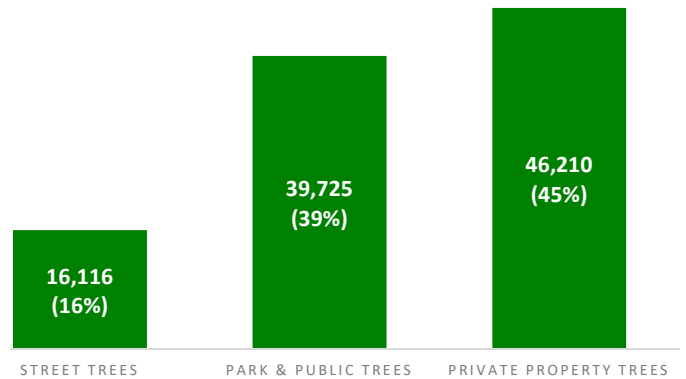
Tree planting on public lands is divided into three components:

Street trees: About 1,500 street trees are planted annually on publicly managed rights of way and boulevards. Many of the easily available planting spots in streets have been filled and new planting is targeting hard to plant sites with poor soils, and replacement planting of unhealthy street trees. Ensuring adequate soil volume is a key challenge for street tree planting in developed sites.

Ornamental park trees: Between 300 and 500 ornamental park trees are planted in Vancouver parks annually to improve park aesthetics, provide shade around playgrounds, and replace dead or unhealthy trees. Most of these ornamental park trees are large species that are challenging to fit into streets or private lands.

Forest Restoration: Over 70% of new trees planted on public lands (around 7,000 trees per year) are native tree species, planted to support the city’s ecological network and increase biodiversity. Native conifers like Douglas-fir are emphasized because many parks already support deciduous forests of red alder and black cottonwood. Coniferous forests support native bird and small mammal species which are absent from deciduous forests. Forest restoration focuses on larger parks like Jericho and Everett Crowley parks where tree cover is patchy because of a history of disturbance.

TREES PLANTED 2010 — 2017



Private Land Tree Planting

Private land planting has averaged around 9,000 trees per year since 2015. The main components of tree planting on private land are:

Spring and Fall Tree Sales & Nursery Sales: The Park Board provides incentives for homeowners to plant trees on residential properties. Tree sales provide a broad range of trees suitable for residential yards at a discount (trees are typically 5 gallon in size and sold for \$10). These sales account for more than half (about 5,000) of the trees planted on private lands annually. A new program allows Vancouver residents to purchase trees at local nurseries and receive a rebate of \$20 against the retail purchase price. This program will expand in 2018.

Development Trees: The City’s Planning staff review development applications and work with landowners, consultants and developers to protect existing trees, as well as to plant trees to replace and increase tree cover if possible. About 3,800 trees are planted as part of development applications annually in the City of Vancouver.

Additional Private Land Trees: It is estimated that about 500 trees per year are planted on private property but not captured as part of the Park Board tracking process. These are trees purchased from nurseries throughout the region, at plant sales, or acquired from other sources.

TOTAL TREES IN VANCOUVER

Vancouver has more than 400,000 trees on public and private land. This estimate is a coarse count of the canopy outlines extracted from LiDAR. More accurate information on Park Board managed street trees is available from Vancouver's tree inventory system.

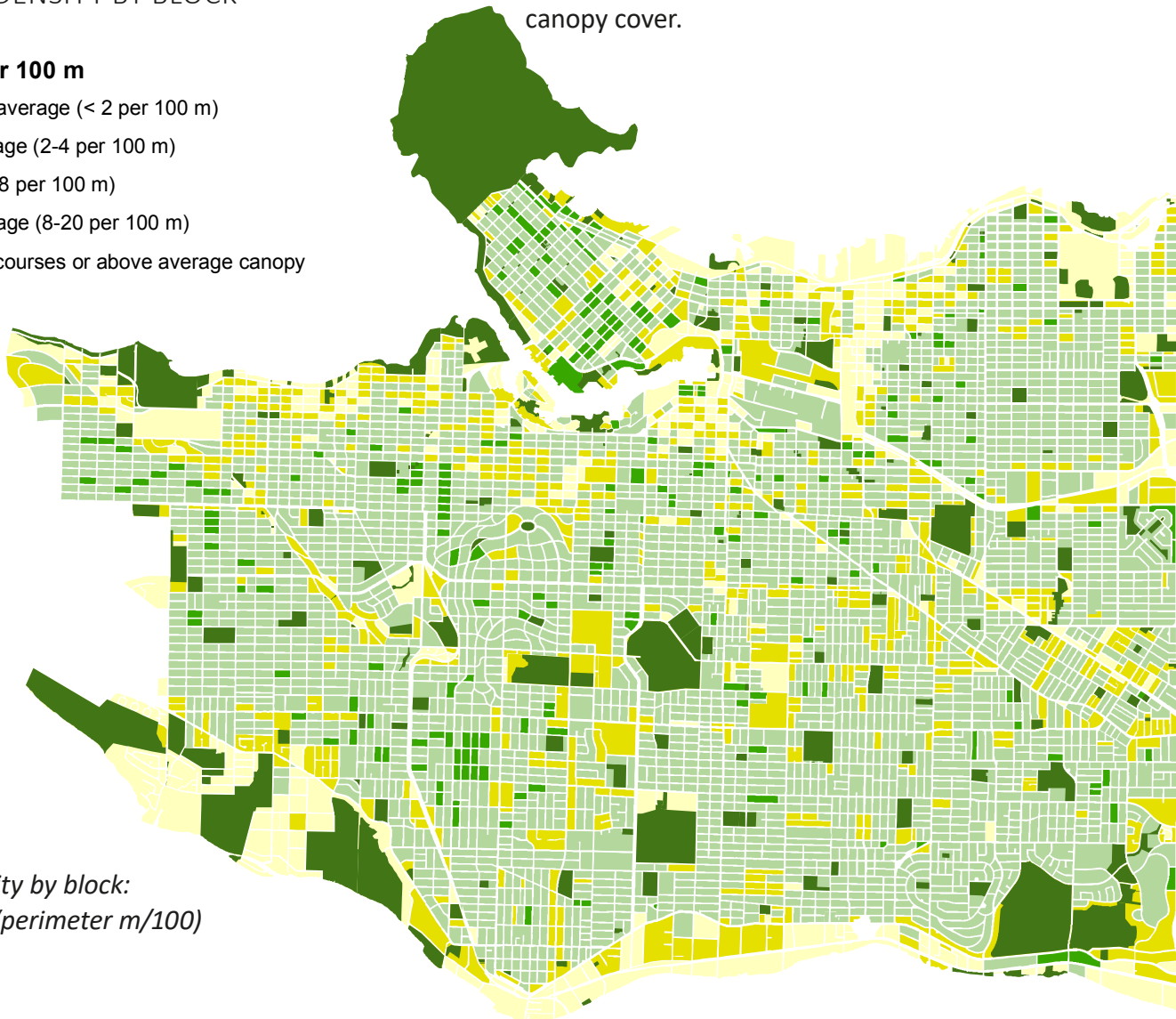
Vancouver has 147,000 street trees that account for one third of the city's canopy cover. The map below shows the density of street trees by block.

Most blocks have 4-8 street trees per 100 m. Blocks with fewer street trees typically have boulevards that are too narrow for trees, are industrial areas, or have private gardens or parks extending canopy cover over the street. This Strategy sets a target to double street tree density in below-average blocks with low canopy cover.

STREET TREE DENSITY BY BLOCK

Street Trees per 100 m

- Well below average (< 2 per 100 m)
- Below average (2-4 per 100 m)
- Average (4-8 per 100 m)
- Above average (8-20 per 100 m)
- Parks, golf courses or above average canopy



*Street tree density by block:
trees per block/(perimeter m/100)*



NATIVE FORESTS: BIODIVERSITY HOTSPOTS

Native forests cover only about 4% of Vancouver but they are a critical part of the city’s ecological network. Native forests were mapped as part of the City’s Biodiversity Strategy (2016) and were defined as treed areas >0.5 ha in area with a shrub understorey, downed wood and snags, and composed mainly of native plant species. They are sustained by natural processes such as windthrow, competition for resources, nutrient cycling, and vegetation succession.

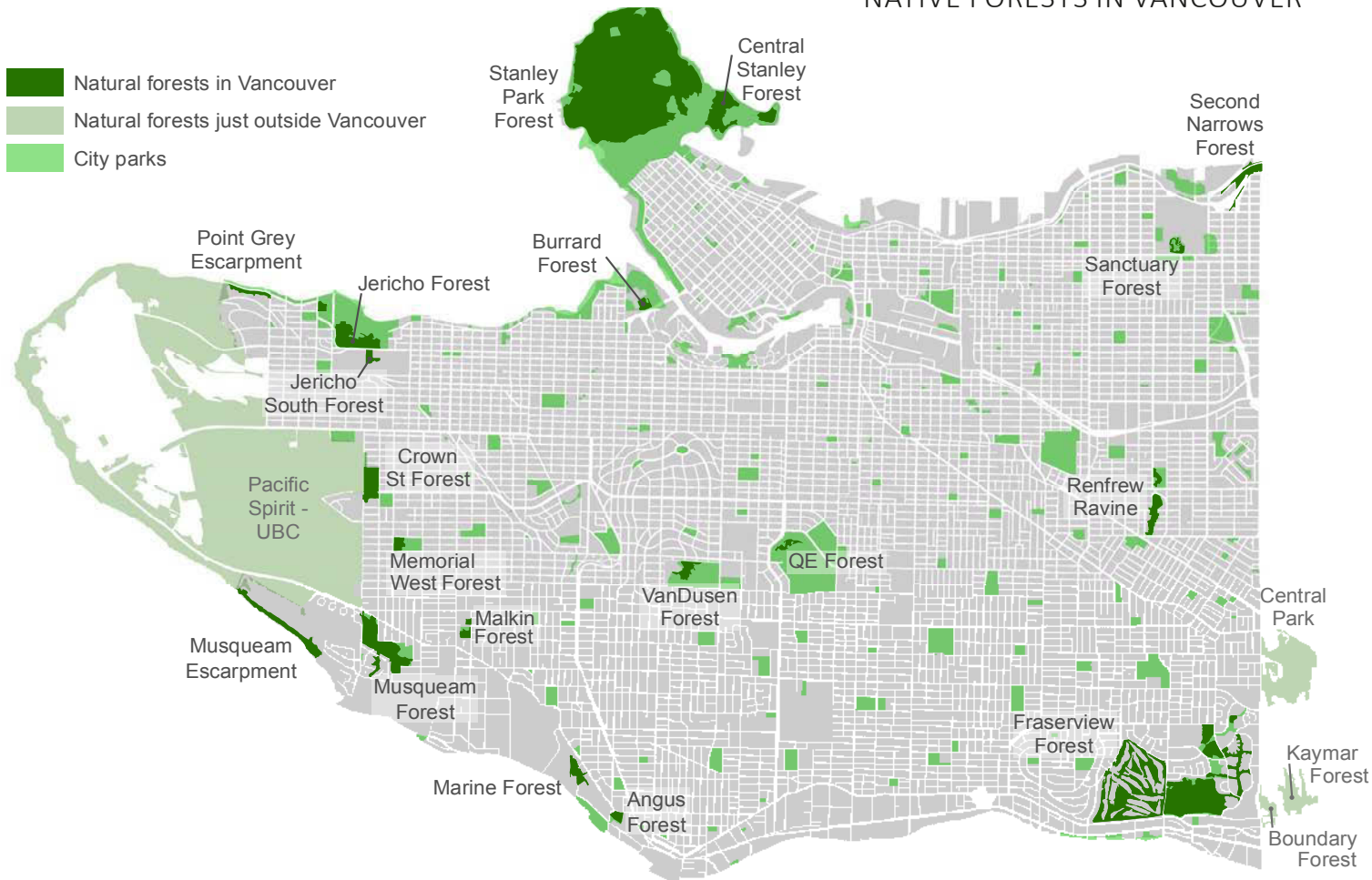
Native forests are essential for forest-dependent plants and wildlife such as Douglas squirrel, pileated woodpecker, rattlesnake plantain, and red-backed salamander. Because most of Vancouver was covered by dense, old-growth forest historically, biodiversity is closely tied to native forests, particularly older coniferous or mixed forest. Efforts to increase natural areas under the City’s Biodiversity Strategy have emphasized the enhancement of native forests in key sites like Everett Crowley, Jericho Beach, Musqueam, and Renfrew Ravine parks.

Less forest restoration work has been done in Stanley Park recently because of the large amount of healthy forest and the extensive and successful work to replant following the 2006 windstorm.

Stanley Park accounts for over 75% of the native forest in Vancouver. It also contains some of the oldest low-elevation forests in the region including many old-growth Douglas-fir and western redcedar trees that were protected from early logging by Stanley Park’s designation as a naval reserve. Vancouver’s tallest tree in the heart of Stanley Park is a 63 m (206 ft) tall Douglas-fir south of Beaver Lake that started to grow around the time of the Great Fire of 1886.

Other important native forests in Vancouver include Fraserview Golf Course, Musqueam Park, Everett Crowley Park, and Renfrew Ravine Park, as well as smaller sites like the Sanctuary Pond in Hastings Park and forests in Queen Elizabeth Park (see map below).

NATIVE FORESTS IN VANCOUVER





Research at UBC has found that as many as 14 forest-dependent birds – species like Marbled Murrelet, Ruffed Grouse, and Band-tailed Pigeon, no longer breed in Vancouver because of the loss of mature, evergreen forests [18]. Native forests like those found Stanley Park are the best way of ensuring the forest-dependent biodiversity is sustained in the city.

6 EMERGING DIRECTIONS

URBAN DEVELOPMENT

Trees on private property account for almost 40% of the city's urban forest. While thousands of new trees have been planted on streets and in parks, Vancouver's city-wide canopy cover has declined incrementally, and most of this decline has been occurring on private property.

In 2014, the City amended the Protection of Trees Bylaw to no longer allow the removal of one tree per year on all private properties. However, canopy continues to be removed due to the construction of new buildings. Over the last few decades the City has experienced rapid change to meet the needs of a growing and changing population. Building footprints often require removing mature trees (on average 2,700 trees have been removed annually since 1996).

On public land, renewal or infrastructure upgrades to support a growing and changing population (for example, the Stanley Park causeway safety barrier and sewer and transportation improvements) also result in tree removal.

Vancouver residents have long recognized that the character elements they value in their neighbourhoods are not limited to the urban design of the buildings but also include the special streetscapes made up of mature trees

and landscaping on both private property and boulevards.

The incremental redevelopment taking place throughout the city and the subsequent tree loss has increased public interest in strengthening the City's urban forest protection initiatives.

In addition to amending the Protection of Trees Bylaw in 2014, the Planning, Urban Design and Sustainability Department has implemented several processes to enable the retention of more trees during the development process, including:

- Pre-screening of development applications for tree retention.
- Facilitation of alternative design solutions at all scales of development.
- Interdepartmental coordination.
- Industry outreach with the arboricultural community.

Future work includes increased enforcement of the Protection of Trees Bylaw and further industry outreach with the design community on how to design for tree retention.



Significant trees retained and protected during new development.

SOIL, RAINWATER AND HARD SURFACES

As Vancouver grows and densifies, the extent of hard surfaces increases and less water can permeate down into the soil. The resulting increase in surface water runoff impacts water quality, soil moisture and flood risk, which further impacts natural ecosystems, forest health and city infrastructure.

Impermeability presents challenges for Vancouver’s urban forest by limiting:

- Space to plant new or replacement trees.
- Soil volume for existing and new trees.
- Rainwater soil infiltration and storage.

By comparing canopy cover and permeability in each block, it was evident that Vancouver’s canopy cover becomes limited as impermeability increases. Once impermeability exceeds about 50% of the block, tree canopy averages less than 10%. In most cases, very impermeable blocks will have few to no trees so the canopy that does exist is usually provided by overhanging street trees. Approximately half of the city’s blocks exceed 50% impermeable cover. Impermeability increases from west to east in a similar pattern to decreasing canopy cover.

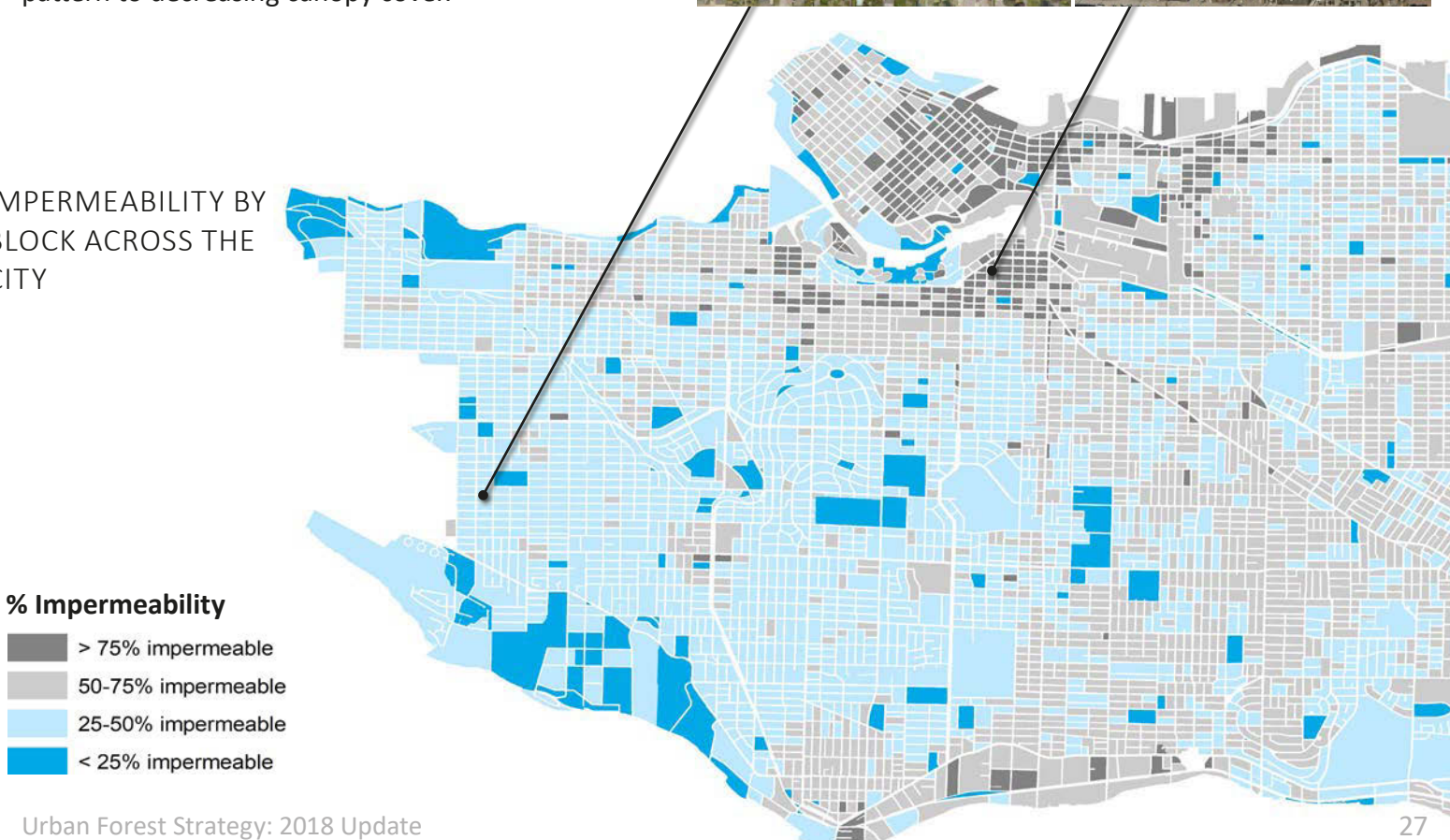
Increasing canopy cover city-wide will be more successful if permeable area can be protected and increased. In impermeable locations, planting sites may need to be built with imported soil or special structural soils to create soil volume under load bearing hardscape (e.g., bike paths, sidewalks etc.). Building these types of planting sites can result in healthy trees and good canopy cover but it also means that tree planting costs will be higher in locations with low permeability.

25-50% impermeable

>75% impermeable



IMPERMEABILITY BY BLOCK ACROSS THE CITY



% Impermeability

- > 75% impermeable
- 50-75% impermeable
- 25-50% impermeable
- < 25% impermeable

CLIMATE CHANGE AND THREATS TO FOREST HEALTH

Under climate change, warmer and drier summers are expected to reduce moisture available to trees during the growing season. Windstorms, pests and diseases, drought and wildfire already affect Vancouver's urban forest, and in the future, the variability, frequency and intensity of disturbance events in the urban forest will increase.

Increased summer drought stress combined with increasing disturbance activity could have widespread impacts on tree health, growth and mortality rates in Vancouver.

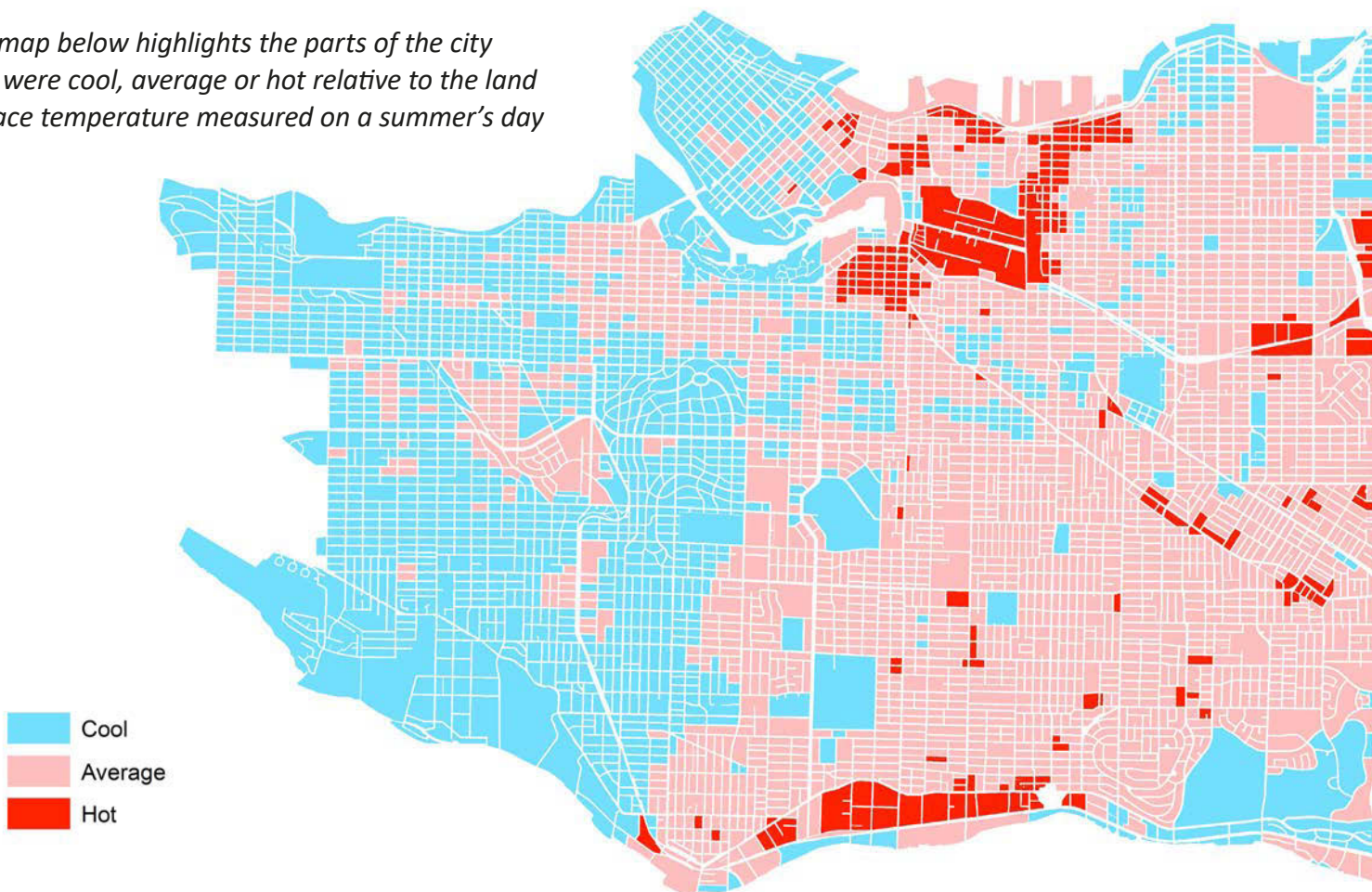
The hotter than average locations mapped below are also some of the most impermeable in the city. These locations will be difficult to grow trees in because they are likely to have poor soils and be hot and dry in summer. However, many of these locations are also priorities for increasing canopy cover because of the expected benefits to people.

A healthy tree will be more resilient to climate change and other threats. To build resilience in the urban forest population, new trees will need to be provided with access to a reasonable volume of good soil, adequate soil moisture and space to grow.

There are synergies among Vancouver's strategic initiatives related to climate adaptation, rainwater management and the urban forest. Implementing green infrastructure solutions that improve permeability, increase soil volume and restore rainwater infiltration into the soil will also improve growing conditions for trees while mitigating some of the impacts of extreme rainfall. Healthy urban forest canopy cover and moist soils in hot spots will also create more continuous cool refuges across the city to reduce people's vulnerability during heat waves, and lower building energy consumption.

RELATIVE SURFACE TEMPERATURE ON A SUMMER DAY

The map below highlights the parts of the city that were cool, average or hot relative to the land surface temperature measured on a summer's day





The windstorm that ripped through Stanley Park on the night of December 14, 2006 toppled as many as 10,000 trees in the park. Trees as old as 500 years were piled like pick-up sticks. But 10 years later, a new forest is developing that shows the amazing resilience of coastal forests to infrequent, large-scale disturbances like wind and fire.

– Bill Stephen, Urban Forester, Vancouver Park Board

GREEN INFRASTRUCTURE

The City of Vancouver is developing a green infrastructure strategy to improve and protect Vancouver's water quality, and proactively prepare for climate change. By linking urban rainwater management with land use planning, Vancouver can improve the way the built environment is developed to make the city more resilient to rising sea level, flooding and extreme rain and heat events.

Green infrastructure is a cost-effective approach and provides multiple benefits for Vancouver. These green infrastructure practices have the capacity to cool the urban environment, reduce energy consumption, mitigate flooding, improve water quality and increase habitat while maximizing existing grey infrastructure and leveraging co-benefits for other City initiatives including the Urban Forest Strategy.

Trees are natural water managers and the urban forest will play a significant role in achieving the goals and target of the Rain City Strategy.

The Rain City Strategy sets a target to capture and clean 90% of Vancouver's rainfall on both public and private property. The strategy's goals are to:

1. Improve and protect Vancouver's water quality.
2. Increase Vancouver's resilience through sustainable water management.
3. Enhance Vancouver's livability by improving natural and urban ecosystems.

The Rain City Strategy and Urban Forest Strategy work in tandem to achieve their mutual goals resulting in a healthier urban forest, improved water quality, stronger resilience, and enhanced natural and urban ecosystems.



The wetland in Hinge Park receives rainwater from buildings in Olympic Village



The leaves and branches of urban trees intercept rainfall before it reaches the ground and slow the amount of stormwater generated in storms. Our research in North Vancouver used a novel method for measuring interception. We found that large native conifers like western redcedar and Douglas-fir intercepted between 40 and 60% of rainfall, and highlighted the importance of urban forests in managing urban runoff.

— Dr. Markus Weiler, Professor of hydrology, University of Freiberg

BIODIVERSITY

The goal of Vancouver’s Biodiversity Strategy is to increase the amount and ecological quality of Vancouver’s natural areas to support biodiversity and enhance access to nature. Building the ecological network — the interconnected system of large to small natural areas across the city — is essential to sustaining Vancouver’s biodiversity over the long term.

The Urban Forest Strategy contributes to Vancouver’s ecological network by promoting tree planting, protecting native urban forests, and by connecting forest canopy throughout the urban environment.

Vancouver’s native trees are concentrated within the parks network, with significant stands of native forest located in Stanley Park, Jericho Beach, Musqueam, Everett Crowley, Renfrew Ravine and other large parks. Common native trees in Vancouver forests include western redcedar, Douglas-fir, western hemlock, bigleaf maple, cottonwood and red alder.

Structurally diverse native forests play a critical role in sustaining biodiversity in the city by providing habitat for native flora and fauna, and by providing people with access to nature. It is important that native trees and forests remain a significant component of the urban forest. Many are also adapted to Vancouver’s coastal climate.

Within City streets, native trees represent less than 2% of the tree population. While this seems low, native trees are rarely suitable for streets, boulevards or higher density residential areas because of their growth characteristics. Streets also typically lack structural diversity found in native forests (e.g., old trees, understorey vegetation and woody debris) due to maintenance and risk management considerations.

Successful urban trees thrive in modified urban soils, tolerate polluted air, pruning, compaction and numerous other activities occurring in urban land uses. In many cases, native trees cannot tolerate or are unsuitable for urban sites (for example, they are too large for the available space or prone to branch breakage). However, there are locations — like wide medians, streets bordering park edges, or residences with big yards — that are good opportunities to plant native trees and add more structure outside parks.



BC’s largest recorded big-leaf maple is in Stanley Park. It stands 29 m tall and has a trunk circumference of 10.7 m. The photo above shows the tree today.

TREE DIVERSITY

Maintaining tree diversity within the urban forest population, and selecting trees that are expected to thrive in future climate, is important for the health of the urban forest. A diverse and well-adapted tree population will be less vulnerable to insect and disease attack, more resilient to climate change, and provide a stable supply of ecosystem services.

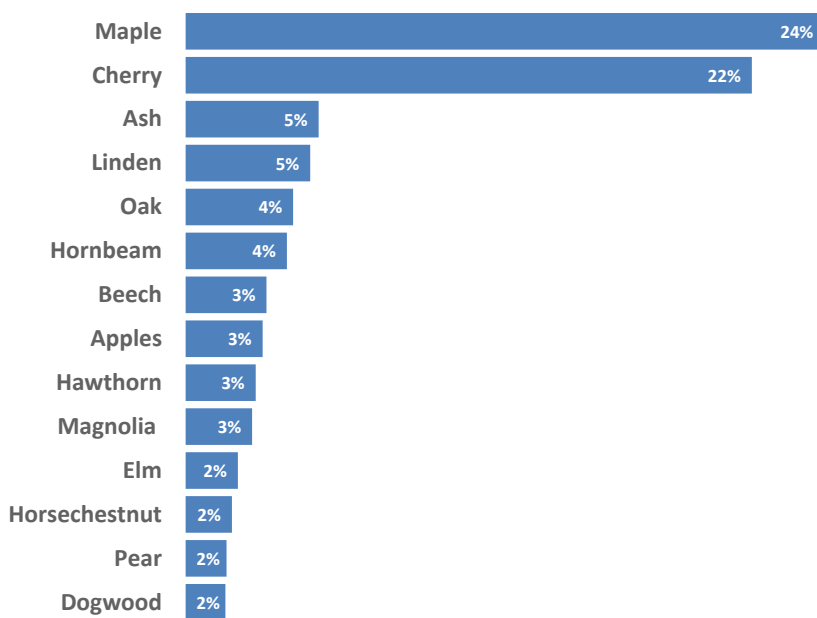
TREE SPECIES DIVERSITY IN STREETS

The graph to the right lists the most common genera in Vancouver's streets. The 10-20-30 rule-of-thumb recommends that populations have no more than 10% of any species, no more than 20% of any genus and no more than 30% of any family [19]. Vancouver's street trees conform to the guideline for species and family diversity but exceed the guideline at the genus level for maple and cherry (including plum).

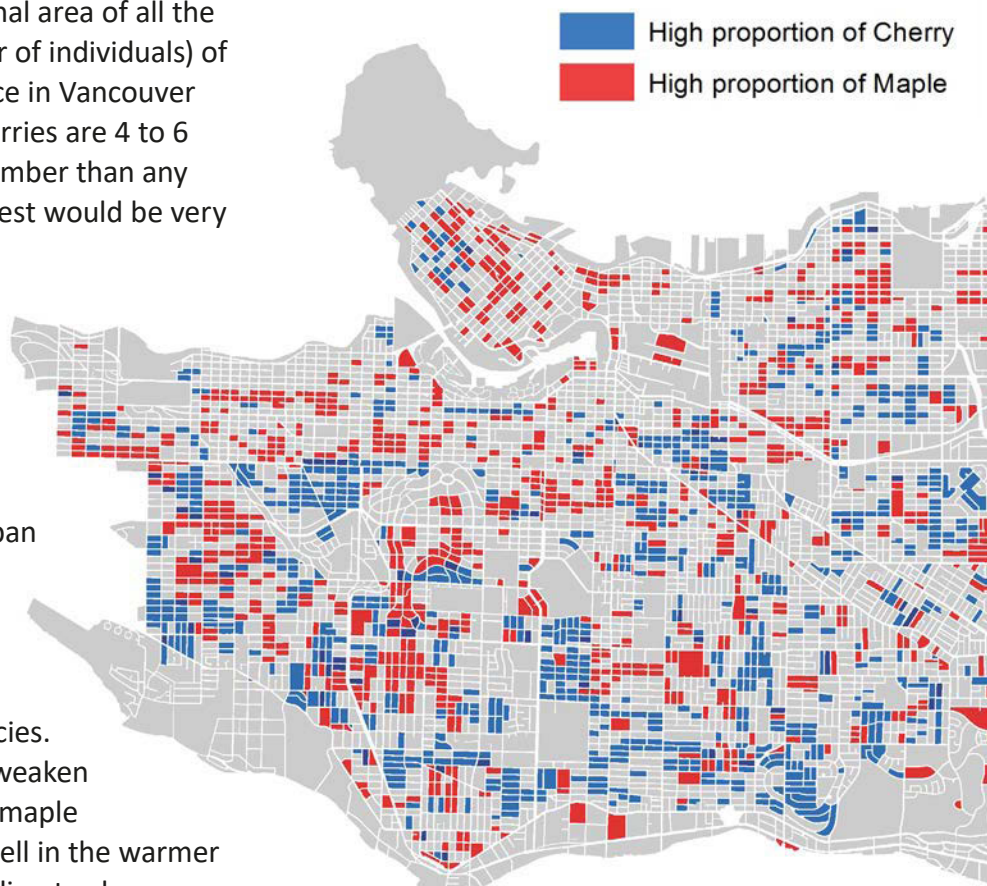
The map below shows the blocks where cherry and maple dominate the street tree makeup. Using the percentage basal area (cross-sectional area of all the tree stems) and abundance (number of individuals) of each genus, their relative importance in Vancouver streets was ranked. Maples and cherries are 4 to 6 times more dominant in size and number than any other genus, meaning the urban forest would be very vulnerable to their loss.

Asian long-horn beetle and pink gypsy moth are two significant pest threats that target maple and cherry respectively (and a number of other broadleaf species). These pests could devastate the urban forest if they established in Vancouver. The Japanese Beetle recently detected in False Creek is also a defoliating pest of cherries, some maples and several other species. Successive years of defoliation will weaken trees. In addition, many cherry and maple species are not expected to do as well in the warmer and drier summers predicted with climate change.

MOST COMMON STREET TREE GENERA IN VANCOUVER



BLOCKS WITH HIGH PROPORTION OF CHERRY OR MAPLE STREET TREES





The Vancouver Cherry Blossom Festival story is one of romance. It is an annual celebration that marks the reawakening in our community of all that makes us alive and human. We smile at one another. We take our lunches under the spreading blossoms. We spend the warming nights between illuminated clouds of flowers. We celebrate as men and women have celebrated since time immemorial: with poetry, music, dance, good food and drink, laughter, and love.

— Linda Poole, Executive Director, Vancouver Cherry Blossom Festival

There are opportunities to diversify the urban forest thanks to Vancouver’s temperate climate. Relatively mild winters and summers mean that a wide range of tree species thrive here. Under climate change, milder winters and warmer summers may also enable previously unsuccessful species to thrive.

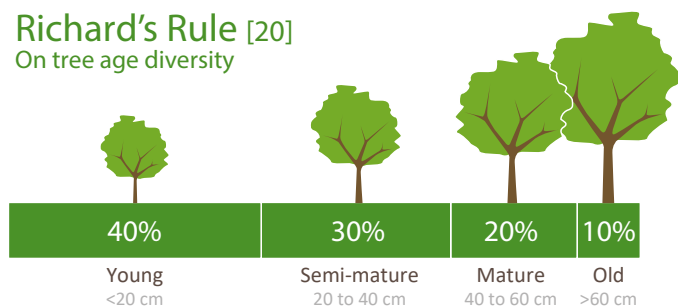
While cherry and maple trees will remain important in Vancouver’s urban forest, vulnerability can be reduced in Vancouver’s tree population by choosing locations to strategically replace cherries and maples with other species as they are removed.

SPECIES DIVERSITY ACROSS NEIGHBOURHOODS

A diversity index is another way of describing how diverse a population is by looking at the number of species or genera (richness) as well as their relative abundance (evenness). Street tree genus diversity was examined across Vancouver’s neighbourhoods. Strathcona has the highest genus diversity among neighbourhoods. While maples and cherries still dominate, Strathcona also has a higher representation of other species like hornbeam, oak, pear, linden, elm and beech trees. Vancouver’s least diverse neighbourhood is downtown, which is dominated by maple, beech and oak.

AGE AND SIZE DIVERSITY

Age and size diversity is important for maintaining a relatively stable urban forest population over time. Using size as a proxy for age, the 40:30:20:10 guideline (based on research in Syracuse, New York) suggests urban tree populations should have the distribution shown below [20]. Vancouver’s street tree population approximately conforms to this size distribution.



GENETIC DIVERSITY

Genetic diversity is also important for having resilient individuals in the tree population, and for genetic conservation of diversity within tree species. The genetic diversity of Vancouver’s street tree population is largely unknown. However, it is likely to be declining because modern nursery practices rely heavily on industrial-scale production of clonal trees of limited types.

Increasing species and genetic diversity within Vancouver’s urban forest over the long term will need to be coordinated with the nursery industry who supply the tree stock.

The Strathcona neighbourhood has the highest tree species diversity in Vancouver.





Since 2015 the City has offered Vancouver residents \$10 tree sales in spring and fall, and now provides a tree rebate program. Fruit producing trees have been particularly popular. As a result, hundreds of fig, apple, cherry and plum trees have been planted on Vancouver properties.

MAINTENANCE AND SUCCESSION PLANNING

Vancouver's street tree population, heavily reliant on cherries and small, short-lived species, has many trees reaching the end of their life expectancy. The map below shows locations where street trees are expected to need replacing in the next 5 to 30 years due to condition, age or species performance.

Approximately half of the Pissard plums and Kwanzan cherries, which comprise 18% of Vancouver's street tree population, are reaching the end of their lives and need to be replaced. English hawthorn and silver birch are performing poorly in all age classes. In addition, some species have recurring maintenance issues, like lindens with aphid infestation. Some more recently introduced types of trees that are performing well and increasing urban forest diversity include beech, ginkgo, ironwood, tupelo, stewartia, redbud and snowbell.

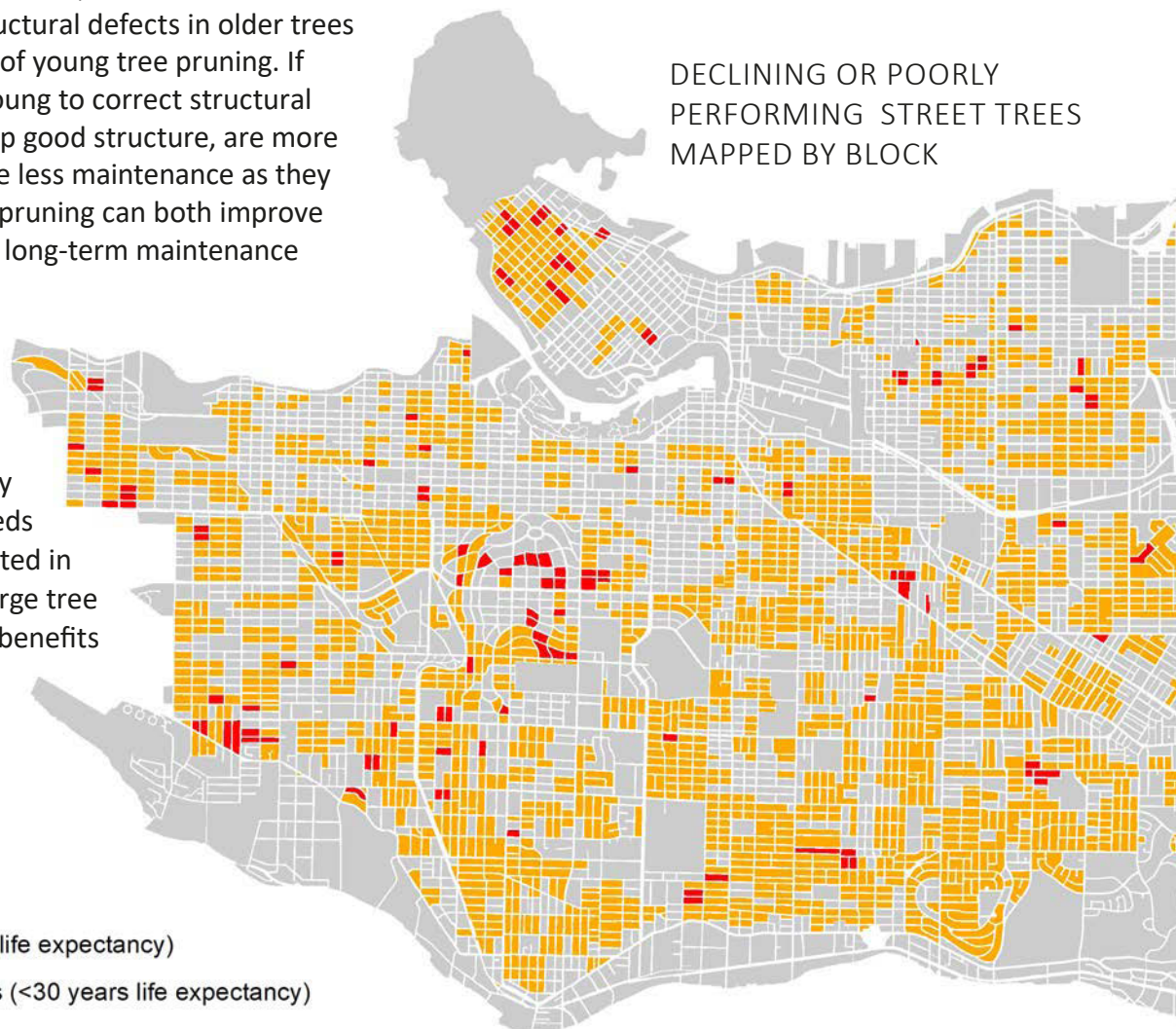
A number of the city's older trees have structural defects that cannot be restored, which will reduce their life expectancy. Structural defects in older trees are, in part, due to a lack of young tree pruning. If trees are pruned when young to correct structural defects, then they develop good structure, are more wind resistant and require less maintenance as they age. Effective young tree pruning can both improve tree lifespans and reduce long-term maintenance costs.

To maximize urban forest benefits and increase resilience, a diversity of predominantly large, long-lived trees needs to be planted. When planted in the right place, a single large tree provides many times the benefits of a small tree over its lifetime.

Larger, long-lived trees currently in Vancouver's streets include maple, oaks, elms, horse-chestnut, ash and hornbeam. Several more recently introduced species are also expected to become large over time. Of course, it is not suitable to plant large trees in every location but they should be prioritized where space is adequate.

Planting large, long-lived trees and implementing a young tree pruning program will:

- Reduce the number of trees that need to be planted.
- Reduce the frequency of tree removals.
- Minimize the proliferation of structural defects that lead to high risk trees.
- Lower long-term costs and fossil fuels consumption for planting and maintenance.



URBAN FOREST STEWARDSHIP

The Musqueam (xʷməθkʷəy̓əm), Squamish (Sḵw̱x̱ wú7mesh), and Tsleil-Waututh (səlilwətaʔt) have cared for this land for many generations. Vancouver is also the birthplace of many of Canada’s longest standing environmental non-profit organisations. Stewardship is an important element of our community’s identity.

Stewardship comes in many forms including participating in educational programs, watering street trees and encouraging neighbours to do the same, reporting diseased or unsafe trees, and volunteering on forest restoration projects in local parks.

Parks are managed by the Park Board and its partners, including initiatives delivered by community, non-profit and academic organizations. Park Board and the City recognize the need to work with local First Nations to develop culturally-appropriate forest stewardship practices.

Stewardship by environmental groups and community volunteers currently supports urban forest management in many parks in Vancouver. Some of the most successful forest restoration projects have been completed in partnership with groups like the Stanley Park Ecology Society, Jericho Stewardship Group, Everett Crowley Park Committee, and Evergreen.

These programs allow residents to participate and learn about the function and importance of the urban forest. Stewardship also has a social benefit. In cities, there is an increasing need and desire to access nature close to home. The urban forest and large natural areas in cities offer immersive nature experiences in the city.

Park Stewards is an example of a Park Board initiative inviting members of the public to “adopt” spaces in natural areas like Everett Crowley and Jericho parks; volunteers work to remove invasive plants, plant native plants and report issues in key restoration sites. These activities foster an ethic of stewardship and responsibility for the urban forest and offer opportunities to connect community members to each other and to nature.



Earth Day tree planting in Everett Crowley Park.



Vancouver's urban forest sequesters approximately 24,000 metric tonnes of CO₂ each year. That's equivalent to the annual greenhouse gas emissions from 5,000 passenger vehicles. See the Urban Forest Index at the end of this document for more urban forest statistics and sources.

RECONCILIATION

Vancouver is committed to being a City of Reconciliation, and developing sustained relationships of mutual respect and understanding with our host First Nations — Musqueam (xʷməθkʷəy̓əm), Squamish (Sḵw̓x̓ wú7mesh), and Tsleil-Waututh (səlilwətaʔt) — and the urban Aboriginal community.

The City adopted a formal Framework for Reconciliation in 2014. Both the City and the Board of Parks and Recreation have since adopted Calls to Action which come out of the Truth and Reconciliation Commission's Calls to Action. The Calls to Action adopted include promoting the health, wellness and well-being of indigenous people, as well as supporting cultural and language revitalization. Working together to protect and enhance the urban forest can contribute to achieving these objectives.

The arrival of settlers in the 1800s has changed Vancouver's landscape drastically. What was once dense, old-growth coastal rainforest has been converted to urban land uses with mixes of native and exotic forest trees in streets, parks and backyards. This conversion has impacted the availability of resources of importance to local First Nations.

One story that exemplifies impacts from Vancouver's landscape transformation comes from the xʷməθkʷəy̓əm community, for whom canoe carving is an important part of culture. Beginning in 2015, the 'Awakening the Spirit: Revitalization of Musqueam Canoeing Project'³ sought to find a 40' to 50' cedar log in order to carve an ocean-going journey canoe at xʷməθkʷəy̓əm. No suitable cedars could be found in xʷməθkʷəy̓əm territory and, after an extensive search, a 350 year old cedar log was imported from Shell Beach, Vancouver Island. The 'Old Woman' log was made into the first canoe carved at xʷməθkʷəy̓əm in more than 30 years.

The City and Park Board are committed to working together with local First Nations and the urban Aboriginal community to identify the ways the urban forest can be managed to support indigenous health, wellness and well-being, and revitalize culture.



xpey̓ətp (cedar trees) provide many important cultural values to the Musqueam, Squamish and Tsleil-Waututh First Nations.

³ <https://www.tru.ca/edsw/research/indigenizing-higher-education/awakeningthespirit/awakening-the-spirit.html>
Information shared with permission from Shelly Johnson, Corrina Sparrow, Andrea Lyall, Jo-ann Archibald, Dick Louis and Leona Sparrow.



It's a real special moment to us. We haven't had a canoe built on this reserve in 30 years or more because our canoe builders all passed away, and with them we almost lost our canoemanship.

– Musqueam master carver Dick Louis, speaking of the Awakening the Spirit project in the spring of 2017

7 PRINCIPLES

Twelve principles underpin the urban forest strategy. Any decisions the Park Board makes about Vancouver’s urban forest should be consistent with these principles to achieve a healthy and resilient urban forest.

1. Protect our existing urban forest
2. Create beautiful urban landscapes
3. Enhance habitat & support biodiversity
4. Select the right tree for the right place
5. Distribute ecosystem services equitably

6. Mitigate & adapt to climate change
7. Support healthy & safe trees
8. Contribute to a healthy city
9. Celebrate Vancouver’s cultural & natural identity
10. Collaborate with a broad range of partners
11. Use sound science
12. Measure progress



8 GOALS, STRATEGIES & ACTIONS

The purpose of Vancouver's Urban Forest Strategy is to create a diverse, resilient and beautiful urban forest by guiding our collective efforts to protect, plant, and manage trees on public and private lands across the city.

URBAN FOREST GOALS

PROTECT the urban forest during development.

PLANT trees to grow the urban forest.

MANAGE trees for health and safety.

ENGAGE citizens in the urban forest.

MONITOR the status and condition of the urban forest.

URBAN FOREST TARGETS

1. Plant 150,000 trees between 2010 and 2020.
2. Increase the urban forest canopy to 22% by 2050.
3. Restore or enhance 25 ha of natural areas, including forests, by 2020.
4. Double street tree density in below average blocks of the Downtown Eastside, Marpole, and other priority neighbourhoods by 2030.



GOAL: PROTECT THE URBAN FOREST DURING DEVELOPMENT

It takes decades and much care for a young tree to reach maturity. Mature trees deliver benefits to the community that cannot be replaced easily or quickly. By protecting Vancouver's existing trees, a steady flow of benefits is maintained, canopy decline is prevented and successful growing sites are protected for both existing and future trees.

Tree roots often straddle public and private land so it is important that development on either side of the boundary protects neighbouring trees. Private land tree protection is governed by the Protection of Trees By-law but many other City policies also determine how land can be used and therefore influence tree retention. On public land, tree protection requirements are determined by the managers of City trees and usually Park Board arborists. The types of development that often happen on public land include City managed capital infrastructure projects (e.g., sewer, roads, parks etc.) and privately managed development projects that interface with public property (e.g., new sidewalks, boulevards etc.).

The actions outlined here focus on improving the process, design standards and construction outcomes for protecting healthy, mature trees on public and private land.

Strategy: Retain and protect more trees during development.

Action 1. Update policies and standards to enable proactive design for retaining healthy, mature trees.

Action 2. Develop policy for retaining soil and growing space for trees on private property in coordination with other Planning policy updates and sustainable site design goals.

Action 3. Develop forest canopy targets by land-use type or neighbourhood, in coordination with other Planning policy updates and sustainable site design goals.

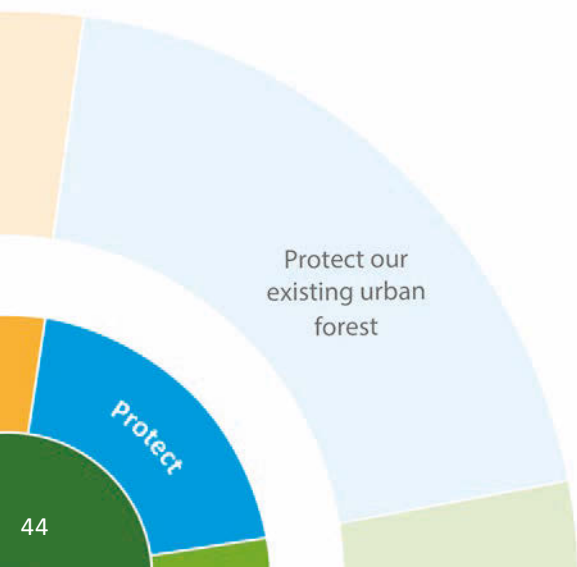
Action 4. Update policy and procedures to enable securities to be taken for tree protection and replacements.

Action 5. Track pre- and post-construction tree canopy during the rezoning and permit application process.

Strategy: Update standards for protecting trees on public property.

Action 6. Expand the coordinated permit application review and enforcement of protection of public trees affected by development.

Action 7. Ensure that tree protection standards on public property meet or exceed the standards required on private property.



GOAL: PLANT TREES TO GROW THE URBAN FOREST

Planting trees is the primary means of growing Vancouver's urban forest canopy. Enough trees will need to be planted to both replace what Vancouver is losing through densification, and increase the canopy cover to 22% by 2050. While it's important that an adequate number of trees are planted, it's equally important that there are strategies in place to ensure that Vancouver's young trees are healthy, diverse and resilient, and planted in locations where they will reach maturity and deliver the benefits Vancouver needs. The following actions address these needs.

Strategy: Increase tree planting in neighbourhoods with low urban forest cover.

Action 8. Increase street tree planting in the Downtown Eastside, Marpole, False Creek Flats, and other priority neighbourhoods with below average urban forest cover.

Action 9. Expand tree planting in residential neighbourhoods using subsidized tree sales and nursery rebate programs.

Action 10. Partner with First Nations, the Vancouver School Board, and other groups to support tree planting on private and institutional lands.

Action 11. Discontinue the policy of allowing residents to deny street tree planting adjacent to their property supported by improved notification and engagement efforts.

Strategy: Enhance biodiversity through tree planting.

Action 12. Enhance natural forests in Stanley, Jericho, Musqueam, Everett Crowley, Renfrew Ravine, and other large parks, and riparian areas, as critical parts of Vancouver's ecological network.

Action 13. Plant trees to enhance bird and pollinator populations, including expanded use of native trees in park and street tree planting.

Strategy: Increase street and park tree diversity.

Action 14. Update tree selection guidelines to reflect the City's goals for climate adaptation, rainwater management, food production, biodiversity, and reconciliation.

Action 15. Work with the BC Landscape Nursery Association, other municipalities, and tree nurseries to grow diverse tree and understory species suited for Vancouver's urban forest.

Strategy: Plant trees to support green infrastructure and reduce climate change impacts.

Action 16. Increase tree planting to create cool streets and parks where vulnerable populations are at risk from urban heat.

Action 17. Identify tree species, varieties, cultivars, or geographic seed sources that are suited for Vancouver's future climate.

Action 18. Plant trees to strategically improve air quality, especially as buffers between residential areas and truck routes or arterial streets.

Action 19. Increase canopy cover in conjunction with green infrastructure initiatives to improve rainfall interception and infiltration.



GOAL: **MANAGE** TREES FOR HEALTH AND SAFETY

While healthy trees provide a wide range of benefits, unhealthy trees present a risk to public safety. The actions outlined here focus on keeping Vancouver's urban forest healthy by maintaining a high standard of management throughout the tree life-cycle, keeping good records about Vancouver's trees, and by studying the broader urban forest ecosystem to support natural processes and manage disturbance in the landscape.

Strategy: Manage public trees for public safety and support tree health.

Action 20. Create a "Public Tree Management Guidebook" to guide staff in tree planting, maintenance, inspection, protection, and other operational tasks.

Action 21. Update the "Street Tree Guidelines for the Public Realm" to reflect best practices and set targets for soil volume to support healthy mature trees.

Action 22. Incorporate increased tree planting, establishment, and maintenance costs into asset management, and capital and operational budgets.

Action 23. Update the risk management process used for public trees.

Action 24. Match urban forestry staff resources to meet the demand of ensuring the health and establishment of newly planted trees.

Strategy: Update inventory and data management for public trees.

Action 25. Replace the Vantree inventory and work order management software with a GIS-based tree information system.

Action 26. Improve notification, education, and public engagement around public tree management including tree removals.

Action 27. Complete the inventory of all ornamental park trees.

Strategy: Manage natural forests to increase resilience and enhance biodiversity.

Action 28. Where appropriate, retain dead or dying trees and downed wood to sustain forest ecosystems and biodiversity.

Action 29. Enhance forest ecosystem components in parks such as understorey vegetation to support birds and other biodiversity.

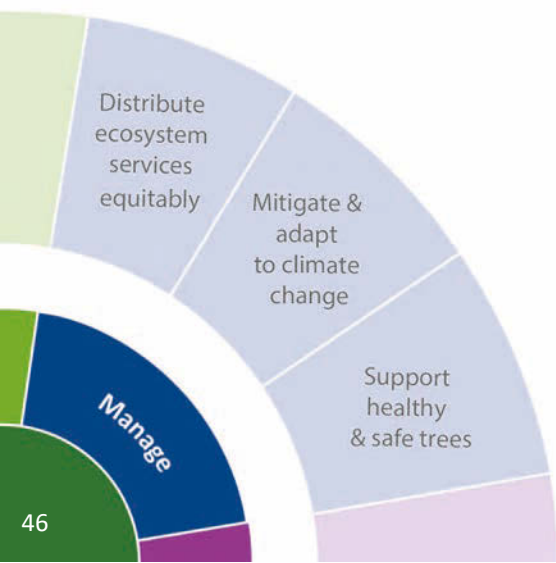
Action 30. Control invasive species that degrade forest ecosystems.

Action 31. Meet or exceed legal requirements to protect nesting birds and other wildlife during urban forest management activities.

Strategy: Prepare for disturbance events including wildfire, pest and disease outbreaks, and windstorms.

Action 32. Update integrated pest management policies to address current and future threats to Vancouver's urban forest.

Action 33. Work with Vancouver Fire and Rescue Services to update procedures for preventing, minimizing, and controlling wildfire in urban forests.



GOAL: ENGAGE CITIZENS IN THE URBAN FOREST

Protecting, planting and managing Vancouver's urban forest is a responsibility shared by the City, Park Board and all people who manage and care for land in Vancouver. Vancouver's success at meeting the targets of the Urban Forest Strategy depends on support from the public and partnerships with stewards and land managers who can advocate for and enhance the urban forest beyond City lands.

By also offering opportunities for partnership and participation in the City's stewardship of the urban forest, pathways are provided for accessing urban forest benefits that come with connecting members of the community with nature and with each other.

Strategy: Raise awareness of the importance of the urban forest.

Action 34. Develop and share educational materials that highlight Vancouver's urban forest.

Action 35. Identify a 'City Tree' for Vancouver using a public engagement process.

Action 36. Support school-based education about urban forests, with emphasis on hands-on experience in parks.

Strategy: Support volunteers, NGOs, schools, and neighbourhood groups in urban forest stewardship.

Action 37. Expand the Park Stewards program to support volunteer- and school-based stewardship of urban forests in parks.

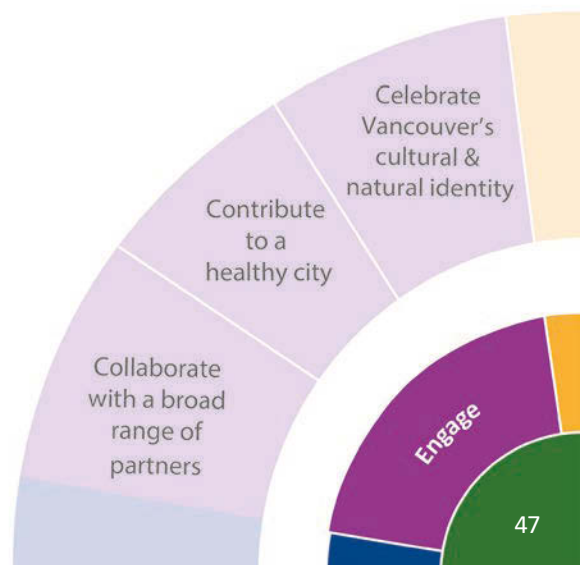
Action 38. Expand the Tree Guardians program to involve residents in watering street and park trees.

Action 39. Provide funding, staff support, and resources for stewardship organizations to undertake urban forest projects and programs.

Strategy: Work together with local First Nations and the urban Aboriginal community to support indigenous health, wellness and well-being, and revitalize culture through urban forestry.

Action 40. Work together with local First Nations and the urban Aboriginal community to identify opportunities to manage the urban forest to revitalize culture.

Action 41. Work together with local First Nations to develop culturally-appropriate forest stewardship practices.



GOAL: MONITOR THE STATUS AND CONDITION OF THE URBAN FOREST

The Urban Forest Strategy is intended to guide Vancouver in meeting the goals and targets for growing a beautiful, diverse and resilient urban forest. To understand whether implementation is effective, and to fill knowledge gaps, the urban forest will need to be monitored over time. Monitoring results will inform whether Vancouver is succeeding in meeting its goals and targets, or whether management strategies need to be adapted.

Strategy: Measure changes to the urban forest.

Action 42. Measure Vancouver's urban forest canopy every 5 years using LiDAR and i-Tree methods.

Action 43. Track trees planted and managed across the city on an annual basis.

Action 44. Map and assess the distribution and condition of native forests.

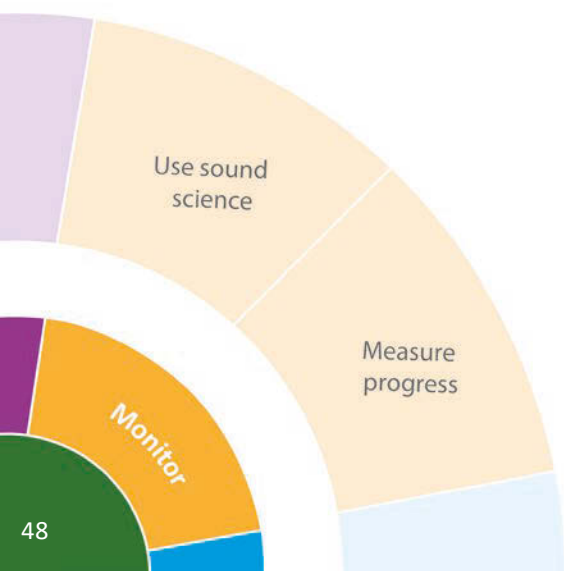
Strategy: Support research on urban forests.

Action 45. Support knowledge sharing and advocacy, including hosting events such as the Canadian Urban Forest Conference in 2018, and on-going opportunities.

Action 46. Partner with academic institutions to test innovative methods for monitoring the abundance, distribution, and health of the urban forest.

Action 47. Support citizen-science as a component of urban forest management and monitoring.

Action 48. Support the Greenest City Scholar program, City Studio and other academic partnerships with urban forest-focused collaborations.



9 CONCLUSION

The vision of this strategy is to create and manage a healthy, resilient, and beautiful urban forest that will bring nature and people together harmoniously. By achieving this vision, Vancouver will prepare its urban forest for the challenges and risks ahead – urban densification, summer droughts, windstorms – and will reinforce the importance of the urban forest as a critical part of the city’s infrastructure.

Urban forests make cities greener, wilder, healthier, cooler and happier human habitats. Recognizing that Vancouver’s urban forest management must adapt rapidly to intensifying urban development and the impacts of climate change, it is a matter of urgency that the City, Park Board and the broader community work together to implement the Urban Forest Strategy.

In seven years, 102,000 trees have been planted to meet the City’s 150,000 tree target. This intensive planting effort depends on the work of many people and demonstrates how much can be achieved in a few short years. There have also been significant efforts to protect more trees during the development process. Now is the time to harness the momentum of past successes and redouble efforts to further plant, protect, manage, engage and monitor the urban forest.

Success of the Urban Forest Strategy depends on supporting urban forest champions in the City, Park Board, community, universities, professional organizations, and other groups who will help implement strategic actions and better integrate the urban forest into Vancouver’s systems and infrastructure.

Looking outward, the City and Park Board will need to engage meaningfully with partners to create an urban forest and a sense of stewardship that reflects the broad needs and values of the community. For those involved in private property development, the most effective actions will involve protecting and planting more trees during the development process. Private citizens contribute importantly by planting and caring for trees and gardens, and by advocating for the urban forest at home and in the community.

Many trees in Vancouver are older than any person alive on earth and have lived through wind storms and summer droughts, and have watched as the city has changed around them and politicians and city staff have come and gone. The urban forest depends on our collective efforts to keep it healthy and growing: how will you contribute to sustaining Vancouver’s urban forest for the future?



REFERENCES

- [1] Kahn Jr., P.H., and S.R. Kellert. 2002. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*. MIT Press, Cambridge MA.
- [2] Chawla, L. 1999. Life Paths into Effective Environmental Action. *Journal of Environmental Education* 31, 1:15-26.
- [3] Westphal, L.M. 2003. Urban Greening and Social Benefits: A Study of Empowerment Outcomes. *Journal of Arboriculture* 29, 3:137-147.
- [4] Vaske, J.J., and K.C. Kobrin. 2001. Place Attachment and Environmentally Responsible Behavior. *The Journal of Environmental Education* 32, 4:16–21.
- [5] Adevi, A.A., and P. Grahn. 2011. Attachment to Certain Natural Environments: A Basis for Choice of Recreational Settings, Activities and Restoration from Stress? *Environment and Natural Resources Research* 1, 1:36-52.
- [6] Musqueam Band Council. 1984. *Musqueam Comprehensive Land Claim Preliminary Report on Musqueam Land Use and Occupancy*. Presented to the Office of Native Claims. Retrieved from http://www.musqueam.bc.ca/sites/default/files/miba_170_03_musqcomclaim_sm_0.pdf
- [7] K. Wolf. 2008. *City Trees, Nature and Physical Activity: A Research Review*. *Arborist News*, vol. 17, no. 1, pp. 22-24, 2008.
- [8] Giles-Corti, B., M.H. Broomhall, M. Knuiman, C. Collins, K. Douglas, K. Ng, A. Lange, and R.J. Donovan. 2005. Increasing Walking: How Important is Distance to, Attractiveness, and Size of Public Open Space? *American Journal of Preventive Medicine* 28:169-176.
- [9] Korpela, K.M., M. Ylén, L. Tyrväinen, and H. Silvennoinen. 2008. Determinants of Restorative Experiences in Everyday Favorite Places. *Health & Place* 14, 4:636-652.
- [10] Morita, E., S. Fukuda, J. Nagano, et al. 2007. Psychological Effects of Forest Environments on Healthy Adults: Shinrin-Yoku (Forest-Air Bathing, Walking) As a Possible Method of Stress Reduction. *Public Health* 121, 1:54-63.
- [11] Ulrich, R.S. 1984. View Through A Window May Influence Recovery From Surgery. *Science* 224:420-421.
- [12] Taylor, A.F., F.E. Kuo, and W.C. Sullivan. 2001. Coping with ADD: The Surprising Connection to Green Play Settings. *Environment and Behavior* 33:54-77.
- [13] Metro Vancouver. 2016. *Climate Projections for Metro Vancouver*. Burnaby, Canada. Retrieved from: <http://www.metrovancouver.org/services/air-quality/AirQualityPublications/ClimateProjectionsForMetroVancouver.pdf>
- [14] Aminipouri, M., A. Knudby. 2015. *Vulnerability to heat amongst socially disadvantaged groups in Vancouver*. Report commissioned from Simon Fraser University by City of Vancouver.
- [15] Laforteza, R., G. Carrus, G. Sanesi and C. Davies. 2009. Benefits and well-being perceived by people visiting green spaces in periods of heat stress. *Urban Forestry & Urban Greening*, 8, 97-108.
- T. Zupancic, C. Westmacott and M. Bulthuis, “The impact of green space on heat and air pollution in urban communities: a meta-narrative systemic review,” David Suzuki Foundation, Vancouver, 2015.
- [16] Hansen, M.C., P.V. Potapov, R. Moore, M. Hancher, S.A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S.J. Goetz, T.R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C.O. Justice, J.R.G. Townshend. High-resolution Global Maps of 21st-Century Forest Cover Change. 2013. *Science* 342 (6160), 850-853.
- [17] Li, X., C Zhang, W Li, R Ricard, Q Meng, W Zhang. 2015. Assessing street-level urban greenery using Google Street View and a modified green view index. *Urban Forestry & Urban Greening* 14 (3), 675-685
- Seiferling, I., N Naikc, C Ratti, R Proulx. 2017. Green Streets – Quantifying and Mapping Urban Trees with Street-level Imagery and Computer Vision. *Landscape and Urban Planning* 165: 93–101
- [18] Er, K.B.H., J. Innes, K. Martin, B. Klinkenberg. 2005. Forest Loss with Urbanization Predicts Bird Extirpations in Vancouver. *Biological Conservation*. 123(3): 410-419.

[19] Santamour, F. 1990. Trees for Urban Planting: Diversity, Uniformity and Common Sense. Proceedings of the 7th Conference of the Metropolitan Tree Improvement Alliance. 7:57-65

[20] Richards, N.A. 1983. Diversity and stability in street tree populations. *Urban Ecology*. 7:159-171.

PHOTO CREDITS

If photos are not credited, they were sourced from <https://www.shutterstock.com>.

Cover: 'Vancouver Special' by Jon West © 2016
Original image modified for cover.

Page ii, *Vancouver street*, Lucy Foley

Page 6, *Grove of cedars and firs, Stanley Park*,
Vancouver Archives

Page 6, *Drought-stressed trees on Habitat Island*, Nick Page

Page 9 (middle), *Vancouver street*, Camille Lefrançois,
(bottom), *Vancouver street*, Amelia Needoba

Page 13, *On the Road to the Fisheries & Georgia Street looking east* Vancouver Archives

Page 19 *Felled tree*, Nick Page

Page 21, *Vancouver street*, Camille Lefrançois, *Rays of Autumn Light in Toronto*, Ian Muttoo on Flickr,
Knitted Trees, DieselDemon on Flickr

Page 23 (all photos), *Low, medium and high canopy cover on Vancouver streets*, Amelia Needoba

Page 26 *Home under construction*, City of Vancouver

Page 25, *Second growth forest*, Nick Page

Page 29, *Stanley Park 2006 windstorm*, Nick Page

Page 30, *Integrated stormwater management*, Nick Page

Page 31, *Rain on cedar foliage*, Nick Page

Page 32, *Big-leaf maple*, Nick Page

Page 34, *Cherry blossoms*, Nick Page

Page 35, *Chinatown*, Xicotencatl, Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0), <https://creativecommons.org/licenses/by-sa/3.0/deed.en>

Page 36, *Apples*, Nick Page

Page 38, *Community stewardship event*, Nick Page

Page 39, *Hastings Street*, Nick Page

Page 40, *Corrina Sparrow and Shelly Johnson shaking hands over 'Old Woman' log*, Myles Clay

Page 41, *Dick Louis and canoe*, Arlen Redekop,
Vancouver Sun

Page 43, *Prince Edward Park*, Amelia Needoba

Page 49, *Norquay Park*, Amelia Needoba

URBAN FOREST INDEX

Vancouver's canopy cover in 2015: 19% +/-1%, no significant change since 2013 (source, i-Tree Canopy)

Vancouver's canopy cover metrics in 2013: Total city 18%, private land 12%, public land 26%, Stanley Park 62%, (source, LiDAR)

Amount of CO₂ sequestered each year by Vancouver's urban forest: approximately 24,000 metric tonnes of CO₂ is sequestered each year for an economic benefit estimated at \$1.1 million (source, 2015 i-Tree Canopy analysis). That's equivalent to the annual greenhouse gas emissions from 5,000 passenger vehicles (source, <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>).

Amount of CO₂ stored in Vancouver's urban forest: approximately 611,080 metric tonnes of CO₂ is stored in the urban forest for an economic benefit estimated at \$29 million (source, 2015 i-Tree Canopy analysis).

Amount of pollutants (CO, NO₂, O₃, PM2.5, SO₂, PM10) removed by Vancouver's urban forest each year: 186 metric tonnes of pollutants removed annually for an economic benefit estimated at \$88,000. The greatest benefits come from the removal of ozone and particulate matter (source, 2015 i-Tree Canopy analysis).

Number of street trees in the Park Board's inventory: 147,000 trees of more than 350 different species (source, 2017 City of Vancouver Tree Inventory).

Most common street trees: Maples (24%) and cherries/plums (22%) (source, 2016 City of Vancouver Tree Inventory).

Estimated replacement amenity value of Vancouver's street trees: \$1.1 Billion (source, Bill Stephen, City of Vancouver).

Date that Stanley Park was protected as a park: 1888 Stanley Park was protected as Vancouver's first park. Prior to that, the area was reserved by the military in the 1860s as a source of trees for masts and spars for Royal Navy ships (sources, (sources, <http://vancouver.ca/parks-recreation-culture/stanley-park-history.aspx> <http://www.cbc.ca/news/canada/british-columbia/stanley-park-s-forgotten-military-history-1.2830524>).

Height of Vancouver's tallest tree: 63 m, a Douglas fir located in Stanley Park (source, Ira Sutherland <https://vancouverbigtrees.com>).

Location of BC's largest bigleaf maple: Stanley park contains a bigleaf maple with a height of 29 m and a circumference of 10.7 m (source, Ira Sutherland <https://vancouverbigtrees.com>).

Number of active eagle nest trees in 2016: 10, located in Vancouver and Point Grey (source, Nick Page, City of Vancouver).

Location of North America's largest sweet chestnut population: Vancouver! The 1900 block of west 18th and Stanley Park (near Malkin Bowl) are excellent places to see large specimens (source, Bill Stephen, City of Vancouver).

*Vancouver residents enjoy incomparable access to green spaces,
including the world's most spectacular urban forest
- Greenest City 2020 Action Plan goal*

