Urban Forestry Master Plan Phase II

# Street Tree Master Plan

November 30th, 2004

the city of north vancouver

LANARC CONSULTANTS LTD

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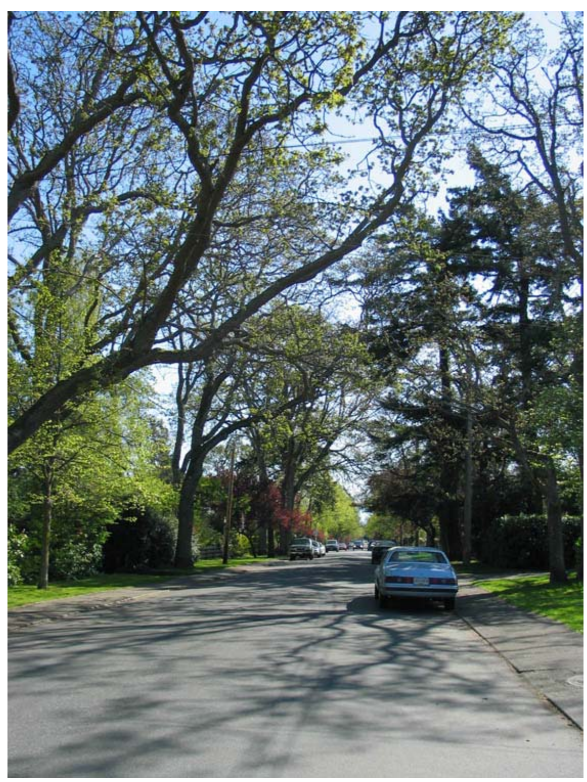

# STREET TREE MASTER PLAN

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City of North Vancouver Urban Forest Plan

# STREET TREE MASTER PLAN

# 1. Introduction

The City of North Vancouver (CNV) is an evolving leader in sustainable development, and the urban forest plays a key role in its sustainable future. The City's forested ravines and native conifers are a link to its natural environment, while its planted streets and green spaces help to define its character. All together, they function as the lungs of the City.

The urban forest can be defined as the total of all vegetation growing within an urban area. "The urban forest is a diverse patchwork of vegetation, a mosaic of green infrastructure from historic boulevards with exotic shade trees to natural areas that protect remnant Coastal Western Hemlock forest, streams and creeks" (CNV, 2003). The urban forest provides many benefits to the quality of life of communities.

The Department of Engineering, Parks and Environment is responsible for managing the City's urban forest, and is developing an Urban Forest Master Plan. Phase I, completed in 2001, created an inventory of street trees in the City. Phase II, this project, has a focus on the street tree component. Future Phases will extend the planning effort to parks and woodlands in the city.

This Street Tree Master Plan was developed by Lanarc Consultants Ltd., who was assisted by the Centre for Urban Forest Research (CUFR), a research arm of the US Forest Service.

## 1.1 Purpose of the Street Tree Master Plan

Street trees, as one component of the urban forest, are any trees growing naturally or planted within a municipally owned road allowance/right of way. Based on its existing inventory, the CNV has approximately 5415 street trees.

The purpose of this Plan is to provide a design and long-term planning framework for the planting, maintenance and funding of the CNV's street trees. The objectives of the Plan are to:

- **Integrate** with various existing City master plans and strategies.
- **Define Landscape Character Areas** and strategies to support them as the City redevelops, addressing heritage tree/landscape features.
- Provide detailed **street tree plans** for Lower and Central Lonsdale corridors to support redevelopment activity and urban design objectives.
- Provide **Street Tree Guidelines** and demonstrate their use through **Demonstration Projects** in residential areas.
- Provide an **Implementation Strategy** that sets out planting and maintenance targets, tree cover densities, community involvement measures, partnering opportunities, funding strategies and that builds on the current GIS street tree database.
- **Survey community attitudes** towards the urban forest and develop methods to **inform and educate the public** through the City's web resources and other media.

## 1.2 Methodology for Developing the Plan

Box 1 below outlines the main steps undertaken by the consulting team, in collaboration with CNV staff, to develop this Plan. Several interim products were generated:

- Street Tree Poster.
- Introductory PowerPoint slideshow.
- Street Tree Master Plan Backgrounder report (for a public audience).
- A Survey Response Form (online and paper versions) and Summary Report.

---

**Box 1: Steps in developing the Street Tree Master Plan**

1) Background Review

Collect and review existing GIS data and tree database.

Review and assess gaps in previous urban forestry initiatives.

Review existing Strategic Plans and record interfaces with UFMP.

Workshop A: Priorities and Team Roles

2) Landscape Character and Feature Study

Map draft landscape character areas.

Field review landscape character areas - create image record of views, refine boundaries.

Field review key urban design features-gateways, green necklace, heritage trees/corridors.

Summarize Landscape Character and Features/Opportunities in Map Form

3) Urban Forest Benefit:Cost Analysis

Adapt and run STRATUM program to calculate benefits:costs of existing urban forest.

Use STRATUM to analyze structure and weaknesses of the existing urban forest.

Summarize Benefit:Cost Analysis in written, graph, slide form.

4) Investigate Guiding Principles and UFMP Alternatives

Produce Draft Guiding Principles based on above research and analysis.

Create Alternative Approaches to meet the Guiding Principles, for discussion.

Run STRATUM Analysis of alternative approaches.

Prepare an outline of communication materials - web, posters, brochure, slides, response form.

Workshop B: Review Data, Analysis, Principles, Alternatives and Public Process

5) Finalize Communication Materials

Prepare digital visualizations of a residential and a commercial street tree application

Prepare poster display for mall, library, city hall, school use, web distribution

Prepare a web information site

Prepare both written and web response forms

Prepare a slide show for use by staff and volunteers

Prepare a press release and press kit.

Workshop C: Joint with PRAC, EPPC, HAC

First Council Presentation

6) Facilitate Public Process for Earth Week

Maintain the web site and on-line response form facility

Distribute slide and poster materials to interested schools

Support volunteers at key locations during Earth Week / Arbour Day

Collect and summarize response form results

7) Prepare Policy and Regulatory Recommendations

Finalize Guiding Principles, Goals and Objectives based on public input received.

Recommend a Policy and Regulatory Framework in a 20 Year Vision

Prepare Draft Street Tree Plans and Related Budgets

Prepare a Draft Implementation Strategy and 20 Year Budget Schedule

Workshop D: Staff Workshop re Draft Implementation Strategy

8) Draft and Final Reports

Produce Draft Report and submit for staff review.

Update poster, slide and web communication materials to final recommendations

Second Council Presentation

9) Submission of Final Products

## 1.3 Relationship to the Official Community Plan

Proactive planning and management of the City's Street trees addresses a broad range of community goals described in the Official Community Plan, in particular the broad vision of a sustainable community. To quote the 2002 OCP:

***"COMMUNITY VISION: To be a vibrant, diverse and highly livable community that strives to balance the social,economic and environmental needs of our community locally."***

"By addressing social, economic and environmental concerns as stated in this Vision, the City hopes to become a more "sustainable" community . . . a truly livable city with a distinct sense of place and visible links to the community's natural and cultural past. A city that is safe, welcoming, inspiring and inviting to all people."

"Our community has its origins in the natural environment.To achieve a sustainable community, it will be critical that we respect that environment and work with it, not against it. . . From the perspective of creating a sense of place, it is important that efforts be made to help people learn about our natural environment and relate to it. Although much of the City will be urban, opportunities to celebrate the natural environment should be explored. Our West Coast landscape origins should remain a distinctive part of our City's character. Connecting urban life with the natural environment is an important consideration."[1]

## 1.4 Relationship to the Corporate Strategic Plan

The Street Tree Master Plan also supports the City's Corporate Strategic Plan, specifically:

C2 We will protect and maintain new and existing public infrastructure and amenities and enhance the natural and built environment.

C3 We will enhance community safety.

C4 We will establish and maintain a customer service culture that is responsive to community needs.

C5 We will enhance communications with residents, businesses, and staff.

## 1.5 Other Related City Plans and Policies

Appendix 3 provides an overview of City of North Vancouver Plans and Policies that provide context or affect the Street Tree Master Plan.

The key relevant documents include:

Previous Urban Forestry Initiatives

- 1983 Street Trees of North Vancouver
- 1987 Street Tree Plan: Phase 1
- 1992 Urban Forest Management Plan
- 1992 CNV Detailed Design Urban Forest Inventory
- 1993 Urban Forest Management Plan: Advanced Solutions
- 2001 Urban Forestry Master Plan Phase 1
- 2003 Assessment of Tree Conditions in Selected Parks within the City of North Vancouver

[1] City of North Vancouver, Official Community Plan, 2002

Current Strategic Plans and Policies

- 1994 CNV Heritage Inventory
- 1996 Bicycle Master Plan
- 2000 Lonsdale Corridor Master Plan
- 2001 Traffic Calming Program
- 2001 Lighting Master Strategy Phase 2
- 2001 Environmental Protection Program
- 2002 Official Community Plan
- 2002 Parks & Greenways Strategic Plan
- 2003 CNV Tree Policy
- 2003 CNV Senior Park and Open Space Study
- Integrated Stormwater Management Plans
- Partners for Climate Protection Program;

The Street Tree Master Plan is intended to complement, not conflict, with these prior plans and policies.

# 2. The Role of Street Trees

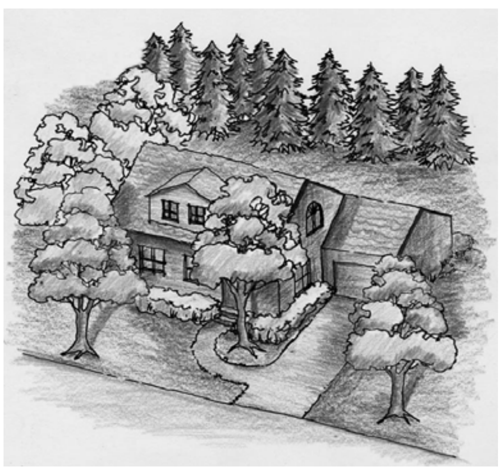
North Vancouver's setting location makes it ideal for high-density living, providing alternatives to continued suburban development that trigger automobile-based commuting and associated pollution. However, high-density development, when poorly designed, can lead to a proliferation of roof, pavement, and hard surface – hardscape. In North Vancouver, there are many opportunities to ameliorate the problems associated with hardscape through strategic tree planting and stewardship of existing trees. A well-designed street tree program can reduce stormwater runoff, conserve energy and water, sequester $CO_2$, attract wildlife, and provide other aesthetic, social, and economic benefits.

## 2.1 Component Benefits and Costs in the CNV

The Centre for Urban Forest Research (CUFR) customized a sophisticated computer program called STRATUM (Street Tree Resource Analysis Tool for Urban Forest Managers) to model the benefits and costs of the CNV's urban street tree populations. The methodology is described in Appendix 2 "STRATUM Application for the City of North Vancouver – Methodology and Procedures". While this approach has been carried out in many western U.S. cities, this was the first application of STRATUM in Canada.

STRATUM measured the following benefits/costs of the CNV's existing collection of street trees.

### 2.1.1 Energy Savings



Street trees modify the local microclimate and conserve building energy use through shading, transpiration (using solar energy that would otherwise heat the air to convert moisture to water vapour), and wind speed reduction. In so doing, street trees also reduce the "urban heat island effect" – the localized heating formed by concentrations of asphalt, concrete and other structures that absorb, rather than reflect, the sun's heat, causing local ambient temperatures to rise.

STRATUM estimated that the CNV's 5415 street trees:

- ❑ Saved 34.1 MWH annually.
- ❑ Saved 426.2 Mbtu of gas annually.
- ❑ This is equivalent to the energy use of approximately 12 homes in the CNV.
- ❑ This represents a savings of $6,514/year.

### 2.1.2 Greenhouse Gas ($CO_2$) Reductions

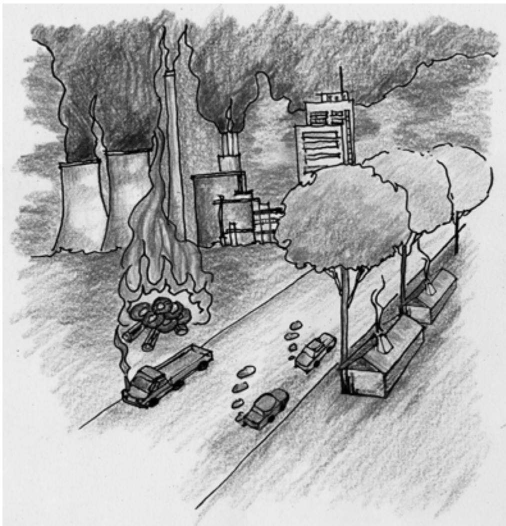
Trees capture carbon dioxide ($CO_2$) to build wood and foliage while they grow, though they also release $CO_2$ when they die. When they are near buildings, trees can reduce heating and air conditioning demands, thereby reducing $CO_2$ emissions from power generation.

STRATUM estimated that the CNV's 5415 street trees:

- ❑ Sequester 1,264,752 lbs (569,138 kg) of $CO_2$ per year.
- ❑ By reducing energy use, avoid the production of 4,560 lbs (2052 kg) of $CO_2$ per year.
- ❑ Release 334,379 lbs (150,471 kg) of $CO_2$ per year through decomposition and maintenance activities.
- ❑ This results in a Net Reduction of 934,933 lbs (420,719 kg) of $CO_2$ per year.
- ❑ This is the equivalent of $CO_2$ emitted by about 78 lightweight vehicles (12,000 lb/year/vehicle) in a year.
- ❑ This represents a dollar value of $9,366 per year.

### 2.1.3 Air Quality Improvements

Trees absorb air pollutants like ozone and nitrogen oxides and intercept particulates like dust and smoke. They also release oxygen through photosynthesis and lower local air temperatures, which reduces the effect of ground-level ozone - a major contributor to smog. At the same time, though, trees can release biogenic volatile organic compounds (BVOCs), such as isoprenes and monoterpenes that can contribute to ozone formation. The BVOC generating potential of different tree species varies considerably.

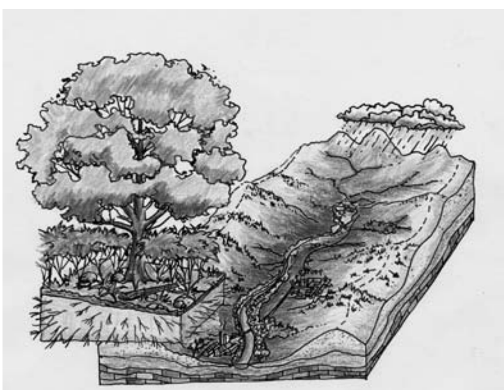


STRATUM estimated that the CNV's 5415 street trees:

- Remove 1013 lbs (460 kg) of ozone, nitrous oxide, particulate matter and sulphur dioxide.
- Avoid the production of 42.3 lbs (19 kg) of similar compounds by reducing energy use.
- Contribute about the same quantity (480 kg) of BVOCs.
- Overall, air quality benefits are likely neutral or better in the CNV's air shed, depending on tree species planted.

### 2.1.4 Stormwater Management

Trees intercept rainfall in significant amounts, thereby reducing stormwater runoff from roofs and pavement. A typical large street tree is estimated to reduce runoff by over 2000 liters (550 gallons) in places like Seattle and North Vancouver.



STRATUM estimated that the CNV's 5415 street trees:

- Intercept 521,948 US gallons (almost 2 million liters) of rainfall per year.
- This is enough water to fill 20 backyard swimming pools
- This represents a savings in stormwater management of $66,362 per year.
- Coniferous trees have the highest values for stormwater management.

### 2.1.5 Aesthetics & Other Benefits

Trees are beautiful (naturally), and while the benefits from their aesthetic appeal are difficult to quantify, research has shown that:

- ❑ Shoppers come more often, stay longer and pay more in commercial areas with trees than those without trees (Wolf, 1999).
- ❑ Office workers with a view of trees and nature report lower illness rates and greater satisfaction with their jobs.
- ❑ In public housing complexes, outdoor spaces with trees were used significantly more often than spaces without trees (Sullivan and Kuo, 1996).
- ❑ By facilitating interactions among residents, trees can contribute to reduced levels of domestic violence, as well as foster safer and more sociable neighborhood environments (Sullivan and Kuo, 1996).

### 2.1.6 Property Values

Well-maintained trees increase the ‘curb appeal’ of properties. Research shows that people are willing to pay 3-7% more for a property with trees than one without (assuming water views are not impacted).

STRATUM estimated that in the CNV’s, street trees:

- ❑ Increase total property values by $419,728 per year.
- ❑ The increase per tree averages $78.44 per year.

## 2.2 Overall Benefit:Cost Ratio

Adding up all the above benefits and costs, the CNV's street trees are estimated to provide:

- Average annual benefits of $501,000 per year total or $94 per tree per year.
- Approximately $25 million in benefits over 50 years.
- With annual maintenance costs of $94,000 (based on costs in 2003 for managing street trees - pruning, tree and stump removal, watering, replacement planting), the existing street tree population in the CNV has a **benefit:cost ratio of greater than 5:1.**

The results of the STRATUM analysis and Lanarc's review also revealed the following features of the CNV's urban forest:

- Conifers with wide, high canopies (like Douglas Fir) have better energy and stormwater benefits than narrow conifers with needles to the ground (like Western Red Cedar).
- Care should be taken to avoid over-planting or concentration of common species (e.g. Japanese Flowering Cherry and Red Maple), to guard against the impacts of disease.
- There are many public streets in the City of North Vancouver that do not have street trees but could accommodate them.
- Overhead power lines in many locations are a constraint to planting of large trees.

## 2.3 Role of Street Trees in Urban Design

As well as environmental benefits, street trees are a key part of urban design. Along with building architecture, the placement and organization of street trees contributes the following to the City of North Vancouver:

**Sense of Place**: tree planting design can differentiate the City from more rural areas, and can provide an strong identity and civic pride.

**Sense of History**: the growth and aging of street trees provides a sense of time. Mature street trees provide a feeling of permanence and grace.

**Connection to the Natural Environment**: Street trees – and native conifers in particular – are a visual and ecological reminder of the rainforest environment.

**Urban Fish and Wildlife**: Linkages of street trees provide habitat and movement corridors for birds and small mammals between the forested ravines. Many people take comfort and enjoyment from watching this urban wildlife.

**Spatial Definition and Unity**: Strongly organized plantings of street trees can define spaces like urban plazas and corridors. Trees can unify a space.

**Focal Points**: Choosing trees which contrast their surroundings in shape or colour can provide a strong visual focal point, which can act as a landmark or attraction.

**Human Scale**: Trees at street level can create 'urban rooms' that are comfortable in scale for pedestrians. This is a particularly important design device in reducing the apparent scale of large or high buildings.

**Softening of Urban Spaces**: The dappled effect of light through street tree branches and leaves provides a pleasing, reassuring texture on hard urban surfaces like pavement and blank building walls.

**Sense of Seasons**: Street trees mark the seasons with changes in colour, flower, fruit and leafiness.

**Visual Attraction and Comfort:** Street trees make people feel more comfortable. Studies have shown this leads to people staying longer, and spending more, in retail shopping streets.

**Opportunities for Amenity Lighting**: The lighting of street trees, either by uplights or through use of LED 'fairy lights', is a key part of creating attractive urban spaces.

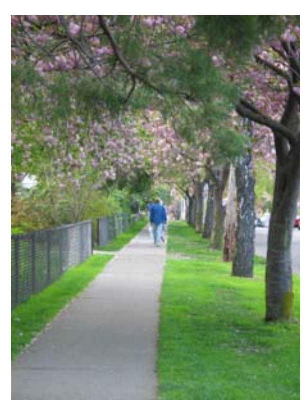
**Traffic Calming**: Street trees planted in traffic circles, and curb bulges, make these features more visible to motorists, and offer a visual narrowing of the street which promotes slower traffic. Tree locations at crossings need to carefully consider sight distance between motorists and pedestrians.

**Separation of Pedestrians from Traffic**: Street trees in boulevards or tree grates are effective at separating pedestrians from vehicular traffic.

**Shade and Shelter**: Street Trees provide amelioration of microclimate – offering shade and shelter from strong winds.

**Buffering**: Street trees can be designed to provide visual buffers to unsightly or conflicting areas.

The above Urban Design functions of street trees are calculated in the Benefit:Cost Analysis as increased property values. They are the largest single added value that street trees bring to the City.



## 2.4 Role of Street Tree Programs in Comparable Municipalities

The City of North Vancouver is joining a long list of leading Municipalities in formalizing its Street Tree Program.

Table 1a below shows how the City of North Vancouver compares with Street Tree Programs in Vancouver, Seattle and Portland.

Table 1a: Comparison of Street Tree Programs in Four Western Cities

| Factor | Vancouver | Seattle | Portland | City of North Vancouver |
|---|---|---|---|---|
| # of Street Trees | 124,000 | 139,000 | 200,000 | 5,415 |
| Annual Budget | $3.1M operating | $2.3M US includes parks | $1.4M US | $0.1M operating |
| Pruning Cycle | 7 yrs residential, 2 yrs commercial | Limited | 7 years | No program |
| Population (persons) | 560,000 | 540,000 | 550,000 | 44,303 |
| Street Trees / population. | 0.22 | 0.25 | 0.36 | 0.12 |
| Street Tree Budget/ population. | $5.54 operating | $4.25 US includes parks | $2.55 US | $2.25 operating |

The City of North Vancouver is less aggressive than all of these comparables in its planting, maintenance and funding of street trees.

Table 1b provides summarizes other aspects of the street tree programs of several comparable municipalities.

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**Table 1b City of North Vancouver – Street Tree Master Plan**

## URBAN FOREST MANAGEMENT – MUNICIPAL COMPARISON

| | NORTH VANCOUVER CITY | CALGARY | EDMONTON | OTTAWA | PORTLAND | SEATTLE | VANCOUVER | WINNIPEG |
|---|---|---|---|---|---|---|---|---|
| **DEMOGRAPHICS** | | | | | | | | |
| **Population** | 44,303 | 905,000 | 666,104 | 774,072 | 550,000 | 540,000 (1998) | 560,000 | 619,544 |
| **Area (ha)** | 1,195 | 72,173 | 67,000 | 277,964 | 89,600 acres = 36,260 ha | 84 sq.miles = 21,756 ha | 11,467 | 46,205 |
| **TREE RESOURCES** | | | | | | | | |
| **Tree inventory** | 5415 | 335,000 in groomed parks and boulevards; many more in natural areas (separate stats for Birthplace forests) | 115,000 boulevard trees<br>163,000 roadway buffer and park trees | >200,000 street trees | 200,000 street trees | 139,000 street trees<br>115,000 park trees in landscaped areas<br>250,000-400,000 on residential lots | 124,000 street trees | 185,000 |
| **Canopy Cover** | Unknown | | | | | 25% overall<br>15.5% in residential areas<br>Goal: 40% overall | | |
| **Trees/ha** | 4.5 | 4.64 | 4.15 | | 5.52 | 6.39 for street trees only<br>11.68 street and park trees | 10.8 | 4.0 |
| **Species** | See Stratum Report | | Boulevards:<br>- American elm 35%<br>- Green ash 40%<br>- Black ash 15%<br>Natural areas:<br>- aspen 30%<br>- balsam poplar 35%<br>- white spruce 15% | | | Street trees:<br>- 300 species<br>- 25% ornamental plums or cherries<br>- 13.5% Sweetgum<br>- 13% Norway maple<br>Majority of City-owned trees in natural areas and parks, dominated by red alder and bigleaf maple. | Street trees: 600 species/ cultivars<br>Most common: Japanese flowering cherry >19000 in boulevards | |
| **Value** | Unknown | $335 million | $850 million | | $150 million for street trees | $635 million<br>Estimated to increase assessed property valuation by up to $630 million.<br>Estimated $42 million annual savings in air quality and stormwater management remediation | >$500 million | |
| **MANAGEMENT FRAMEWORK** | | | | | | | | |
| **Agency** | Parks Division, Engineering, Parks and Environment Dept. | Urban Forest section, Parks Dept. | Edmonton Community Services Department | Forestry Services, Planning, Environment and Infrastructure Dept. | Urban Forestry, Dept. Parks & Recreation<br>Urban Forestry Commission - 11 volunteer citizens; reviews plans and policies; advises on annual Urban Forestry budget request, sponsors Heritage Tree Program, educates community about urban forestry issues; resolves conflicts relating to trees by hearing citizen appeals. | Seattle Transportation (SeaTran) – street trees, ROWs<br>Parks & Recreation Dept – City properties<br>Urban Forest Coalition – include above + Seattle City Light, Public Utilities, Fleets & Facilities, Dept. Neighbourhoods, Seattle Center, Dept. Design, Construction & Land use, Office of Sustainability & Env. Seattle City Light | Vancouver Park Board | Forestry Branch, Parks and Open Space Division, Public Works Department |
| **Staffing** | 1 Arborist, 1 field staff | | | | | SDOT – City Arborist, Admin'r, 3 Certified arborists, Tree Crew supervisor<br>Parks & Rec - Senior Urban Forester, two 2-person tree | >50 arboriculture staff | |

| | NORTH VANCOUVER CITY | CALGARY | EDMONTON | OTTAWA | PORTLAND | SEATTLE | VANCOUVER | WINNIPEG |
|---|---|---|---|---|---|---|---|---|
| | | | | | | crews and a part-time Urban Forester. | | |
| **UF Plan** | 2001 Urban Forest Inventory, current planning | | | Urban Forest Strategy proposed under Environmental Strategy, part of 20/20 vision. | Updated UF Management Plan in draft. Includes 8 recommendations and specific actions for each; address coordination, documentation, expansion of the urban forest, regulations, funding, development incentives and education. http://www.parks.ci.portland.or.us/Planning/PDFfiles/ufmp_publicreviewdraft_b.pdf | Seattle Urban Forest Assessment: Sustainability Matrix (2000)<br><br>SDOT Street Tree Master Plan – 3-phase study (1992-99) recommends priorities for tree plantings in arterial streets, provides list of trees, and presents concepts for plantings to connect existing green spaces. | Street Tree Management Project see note 2 | See note 1 |
| **Bylaw** | Parks Bylaw, Tree Protection Policy | Applies to City/public land only. Requires permit and tree protection plan for any construction within 6 m of a tree in ROW. | Boulevard tree bylaw (7829) | Trees Bylaw addresses the protection, maintenance, and control of trees on highways and City property, sets out the responsibilities for persons carrying out work in the vicinity of a City owned tree. | Tree Cutting Ordinance regulates cutting of trees 12" diameter or greater on certain private properties; regulate the removal of any tree in public right-of-way. | Proposed Street Tree Ordinance<br>Proposed PROPARKS levy<br>Tree Protection Standards | Street Tree Bylaw no. 5985.<br>Private Property Tree By-law (No. 7347) and Guidelines: requires all property owners to obtain a permit ($25) to remove a tree (as defined); allowed one removal per 12 months with exceptions. http://www.city.vancouver.bc.ca/commsvcs/BYLAWS/TREE/Tree.htm | |
| **Manage-ment tools** | | | | | | | TreeCare – street tree management program<br>VanTree – computerized database tracks each tree's vital statistics, maintenance, enquiries; planting sites. | Computerized street tree inventory, low level helicopter aerial photography |
| **MANAGEMENT ACTIVITIES** | | | | | | | | |
| **Planting** | No formal program, incidental to development and civic projects | *Community Tree Planting Program* – free trees for communities to plant on City land – see below. | 5-10,000 trees & shrubs/yr planted by City and developers | | Citizens can apply for free permit from Urban Forestry to plant trees on public ROW; Arborist will assess and provide advice on species and planting. | | >3000 street trees/yr<br>4 programs:<br>- capital<br>- local improvement<br>- greenways<br>- replacement<br>8-ha nursery in Campbell R Valley Park holds 10,000 trees; harvest av. 2000 trees/ year. | 800/yr on boulevards and in parks |
| **Mainten-ance & Pruning** | No formal program | | 6 year cycle, except 40,000 elm pruned on 4 yr cycle for DED prevention | | 7 year cycle, interrupted by responses.<br>Relies heavily on adjacent property owners.<br>Citizens can apply for free permit to prune trees on public ROW; Arborist will assess and provide advice on pruning needs. | 19-year cycle?<br>SeaTran maintains street trees planted by the City only; all other street trees are responsibility of adjacent property owner.<br>Street use permit required to prune or remove tree in ROW. | 7-year cycle in neighbourhoods; prune 1/7 trees in each of 22 neighbourhoods each year.<br>1-2 year cycle in commercial areas.<br>>17,500 trees/yr -<br>When pruning, staff update info re. trunk diameter, height, condition.<br>3 million ladybugs released/yr to help control aphids.<br>>5000 service calls/yr on street trees | 12 year cycle<br>18,000 trees/yr |

| | NORTH VANCOUVER CITY | CALGARY | EDMONTON | OTTAWA | PORTLAND | SEATTLE | VANCOUVER | WINNIPEG |
|---|---|---|---|---|---|---|---|---|
| **Removal/ loss** | unknown | | 600-900/yr | | Citizens can apply for free permit from Urban Forestry to remove and replant trees on public ROW; Arborist will assess and issue permit if warranted. | | 1200/year average | 300-400 boulevard trees/yr – damage, age |
| **Annual budget/ funding** | $0.1 million | | $2.6 million | | (US) $1.4 million | (US) $2.3 million in neighbourhoods, parks and open spaces<br>$3.6 million if include costs of powerline clearance (City Light)<br>$4.25-$6.60 per capita (range for US cities: $1.13 - $18). | $3.1 million street tree operations; $1.1 million capital/tree planting | |
| **Special concerns** | Lack of maintenance program | Black knot fungus<br>Elm scale and Ash psyllid | DED (Dutch elm disease) | | DED | | Species with perennial disease problems: Blireana plum, English hawthorn, Modesto ash, old cultivars of Flowering crab. | Dutch elm disease (DED) |
| **Powerline mgmt** | Done by BC Hydro | | | | | Seattle City Light - Power Line Clearance Program<br>http://www.cityofseattle.net/light/neighborhoods/nh4_trtr.htm | Provides general information to residents; suggests contacting BC Hydro Vegetation management branch. | |
| PUBLIC PROGRAMS | | | | | | | | |
| **Education** | No formal program | Information on website re. benefits of trees, tree pruning, tree protection bylaw. | Information on website re. benefits of trees, tree pruning, watering, "drought stressed trees", tree protection bylaw. | Information on website re. benefits of trees, tree pruning, watering, tree bylaw. | Extensive information online and as booklets on tree permits, planting, pruning, care, cutting, etc.<br>http://www.parks.ci.portland.or.us/urbanforestry/UrbanForestry.htm#brochures<br>Guided walks to showcase noteworthy tree species in Portland. | Extensive information online on tree planting, pruning, care, cutting, etc.<br>Variety of workshops provided to train residents on pruning, etc. | Descriptions online of City's programs | |
| **Planting programs** | No formal program | *Planting Incentive Program* (PIP): planting on **residential properties**; community associations, neighbourhood groups or individuals apply to Calgary Parks for **50% funding.** Parks/urban forests staff review applications, meet with applicants, recommend species and site locations. Parks staff prepare hole and planting. Maintenance except pruning is responsibility of residents.<br>*Forever Green Program* – partners: BP Canada, Golden Acre Garden Sentres, Calgary Health Region, CPR. Sponsors:<br>*Community Tree Planting Program* – free trees to | *Arbor Day* – evergreen seedling given to all grade 1 students. 1 school awarded to host official ceremony and plant a tree on school's property.<br>*Commemorative tree planting* - $800/tree.<br>*Tree donation/transplanting* – specifies criteria to be met. | *Trees in Trust* - Street trees available by request. No charge - tree and planting provided by the City. Applies only to homes with space between property line and the roadway. Property owner must pledge to assist with the proper tree care for first 3 years; instructions provided. Minimum tree size of 50 mm diameter, or 2-3 meters in height. Limit 1 tree per single fronting household or 2 trees per corner lot.<br>*Community Partnership Tree Planting Program* – provides grants up to $2000 (funds or trees) to groups with acceptable plan and showing commitment to maintain. | *Neighborhood Tree Liaison Program* is a 'learn and serve' volunteer program that provides 20 hr instruction in overall tree knowledge to certify you as a Neighborhood Tree Liaison, enabling you to work with Urban Forestry and your neighborhood to plan projects promoting trees in your community<br>http://www.parks.ci.portland.or.us/Services/treeliaison.htm<br>*Heritage Tree Program* – trees identified by location, species, etc.; can be nominated by public.<br>*Arbor Day and Month events* – includes planting, free workshops, walks.<br>http://www.parks.ci.portland.or | *Tree Fund*, *part of Neighbourhood Matching Fund, Dept. of Neighbourhoods* – provides 10-40 trees, neighbors (minimum 5 households on a block) share planting and caring of trees in planting strips on residential streets; participants must attend a training session and provide tools. Budget: $100,000/yr.<br>*Urban Tree Replacement Program, City Lights* – sponsors neighbourhood plantings to replace inappropriate trees under power lines; plants 3 trees for every 1 removed.<br>*Tree Steward Program, SeaTran* – encourages | *Commemorative tree program:* min. $500/tree, tax-deductible donation.<br>*Arbor Week tree planting*<br>*Street beautification projects*<br>*Tree Trust Program* - community partnerships and projects between the City, residential communities, businesses and property developers throughout the city. Monetary and in-kind contributions provide support for existing and new community programs. Contributions recognized through Gold, Silver and Bronze Leaf partnership opportunities.<br>http://www.city.vancouver.bc.c | *Reforestation programs*<br>*Evergreen Project*<br>*Take Pride Winnipeg* |

| | NORTH VANCOUVER CITY | CALGARY | EDMONTON | OTTAWA | PORTLAND | SEATTLE | VANCOUVER | WINNIPEG |
|---|---|---|---|---|---|---|---|---|
| | | community associations to plant on City lands. Applicants must demonstrate commitment to maintain, hold planting event and supply adequate volunteers.<br>*BP Birthplace Forest* – parents pay for(?) a tree to be planted in designated urban forest when baby is born; e.g., 7600 trees planted in Elliston Park to represent every baby born in 2001.<br>*Arbor Day* – 1st Thursday in May, a seedling given to all grade 1 students to plant at home. 1 school awarded to host official ceremony and plant a tree on school's property.<br>*Memorial Drive Project* – trees planted from 1922-28 to memorialize fallen soldiers; trees are now being regenerated and greater variety of species being replanted. | | *Commemorative Tree Program* – citizens can have tree planted in park; $400. | .us/urbanforestry/UrbanForestry.htm#arbor%20month | residents to plant trees in planting/parking strips, provides sight-line rules, tree species guidelines (inc. prohibited trees), tree planting and watering advice; http://www.seattle.gov/transportation/outreach.htm<br>*Adopt-a-park program,* participate in urban forest management<br>*PlantAmnesty Heritage Tree Program* - 4 categories: specimen, landmark, historic, collection | a/commsvcs/planning/treebylaw/trust.htm | |
| **Website** | No formal program | http://content.calgary.ca/CCA/City+Hall/Business+Units/Parks/Urban+Forestry/Urban+Forestry.htm | http://www.edmonton.ca/portal/server.pt/gateway/PTARGS_0_2_271_213_0_43/http://CMSServer/COEWeb/environment+waste+and+recycling/beautification/UrbanForestry.htm | http://ottawa.ca/city_services/environment/forestry/index_en.shtml | http://www.parks.ci.portland.or.us/Services/UrbanForestry.htm | http://www.cityofseattle.net/environment/urban_forest.htm | http://www.city.vancouver.bc.ca/parks/trees/index.htm | http://www.city.winnipeg.mb.ca/PWDforestry/aboutus.htm |
| **Contact** | Parks and Environment Department | Parks Urban Forestry section at 216-5252 or email parks@calgary.ca. | (780) 496- 8733<br>E-mail: citytrees@edmonton.ca | | pkweb@ci.portland.or.us<br>503-823-4489 | (206) 684-7649, or e-mail Nolan Rundquist, City Arborist. | City of Vancouver *Tree Hotline*, 604.871.6378<br>e-mail: rick_scobie@city.vancouver.bc.ca | tel: 204.986.7623 |

1. Winnipeg UFP objectives:
   - environmental modification of urban climates and other stress effects including pollution.
   - to increase popular support and public involvement.
   - to recruit key organizations from the public, private and voluntary sectors.
   - to make full use of all available land.
   - to promote the best technical practice.
   - to secure long-term management of resources.
   - to assess and promote the benefits of urban forestry.
   - to provide a demonstration for other regions as there is considerable interest in the plan from other regions within Canada, and beyond, including interest from the Internet community.

2. Goals of Vancouver Street Tree Management program:
   - to substantially increase the City's street stock;
   - to improve the pruning and care of Vancouver's street trees;
   - to effectively respond to the needs and expectations of City residents with regard to the City's street trees;
   - to improve the quality of our urban environment; and
   - to broaden species diversity.

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# 3. Goal and Principles

## 3.1 Goal

The general goal of the CNV's Street Tree Program is *to maintain and increase the long-term sustainability of the City of North Vancouver's urban forest assets*, as a part of meeting the sustainability objectives of the Official Community Plan.

## 3.2 Guiding Principles

**1. Increase existing benefits of the urban forest, by planting more street trees on public land, with a target of a fully stocked condition within 50-60 years.**

The current (2003) tree population is 5415. A fully stocked condition is estimated at approximately 16,500 street trees. Neighbourhoods where tree stock levels are low should be given priority in reaching this target, to provide more equitable distribution of the benefits provided by trees.

**2. Be sensitive to planting large trees in locations where they would conflict with views from existing residences to the water or mountains.**

It is important to support the property benefits of trees while still being cognizant of view impacts.

**3. Increase environmental benefits by striving to plant more trees that grow to larger size in locations without conflicts with views or utilities.**

Urban forest research has shown that on average, large trees have higher benefits per tree than small trees in terms of stormwater management, greenhouse gas uptake, and energy savings. Priority should be given to sites that can accommodate large trees at maturity.

**4. Provide locations and methods to re-establish native trees so that the proportion of native to ornamental trees is at least as exists now, as reflecting in existing inventory of trees.**

Most of the CNV's native trees are conifers located in the ravine parks or isolated specimens in manicured parks like Grand Boulevard. There is also a scattering of conifers on municipal and private property throughout the city. These widely spaced conifers are important for both their environmental function, but also for the 'sense of place' that they provide the City. However, this sprinkling of native conifers is a resource that appears to be in decline as redevelopment occurs.

This principle promotes: a) the conservation of existing native trees on public property; b) where it is necessary to remove existing native trees, their replacement with similar species in sizes as large as possible; and c) locating vacant street sites of sufficient size and with no conflicts with views and utilities for the re-establishment of native trees.

**5. Reduce the risk of disease decimating the street tree population by aiming for a mix of species, with a target of no one species greater than 10% of the population.**

Determining an appropriate species mix means balancing between limiting the number of tree species for maintenance efficiency with maintaining a healthy species diversity. A rule of thumb commonly accepted in the urban forestry literature is that no one species should comprise more than 10% of the street tree population, and no single genus (such as *Prunus*) should make up more than 30% of the population.

**6. Plan for a mix of tree ages and gradual tree replacement, recognizing that living trees will eventually die.**

A general target for an urban forest population is an age mix of 20% "young"; 60% "mature" and 20% "over-mature" trees (age categories will be species-specific). A gradual planting program to create fully stocked streets over 50-60 years will create age diversity – with the City always having some old, medium and young aged trees. Once a fully-stocked condition is reached, the City will enter a replacement phase.

**7. In new plantings, focus on long-lived species that do well in the CNV environment, to maximize the benefits of available growing space.**

While some short-lived species may be "prettier", long-lived species provide the most benefits for the least cost in the long term. Also, species already planted that have maintained high percentages of trees in good condition are likely to provide greater benefits at less cost than planted species with more trees in fair and poor condition.

**8. As a priority, plant in areas that drain to sensitive watercourses rather than areas that drain to the sea.**

This principle acknowledges the high stormwater management benefits that trees can play in the CNV. Tree canopy cover in stream watersheds play a role in reducing instream erosion that impacts fish habitat.

**9. The City "Gateways" - Marine Drive, Westview, Lonsdale, Boulevard Crescent, Lynn Creek and Lower Lonsdale/Esplanade – should be given consideration and some priority in tree planting.**

This acknowledges the significant role that gateways play in creating an attractive city. The aesthetic benefits of trees must be balanced with the need to provide clear visibility (consideration of sight lines and shadows) and safe travel environments in these areas. Also, planting of gateways should not be at the expense of neighbourhood planting programs.

**10. Develop a scheduled and adequately supported maintenance program for tree pruning and disease control of street trees.**

Programmed pruning, under a reasonable timeline, can improve public safety by eliminating conflicts, reduce costs through program efficiency, and increase benefits by improving tree health and condition. Any short term dollar savings realized by deferring pruning only do so at a loss of tree value (Miller and Sylvester, 1981). A 3-6 year cycle in residential areas, and annual maintenance in commercial areas, is typically recommended (Miller 1997).

**11. Diversify sources of funding and resources for both planting and maintenance.**

Funding sources include:

- General property tax revenues – justified on the premises that: a) property values increase due to the presence of street trees; and b) many tree benefits accrue to the neighbouring property owners (e.g., stormwater capture, energy reduction).
- Fees based on a "user pay" principle – i.e., those who clear land, create impervious surface area and/or increase emissions compensate for impacts by funding trees.
- Funding programs of senior governments and private organizations – e.g.:
    - Targeted tree planting programs;
    - Federal green infrastructure funding (commonly expects a 30% improvement target);
    - Federal climate change funding;
    - GVRD Sustainability and Demand Management funds.
- A 'Tree Bank' to allow the holding of funds for replanting and/or maintenance in alternate locations.
- Encouraging active roles for volunteers, particularly in planting and maintenance (except pruning) of trees on their street. This may be facilitated by a City Stewardship Co-ordinator.
- Bequests and Donations – such as commemorative memorial trees.

**12. Promote knowledge and understanding among the citizens of the CNV about the benefits of the urban forest, and ways in which they can effectively support this valuable community asset.**

This principle forms the basis for developing a public education and involvement program that encompasses written and on-line information and staff resources to provide advice and coordination in a vibrant urban forest program.

# 4. Design and Management Guidelines

## 4.1 General Street Tree Guidelines

The priorities of the CNV Street Tree Plan are:

- planning for species diversity,
- planting large trees as conditions and budgets allow, for environmental benefits,
- re-establishing native trees, and
- avoiding or reducing conflicts with utilities, views and other urban constraints.

### 4.1.1 Species Diversity

- No one species should represent more than 10% of the total street tree population throughout the city.
- No one genus (e.g., Prunus) should represent more than 30% of the total street tree populations.
- No one species should be concentrated in a given neighbourhood – cluster species on a block-by-block basis.

### 4.1.2 Native Conifer Targets

- Conifers should be considered first where space allows. For every 40 deciduous trees, plant an average of 2 native conifers likely near mid-block or lanes.
- Total conifer target population would be about 820 trees -- 5% of 16,415 trees (target population) to be conifers.

### 4.1.3 Large vs. Small-sized Species

- Plant the largest tree species possible to maximize leaf canopy, respecting site limitations such as utility lines (overhead), root space (ground) and views (see section 5.2).
- Recognize that smaller specimens are typically less expensive, so in some cases, it may be more cost effective to plant/replant smaller specimens more densely than a few large trees.

### 4.1.4 Compatibility with an Urban Setting

- Avoid trees that are shallow rooted, predisposed to excessive amount of disease and insects, and tree species with fruit or growth habits that are unsuited in an urban location.

## 4.2 Street Tree Opportunities and Constraints

Map 1 attached summarizes the opportunities and constraints for street trees in the City of North Vancouver.

### 4.2.1 Opportunities

There are many boulevards along streets in the City which are not stocked with street trees. These present opportunities to expand the street tree population and its benefits.

Heritage trees and landscape features have also been identified in several parts of the City. See Map 4

### 4.2.2 Constraints

There are also constraints on many streets – with overhead utility lines being a prime example. Other constraints include narrow boulevards, paving of the entire right of way for traffic uses, and encroachment of private plantings onto city property.

### 4.2.3 Species Concentrations and Disease Risk

In reviewing the existing street tree collection, there are parts of the City where trees of a single species are concentrated. This provides risks for high impacts from disease outbreaks (such as Dutch Elm Disease or Mountain Pine Beetle), and should be avoided. Map 2a and 2b show concentrations of red maples and cherries in the City.

### 4.2.4 Native Conifers at Risk

Native conifers are a significant resource to the City, both for ties to natural heritage, and for their superior environmental values. Map 3 shows the rather random distribution of conifers on city streets.

### 4.2.5 Constraint Classes

A variety of planting conditions exist on the CNV's streets. To take this into consideration, the 5 following constraint classes have been identified:

- Constraint Class 1: No prominent constraints
- Constraint Class 2: Narrow boulevard
- Constraint Class 3: Overhead lines
- Constraint Class 4: Overhead lines + narrow boulevard
- Constraint Class 5: Planting in paving

The following pages illustrate each class through picture examples, and recommend appropriate tree types and species for each class.

Refer to Section 4.6 for a detail listing of recommended street trees.

**Constraint Class 1: No prominent constraints**. Large trees with a height greater than 9 m such as *Acer rubrum* (Red Maple), *Quercus palustris* (Pin Oak) and *Zelkova serrata* (Japanese Zelkova) are suitable for this type of street.

*27th at Mahon east*

*Chesterfield at 12th*

**Constraint Class 2: Narrow boulevard, less than 1.5 m width**. Medium size trees that may have a height greater than 9m but with a slender tree shape (maximum spread of 8 m) are best suited due to limited space above and below ground. Tree roots are related to the canopy spread or drip line; usually tree roots extend two or three times beyond the drip line. Some examples of medium trees are *Ginkgo biloba* `Princeton Sentry' (Princeton Sentry Ginkgo), *Oxydendron arboretum* (Sourwood), and *Acer platanoides* `Columnar' (Columnar Norway Maple).

*Chesterfield at 6th*

*3rd at St.David*

**Constraint Class 3: Overhead lines**. Small trees and shrubs are suggested under and near overhead lines. Directly under lines, vegetation with a maximum height of 6 m is suitable; near overlines (10 m from the pole), trees less than 12 m are preferred. *Acer griseum* (Paperbark Maple), *Cornus florida* (Flowering Dogwood) and *Acer circinatum* (Vine Maple) are appropriate near overhead utilities.

*16th at St. Andrew*

*Chesterfield at 2nd*

**Constraint Class 4: Overhead lines + narrow boulevard**. Small trees and shrubs are recommended; e.g., *Prunus serrulata* `Amanogawa' (Amanagawa Cherry), *Juniperus communis* (Common Juniper), and *Amelanchier alnifolia* (Saskatoon).

*6th near Lonsdale*

*Chesterfield at 23rd*

**Constraint Class 5: Planting in paving**. Avoid trees with large surface roots, dense canopies, and trees that can litter the pavement. *Tilia cordata* (Littleleaf Linden), *Cercidiphyllum japonicum* (Katsura Tree) and *Nyssa sylvatica* (Tupelo) are good trees to plant in pavement.

*Esplanade W of Lonsdale*


*Marine near Bewick*

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# Cherry Trees

## City of North Vancouver

Scale nts

MAP 2B

LANDSCAPE ARCHITECTURE
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INFORMATION ARCHITECTURE

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# Red Maples

City of North Vancouver
Scale NTS

MAP 2A

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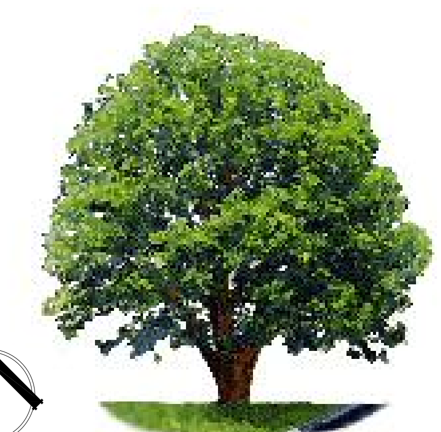

# Coniferous Trees

## City of North Vancouver

Scale NTS

MAP 3


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COMMUNITY PLANNING
ENVIRONMENTAL DESIGN
INFORMATION ARCHITECTURE

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30 November 2004 NVU3-59\Mapping - Street Tree System\What Trees Where\Map3 coniferous trees.dwg

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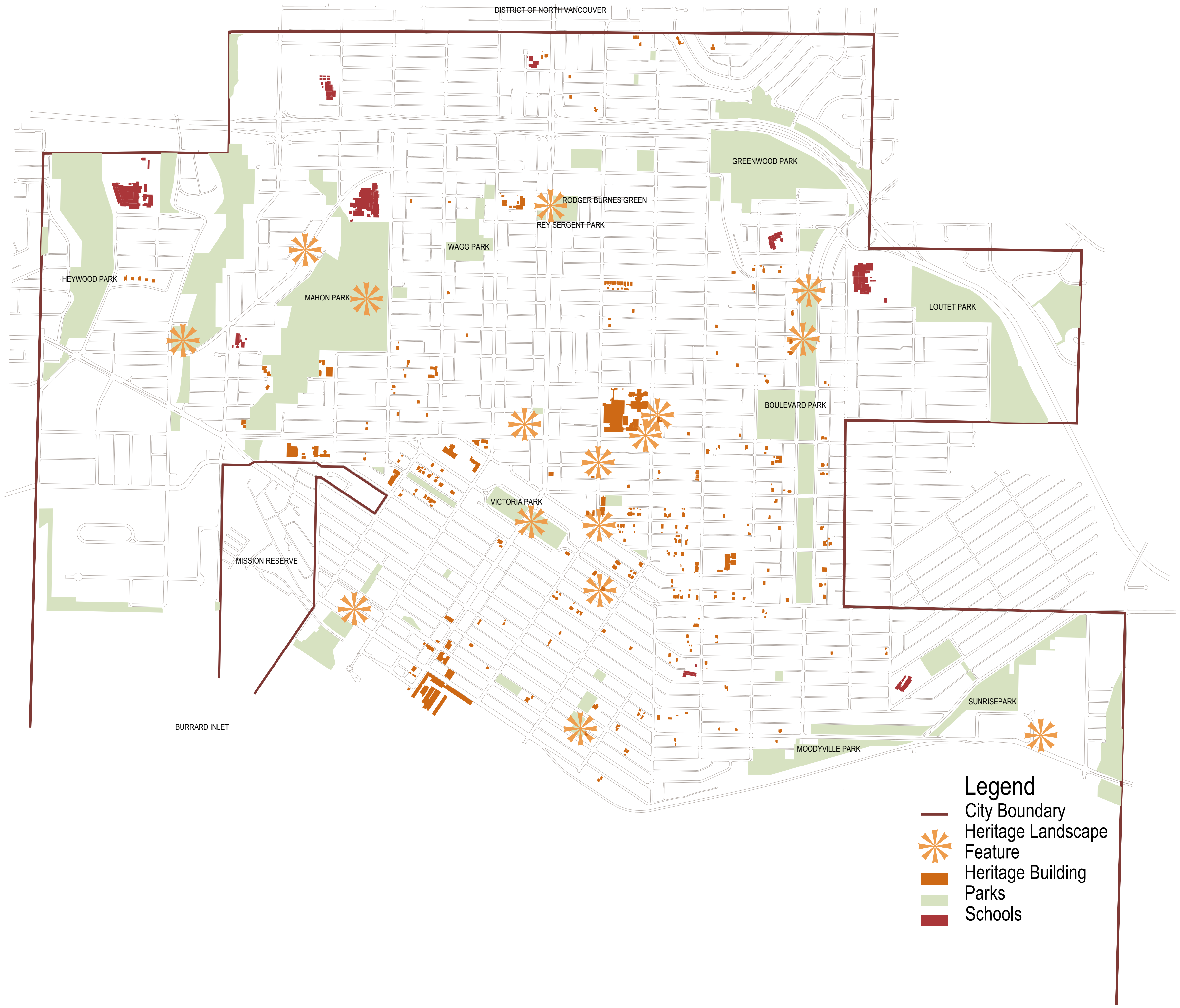


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# Heritage Landscape Features

## City of North Vancouver

Scale NTS

MAP 4



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## 4.3 Landscape Character Areas and Street Tree Guidelines

The City of North Vancouver has been divided into a set of Landscape Character Areas – see Map 5. The areas are identified for the purpose of defining street tree priorities and area-specific street tree design and management guidelines.

### 4.3.1 Mapping of Landscape Character and Street Tree Management Areas

Mapping of Landscape Character and Street Tree Management Areas on Map 5 is based on:

1. Watershed boundaries – separating areas which drain directly to Burrard Inlet from those areas that drain into salmon-bearing streams.
2. Density of existing vegetation, in particular native trees, as reflected in the Environmentally Sensitive Areas map. The presence of existing mature or heritage trees is also considered.
3. Relationships to existing parkland and publicly-managed woods. While parks and schoolgrounds are not included in the polygons, they influence the character of some polygons by providing a nearby backdrop of native trees that dominates the landscape.
4. Distribution of land use types. Higher density zoning, either residential or commercial / industrial, and resulting land development has a dramatic influence on the existing character and design guidelines for street trees.
5. Concentration of heritage resources, either in heritage trees or heritage architecture.
6. View potential from residential areas which may be affected by street tree planting. This is more relevant in sloping single family areas, where views from low buildings could be affected by tree planting. In higher density residential areas, it is the height of buildings that usually creates view barriers, rather than tree planting. However, the plan considers the view down street corridors between buildings to Burrard Inlet or Lions Gate, or up street corridors to North Shore Mountains.

The Landscape Character Map also shows gateways into the City at major road entrances, as well as important corridors through the City which merit special attention.

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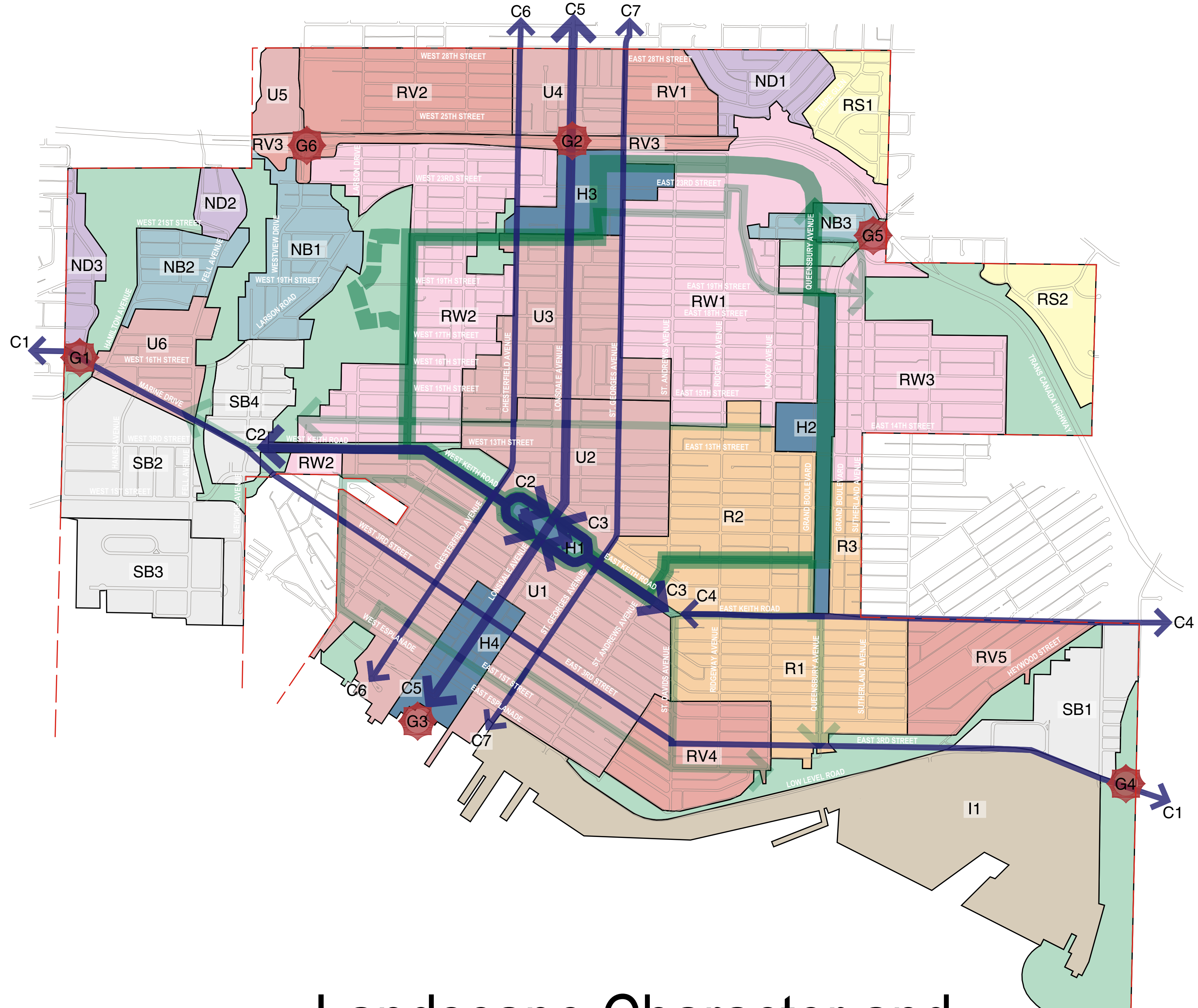


Legend

City Boundary

Park/School Area

Heritage Character Area
- H1 - Victoria Park
- H2 - Grand Boulevard
- H3 - Upper Lonsdale Civic Area
- H4 - Lower Lonsdale Heritage

Industrial
- I1 - Low Level Port

Native - Backdrop
- NB1 - Larson
- NB2 - Upper Hamilton
- NB3 - Greenwood Heights

Native - Dominant
- ND1 - Temple Crescent
- ND2 - Upper Fell
- ND3 - Heywood

Residential
- R1 - Queensbury
- R2 - Ridgeway
- R3 - Sutherland

Residential Stocked
- RS1 - Tempe Heights
- RS2 - Eastview

Residential View Potential
- RV1 - Upper Levels East
- RV2 - Upper Levels West
- RV3 - Upper Levels Greenway
- RV4 - Moodyville Slopes
- RV5 - Cloverly

Residential Watershed
- RW1 - Greenwood Bowl
- RW2 - Mahon
- RW3 - Boulevard East

Suburban Business
- SB1 - Park and Tilford
- SB2 - Hamilton
- SB3 - Harbourside
- SB4 - Bewicke

Urban
- U1 - Lower Lonsdale
- U2 - Civic Lonsdale
- U3 - Central Lonsdale
- U4 - Upper Lonsdale
- U5 - Westview
- U6 - Lower Fell

Gateways
- G1 - Marine Drive Gateway
- G2 - Upper Lonsdale Gateway
- G3 - Lower Lonsdale Gateway
- G4 - Main Street Gateway
- G5 - Boulevard Crescent Gateway
- G6 - Westview Gateway

Corridors
- C1 - Marine Drive/3rd Street Corridor
- C2 - Keith Road Median West Corridor
- C3 - Keith Road Median East Corridor
- C4 - Keith Road Non-Median Corridor
- C5 - Lonsdale Corridor
- C6 - Chesterfield Corridor
- C7 - St. Georges Corridor
- C8 - Green Necklace Corridor
- C9 - Other Greenway Corridors

# Landscape Character and Street Tree Management Areas

## City of North Vancouver

N.T.S.

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### 4.3.2 Guidelines for Landscape Character and Street Tree Management Areas

The following describes each character area and provides design guidelines for street tree planting, both for the character type, and for specific areas of the City.

Recommended Planting Priority for each Landscape Character and Street Tree Management Area is provided with their description, and summarized below.

**Table 2: Street Tree Planting Program – Planting Priorities by Street Tree Management Area**

| High Planting Priority | Moderate Planting Priority | Low Planting Priority |
|---|---|---|
| H1: Victoria Park | H2: Grand Boulevard | H3: Upper Lonsdale Civic Area |
| RW1: Greenwood Bowl | R1: Queensbury | H4: Lower Lonsdale Heritage |
| RW2: Mahon | R2: Ridgeway | I1: Low Level Port |
| RW3: Boulevard East | R3: Sutherland | NB1: Larson |
| U1: Lower Lonsdale Mixed Use | RV1: Upper Levels East | NB2: Upper Hamilton |
| U3: Central Lonsdale | RV2: Upper Levels West | NB3: Greenwood Heights |
| U4: Upper Lonsdale | RV3: Upper Levels Greenway | ND1: Tempe Crescent |
| C1: Marine / 3rd Street | U2: Civic Lonsdale | ND2: Upper Fell |
| C2: Keith Median West | C5: Lonsdale Corridor | RS1: Tempe Heights |
| C3: Keith Median East | G6: Westview Gateway | RS2: Eastview |
| C4: Keith Rd Non-Median | | RV4: Moodyville Slopes |
| *C6: Chesterfield Corridor | | RV5: Cloverly |
| *C7: St. George Corridor | | SB1: Park & Tilford |
| C8: Green Necklace Corridor | | SB2: Lower Hamilton |
| C9: Other Greenway Corridors | | SB3: Harbourside |
| G2: Upper Lonsdale Gateway | | SB4: Bewicke |
| G4: Main Street Gateway | | U5: Westview |
| G5: Boulevard Crescent Gateway | | U6: Lower Fell |
| | | G3: Lower Lonsdale Gateway |

*high planting priority if overhead lines are undergrounded

Detailed street tree plans for portions of these character areas are presented in sections 4.4 and 4.5.

**Landscape Character**
**& Street Tree Management Area**

# HERITAGE

### Description

In areas of Heritage Landscape Character, street tree management should respect the significant heritage values of existing trees or architecture.

These include key treed open spaces from the 1905 Town Plan – Victoria Park and Grand Boulevard.

Stands of established heritage trees in the area of Rodger Burnes Green, Rey Sargent Park and Lonsdale Elementary combine with civic uses to create an evolving heritage area.

The areas of architectural heritage in Lower Lonsdale merit special attention as to how the existing and future street trees could complement this heritage.

Known individual or small groupings of heritage trees outside of these polygons are shown on Map 5.

### General Guidelines

- Give priority to retention of existing established trees in the heritage character areas.
- Removal of existing established trees should be considered only if the trees are deemed hazard or diseased by a certified arborist.
- Plant new trees in these areas to provide age diversity, and to eventually replace the existing mature trees when they die.
- New street trees should be chosen to provide species diversity to the existing tree stock in the heritage space.
- Tree planting location and pattern should reflect heritage, classic forms.
- Tree planting should be designed to frame, but not block, the view of heritage architecture.

### Related Policies & Reports

- Heritage Inventory, City of North Vancouver
- Parks and Greenways Plan
- Victoria Park Enhancement Plan and Current Design Initiatives
- Grand Boulevard Park Management Plan
- Lonsdale Corridor Master Plan

**Area Specific Guidelines**

| | |
|---|---|
| H1<br>**Victoria Park**<br>Includes the existing park both east and west of Lonsdale.<br><br>**Planting Priority: High** | ❑ Around Victoria Park, there are tulip trees, red oaks, plane trees, Japanese cherries and spruces (Liriodendron tulipifera, Quercus rubra, Platanus x acerifolia, Prunus serrulata, Picea omorika, and Picea abies).<br>❑ Maintain an open view from Lonsdale into the park lawns and to mature trees.<br>❑ Plant young trees on a gradual basis for age diversity.<br>❑ Tree planting at the park perimeter should be in rows on both sides of the adjacent streets – to provide a spatial definition to Victoria Park, as well as to unify the perimeter of the space. |
| H2<br>**Grand Boulevard**<br>Includes the median between East and West Grand Boulevard<br><br>**Planting Priority: Mod.** | ❑ Tree Planting should follow the guidelines in the Grand Boulevard Park Management Plan. Since there is an excess of species diversity within the park, new tree plantings in the short term should be designed to provide structure and unity to the park collection, and should be located to define public spaces within the park.<br>❑ Existing native conifers in the Park should be given special protection, and replacement plantings. |
| H3<br>**Upper Lonsdale Civic Area**<br>Includes the area fronting Lonsdale from 21st St. to the Upper Levels Highway, plus adjacent institutional and high density areas.<br><br>**Planting Priority: Low** | ❑ Give priority to protection of the row of horse chestnut, mature red oaks, and other mature trees in this area.<br>❑ Maintain recent plantings of the Lonsdale Gateway at the Upper Levels Highway, and the area fronting the Youth Park to make trees dominate this precinct .<br>❑ Add to tree plantings on side streets and fronting instituional buildings and grounds.<br>❑ Follow the guidelines in the Lonsdale Corridor Master Plan for the Recreational / Cultural / Educational Precinct. |
| H4<br>**Lower Lonsdale Heritage**<br>Includes the Lonsdale corridor from 4th St. down to the water's edge.<br><br>**Planting Priority: Low** | ❑ Maintain the existing plantings of Red Maple that line both sides of this street section.<br>❑ When tree replacement is required, use trees with similar appearance to the red maples, but use a different species for disease control e.g. Sweetgum.<br>❑ Install structural soils of sufficient volume under the paving to support the trees full grown.<br>❑ Employ paving, grates and tree accessories in accordance with the Lonsdale Corridor Master Plan for the Lower Lonsdale Precinct. |

**Landscape Character**
**& Street Tree Management Area**

# INDUSTRIAL

## Description

Industrial Landscape Character Areas in the City of North Vancouver are concentrated in the Port Lands fronting Low Level Road.

The area is dominated by elevator buildings and rail infrastructure.

Also included is the commercial section of Esplanade East of St. George Ave.

At the east end of the Industrial Area, a screen of street trees provides a buffer between upland commercial uses and the waterfront heavy industry.

Other than the area of the existing treed buffer, all of the public street right of way in this area has a limit of physical space for tree planting.

## General Guidelines

- As road redevelopment occurs in this area, review road width to look for possibilities to narrow road pavement or utility location to support installation of street trees.

## Related Policies & Reports

- N/A

## Area Specific Guidelines

| | |
|---|---|
| **I1**<br>**Low Level Port**<br>Industrial Streets including Esplanade east of St. George, and Low Level Road.<br><br>**Planting Priority: Low** | ❑ As roadways are redeveloped, consider how road laning or utilities could be reconfigured to allow space for tree planting.<br>❑ As an objective at the time of street redevelopment, on Esplanade east of St. George, provide a row of street trees on both sides of the road.<br>❑ As an objective when Low Level Road is redeveloped, provide a row of street trees on the water side of the road, between the road and the railway tracks.<br>❑ Maintain the treed buffer on the south side of 3$^{rd}$ St. that separates the waterfront port from upland commercial areas. Where possible, extend this buffer along Low Level Road. |

**Landscape Character**
**& Street Tree Management Area**

# NATIVE-BACKDROP

## Description

The City of North Vancouver is bisected by several deep ravines on the west side. Large stands of native trees also dominate the area of Greenwood Park.

Native-Backdrop Landscape Character Areas are small neighourhoods that are sandwiched between these ravines and woodlands. The scale of the woodlands provides a forested backdrop to the neighbourhood, and also restricts views out of the neighbourhood.

This native backdrop becomes the dominant landscape character in the neighbourhood, even in cases where the residential areas do not have many native trees within the developed area.

## General Guidelines

- Protect existing native trees and woodlands in parks, from encroachment or harm.
- Plant or allow native regeneration of young native trees, for age diversity.
- Design Street Tree Plantings to complement, rather than compete, with the backdrop of natives.
- Give preference, where space permits, to ‘random’ or ‘clustered, informal’ arrangements of street trees rather than formal rows.
- Consider street tree species that are light green in colour, and that are relatively fine textured, to provide a contrast to the dark foliage of the forest.
- Recognize that some residences will be heavily shaded by the native forest, and in those cases be sensitive to the residents preference – light may be more important than more trees.
- Planting of additional native trees, although encouraged, shall not be a priority in these areas.

## Related Policies & Reports

- Environmental Protection Program
- Parks and Greenways Plan

**Area Specific Guidelines**

| | |
|---|---|
| NB1<br>**Larson**<br>Includes the residential neighbourhood sandwiched between Wagg Creek ravine and Mosquito Creek ravine, nroth of 17$^{th}$ St.<br><br>**Planting Priority: Low** | ❑ Back alleys and side streets in this neighbourhood generally provide views into neighbouring wooded ravines. These views to native woodland should be complemented, but not obscured, by street tree planting.<br>❑ Both Larson Road and Westview Drive are paved for almost the entire width of their right of way. As redevelopment of these streets occurs, consider addition of boulevard or median that could support street tree planting, to reduce the scale of these streets, and to reduce the tendency to speed. |
| NB2<br>**Upper Hamilton**<br>Includes the residential area between Fell and Hamilton Ave., south of 21$^{st}$ St., between Mosquito Creek and McKay Creek ravines.<br><br>**Planting Priority: Low** | ❑ The grid pattern streets and alleys of this neighbourhood focus the view to the native forest at the east/west street ends. Street tree planting should complement but not obscure this view.<br>❑ Where Hamilton Ave, and Fell Ave. directly abut native forest, street tree planting is not recommended on the wooded side.<br>❑ Priority for street tree planting in this neighbourhood is to the centre of the neighbourhood, away from the native woods. |
| NB3<br>**Greenwood Heights**<br>Includes the new neighbourhood bewteen Queensbury Elementary school and Greenwood Park.<br><br>**Planting Priority: Low** | ❑ Retain and maintain the existing naturescape plantings in this neighbourhood, that reduce through traffic and maintain a small neighbourhood scale.<br>❑ This area is dominated by existing woods in public ownership on three sides – street tree planting should be deciduous, of medium height and fine texture to provide some shade and interest, while maintaining access to light for homes, in particular in winter months. |

**Landscape Character**
**& Street Tree Management Area**

# NATIVE-DOMINANT

## Description

Native-Dominant Landscape Character Areas occur where there is a concentration of native trees on the street and private property that is intermixed with residential development.

This intermix of housing and native conifers occurs in small pockets across the City, but is concentrated in two areas in particular – the area of Tempe Crescent north to the City boundary, and the area of Upper Fell Ave.

## General Guidelines

- Provide incentives and policies to encourage the on-going protection of native trees in these neighbourhoods, both on public and private land.
- Provide for replanting of native species as required to provide age diversity and longevity to the native forest.
- Other that as required for age diversity of the native conifers, choose decidious street tree species that will contrast with the existing conifers, and that will allow winter-time light penetration.

## Related Policies & Reports

- Environmental Protection Program

**Area Specific Guidelines**

| | |
|---|---|
| ND1<br>**Tempe Crescent**<br>Includes the winding streets of Tempe Crescent , Brand St. and Somerset St.<br><br>**Planting Priority: Low** | ❑ Encourage residents to maintain the existing native trees on their properties.<br>❑ Continue the prohibition on removal of trees on City land without a permit.<br>❑ Start of program of tree age diversity for native trees in this neighbourhood.<br>❑ When street tree planting is considered, select deciduous and fine textured species that will contrast with the native trees, and provide access to winter light. |
| ND2<br>**Upper Fell**<br>Includes the forested neighbourhood beside Edgemont Boulevard.<br><br>**Planting Priority: Low** | ❑ Encourage residents to maintain the existing native trees on their properties.<br>❑ Continue the prohibition on removal of trees on City land without a permit.<br>❑ Start of program of tree age diversity for native trees in this neighbourhood.<br>❑ When street tree planting is considered, select deciduous and fine textured species that will contrast with the native trees, and provide access to winter light. |

**Landscape Character**
**& Street Tree Management Area**

# RESIDENTIAL

### Description

includes single family neighbourhoods that have opportunities for street trees, that do not have significant view potential, and that drain to Burrad Inlet rather than to salmon-bearing watercourses.

These neighbourhoods are concentrated in the plateau on both sides of Queenbury Ave. and lower Grand Boulevard.

### General Guidelines

- Native conifers are sprinkled throughout these neighbourhoods, and provide a strong visual connection to the forest heritage of the City, as well as providing stormwater and other environmental benefits. Incentives and policies should protect these conifers on both public and private land.
- Where street trees already exist in these residential neighbourhoods, the City should move to increase inspection and maintenance programs to ensure their long-term survival.
- Where streets have gaps with no street trees, new planting should be pursued in co-operation with adjacent residents and the neighbourhood.
- Constraint classes vary – but several streets in this class are highly constrained by overhead power lines. Undergrounding of these lines is unlikely to be affordable in the foreseeable future. Street tree species choices, therefore, should follow BC Hydro requirements for clearance to overhead lines.
- These neighbourhoods that drain to Burrard Inlet have a moderate level of priority, as opposed to those that drain to salmon bearing streams, which have a higher priority.

### Related Policies & Reports

- Environmental Protection Program
- Grand Boulevard / Queensbury Transportation Plan

**Area Specific Guidelines**

<table>
<tr>
<td>R1<br>Queensbury<br>Includes the residential lands from Moodyville Park north to East Keith Road, from Hendry Ave. in the east to St. Davids Ave. in the west.<br><br>Planting Priority: Mod.</td>
<td>❑ Street Tree planting should be completed on both sides of Queensbury as a part of any street redevelopment.<br>❑ Native conifers on public streets should be retained,<br>❑ New native conifers should be planted on public land, as much as possible, and a least 2 native conifers per block.<br>❑ Street tree plantings will have to meet the BC Hydro line clearance requirements, but planting species for the street constraint class as set out in this report.</td>
</tr>
<tr>
<td>R2<br>Ridgeway<br>Includes the residential lands west of Grand Boulevard to St Andrews Ave., from Keith Road north to E 14th St.<br><br>Planting Priority: Mod.</td>
<td>❑ The eastern half of this area is constrained by overhead utility lines on the street, whereas the western half tends to have overhead utility lines in the alleys. Street tree planting design should reflect the constraint classes established by the existing overhead lines.<br>❑ The same guidelines as R1 apply.</td>
</tr>
<tr>
<td>R3<br>Sutherland<br>Includes the residential lands on Sutherland Ave. and Hendry Ave. east of Grand Boulevard to the City Boundary, from Keith Road to 12th Ave.<br><br>Planting Priority: Mod.</td>
<td>❑ The same guidelines as R1 apply.</td>
</tr>
</table>

**Landscape Character**
**& Street Tree Management Area**

# RESIDENTIAL-STOCKED

## Description

Limited residential areas of the City of North Vancouver are already fully stocked with street trees.

The newer areas of Tempe Heights and Eastview have complete street tree collections.

## General Guidelines

- Priority for Residential Stocked Areas is the implementation of an effective street tree maintenance and management program.
- Pruning by adjacent residents has varied from none to highly inappropriate. It is necessary for the City to take over responsibility for appropriate and consistent pruning of the street trees.
- Planting will be restricted to replacements as required.
- Replacement plantings should be species that will increase the species and age diversity of the neighbourhood.

## Related Policies & Reports

- N/A

**Area Specific Guidelines**

| | |
|---|---|
| RS1<br>**Tempe Heights**<br>The Tempe Glen and Tempe Knoll areas are fully stocked.<br><br>**Planting Priority: Low, other than new conifers and replacements** | ❑ The great majority of street trees in this neighbourhood are flowering cherries. Disease is becoming a problem, and creates a greater difficulty due to the monoculture planting.<br>❑ A maintenance program is required to treat or remove diseased trees.<br>❑ Replacement street trees should be species other than flowering cherries.<br>❑ Almost no native conifers exist in most of the neighbourhood. Prime consideration should be given to planting coniferous species to create a minimum of 2 large coniferous trees per block.<br>❑ Replacement trees other than conifers will likely fill a random scatter of openings in the rows fo cherries. Replacement species should be chosen that approximate the size of the flowering cherries, to maintain the visual uniformity of the streetscape. |
| RS2<br>**Eastview**<br>The Eastview Neighbourhood also has a pattern of street trees, with very few signficant gaps in the stand.<br><br>**Planting Priority: Low, other than new conifers and replacements** | ❑ Tree species in Eastview has a greater variety than that found in Tempe Heights.<br>❑ A maintenance program is required to treat or remove diseased trees.<br>❑ Eastview has a central park area that provides a wooded backdrop to the neighbourhood. A few conifers exist on the street. Prime consideration should be given to planting coniferous species to create a minimum of 2 large coniferous trees per block.<br>❑ Since there is underground wiring in Eastview, replacement plantings other than conifers should be selected for a large mature size, with a canopy over the street. |

**Landscape Character**
**& Street Tree Management Area**

# RESIDENTIAL-VIEW POTENTIAL

## Description

Where the topography slopes towards the sea, there is increased potential for residences to access a view of water, the Lions Gate bridge, or downtown Vancouver.

In higher density areas of the City, the view is impacted primarily by building height, and most buildings that achieve views are higher than normal street trees.

In single family residential areas, view potential is apparent in five areas. The Residential View Potential Character Areas tend to be on slopes close to the waterfront, or on slopes that take advantage of the opening that the Upper Levels Hwy 1 provides.

## General Guidelines

- Within Residential View Potential Areas, there are opportunities for street trees in unstocked boulevards and city lands in front yards without overhead lines.
- Design of street tree planting location in these areas should be done in consideration of the existing views. The location of trees may be chosen to maintain the view – e.g. by locating trees on property lines or otherwise staggered away from sight lines from key windows.
- The height of street trees in these neighbourhoods may be kept relatively low to avoid blocking views from blocks above.
- Retention of native conifers in these neighbourhoods is especially important, as replacement of them may be difficult.

## Related Policies & Reports

- Parks and Greenway Plan

**Area Specific Guidelines**

| | |
|---|---|
| RV1<br>**Upper Levels East**<br>Includes the slopes above Hwy. 1 from Tempe Heights to St. George Ave.<br>**Planting Priority: Mod.** | ❑ This area drains to a salmon-bearing watershed. Retain existing coniferous natives.<br>❑ Street Tree planting opportunities existing on 26th and 27th St. , where overhead utilities are in lanes. Opportunities also existing along St. Andrews Ave.Follow the General Guidelines for Residential View Potential Character Areas. |
| RV2<br>**Upper Levels West**<br>Includes the slopes above Hwy. 1 from Chesterfield west to Westview.<br>**Planting Priority: Mod.** | ❑ This area drains to a salmon-bearing watershed. Retain existing coniferous natives.<br>❑ Street Tree planting opportunities existing on 26th and 27th St. , where overhead utilities are in lanes. Opportunities also existing along Mahon, Jones and Larson Ave.Follow the General Guidelines for Residential View Potential Character Areas. |
| RV3<br>**Upper Levels Greenway**<br>Includes the 25th St. allowance which runs just north of the Hwy. 1 cut. This provides views across the cut to Burrard Inlet.<br>**Planting Priority: Mod.** | ❑ This area is proposed as a Greenway in the Parks and Greenway Plan. It provides views for residents and the public, and also access to pedestrian crossings at the bridges over Hwy. 1.<br>❑ View conditions vary – some areas are open, whereas other areas to the west are behind sound attenuation fences.<br>❑ Street Tree planting design should not interfere with panaramic views where they exist, but should be provided to where views are not impacted. |
| RV4<br>**Moodyville Slopes**<br>Includes the single family residential area from 4th St. south to the Low Level Road, between Moody Ave. and St. Patrick's Ave.<br>**Planting Priority: Low** | ❑ This older , sloping area of residential development benefits from views of Burrard Inlet and Downtown Vancouver. Opportunities for Street Tree Planting exist along parts of 4th St., and also along Ridgeway and St. David Ave.Two greenways dissect the area – one along 2nd St. E., and another up St. David's Ave. These two greenway streets should be priorities for street tree planting in the neighbourhood.<br>❑ In general, protection of the few remaining conifers is a key priority, but street tree planting should be provided in this area on a voluntary basis with individuals or the neighbourhood. |
| RV5<br>**Cloverly**<br>Includes the single family residential slopes east of Hendry Ave.<br>**Planting Priority: Low** | ❑ These slopes have some views of East Vancouver, due to the steep slope. Lower areas of the neighbourhood are sheltered by Sunrise Park.<br>❑ Streets in this area have a reasonable supply of native conifers and existing street trees, which should be maintained. New planting needs are limited. |

**Landscape Character**
**& Street Tree Management Area**

# RESIDENTIAL WATERSHED

## Description

Residential Watershed Character Areas are single family residential areas that do not have water view potential, but that drain to salmon-bearing watercourses.

These areas are generally located on the central plateau of the City.

Street Trees play a role in stormwater management that supports the salmon life cycle, and for this reason residential watersheds are treated differently than other residential areas in the City.

## General Guidelines

- Tree cover is important for watershed health, and for that reason Residential Watershed areas should be given high priority for both protection of existing tree cover, and planting of new trees
- Existing coniferous trees are of high value for watersheds, and should be retained where feasable by incentives and policy.
- New street tree plantings should include coniferous tree planting to provide age diversity and replace, in time, existing conifers as they become too large.
- New Street Trees should be planted with consideration for the Constraint Class that the street presents. Within the Constraint Class, plant the tree with the largest canopy possible.

## Related Policies & Reports

- Wagg Creek Stormwater Management Plan
- Parks and Greenway Plan
- Environmental Protection Plan

**Area Specific Guidelines**

| | |
|---|---|
| RW1<br>**Greenwood Bowl**<br>Includes the residential area west of Greenwood Park, between 14 St.E north to Hwy. 1, and from Grand Boulevard west to St George Ave.<br><br>**Planting Priority: High** | ❑ Many street tree planting opportunities exist in this neighbourhood. Constraint classes vary, but several of these streets do not have overhead wires.<br>❑ Protect existing conifers on public property. Plant to ensure at least 2 conifers per block in the public street.<br>❑ Planting should be with species that will provide the maximum canopy spread possible within the constraint class.<br>❑ When infilling blocks, choose one species as a deciduous tree, and a second species for coniferous. Different species should be used on each block, to provide species diversity. |
| RW2<br>**Mahon**<br>Includes the residential area from Keith Road north to Hwy. 1, from Mahon Park east to higher density residential near Chesterfield Ave.<br><br>**Planting Priority: High** | ❑ Same as RW1 |
| RW3<br>**Boulevard East**<br>Includes the area east of Grand Boulevard, from 12th St. E north to Hwy. 1.<br><br>**Priority: High** | ❑ Same as RW1 |

**Landscape Character**
**& Street Tree Management Area**

# SUBURBAN / BUSINESS

### Description

Suburban Business Landscape Character Areas occur incommercial districts away from the Lonsdale Corridor.

These areas are typified by high site coverage, and large building footprints, with limited green space. Some developments include extensive private landscape such as at Park & Tilford, but few public street trees.

Renovations at Capilano Mall have planted many new street trees.

The Harbourside Business Park provides an extensive systems of public boulevards and street trees, whereas older commercial areas often are void of plantings.

### General Guidelines

- Where street trees have been planted in these areas, the City should move to an organized program of maintenance inspection and pruning to encourage longevity.
- Newly planted trees should be added to the CNV Street Tree Inventory.
- When redevelopment occurs, frontage works should include the provision of street trees – with details of planting appropriately chosen from Appendix 7 of this document.
- As more formal business areas, the design of street tree plantings should be uniform within each block, with species diversity between blocks.
- Street trees should not be removed for purposes of views to signage.

### Related Policies & Reports

- Parks and Greenway Plan
- Environmental Protection Program

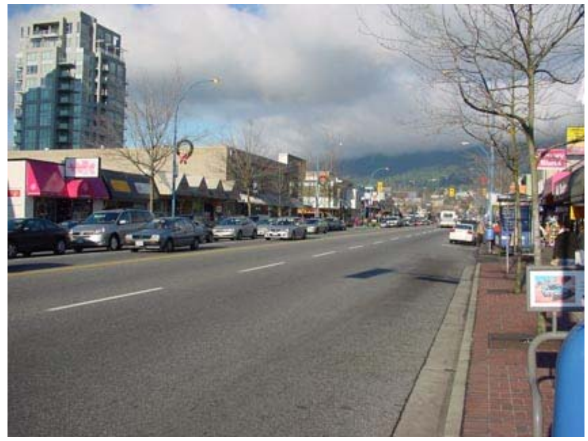
**Area Specific Guidelines**

| | |
|---|---|
| SB1<br>**Park & Tilford**<br>Includes the commercial / studio / high density area between Cotton Drive (Main Street) and Ketih Road.<br><br>**Planting Priority: Low** | ❑ Other than the treed buffer at the Port Industrial Lands, public street trees are almost non-existent in this area.<br>❑ As road redevelopment occurs, provision for new street trees should be provided.<br>❑ Design street tree plantings to provide as much canopy cover as can be compatible with the constraint class.<br>❑ Encourage undergrounding of overhead lines to allow planting of larger trees appropriate to the land use type.<br>❑ See 'Main Street Gateway' for specific guidelines. |
| SB2<br>**Lower Hamilton**<br>Includes the warehouse / retail district between the railway and Marine Drive, including Capilano Mall<br><br>**Planting Priority: Low** | ❑ Street Trees exist on Hanes Ave., W 3rd St., and Fell Ave. in this area. Recent street tree plantings have also been added at Capilano Mall.<br>❑ As road redevelopment occurs, provision for additional street trees should be provided.<br>❑ Design street tree plantings to provide as much canopy cover as can be compatible with the constraint class.<br>❑ Encourage undergrounding of overhead lines to allow planting of larger trees appropriate to the land use type.<br>❑ See 'Marine Drive Gateway' for specific guidelines. |
| SB3<br>**Harbourside**<br>Includes the North Shore Auto Mall and other recent commercial / office development on the Fullerton Fill.<br><br>**Planting Priority: Low** | ❑ Many street trees have been planted in boulevards at the Harbourside site.<br>❑ Add the new plantings to the City Street Tree Inventory.<br>❑ As developer warranties expire, ensure healthy tree plantings are brought into the CNV maintenance system.<br>❑ Add plantings of conferous trees, where possible, to include a minimum of two per block. Where space does not allow this, add conferous tree plantings to adjacent parks. |
| SB4<br>**Bewicke**<br>Includes the business area straddling Marine Drive between the City operations yard and W 17th St.<br><br>**Planting Priority: Low** | ❑ This area varies from CityOperations Yard uses to various densities of housing. The character of the area is heavily influenced by the backdrop of forest in Mahon and Mosquito Creek Parks.<br>❑ Most streets in this area have overhead utility lines. Planting of small street trees should be pursued in accordance with the constraint class. |

**Landscape Character**
**& Street Tree Management Area**

# URBAN

## Description



Urban densities of mixed use generally occur in the central area of the City, focussed on Lonsdale and adjacent Avenues.

Isolated areas of higher density mixed use also are developing at Westview, and in the Lower Fell Ave. area near Mosquito Creek Park.

## General Guidelines

- Street Tree planting spaces in these higher density areas varies – in some cases trees can be planted in grassy boulevards or on public land behind the sidewalk, in other cases trees will need to be installed with structural soils under paving.
- Tree species chosen for these ultra-urban environments will often be medium-sized growth habit – to balance the wish for a green street against the available space for both roots and canopy.
- A high level of design and care in construction is expected in these high density areas. Tree installation should be professionally performed and supervised.

## Related Policies & Reports

- Parks and Greenways Plan
- Environmental Protection Program
- Lonsdale Corridor Master Plan

**Area Specific Guidelines**

| | |
|---|---|
| U1<br>**Lower Lonsdale Mixed Use**<br>Includes the mixed use area from the waterfront nroth to Victoria Park, and including high density uses between St Patricks Ave. on the east and Forbes Ave. on the west.<br><br>**Planting Priority: High** | ❑ Guidelines for key corridors including Lonsdale, Chesterfield, St. George, and 3$^{rd}$ St. are provided under the Corridors section below. See also the 'Detailed Street Tree Plan' for specific recommendations for street trees on other streets in this area.<br>❑ Most east west streets are Constraint Class 1, without overhead lines. View potential is determined by building massing, not tree massing. In these circumstances, planting plans focus on choosing an appropriate medium sized deciduous tree species for each block, and a supplementary conferious tree species (minimum target 2 coniferous trees / block). Combined with existing plantings, this provides an appropriate balance between street unity and species variety. |
| U2<br>**Civic Lonsdale**<br>Includes the high density mixed and institutional uses – City Hall, Hospital, RCMP - from Victoria Park to 14$^{th}$ St., from St. Andrew Ave. to Mahon Ave. Area drains to Burrard Inlet<br><br>**Planting Priority: Mod.** | ❑ Guidelines for key corridors including Lonsdale, Chesterfield, St. George, Keith and 13th St. are provided under the Corridors section below. See also the 'Detailed Street Tree Plan' for specific recommendations for street trees on other streets in this area.<br>❑ The prescence of overhead lines and other constaints vary. The focus of the 'Detailed Street Tree Plan' is infill of street trees, in particular to side streets, in accordance with the General Guidelines. |
| U3<br>**Central Lonsdale**<br>Includes the retail / high density residential area bounded by 14$^{th}$ St., 21$^{st}$ St., St. George Ave. and Wagg Creek Park. Area drains to salmon-bearing stream.<br><br>**Planting Priority: High** | ❑ Guidelines for key corridors including Lonsdale, Chesterfield, and St. George,are provided under the Corridors section below. See also the 'Detailed Street Tree Plan' for specific recommendations for street trees on other streets in this area.<br>❑ Opportunities for street tree infill exist, in particular along 18$^{th}$ St. and 20$^{th}$ St. where constraints are limited. |
| U4<br>**Upper Lonsdale**<br>Includes the area north of Hwy. 1 including Lonsdale, St. George and Chesterfield.<br><br>**Planting Priority: High** | ❑ Guidelines for key corridors including Lonsdale, Chesterfield, and St. George,are provided under the Corridors section below. See also the 'Detailed Street Tree Plan' for specific recommendations for street trees on other streets in this area.<br>❑ East-west streets 26$^{th}$ and 27$^{th}$ St. have opportunities for infill street tree planting, as do Western Ave. and Eastern Ave.<br>❑ Ensure coniferous tree targets are met on the minor streets in the area. |

| | |
|---|---|
| U5<br>**Westview**<br>Includes the area between Westview Ave. and the Mosquito Creek Ravine, which includes high density housing and the Westview Shopping Centre.<br><br>**Planting Priority: Low** | ❑ Westview Ave. is the only public street in this polygon. It has been developed such that little room for street tree planting is provided in the median or sidewalk areas.<br>❑ If traffic calming or street redevelopment were to occur, provision for street trees of medium stature should be made in the road cross section.<br>❑ Structural soils and root barriers should be used for trees in paving along this section. |
| U6<br>**Lower Fell**<br>Includes the high density commercial and housing uses north of Marine Drive, between Fell Ave and Hamilton Ave.<br><br>**Planting Priority: Low** | ❑ Most streets in this area have reasonable stocking of street trees. CNV should operationalize regular inspection and pruning maintenance practices.<br>❑ W 17$^{th}$ St. has opportunities for medium-size street trees.<br>❑ Guidelines for Marine Drive are provided in the 'Corridor' section below. |

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**Landscape Character**
**& Street Tree Management Area**

# CORRIDOR

## Description

In addition to the Landscape Character Areas defined above, there are Landscape Corridors of special significance for the Street Tree Master Plan.

Residents and visitors take their first impressions of the City of North Vancouver from the major and minor arterials, including Lonsdale Ave., Marine Drive, Keith Road, Third Street, Chesterfield Ave. and St. George Ave. Street Tree recommendations for these street corridors are provided in this report.

Street Tree recommendations are also made for the Green Necklace, which will recreate an historic linear experience focussed on pedestrians and cyclists. The Parks and Greenway Plan also identfies several other Greenway corridors, many of which follow minor streets. General street tree guidelines are provided for them as well.

## General Guidelines

- Street Tree planting and maintenance should be a priority in all of the Corridors identified in this report.
- Where existing street conditions preclude the planting of street trees, street tree planting may be deferred until street reconstruction is triggered by adjacent redevelopment, capital projects, or major maintenance. However, the design of such reconstruction should make every effort to incorporate street trees.
- For appropriate proportion in relation to the scale of the street, tree planting should be of large scale species in these major corridors.
- To allow for the appropriate size of tree, undergrounding of overhead utility lines should be a priority in these highly visible corridors, where it has not been accomplished already.
- Refer to the Detailed Street Tree Plan for specific recommendations for street trees in the named road corridors.

## Related Policies & Reports

- North Vancouver Transportation Network Study
- Parks and Greenway Plan, related implementation plans
- Community Traffic Calming Program
- Lonsdale Corridor Master Plan
- Environmental Protection Program

## Area Specific Guidelines

| | |
|---|---|
| **C1**<br>**Marine / 3rd Street**<br>Includes the length of Marine Drive from the west City boundary to the confluence with Keith. This corridor then follows Third Street to Cotton Road and Main Street at the City eastern boundary.<br><br>**Planting Priority: High** | ❑ There are several sections of Marine Drive that are not suitable for planting because boulevards and medians are narrow and/or there are conflicts with utilities. The existing street trees are predominantly flowering cherries with some pin oaks ( Prunus serrulata and Quercus palustris).<br>❑ Conditions vary along Third Street. Between Chesterfield and Lonsdale, the street is well stocked with red maples, mountain ash and cherries (Acer rubrum, Sorbus aucuparia, and Prunus spp.). There is a significant group of cherries and a few Douglas fir (Prunus sp. and Pseudotsuge menziesii) between Ridgeway and Queensbury. Planting conditions on Third Street are variable; generally there are more constraints east of St. David's Street.<br>❑ The design goal for Marine Drive/Third Street is create a canopy over the street. Management guidelines. Where constraints preclude this at present, implementation may wait until redevelopment and/or reconstruction of streets occur.<br>❑ Create plantable medians wherever possible. Plant median with canopy trees, to create a triple row of trees (boulevard on both sides and median).<br>❑ Cluster tree species on block-by-block basis.<br>❑ Highlight the crossings of MacKay, Mosquito, and Wagg Creeks alongside Marine Drive with large native trees. |
| **C2**<br>**Keith Median West**<br>Includes the large median island from Marine Drive up the hill to Queen Mary School.<br><br>**Planting Priority: High** | ❑ Maple trees are the dominant genus along West Keith Road (Acer platanoides, Acer campestre, Acer saccharum, Acer psuedoplatanus) with a few pines, red oaks, silver birch, mountain ash, cherry, and beech ( Pinus nigra, Quercus rubra, Betula pendula, Sorbus aucuparia, Prunus spp., and Fagus sylvatica).<br>❑ Add native conifers to create a sense of west coast forest. The effect, when combined with the existing trees, may be like King Edward and simlar medians in Vancouver.<br>❑ Plant medians with 75% conifers, randomly spaced to respect views where they exist. |
| **C3**<br>**Keith Median East**<br>Includes the large median island in Keith Road from Victoria Park east to St. David's Ave.<br><br>**Priority: High** | ❑ A greenway trail is proposed to be added to this median. Existing trees and relatively young and small. Housing blocks views from this site to the ocean.<br>❑ Extend the treatment proposed for Victoria Park into this median. |

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| C4<br>**Keith Rd Non-Median**<br>Includes sections of West Keith Road and East Keith Road where no median exists.<br><br>**Planting Priority: Mod.** | ❑ The non-median sections of Keith Road do not have space to add a median. Constraints vary along the length.<br>❑ For the portion fronting Queen Mary School, provide roadside street trees on both sides of the street, with one exception – an open view should be maintained to the façade of the heritage Queen Mary School building.<br>❑ For East Keith Road east of St. David, install roadside street trees both sides of the road where feasable. Include coniferous trees in accordance with the general objective of two conifers per block. |
| C5<br>**Lonsdale Corridor**<br>Including the length of Lonsdale Ave. from the waterfront to the north City boundary.<br><br>**Planting Priority: Mod.** | ❑ At present, Lower Lonsdale is well stocked with red maples (Acer rubrum). Central Lonsdale is also mostly red maples, except for the section between 21st and 22nd where there is a mix of chestnut, beech, maple, cherries, hemlock and magnolia trees (Aesculus hippocastanum, Fagus sylvatica, Acer platanoides, Prunus sp., Tsuga heterophylla, and Magnolia kobus). Liquidambar is now being used to replace maples (for example at 16th Street). Generally there are no constraints to planting,<br>❑ For Upper Lonsdale north of Hwy 1, there are few opportunities for planting trees because the boulevard is narrow and/or there are conflicts with underground utilities. When road reconstruction occurs, these constraints should be removed.<br>❑ Street Tree planting for Lonsdale should follow the extensive guidelines in the Lonsdale Corridor Master Plan.<br>❑ Red maple should remain the dominant species to plant with breaks for visual character and disease management between 21st and 22nd Street, 4th and 5th Street, and at Victoria Park.<br>❑ As redevelopment and/or reconstruction occurs above Hwy 1, create areas suitable for planting, and plant with Liquidambar.<br>❑ Refer to the Detailed Street Tree Plan for proposed tree plantings and species. If double rows of trees can be achieved where suggested by the Lonsdale Corridor Master Plan, the two rows would be of the same species, to create a bosque. |
| C6<br>**Chesterfield Corridor**<br>C7<br>**St. George Corridor**<br>Description<br><br>**Planting Priority: High if remaining overhead lines can be undergrounded.** | ❑ There are overhead hydro lines on the west side of St. George and few existing street trees. Similarly, Chesterfield has hydro lines on the west side, with large gaps in the existing canopy. On the east side of St. George and Chesterfield, there are few planting constraints.<br>❑ Both these streets should be priorities for undergrounding of overhead utilities.<br>❑ The design goal is to create a treed character while respecting viewscapes down the streets to the waterfront. In general, fastigiate or columnar tree forms should be used.<br>❑ Different species should be chosen on a block by block basis, to |

| | |
|---|---|
| | give each block a somewhat distinctive character while providing species diversity. |
| C8<br>**Green Necklace Corridor**<br>Includes a pedestrian / cycle route that combines park routes with several streets: Keith Road, 9th St., Grand Boulevard, Upper Queensbury, 22nd St. 21st St, and Jones Ave.<br><br>**Planting Priority: High in conjunction with streetscape improvements** | ❑ The Green Necklace envisions a re-creation of the historic 'green lungs' set out in the 1907 Town Plan. The majority of the route is in parks, but where the Green Necklace follows streets, the concept calls for redevelopment of portions of the street as demonstration projects in sustainable street design.<br>❑ Guidelines are provided in the Parks and Greenway Implementation Plan, in the Grand Boulevard Parks Plan, and related implementation strategies, as well as Keith Road and Victoria Park sections of this Street Tree Master Plan.<br>❑ For other named roads in the Green Necklace, priority should be given to street tree planting as a municipal demonstration. The planting may be in existing green spaces and boulevards, or may be in landscape areas created by the roadway improvements, such as traffic circles, curb bulges, infiltration swales and rain gardens, or other innovations. |
| C9<br>**Other Greenway Corridors**<br>Includes streets identified as Proposed Greenways in the Parks and Greenways Plan: the Waterfront Trails System, Ravine Trail System, Upper Levels Trail System, and Trans Canada Trail System.<br><br>**Planting Priority: High in conjunction with streetscape improvements or greenway implementation.** | ❑ Several of these proposed greenway routes follow streets and sidewalks not mentioned in this report. Often the greenway route looks for minor or low traffic routes, to avoid conflicts with vehicles.<br>❑ As these greenway routes are designated and improved, they should each be priorities for street tree planting in accordance with the principles and guidelines in the Street Tree Master Plan. |

**Landscape Character**
**& Street Tree Management Area**

# GATEWAYS

## Description

The City of North Vancouver is sited in a Metropolitan Area. It can easily lose its identify as its borders blend into adjacent development.

By creating a strong design statement where major transportation corridors enter the City, North Vancouver will maintain a renewed sense of place, and renewed civic pride.

The major gateways are shown on the Landscape Character Map.

## General Guidelines

- Street Tree Planting should play a strong role in the design of gateways to the City of North Vancouver. Street trees act as symbols of the sustainability of the City.
- Each gateway should have a strong, identifiable design concept. The design will integrate all aspects of the streetscape – lanes, paving, site furniture, lighting, banners, adjacent architecture, and street trees.
- The choice of street tree species will follow from the gateway design process.
- This Street Tree Master Plan provides general ideas to contribute to the gateway design process, but may be superceded by that process.

## Related Policies & Reports

- Parks and Greenway Plan
- Lonsdale Corridor Master Plan

**Area Specific Guidelines**

| | |
|---|---|
| G1<br>**Marine Drive Gateway**<br>Includes the entrance to the City on Marine Drive from the west boundary to Fell Ave.<br><br>**Planting Priority: recently planted (2004)** | ❑ The Marine Drive area has seen recent improvements fronting Capilano Mall.<br>❑ Other retail property is this precinct is a candidate for redevelopment.<br>❑ The design standards of treed median and roadside trees and urban streetscape established by Capilano Mall should be continued to adjacent properties to the west and east. |
| G2<br>**Upper Lonsdale Gateway**<br>Includes the Lonsdale entrance, both south and north of Hwy. 1<br><br>**Planting Priority: High if road reconstruction were to occur.** | ❑ The Youth Park development has included major new street tree and median planting at the Lonsdale Gateway south of Hwy. 1. This treatment should be extended on the west side of Lonsdale if redevelopment occurs.<br>❑ On Lonsdale north of Hwy. 1, existing roadworks leave little room for street tree planting. This should be addressed when roadworks are reconstructed, Tree planting on the roadside is critical. A median should also be provided, but it may be planted with a mix of trees and shrubs, designed to allow the views from this entrance of both the north shore mountains and the Lions Gate and harbour. |
| G3<br>**Lower Lonsdale Gateway**<br>Includes the foot of Lonsdale to the water's edge.<br><br>**Planting Priority: Low** | ❑ The Lonsdale Corridor Master Plan provides guidance for street tree planting along the street sides in Lower Lonsdale. Red maples are established in this area.<br>❑ The priority at the street end 'foot' of Lonsdale is public views to the water, and related pedestrian access. Trees should not block this view. |
| G4<br>**Main Street Gateway**<br>Includes the east entrance into the CNV, from the Lynn Creek bridge to Brooksbank Ave.<br><br>**Planting Priority: High if roadwork improvements were made.** | ❑ The Lynn Creek bridge and associated park provides an effective 'gateway' to the city, but the roadside development to the west of the bridge leaves little room at present for street tree planting.<br>❑ Priority should be given to revitalization or redevelopment of this section of roadway, and street tree planting should play a key role.<br>❑ To create a strong entrance statement, a triple row of street trees should be included in a new road cross section. |

| | |
|---|---|
| G5<br>**Boulevard Crescent Gateway**<br>Includes the Crescent roadway between Hwy. 1 and Grand Bouevard.<br><br>**Planting Priority: High** | ❑ This curving roadway is dominated by the interchange at Hwy. 1.<br>❑ Street tree planting on both sides of the Crescent should be completed to bring down the scale of the cloverleaf, and to provide a strong entrance statement to the City. |
| G6<br>**Westview Gateway**<br>Includes the Westview Road and Hwy. 1 interchange and adjacent sections of Westview Road.<br><br>**Planting Priority: Mod.** | ❑ The ramps and major arterial roadway of Westview create a high-speed traffic environment, that is not pedestrian friendly.<br>❑ Street tree planting to urban standards should be added on the sides of the approach ramps, on MOT property, to bring down the scale and speed of the road.<br>❑ As reconstruction of the City portion of Westview occurs, provision for street trees on each side of the road should be made. Addition of medians with trees would also strengthen the entrance statement, and indicate to traffic that it is entering an urban environment.<br>❑ Roadside tree planting should recreate a west coast forest character to reflect the adjacent Mosquito Creek Park. |

## 4.4 Demonstration Street Tree Projects

Three demonstration street were selected to illustrate the application of these Guidelines and constraint classes:

- **16th Street**, block from St. Andrews east to Ridgeway: constraint class 3, hydro lines both sides, sidewalk both sides with no boulevard.
- **18th Street**, block from Chesterfield to Jones: constraint class 1, no hydro lines (other than cross-street lines), no boulevard (sidewalk next to street).
- **14th Street**, block from St Andrews east to Moody: constraint class 1 and 3, hydro lines one side with crossovers to other side; sidewalk both sides with no boulevard.

The next pages, Maps 6, 7, and 8, contain sample plans for the above streets. Two visual simulations follow the plans; at 14th Street and Ridgeway, and at 4th and St. George.

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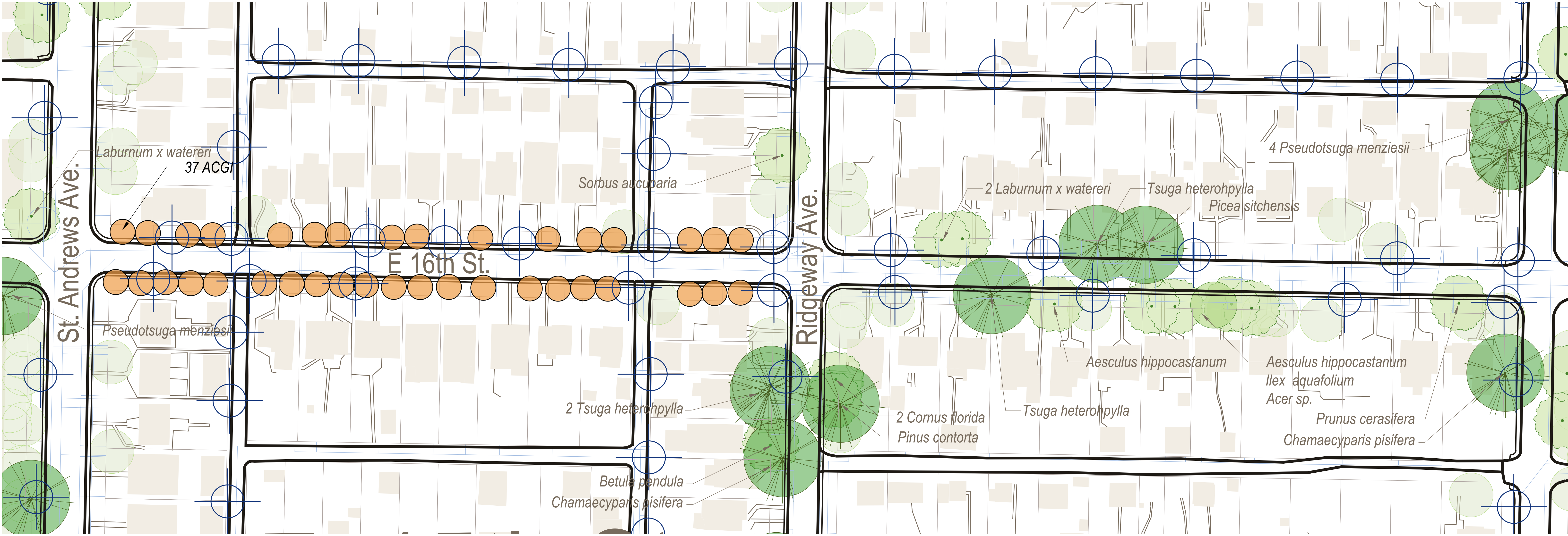



## Legend

- Parks
- Building
- School
- Hydro Pole
- Hydro Lamp
- Underground Utilities: cable TV and telephone ducts, gasmains, watermains and connections, storm and sanitary

**Existing Street Trees**

- Conifer
- Deciduous
- Broad-leaved Evergreen

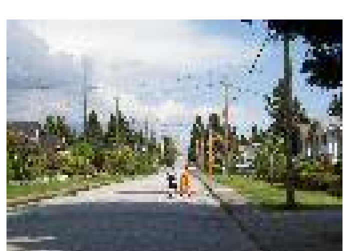
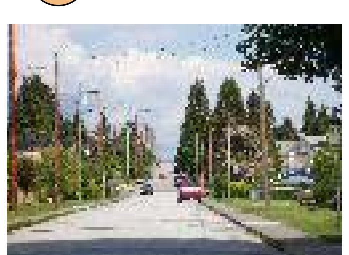
**Tree on Private Property**

**Proposed Street Trees**

- Conifer
- Deciduous

## Plant List

| Qty. | Code | Botanical name | Common Name | Notes |
|---|---|---|---|---|
| 37 | ACGI | Acer ginnala | Amur Maple | small tree, red-gold fall colour spaced 7.5m O.C. |

East 14th Street; hydro lines both sides (Constraint Class CC3), sidewalk both sides with no boulevard.

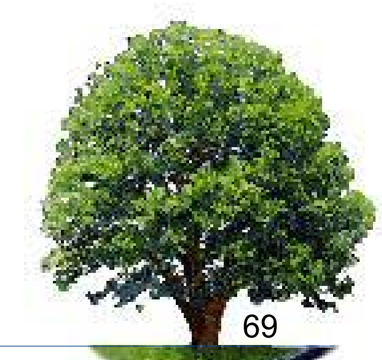
LANARC CONSULTANTS LTD.

East 16th Street
between St. Andrews Ave. and Ridgeway Ave.

# Detailed Street Tree Plan

City of North Vancouver

Scale NTS





MAP 6

Nov.17 2004 NVU3-59\Mapping - Street Tree System\What Trees Where\Detail Plan Areas.dwg

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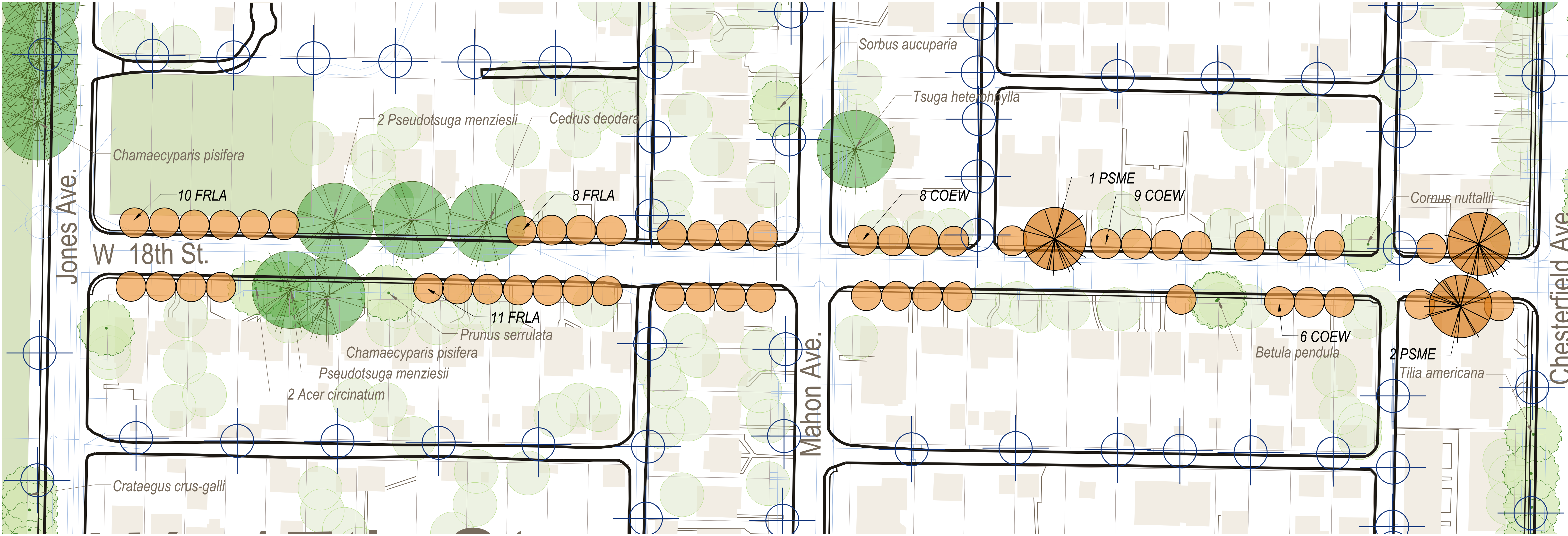



## Legend

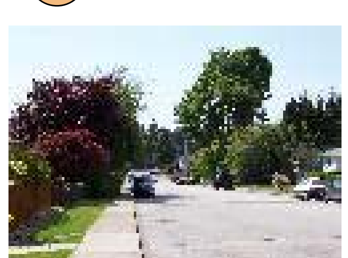
Parks
Building
School
Hydro Pole
Hydro Lamp
Underground Utilities: cable TV and telephone ducts, gasmains, watermains and connections, storm and sanitary

**Existing Street Trees**
Conifer
Deciduous
Broad-leaved Evergreen
**Tree on Private Property**

**Proposed Street Trees**
Conifer
Deciduous

## Plant List

| *Qty.* | *Code* | *Botanical name* | **Common Name** | **Notes** |
|---|---|---|---|---|
| 29 | FRLA | *Fraxinus latifolia* | Oregon Ash | native, provincially red-listed spaced 9m O.C. |
| 23 | COEW | *Cornus `Eddie's White Wonder'* | Eddie's Dogwood | resembles native dogwood, white flowers, red fall colour spaced 9m O.C. |
| 3 | PSME | *Pseudotsuga menziesii* | Douglas Fir | large native conifer randomly spaced |

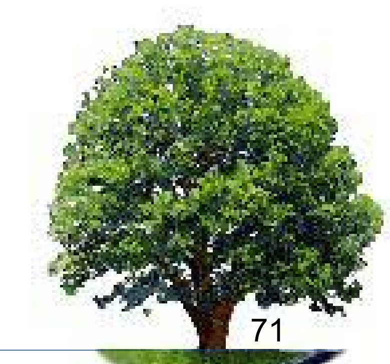
*West 18th Street; no hydro lines (other than cross-street lines), no boulevard (sidewalk next to street). Constraint Class 1 (CC1)-- no prominent constraint for growing street trees.*

LANARC
CONSULTANTS LTD.

West 18th Street
between Jones Ave and Chesterfield

# Detailed Street Tree Plan

City of North Vancouver
Scale NTS





MAP 7

Nov.17 2004 NVU3-59\Mapping - Street Tree System\What Trees Where\Detail Plan Areas.dwg

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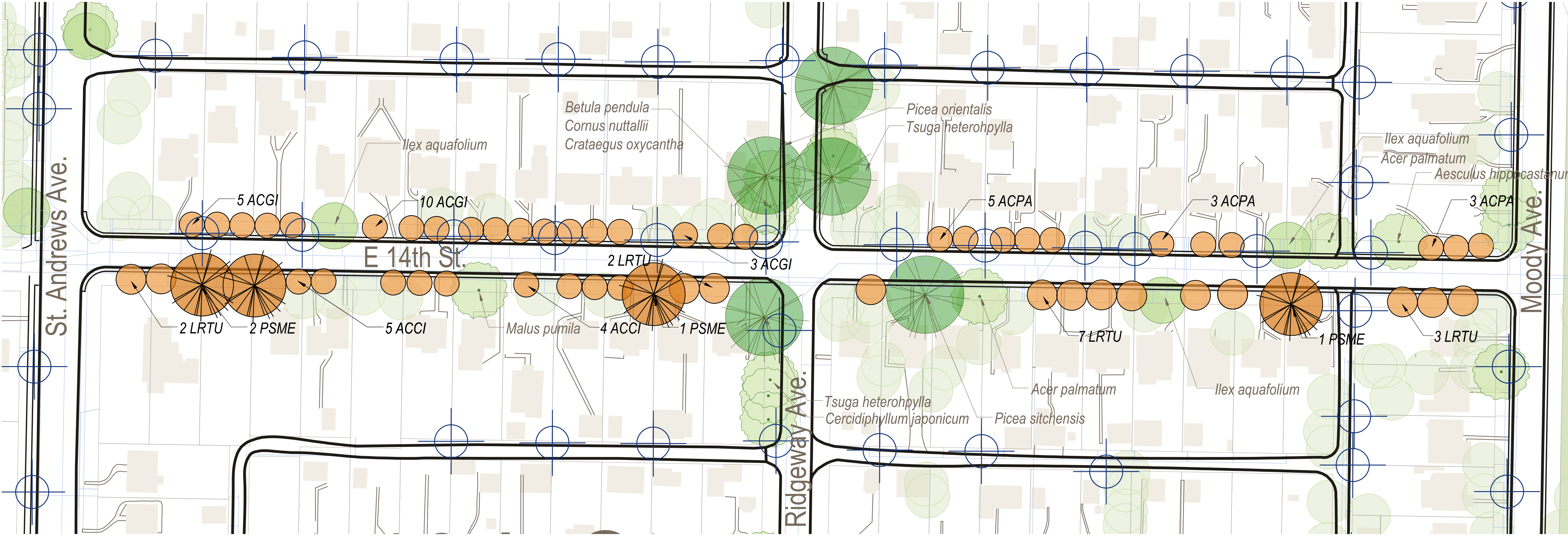



## Legend

- Parks
- Building
- School
- Hydro Pole
- Hydro Lamp
- Underground Utilities: cable TV and telephone ducts, gasmains, watermains and connections, storm and sanitary

**Existing Street Trees**

- Conifer
- Deciduous
- Broad-leaved Evergreen

**Tree on Private Property**

**Proposed Street Trees**

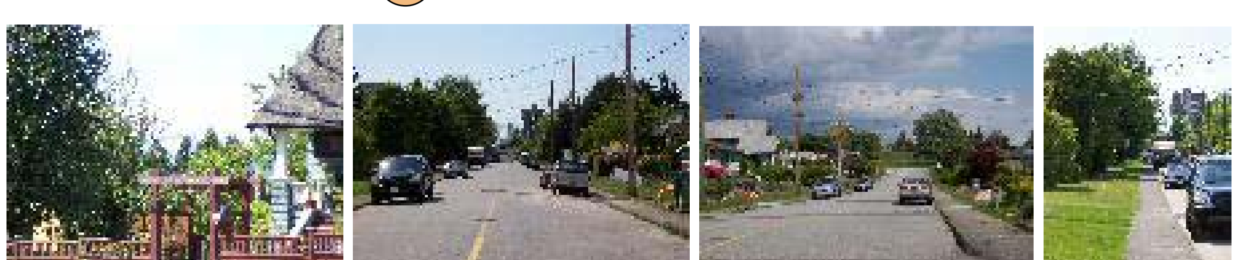
- Conifer
- Deciduous

## Plant List

| Qty. | Code | Botanical name | Common Name | Notes |
|---|---|---|---|---|
| 9 | ACCI | *Acer circinatum* | Vine Maple | native, brilliant fall colour, tolerates shade<br>spaced 7.5m O.C. |
| 18 | ACGI | *Acer ginnala* | Amur Maple | red-gold fall colour, very hardy<br>spaced 7.5m O.C. |
| 11 | ACPA | *Acer palmatum* | Japanese Maple | red-gold fall colour, tolerates shade<br>spaced 7.5m O.C. |
| 14 | LRTU | *Liriodendron tulipifera fastigiatum `Arnold'* | Fastigiate Tulip Tree | showy yellow flowers, gold fall colour<br>columnar form<br>spaced 9m O.C., locate between hydro line crossovers |

*Selected from Constraint Class 1 (CC1) -- note species and varieties with an upright or columnar form must be considered for streets with numerous hydro line crossovers.*

| Qty. | Code | Botanical name | Common Name | Notes |
|---|---|---|---|---|
| 4 | PSME | *Pseudotsuga menziesii* | Douglas Fir | large native conifer<br>located at property corners |



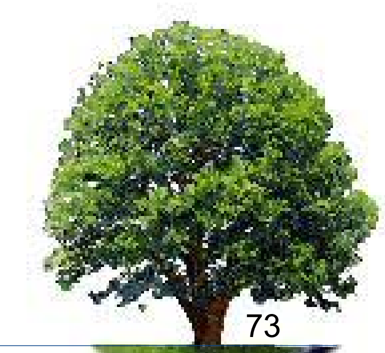
*East 14th Street; hydro lines on the north side of street (Constraint Class 3) with crossovers to the south side (Constraint Class 1), sidewalk both sides with no boulevard.*

East 14th Street
between St. Andrews Ave. and Moody Ave.

# Detailed Street Tree Plan

City of North Vancouver

Scale NTS



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Nov. 17 2004 NVU3-59\Mapping - Street Tree System\What Trees Where\Detail Plan Areas.dwg

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Presently, there are only few public trees on 14th Street. There are overhead hydro lines on the north side of the street (left side on the above photo) with numerous crossovers to the south side.

The above simulation shows 14th Street planted with small maples adjacent to hydro lines, and large fastigiated tulip trees on the other side of the street between the overhead line crossovers.

There are no prominent tree growing constraints along this section of 4th Street.

The illustration above shows 4th Street planted with large trees.

## 4.5 Detailed Street Tree Plans

Detailed Street Tree Plans for Lower Lonsdale, Central Lonsdale Corridor, Keith Road Boulevard and Marine Drive/Third Street Corridor are provided in plan format on the 24X36" plan insert "Detailed Street Tree Plan" – Map 9. Note that this plan shows planting schemes for streets as they exist. As redevelopment and/or reconstruction occurs, there may be more area available for planting and opportunities to select larger tree species. The hard-copy plan illustrates landscape pattern only; the digital copy (GIS) provides more detailed street tree data (constraint class, genus, species and variety). The Detailed Street Tree Plan is to be read in conjunction with Table 3 – Recommended Street Trees.

## 4.6 Recommended Street Trees

Refer to Table 3 – Recommended Street Trees.

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**Constraint Class 1: No Prominent Constraints**

Large trees: trees with height greater than 9m.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| **Preferred Street Trees for areas with no constraints** | | | | | | | | | | |
| *Acer cappadocicum*<br>Coliseum Maple | ACCP | | 10<br>9 | rounded spreading | inconspicuous | golden yellow | f | A | | Benefits:<br>Notes: bright red spring growth, not commonly available in the nursery trade |
| *Acer platanoides*<br>Norway Maple | ACPL | | 20<br>18 | rounded oval | inconspicuous | varies | m | A | Crimson King, Emerald Queen, Columnar, Columnarbroad, Deborah, Parkway | Benefits: adaptable to many soils; easily transplanted<br>Notes: full sun is best |
| *Acer pseudoplatanus*<br>Sycamore Maple | ACPS | | 18<br>15 | oval rounded | inconspicuous | no change | m | A | Spaethii | Benefits: easily transplanted and established; very adaptable; tolerates salt and seaside locations; tolerates high pH and calcareous soils<br>Notes: full sun is best, but can take light shade; prefers cool environment |
| *Acer rubrum*<br>Red Maple | ACRU | | 18<br>15 | pyramidal oval | red | red orange | f | A | Autumn Flame, Bowhall, Karpick, October Glory, Franksred, Scarsen, Red Sunset, Morgan, Green Mountain | Benefits: easy to transplant and establish; adaptable;<br>Notes: moderate biogenic emissions; high canopy; prefers moist, acidic soils; on alkaline soils develops manganese chlorosis; full sun best for development, but can tolerate partial shade |
| *Aesculus x carnea*<br>Horsechestnut | AECA | | 15<br>12 | rounded umbrella | pink to red | bronze | m | A | Briotii, Fort McNair | Benefits: less prone to leaf scorch, leaf blotch and mildew than A. hippocastanum<br>Notes: low canopy |
| *Carpinus betulus*<br>Hornbeam | CABE | | 12<br>12 | pyramidal | inconspicuous | red gold | s - m | A | Fastigiata, Franz Fontaine | Benefits: very soil adaptable as long as the soil is well-drained; tolerates urban conditions and pollution<br>Notes: |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 1: No Prominent Constraints**

Large trees: trees with height greater than 9m.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Cercidiphyllum japonicum*<br>Katsura Tree | CEJA | | 18<br>12 | oval<br>rounded<br>umbrella | inconspicuous | red gold | s | A | Pendula | Benefits: pH adaptable<br>Notes: not easy to transplant; requires water during establishment and dry periods |
| *Fagus sylvatica*<br>European Beech | FASY | | 25<br>20 | oval | inconspicuous | bronze | m - s | A - L | Riversii | Benefits:<br>Notes: prefers moist, well-drained, acidic soil; does not like excessively wet soils; shallow, wide root system |
| *Fraxinus excelsior*<br>*European Ash* | FREX | | 20<br>15 | oval<br>rounded | inconspicuous | no change | m-f | L | none commonly available | Benefits: smog tolerant<br>Notes: male plants preferred; good for difficult growing sites; easy to establish and transplant |
| *Ginkgo biloba*<br>Maidenhair Tree | GIBI | | 25<br>15 | pyramidal | inconspicuous | bright yellow | m | L | Magyar, Fairmount, Sentry | Benefits: adaptable to pH and almost any other conditions; tolerant of pollution, salt air, and heat; pest free<br>Notes: do not plant females-- fruit smells unpleasant |
| *Liquidambar stryraicflua*<br>Sweetgum | LIST | | 14<br>9 | pyramidal | inconspicuous | red gold purple | m - f | L | Worplesdon | Benefits:<br>Notes: high biogenic emissions; best in deep, moist, slightly acid soils; surface roots may lift sidewalks |
| *Liriodendron chinensis*<br>Chinese Tulip Tree | LRCH | | 25<br>12 | pyramidal | yelow | yellow | f | L | | Benefits: attractive to birds and butterflies<br>Notes: moderate biogenic emissions; fragrant flowers |
| *Magnolia kobus*<br>*Kobus magnolia* | MAKO | | 15<br>7.5 | rounded | showy, white-pink | yellow | m | A | | Benefits: adaptable, range of soils<br>Notes: unknown biogenic emissions; flowers early in spring, select root stock |
| *Metasequoia glyptostroboides*<br>Dawn Redwood | MTGL | ✔ | 20<br>8 | conical | inconspicuous | bronze | f | L | National | Benefits:<br>Notes: requires heavy watering |
| *Quercus acutissima*<br>Sawtooth Oak | QUAC | | 13<br>12 | rounded | golden male catkins | golden yellow | m-f | L | | Benefits: tolerant of drought and compacted soils; attacts wildlife<br>Notes: adaptable; clean foliage; easy to tranplant |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 1: No Prominent Constraints**

Large trees: trees with height greater than 9m.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Quercus palustris*<br>Pin Oak | QUPA | | 16<br>12 | pyramidal<br>rounded<br>umbrella | inconspicuous | bronze<br>red gold | m - f | L | Crownright | Benefits: easily transplanted<br>Notes: fast growing for an oak |
| *Quercus phellos*<br>Willow Oak | QUPH | | 20<br>12 | rounded | inconspicuous | yellow<br>brown | m-f | L | | Benefits: adaptable<br>Notes: high biogenic emissions; tolerates heat, drought, pollution, compacted soils, and standing water |
| *Robinia pseudoacacia*<br>Locust | ROPS | | 13<br>10 | oval | white | gold | f | A | Purple Robe, Frisia | Benefits: easily transplanted and grown; tolerant of salt, heat, pollution<br>Notes: high biogenic emissions; tolerant of most soils |
| *Tilia tomentosa*<br>Silver Linden | TITO | | 18<br>12 | oval | yellow | yellow | f | A | | Benefits: attactive to insects and birds<br>Notes: tolerates range of wide range of soils, wind, salt, and pollution |
| *Zelkova serrata*<br>Japanese Zelkova | ZESE | | 25<br>18 | rounded<br>umbrella | inconspicuous | bronze<br>red gold | m - f | A | Green Vase, Village Green | Benefits: easy to transplant and establish<br>Notes: low biogenic emissions; shows fairly good resistance to Dutch Elm Disease and bacterial canker, but not immune |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 1: No Prominent Constraints**

Large trees: trees with height greater than 9m.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| **Other trees that may do well on streets with no constraints** | | | | | | | | | | |
| *Abies grandis**<br>Grand Fir | ABGR | ✔ | 20<br>10 | pyramidal | inconspicuous | no change | m - f | L | none commonly available | Benefits:<br>Notes: moderate biogenic emissions; |
| *Acer platanoides* \`Crimson King'<br>Crimson King Maple | ACPL | | 18<br>15 | rounded | inconspicuous | brown purple | m | A | N/A | Benefits: dense shade; high large canopy; tolerates poor soil conditions; heat and drought tolerant<br>Notes: surface-rooted; maroon leaf colour; may seed itself |
| *Acer platanoides* \`Emerald Queen'<br>Emerald Queen Maple | ACPL | | 20<br>18 | oval rounded | inconspicuous | golden yellow | m - f | A | N/A | Benefits: adapted to poor soil; heat and drought-tolerant<br>Notes: erect-spreading form; surface-rooted; brilliant red new growth; may seed itself |
| *Acer saccharum*<br>Sugar Maple | ACSC | | 18<br>15 | oval rounded | inconspicuous | red gold orange | m | L | Bonefire, Commemoration, Green Mountain | Benefits:<br>Notes: extensive canopy; does not perform well when root zone is restricted; prefers well-drained, moist fertile soils; not tolerant of high heat, pollution, road salt; although shade tolerant, full sun is needed for proper development |
| *Acer saccharum* \`Legacy'<br>Legacy Sugar Maple | ACSC | | 18<br>15 | oval rounded | inconspicuous | yellow orange | m - f | L | N/A | Benefits: dense shade; desirable wildlife tree; good drought tolerance<br>Notes: best suited variety for the west coast |
| *Aesculus hippocastanum*<br>Horsechestnut | AEHI | | 20<br>15 | rounded | cream | bronze | f | A-L | none commonly available | Benefits:<br>Notes: avoid hot, dry locations to minimize leaf scorch |
| *Arbutus menziesii**<br>*Pacific* Madrone | ARME | | 18<br>10 | rounded umbrella | pink to white | no change | m | L | none commonly available | Benefits:<br>Notes: low biogenic emissions; difficult to transplant; requires excellent soil drainage; broadleaf evergreen |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 1: No Prominent Constraints**

Large trees: trees with height greater than 9m.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Betula jacquemontii*<br>Jacquemontii Birch | BEJA | | 20<br>9 | columnar | inconspicuous | golden yellow | m - f | A | none commonly available | Benefits: prefers wet/moist sites<br>Notes: whitest bark of all the birches; does not tolerate drought |
| *Betula papyrifera**<br>Paper Birch | BEPA | | 18<br>10 | oval rounded | inconspicuous | golden yellow | m | A | none commonly available | Benefits: tolerates wet/moist sites; easy to transplant and establish from container or B&B<br>Notes: does poorly in high summer heat, especially root zone heat; fairly soil adaptable, often found growing in sandy, gravely soils; prefers well-drained, slightly acid sandy loam soils; does not tolerate pollution or difficult sites |
| *Calocedrus decurrens*<br>California Incence Cedar | CLDE | ✔ | 20<br>6 | conical | inconspicuous | no change | s-m | L | none commonly available | Benefits: heat and drought tolerant<br>Notes: low biogenic emissions; |
| *Catalpa speciosa*<br>Northern Catalpa | CTSP | | 16<br>12 | umbrella | white | bronze gold | s - m | S - A | none commonly available | Benefits: tolerant of many soil types, but prefers deep, moist, fertile soil; withstands wet or dry and alkaline conditions and extremely hot, dry environments<br>Notes: |
| *Cedrus atlantica `Glauca'*<br>Blue Atlas Cedar | CDAT | ✔ | 20<br>12 | conical | inconspicuous | no change | s - m | L | N/A | Benefits: drought tolerant<br>Notes: tolerates a wide range of soils, but not wet |
| *Cedrus deodara*<br>Deodar Cedar | CDDE | ✔ | 18<br>12 | pyramidal | inconspicuous | no change | f | L | Kashmir | Benefits: drought tolerant once established<br>Notes: low biogenic emissions; prefers well-drained and somewhat dry soil; |
| *Chamaecyparis nootkatensis**<br>*Nootka Cypress* | CHNO | ✔ | 25<br>9 | conical | inconspicuous | no change | s-m | L | | Benefits: desirable wildlife plant<br>Notes: low biogenic emissions; |
| *Cladrastis lutea*<br>Yellowwood | CLLU | | 15<br>12 | rounded umbrella | white | gold orange | s - m | A | none commonly available | Benefits:<br>Notes: prefers well-drained soils; tolerates alkaline and acidic soils |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 1: No Prominent Constraints**

Large trees: trees with height greater than 9m.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Cornus `Eddie's White Wonder'*<br>Eddie's Dogwood | COEW | | 10<br>6 | rounded<br>umbrella<br>vase | white | red | m | A | N/A | Benefits:<br>Notes: prefers part shade; best in well-drained, acidic soils high in organic matter |
| *Davidia involucrata*<br>Dove Tree | DAIN | | 18<br>10 | oval | white | gold | s - m | A | none commonly available | Benefits:<br>Notes: prefers sun to part shade (esp. afternoon); prefers well-drained rich soil; protect from wind; exceptionally showy and unusual flower display; may take a decade or more to reach flowering size |
| *Fraxinus americana*<br>*White* Ash | FRAM | | 12<br>7.5 | oval | inconspicuous | gold<br>orange<br>purple | f | A - L | Autumn Applause | Benefits: quite soil adaptable; easily transplanted and established; tolerant of poorly drained soils<br>Notes: |
| *Fraxinus latifolia**<br>Oregon Ash | FRLA | | 18<br>12 | oval | inconspicuous | yellow<br>brown | m - f | L | none commonly available | Benefits: survives standing water in winter months; when established, need not be watered during the summer<br>Notes: provincially red-listed |
| *Fraxinus oxycarpa*<br>Raywood Ash | FROX | | 12<br>7.5 | oval<br>rounded | inconspicuous | red purple | m | A | Raywood | Benefits:<br>Notes: somewhat drought tolerant |
| *Gleditsia triacanthos inermis `Shademaster'*<br>Shademaster Locust | GLTR | | 18<br>13 | umbrella | greenish yellow | yellow<br>brown | m | 0 | N/A | Benefits: good drought tolerance<br>Notes: |
| *Gymnocladus dioicus*<br>Kentucky Coffeetree | GYDI | | 18<br>12 | oval | inconspicuous | gold | m - f | A | none commonly available | Benefits: drought and pollution tolerant<br>Notes: |
| *Lirodendron tulipifera*<br>Tulip Tree | LRTU | | 24<br>13 | oval | yellow orange | bronze<br>gold | f | L | Fastigiatum | Benefits: tolerates urban conditions<br>Notes: moderate biogenic emissions; intolerant of hot, dry sites |
| *Magnolia grandiflora*<br>Southern Magnolia | MAGR | | 15<br>7 | oval<br>rounded<br>umbrella | white | no<br>change | m | L | Edith Bogue, Victoria | Benefits:<br>Notes: moderate biogenic emissions; prefers rich, well-drained soil; somewhat drought tolerant; can not tolerate soil compaction |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 1: No Prominent Constraints**

Large trees: trees with height greater than 9m.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Nothofagus antarctica*<br>Antarctic Beech | NOAN | | 30<br>25 | pyramidal | inconspicuous | bronze<br>gold | f | A | none commonly available | Benefits: tolerates drought once established<br>Notes: |
| *Nyssa sylvatica*<br>Tupelo | NYSY | | 25<br>20 | pyramidal<br>oval | inconspicuous | red<br>orange | s - m | L | none commonly available | Benefits: fire resistant<br>Notes: prefers moist, well-drained, acidic, deep soils |
| *Oxydendron arboreum*<br>Sourwood | OXAR | | 10<br>4 | oval | cream white | red<br>orange | s | A | none commonly available | Benefits:<br>Notes: more sun translates into better fall color and more bloom; avoid polluted, urban locations |
| *Paulownia tomentosa*<br>Empress Tree | PUTO | | 15<br>12 | oval<br>rounded | purple | bronze<br>gold | f | S - A | none commonly available | Benefits: drought tolerant; salt tolerant;<br>Notes: prefers wet, deep, well-drained soils |
| *Picea engelmannii**<br>Engleman Spruce | PIEN | ✔ | 15<br>6 | pyramidal | inconspicuous | no<br>change | m | L | none commonly available | Benefits:<br>Notes: high biogenic emissions; best in well-drained, loamy, organic soils |
| *Picea omorika*<br>Serbian Spruce | PIOM | ✔ | 18<br>7 | columnar<br>pyramidal | inconspicuous | no<br>change | s - m | L | Pendula | Benefits: pH adaptable; tolerates pollution<br>Notes: |
| *Pinus contorta**<br>Shore Pine | PNCO | ✔ | 12<br>6 | pyramidal | inconspicuous | no<br>change | f | L | Contorta, Latifolia | Benefits: grows in a wide variety of soil conditions<br>Notes: moderate biogenic emissions; |
| *Pinus nigra*<br>*European* Pine | PNNI | ✔ | 20<br>12 | pyramidal | inconspicuous | no<br>change | s-m | L | | Benefits:<br>Notes: |
| *Pinus ponderosa**<br>Ponderosa Pine | PNPO | ✔ | 25<br>9 | pyramidal | inconspicuous | no<br>change | m - f | L | none commonly available | Benefits: drought tolerant; salt tolerant<br>Notes: moderate biogenic emissions; |
| *Platunus x acerifolia*<br>*London* Planetree | PLAC | | 15<br>12 | oval<br>rounded<br>umbrella | inconspicuous | bronze<br>gold | f | L | Bloodgood, Yarwood, Liberty Island | Benefits: easily transplanted; pollution tolerant; good for difficult growing sites<br>Notes: high biogenic emissions; best in deep, moist, fertile soil, but very adaptable |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 1: No Prominent Constraints**

Large trees: trees with height greater than 9m.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Pseudotsuga menziesii**<br>Douglas Fir | PSME | ✔ | 25<br>6 | pyramidal | inconspicuous | no change | s | L | Fastigiata, Glauca | Benefits:<br>Notes: moderate biogenic emissions; generally dislikes hot, dry sites |
| *Pyrus calleryana*<br>Ornamental Pear | PYCA | | 15<br>10 | oval rounded | white | red gold purple | m | A | Aristocrat, Respire | Benefits: tolerant of dry and hot conditions; great year round tree (flowers, fall color and unique winter habit )<br>Notes: |
| *Quercus coccinea*<br>Scarlet Oak | QUCO | | 16<br>12 | oval rounded umbrella | inconspicuous | bronze red orange | m - f | L | none commonly available | Benefits:<br>Notes: high biogenic emissions; difficult to transplant; prefers somewhat dry, acidic, sandy soils |
| *Quercus rubra*<br>Red Oak | QURU | | 18<br>16 | oval rounded umbrella | inconspicuous | bronze red orange | m - f | L | Aurea | Benefits:<br>Notes: high biogenic emissions; withstands urban conditions well; grows rapidly for an oak; easily transplanted for an oak |
| *Sequoiadendron giganteum*<br>*Giant Sequoia* | SQGI | ✔ | 20<br>9 | pyamidal | inconspicuous | no change | m | L | | |
| *Sorbus aucuparia*<br>Mountain Ash | SOAU | | 10<br>6 | oval | white | red gold orange | m -f | A | Cardinal Royal | Benefits:<br>Notes: stress predisposes the plant to disease and insect problems |
| *Stewartia pseudocamellia*<br>Japanese Stewartia | SWPS | | 12<br>10 | pyramidal | orange white | bronze red purple | s - m | A | none commonly available | Benefits:<br>Notes: does not establish easily; dislikes intense heat and drought |
| *Taxiodium distichum*<br>Bald Cypress | TADI | ✔ | | pyramidal | inconspicuous | no change | m - f | A - L | none commonly available | Benefits:<br>Notes: tolerant of permanently wet soils, but also tolerant of normal soils as long as they are not excessively dry |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 1: No Prominent Constraints**

Large trees: trees with height greater than 9m.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Thuja plicata**<br>*Western Red Cedar* | THPL | ✔ | | pyramidal | inconspicuous | no change | s | L | none commonly available | Benefits:<br>Notes: low biogenic emissions; generally quite adaptable and tolerant once established; a favorite food of deer |
| *Thuja plicata `Excelsa'*<br>Excelsa Western Red Cedar | THPL | ✔ | 6<br>2 | pyramidal | inconspicuous | bronze | s | 0 | N/A | Benefits:<br>Notes: |
| *Tilia americana*<br>Linden | TIAM | | 10<br>8 | pyramidal<br>oval<br>umbrella | white yellow | gold | m | A | Redmond | Benefits: tolerant of difficult, dry or heavy soils; easily transplanted<br>Notes: attracts bees when in bloom |
| *Tilia cordata*<br>Littleleaf Linden | TICO | | 15<br>10 | pyramidal<br>oval<br>umbrella | white yellow | gold | s - m | A | none commonly available | Benefits: tolerant of difficult growing sites and soils; tolerant of urban conditions; pollution tolerant<br>Notes: attracts bees when in bloom |
| *Tilia euchlora*<br>Crimean Linden | TIEU | | 13<br>9 | oval<br>rounded<br>umbrella | white yellow | gold | s - m | A | none commonly available | Benefits: tolerant of difficult growing sites and soils; tolerates urban conditions; pollution tolerant<br>Notes: attracts bees when in bloom |
| *Tsuga heterophylla*<br>Hemlock | TSHE | ✔ | 15 | pyramidal | inconspicuous | no change | m - f | L | none commonly available | Benefits:<br>Notes: moderate biogenic emissions; best in sun, but can take considerable shade |
| *Ulmus `Homestead'*<br>Homestead Elm | UL | | 18<br>15 | pyramidal<br>oval | inconspicuous | gold | f | 0 | N/A | Benefits:<br>Notes: resistant to Dutch Elm disease |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 2: Narrow Boulevard**

Medium trees: trees with a height greater than 9m and a narrow form.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flowers | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| *Acer campestre*<br>Hedge Maple | ACFR | | 15<br>5 | oval<br>rounded | inconspicuous | red<br>orange | f | A | N/A | Benefits: brilliant, long-lasting fall colour;<br>Notes: tolerates drought and poor soil conditions |
| *Acer nigrum* `Green Column'<br>Green Column Maple | ACNI | | 15<br>6 | columnar | inconspicuous | yellow<br>orange | m | A | N/A | Benefits: good close to buildings; heat and drought tolerant; adapted to poor soil<br>Notes: |
| *Acer platanoides* `Columnar'<br>Columnar Norway Maple | ACPL | | 12<br>4.5 | columnar | green yellow | gold | s | A | N/A | Benefits: easily transplanted; adapted to poor soil conditions<br>Notes: shallow root system |
| Acer platanoides `Crimson Sentry'<br>Crimson Sentry Maple | ACPL | | 13<br>6 | pyramidal | inconspicuous | maroon<br>red<br>bronze | m | A | N/A | Benefits: pollution tolerant; adapted to poor soil conditions<br>Notes: |
| *Acer platanoides* `Parkway'<br>Parkway Maple | ACPL | | 12<br>7.5 | columnar | inconspicuous | gold | m | A | N/A | Benefits: easily transplanted; tolerant of urban conditions for a maple<br>Notes: offers heavy shade |
| *Acer rubrum* `Armstrong'<br>Armstrong Red Maple | ACRU | | 15<br>4 | columnar | red | red | f | A | N/A | Benefits: easy to transplant and establish; tolerant of many conditions and adaptable<br>Notes: develops surface roots |
| *Acer rubrum* `Bowhall'<br>Bowhall Maple | ACRU | | 15<br>4 | pyramidal<br>columnar | red | gold red<br>orange | m - f | A | N/A | Benefits: easily transplanted;<br>Notes: develops surface roots |
| *Acer rubrum* `Karpick'<br>Karpick Maple | ACRU | | 13<br>6 | oval<br>rounded | red | gold red<br>orange | f | A | N/A | Benefits: brilliant fall colour<br>Notes: develops surface roots |
| *Acer rubrum* `Scarsen'<br>Scarlet Sentinel Maple | ACRU | | 12<br>6 | oval<br>columnar | red | gold red<br>orange | m - f | A | N/A | Benefits:<br>Notes: will tolerate a range of soil and climatic conditions including relatively wet sites but prefers moist, acidic soils; develops surface roots |
| *Carpinus betulus* `Fastigiata'<br>Pyramidal European Hornbeam | CABE | | 12<br>8 | pyramidal<br>columnar | inconspicuous | red gold | m | A | N/A | Benefits: drought tolerant; tolerates urban conditions; relatively pest free<br>Notes: |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 2: Narrow Boulevard**

Medium trees: trees with a height greater than 9m and a narrow form.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flowers | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| *Fagus sylvatica* `Dawyck'<br>Fastigiate Beech | FASY | | 20<br>3 | columnar | inconspicuous | bronze | s - m | A - L | N/A | Benefits: tree has winter interest due to its unusual form and persistent fruits<br>Notes: moderately drought tolerant once established; develops surface roots |
| *Fagus sylvatica* `Dawyck Purple'<br>Fastigiate Beech | FASY | | 20<br>3 | columnar | inconspicuous | no change | s - m | A - L | N/A | Benefits:<br>Notes: |
| *Fagus sylvatica* `Dawyck Gold'<br>Fastigiate Beech | FASY | | 20<br>3 | columnar | inconspicuous | gold | s - m | A - L | N/A | Benefits:<br>Notes: |
| *Fraxinus americana* `Autumn Applause'<br>Autumn Applause Ash | FRAM | | 12<br>7.5 | oval | inconspicuous | purple | f | L | N/A | Benefits:<br>Notes: will tolerate partial shade; moderately drought tolerant |
| *Fraxinus oxycarpa* ` Raywood'<br>Raywood Ash | FROX | | 10<br>7.5 | oval rounded | inconspicuous | red purple | m | A | N/A | Benefits: tolerates urban conditions<br>Notes: moderately drought tolerant once established |
| *Ginkgo biloba* `Princeton Sentry'<br>Princeton Sentry Ginkgo | GIBI | | 20<br>5 | columnar | inconspicuous | gold | m - f | L | N/A | Benefits: tolerates a wide range of soils; tolerates urban conditions; beautiful fall color<br>Notes: do not plant females-- fruit smells unpleasant |
| *Liriodendron tulipifera fastigiatum* 'Arnold'<br>Fastigiate Tulip Tree | LRTU | | 20<br>6 | oval columnar | yellow orange | bronze gold | f | L | N/A | Benefits:<br>Notes: |
| *Magnolia* `Galaxy'<br>Galaxy Magnolia | MAGL | | 20<br>6 | pyramidal oval | bright pink | bronze gold | m | A | N/A | Benefits: tolerates a wide range of soils<br>Notes: |
| *Magnolia kobus*<br>*Kobus magnolia* | MAKO | | 9<br>6 | rounded | white pink | no change | s - m | A | Wada's Memory | Benefits: branches resist breakage<br>Notes: |
| *Oxydendron arboreum*<br>*Sourwood* | OXAR | | 20<br>4 | oval | cream white | red orange | s | A | none commonly available | Benefits: relatively pest free<br>Notes: does not tolerate pollution/urban conditions |
| *Prunus sargentii* `Columnarus'<br>Columnar Sargent Cherry | PRSA | | 11<br>4.5 | columnar vase | pink | gold red bronze | s - m | A | N/A | Benefits:<br>Notes: moderately drought tolerant once established |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 2: Narrow Boulevard**

Medium trees: trees with a height greater than 9m and a narrow form.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flowers | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| *Prunus x hillieri* `Spire'<br>Spire Cherry | PRHI | | 15<br>2.5 | vase | pink | yellow red | m | A | N/A | Benefits:<br>Notes: |
| *Pyrus calleryana* `Chanticleer'<br>Flowering Pear | PYCA | | 12<br>5 | pyramidal | white | purple red | m | A | N/A | Benefits:<br>Notes: hardier than species |
| *Quercus robur* ' Fastigiata'<br>Fastigiate English Oak | QURO | | 18<br>8 | columnar<br>pyramidal | inconspicuous | bronze | m | L | N/A | Benefits: tolerates urban conditions<br>Notes: autumn foliage persists throughout winter |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 3: Overhead Lines**



| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| **Low Zone: height 6m or less** | | | | | | | | | | |
| *Acer ginnala*<br>Amur Maple | ACGI | | 6<br>6 | oval | yellow | red gold | s -m | S - A | Flame | Benefits: very hardy; easily transplanted<br>Notes: |
| *Acer palmatum*<br>Japanese Maple | ACPA | | 6<br>6 | rounded<br>umbrella<br>vase | inconspicuous | red gold<br>orange | s -m | A | Atropurpureum, Bloodgood, Butterfly, Crimson Queen, Sango Kaku, Versicolour | Benefits:<br>Notes: single or multi-stemmed; may suffer leaf scorch with excess sun, wind, or drought; moderate biogenic emissions |
| *Acer platanoides globosum*<br>Globe Norway Maple | ACPL | | 4.5<br>5.5 | rounded | inconspicuous | gold | s -m | A | N/A | Benefits: easily transplanted; tolerates a wide range of soils<br>Notes: branches resist breakage; |
| *Corylus americana*<br>Filbert | COAM | | 6<br>6 | rounded<br>umbrella | yellow brown | bronze<br>red | s -m | A | none commonly available | Benefits: relatively pest and disease free<br>Notes: prefers shaded areas; |
| *Fraxinus oxycarpa aureopolia*<br>Golden Desert Ash | FROX | | 6<br>5.5 | rounded | inconspicuous | gold | - | - | N/A | Benefits:<br>Notes: unusual gold coloured bark |
| *Hamamelis x intermedia*<br>Witch Hazel | HMIN | | 5.5<br>5.5 | - | yellow orange<br>red | red gold<br>orange | m | A | Arnold's Promise, Dianne, Jelena | Benefits: relatively disease and pest free<br>Notes: |
| *Holodiscus dicolor**<br>Ocean Spray | HODI | | 1.5 1.5 | rounded<br>umbrella | white cream | gold | f | - | none commonly available | Benefits:<br>Notes: |
| *Magnolia soulangiana*<br>Saucer Magnolia | MASO | | 6<br>6 | rounded<br>umbrella<br>vase | pink purple white | bronze<br>gold | m | A | Susan, Rustica Rubra | Benefits: tolerant of urban conditions<br>Notes: fairly adaptable to a wide range of soils; moderate biogenic emissions |
| *Pinus mugo*<br>Mugo Pine | PNMU | ✔ | 6<br>6 | pyramidal<br>rounded | inconspicuous | no<br>change | s -m | - | Mugo, Tannenbaum | Benefits: easily transplanted;<br>Notes: tolerates some shade; |
| *Sambucus racemosa**<br>Red-berry Elder | SMRA | | 6<br>6 | - | white cream | 0 | f | - | - | Benefits: transplants easily<br>Notes: multi-stemmed; |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

## Constraint Class 3: Overhead Lines

Small trees.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| **Medium Zone: less than 12m height** | | | | | | | | | | |
| *Acer truncatum x* \`Warrenred'<br>Pacific Sunset Maple | ACTR | | 9<br>7.5 | rounded<br>pyramidal | inconspicuous | red yellow<br>orange | m | A | N/A | Benefits: pest resistant; drought tolerant once established<br>Notes: best in full sun but will tolerate partly shady sites; |
| *Acer buergeranum*<br>Trident Maple | ACBU | | 9<br>9 | oval<br>rounded | yellow | red gold | f | A | none commonly available | Benefits: tolerates wind, salt, drought, air pollution, and soil compaction; does not develop leaf scorch during drought<br>Notes: |
| *Acer campestre*<br>Hedge Maple | ACCA | | 9<br>9 | rounded | green | gold | s | S - A | See below | Benefits: easy to transplant<br>Notes: will tolerate drought; shallow root system; |
| *Acer campestre* \`Queen Elizabeth'<br>Queen Elizabeth Maple | ACCA | | 9<br>9 | upright | inconspicuous | gold | s | S - A | N/A | Benefits: tolerant of dry soils, compaction and air pollution<br>Notes: |
| *Acer circinatum**<br>Vine Maple | ACCI | | 9<br>6 | rounded<br>vase | inconspicuous | red gold | m | S - A | none commonly available | Benefits:<br>Notes: prefers fairly fertile moist soils, but will tolerate a wide variety of soils; |
| *Acer glabrum*<br>Douglas Maple | ACGL | | 9<br>6 | oval<br>rounded | green yellow | gold | m | S | none commonly available | Benefits:<br>Notes: |
| *Acer griseum*<br>Paperbark Maple | ACGR | | 7.5<br>7.5 | oval<br>rounded | inconspicuous | red | s -m | S - A | none commonly available | Benefits:<br>Notes: outstanding fall colour; offers dappled shade; does not tolerate drought; |
| *Acer japonicum* \`Aconitifolium'<br>Fernleaf Fullmoon Maple | ACJA | | 7.5<br>7.5 | vase<br>rounded | red | red | s -m | S - A | N/A | Benefits: good fall colour<br>Notes: branches resist breakage; |
| *Cercidiphyllum japonicum* \`Pendula'<br>Weeping Katsura Tree | CEJA | | 8<br>7 | rounded | inconspicuous | gold red | f | A | N/A | Benefits:<br>Notes: shallow root system; relatively pest free; |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 3: Overhead Lines** Small trees.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Cercis canadensis*<br>*Eastern* Redbud | CECA | | 9<br>7.5 | rounded<br>umbrella | pink rose | gold | f | S - A | See below | Benefits: drought tolerant<br>Notes: in urban landscapes, tends to be shorter lived due to a combination of urban stresses, diseases, and pests; less adapted to drought than species |
| *Cercis canadensis* `Alba'<br>White Redbud | CECA | | 9<br>7.5 | rounded<br>umbrella | white | gold | m | S - A | N/A | Benefits: drought tolerant<br>Notes: in urban landscapes, tends to be shorter lived due to a combination of urban stresses, diseases, and pests; less adapted to drought than species |
| *Cercis canadensis* `Forest Pansy'<br>Forest Pansy Redbud | CECA | | 6.5<br>7.5 | rounded<br>umbrella | purple red | bronze<br>purple | m | S - A | N/A | Benefits:<br>Notes: in urban landscapes, tends to be shorter lived due to a combination of urban stresses, diseases, and pests; less adapted to drought than species; |
| *Cercis canadensis ssp. texensis*<br>`Oklahoma'<br>Oklahoma Redbud | CECA | | 7.5<br>7.5 | vase<br>rounded | pink | gold | f | S - A | N/A | Benefits:<br>Notes: habit is more dense and compact than the species; |
| *Chamaecyparis pisifera* `Filifera'<br>Cypress | CHPI | | 9<br>6 | pyramidal | inconspicuous | no<br>change | s -m | L | N/A | Benefits:<br>Notes: does not do well in alkaline soil; |
| *Cornus florida*<br>*Flowering Dogwood* | COFL | | 9<br>7.5 | umbrella | white pink rose<br>yellow | red | m | A | Cherokee Chief, Rubra | Benefits: has four season appeal (flowers, fruits, fall, color, bark) and branching character<br>Notes: not tolerant of stresses such as heat, drought, pollution, road salt; |
| *Cornus kousa* `Chinensis'<br>Chinese Dogwood | COKO | | 9<br>7.5 | umbrella<br>vase | cream white | red gold | m | A | N/A | Benefits: relatively drought tolerant; four season appeal<br>Notes: low biogenic emissions |
| *Cornus kousa* `National' or `Satomi'<br>Kousa Dogwood | COKO | | 9<br>7.5 | umbrella<br>vase | pink | red gold | m | A | N/A | Benefits:<br>Notes: |

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Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 3: Overhead Lines** Small trees.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Cornus mas*<br>Cornelian Cherry | COMA | | 7.5<br>6 | rounded umbrella | yellow | red gold | m | A | Spring Glow | Benefits: relatively easy to transplant; pest resistant<br>Notes: |
| *Crataegus columbiana**<br>Hawthorn | CRCO | | 9<br>9 | rounded | white | red orange | s | - | none commonly available | Benefits: drought tolerant; pollution tolerant<br>Notes: armored; |
| *Crataegus phaenopyrum*<br>Washington Hawthorn | CRPH | | 9<br>9 | rounded umbrella | white | red orange | m | - | none commonly available | Benefits:<br>Notes: armored; multi-stemmed; |
| *Crataegus x lavallei*<br>Lavalle Hawthorn | CRLA | | 9<br>7.5 | oval | white | red orange | m | A | none commonly available | Benefits:<br>Notes: armored; |
| *Fraxinus ornus*<br>Flowering Ash | FROR | | 9<br>9 | rounded | green white | gold purple | f | A | none commonly available | Benefits: easily transplanted and established; tolerant of poorly-drained soils<br>Notes: male plants preferred for landscape settings (less fruit than female) |
| *Halesia carolina*<br>Carolina Silverbell | HACA | | 9<br>6 | oval | white | gold | m | A | none commonly available | Benefits: relatively disease and pest free<br>Notes: prefers a moist, well-drained, acid soil; |
| *Koelreuteria paniculata*<br>Goldenrain Tree | KOPA | | 9<br>9 | rounded umbrella | yellow | bronze gold | s - m | A | none commonly available | Benefits: drought and smog tolerant<br>Notes: |
| *Magnolia* `Galaxy'<br>Galaxy Magnolia | MAGA | | 7.5<br>7.5 | oval rounded vase | purple red | bronze gold | m | A | N/A | Benefits: relatively disease and pest free<br>Notes: |
| *Magnolia grandiflora*<br>Magnolia | MAGR | | 7.5<br>6 | oval rounded umbrella | white | no change | m | L | Edith Bogue, Little Gem, Victoria | Benefits: moderately drought tolerant; tolerates a variety of soils<br>Notes: difficult to transplant; evergreen; moderate biogenic emissions |
| *Malus*<br>Flowering Crabapple | ML | | 7.5<br>6 | - | - | - | - | - | - | Benefits:<br>Notes: |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 3: Overhead Lines** Small trees.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Parrotia persica*<br>Ironwood | PAPE | | 9<br>9 | oval | red | orange<br>red gold | s - m | A | Ruby Vase | Benefits: drought tolerant; tolerates urban conditions<br>Notes: |
| *Prunus x yedoensis* `Akebono'<br>Akebono Cherry | PRYE | | 7.5<br>7.5 | rounded<br>umbrella<br>vase | pink | bronze<br>gold | m - f | S - A | N/A | Benefits: four season appeal;<br>Notes: drought sensitive; crown will become one-sided if it does not receive light all around the plant; |
| *Prunus blireiana*<br>Flowering Plum | PRBL | | 7.5<br>6 | rounded<br>umbrella<br>vase | pink rose | bronze | m | S - A | none commonly available | Benefits:<br>Notes: trunk develops warts and burls; |
| *Prunus virginiana `Shubert'*<br>Shubert Choke Cherry | PRVI | | 7<br>6.5 | oval<br>rounded<br>umbrella | white | bronze | m | S | N/A | Benefits:<br>Notes: red foliage summer foliage; |
| *Pyrus calleryana*<br>Pear | PYCA | | 9<br>6 | oval<br>rounded | white | red gold<br>purple | m | A | Cleveland Select, Capital, Autumn Blaze | Benefits: adaptable to many different soils; tolerates drying and pollution<br>Notes: |
| *Robinia pseudoacacia* `Purple Robe'<br>Purple Robe Black Locust | ROPS | | 9<br>9 | oval | lavender | gold | f | A | standard size varieties | Benefits: salt tolerant<br>Notes: armored; |
| *Sorbus americana*<br>American Mountain Ash | SOAM | | 7.5<br>6 | rounded | white | red gold | s | S | See below | Benefits:<br>Notes: fruit attracts birds; |
| *Sorbus aucuparia* `Michred'<br>Cardinal Royal Mt. Ash | SOAU | | 9<br>6 | oval | white | gold<br>orange | m - f | A | N/A | Benefits:<br>Notes: |
| *Stewartia pseudocamellia*<br>Japanese Stewartia | SWPS | | 9<br>9 | pyramidal | orange white | bronze<br>red purple | s - m | A | none commonly available | Benefits: four season interest; relatively pest and disease free<br>Notes: does not establish easily; |
| *Stewartia sinensis*<br>Chinsese Stewartia | SWSI | | 7.5<br>7.5 | - | white | red | s | - | none commonly available | Benefits:<br>Notes: |
| *Styrax japonicus*<br>Japanese Snowbell | STJA | | 9<br>9 | rounded<br>umbrella | white | red gold | s - m | S - A | Pink Chimes | Benefits:<br>Notes: flowers attract bees; tolerates some shade; |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 3: Overhead Lines**

Small trees.

| Botanical Name<br>Common Name | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Syringa reticulata*<br>Japanese Tree Lilac | SYRE | | 9<br>7.5 | oval<br>rounded | white | bronze<br>gold | m | A | Ivory Silk | Benefits:<br>Notes: somewhat drought tolerant; |
| *Tilia cordata `De Groot'*<br>Linden | TICO | | 9<br>6 | - | yellow | gold | s - m | - | N/A | Benefits: drought resistant; tolerates urban conditions<br>Notes: suckers less than other t. cordata; |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 4; Overhead Lines and a Narrow Boulevard**

Small trees with a narrow form.

| Tree Species | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| **Low Zone: height 6m or less, maximum spread of 5m** | | | | | | | | | | |
| *Acer tataricum `Pattern Perfect'*<br>Pattern Perfect Tatarian Maple | ACTA | | 6<br>4.5 | oval | inconspicuous | red orange | m - f | A | N/A | Benefits: drought tolerant<br>Notes: does best in well drained soils |
| *Amelanchier alnifloia**<br>Saskatoon | AMAL | | 5<br>5 | oval rounded | white | red gold | m | S - A | none commonly available | Benefits: does well in dry sites<br>Notes: low biogenic emissions; |
| *Cotinus coggygria*<br>Smoke Tree | CCOG | | 4.5<br>4 | rounded | lavender purple | red gold orange | m | S - A | Daydream, Royal Purple | Benefits: tolerant of poor soils; easily transplanted and established<br>Notes: |
| *Fraxinus excelsior Globosum*<br>Globe-headed European Ash | FREX | | 6<br>4.5 | rounded | green purple | gold | a | A - L | N/A | Benefits:<br>Notes: |
| *Arbutus `Marina'*<br>Marina Madrone | ARMA | | 7.5<br>4.5 | rounded umbrella vase | pink rose | no change | s - m | A | N/A | Benefits: drought tolerant once established<br>Notes: |
| *Juniperus communis*<br>Common Juniper | JNCO | | 4.5<br>2 | arching | inconspicuous | no change | s | 0 | Stricta | Benefits: easily transplanted; grows in poor site conditions; once established, requires little maintenance<br>Notes: shrubby |
| *Magnolia stellata*<br>Star Magnolia | MAST | | 3.5<br>3.5 | rounded umbrella vase | white | bronze gold | s | A | Acclaim, Royal Star, | Benefits:<br>Notes: usually multi-stemmed; performs best in partial sun in moist, acidic, deep soils but is quite adaptable to a wide range of soils, soil pHs, pollution, and even wet soils |
| *Prunus serrulata* `Amanogawa'<br>*Amanogawa Cherry* | PRSE | | 6<br>2 | columnar | pink | bronze red | m | 0 | N/A | Benefits:<br>Notes: prefers well drained soil |
| *Rhododendron spp.*<br>Rhododendron | RD | | 2<br>2 | 0 | 0 | 0 | 0 | 0 | 0 | Benefits:<br>Notes: |
| *Viburnum opulus*<br>Snowball Tree | VIOP | | 3<br>4.5 | rounded | white | red purple | m | 0 | Roseum | Benefits: easily transplanted and established; adaptable to extremes of soil and pH<br>Notes: |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 4; Overhead Lines and a Narrow Boulevard**

Small trees with a narrow form.

| Tree Species | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| **Medium Zone: height less than 12m, maximum spread of 5m** | | | | | | | | | | |
| *Fagus sylvatica `Purple Fountain'*<br>Purple Fountain Beech | FASY | | 7.5<br>4 | weeping | inconspicuous | bronze | s - m | A | N/A | Benefits: tolerates urban conditions; drought tolerant<br>Notes: prefers moist, well-drained, acidic soil; does not like excessively wet soils |
| *Prunus cerasifera* `Atropurpurea'<br>Pissard Plum | PRCE | | 9<br>4.5 | oval vase | white | bronze | m - f | S - A | N/A | Benefits:<br>Notes: fruit litter; maintains purple foliage all season |
| *Prunus x hillieri `Spire'*<br>Spire Cherry | PRHI | | 9<br>3 | columnar | pink | red | m | 0 | N/A | Benefits:<br>Notes: copper coloured summer foliage |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 5: Planting in Pavement**

Avoid trees with large surface roots, dense canopies and trees that can litter the pavement.

| Tree Species | Code | Conifer | Height (m)<br>Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Acer campestre*<br>Hedge Maple | ACCA | | 9<br>9 | rounded | green | gold | s | S - A | Queen Elizabeth | Benefits: hardy; easy to transplant<br>Notes: will tolerate drought; shallow root system; |
| *Acer cappadocicum*<br>*Coliseum* Maple | ACCP | | 10<br>9 | rounded spreading | inconspicuous | yellow gold | f | A | | Benefits:<br>Notes: bright red spring growth |
| *Acer ginnala*<br>Amur Maple | ACGI | | 6<br>6 | oval | yellow | red gold | s - m | S - A | Flame | Benefits: very hardy; easily transplanted<br>Notes: |
| *Acer platanoides* `Crimson King'<br>Crimson King Maple | ACPL | | 18<br>15 | rounded | inconspicuous | brown purple | m | A | N/A | Benefits: dense shade; high large canopy; adapted to poor soil; heat and drought-tolerant<br>Notes: surface-rooted; maroon leaf colour; may seed itself |
| *Acer pseudoplatanus*<br>Sycamore Maple | ACPS | | 18<br>15 | oval rounded | inconspicuous | no change | m | A | Spaethii | Benefits: easily transplanted and established; very adaptable; tolerates salt and seaside locations; tolerates high pH, calcareous soils<br>Notes: full sun best, can take light shade; prefers cool environment |
| *Carpinus betulus*<br>Hornbeam | CABE | | 12<br>12 | pyramidal | inconspicuous | red gold | s - m | A | Fastigiata, Franz Fointaine | Benefits: very soil adaptable as long as the soil is well-drained; can tolerate urban conditions and pollution<br>Notes: |
| *Cercidiphyllum japonicum*<br>Katsuratree | CEJA | | 40<br>40 | oval rounded umbrella | inconspicuous | red gold | s | A | Pendula | Benefits: pH adaptable<br>Notes: not easy to transplant; requires water during establishment and dry periods |
| *Fraxinus oxycarpa*<br>Ash | FROX | | 12<br>7.5 | oval rounded | inconspicuous | red purple | m | A | See below | Benefits: tolerates urban conditions<br>Notes: somewhat drought tolerant |
| *Fraxinus oxycarpa* `Raywood'<br>Raywood Ash | FROX | | 10<br>7.5 | oval rounded | inconspicuous | red purple | m | A | N/A | Benefits: tolerates urban conditions<br>Notes: moderately drought tolerant once established |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 5: Planting in Pavement**

Avoid trees with large surface roots, dense canopies and trees that can litter the pavement.

| Tree Species | Code | Conifer | Height (m) Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Fraxinus pennsylvanica*<br>Green Ash | FRPE | | 18<br>12 | oval | inconspicuous | gold | m | L | Marshall, Summit | Benefits: easily transplanted and established<br>Notes: low biogenic emissions; |
| *Ginkgo biloba*<br>Maidenhair Tree | GIBI | | 25<br>15 | pyramidal | inconspicuous | bright yellow | m | L | Magyar, Fairmount, Sentry | Benefits: adaptable to pH and almost any other conditions; tolerant of pollution, salt air, and heat; pest free<br>Notes: do not plant females-- fruit smells unpleasant |
| *Gleditsia tricanthos inermis*<br>Thornless Honey Locust | GLTR | | 18<br>15 | oval umbrella | inconspicuous | gold | f | A - L | Shademaster, Skyline, Sunburst | Benefits: tolerates pollution and heat<br>Notes: dappled shade |
| *Juniperus chinensis*<br>Chinese Juniper | JNCH | ✔ | 15<br>6 | pyramidal | inconspicuous | no change | s - m | S - A | Blue Point, Old Gold, Pfitzeriana | Benefits: drought tolerant<br>Notes: |
| *Koelreuteria paniculata*<br>Goldenrain Tree | KOPA | | 10<br>10 | rounded umbrella vas | yellow | bronze gold | s - m | A | none commonly available | Benefits: drought tolerant; pollution tolerant<br>Notes: high biogenic emissions; |
| *Lirodendron tulipifera*<br>Tulip Tree | LRTU | | 24<br>13 | oval | yellow orange | bronze gold | f | L | Fastigiatum | Benefits: tolerates urban conditions<br>Notes: moderate biogenic emissions; intolerant of hot, dry sites |
| *Nyssa sylvatica*<br>Tupelo | NYSY | | 25<br>20 | pyramidal oval | inconspicuous | red orange | s - m | L | none commonly available | Benefits: fire resistant<br>Notes: prefers moist, well-drained, acidic deep soils |
| *Parrotia persica*<br>Ironwood | PAPE | | 9<br>9 | oval | red | orange red gold | s - m | A | Ruby Vase | Benefits: drought tolerant; tolerates urban conditions<br>Notes: |
| *Prunus sp.*<br>Cherry / Plum | PR | | | 0 | 0 | 0 | 0 | 0 | | Benefits:<br>Notes: |
| Quercus acutissima<br>Sawtooth Oak | QUAC | | 13<br>12 | rounded | golden male catkins | golden yellow | m-f | L | | Benefits: tolerant of drought and compacted soils, attacts wildlife<br>Notes: adaptable, clean foliage, easy to tranplant |
| *Quercus coccinea*<br>Scarlet Oak | QUCO | | 23<br>14 | oval rounded umbrella | inconspicuous | bronze red orange | m - f | L | none commonly available | Benefits:<br>Notes: high biogenic emissions; difficult to transplant; |

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Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

**Constraint Class 5: Planting in Pavement**

Avoid trees with large surface roots, dense canopies and trees that can litter the pavement.

| Tree Species | Code | Conifer | Height (m) Spread (m) | Tree Form | Flower Colour | Fall Colour | Growth Rate | Longevity | Suggested Varieties | Benefits and Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| *Quercus phellos*<br>Willow Oak | QUPH | | 20<br>12 | rounded | inconspicuous | yellow<br>brown | m-f | L | | Benefits: adaptable<br>Notes: high biogenic emissions; tolerates heat, drought, pollution, compacted soils, and standing water |
| *Quercus robur*<br>English Oak | QURO | | 15<br>15 | oval<br>rounded<br>umbrella | inconspicuous | bronze<br>gold | f | L | Fastigiata | Benefits:<br>Notes: high biogenic emissions; prefers moist, fertile, well drained soils |
| *Robinia pseudoacacia*<br>Black Locust | ROPS | | 15<br>10 | oval | white | gold | f | A | Frisia, Purple Robe | Benefits: easily transplanted; tolerates salt, heat, pollution<br>Notes: high biogenic emissions; |
| *Stewartia psuedocamelia*<br>Japanese Stewartia | SWPS | | 9<br>9 | pyramidal | orange white | bronze<br>red purple | s - m | A | none commonly available | Benefits: four season interest; relatively pest and disease free<br>Notes: does not establish easily; |
| *Tilia cordata*<br>Littleleaf Linden | TICO | | 15<br>10 | pyramidal<br>oval<br>umbrella | white yellow | gold | s - m | A | none commonly available | Benefits: tolerant of difficult growing sites and soils; tolerant of urban conditions; pollution tolerant<br>Notes: attracts bees when in bloom |
| *Tilia tomentosa*<br>*S* ilver Linden | TITO | | 18<br>12 | oval | yellow | yellow | f | A | | Benefits: attactive to insects and birds<br>Notes: tolerates range of soils, wind, salt, and pollution |
| *Zelkova serrata*<br>Japanese Zelkova | ZESE | | 25<br>18 | rounded<br>umbrella | inconspicuous | bronze<br>red gold | m - f | A | Green Vase, Village Green | Benefits: easy to transplant and establish<br>Notes: low biogenic emissions; shows fairly good resistance to Dutch Elm Disease and bacterial canker, but not immune |

Growth Rate: s=slow, m=medium, f=fast
Longevity: S=short, 40 to 60 years, A=average 50-150 years, L=long, 100-175 years
* Denotes native species
N/A - Not Applicable

# 5. Implementation and Maintenance Strategy

## 5.1 Tree Population Target

A guiding principle of the CNV's Street Tree Program is to plant more street trees with a target of a fully stocked condition within 50 to 60 years. There are 90,542 lineal metres of public land adjacent to streets that remain unplanted, estimated from the CNV's urban forest inventory (*Opportunities and Constraints,* Map 1). On average, new trees are planted 8 m apart. Therefore, about 11,315 new trees are required to stock unplanted streets (90,542 divided by 8).

The existing tree population of 5415 trees plus new trees yields a total population of 16,730 trees. Plus or minus 15% is factored into the assessment to account for inaccuracies in the City's urban forest inventory and its interpretation. Therefore, the target population to expand the City's forest is between **14,220 and 19,240 trees**.

A planting rate of **200 trees per year** will meet this target population in 55 years (Table 4). After about 55 years, the CNV enters a steady state replacement phase.

**Table 4: Target Tree Population projection** – planting rate of 200 trees/year

| Time span | New trees (cumulative) | Existing trees | Total trees |
|---|---:|---:|---:|
| 5 years | 1000 | 5415 | 6415 |
| 10 years | 2000 | 5415 | 7415 |
| 20 years | 4000 | 5415 | 9415 |
| 30 years | 6000 | 5415 | 11,415 |
| 40 years | 8000 | 5415 | 13,415 |
| 50 years | 10,000 | 5415 | 15,415 |
| 55 years | 11,000 | 5415 | 16,415 |

## 5.2 Planting Location Priorities

Recommendations for the City's directed street tree planting program are outlined in Section 5.2. Planting priorities are:

1. Special Areas: Lower Lonsdale, Central Lonsdale Corridor, Keith Road Boulevard, Marine Drive Corridor.
2. Gateways: at the west side of Marine Drive, east side of Third Street, south side of Lonsdale Quay /Esplanade, and the north side of Lonsdale at Upper Levels. Refer to Map 5: Landscape Character and Street Tree Management Areas for gateway locations.
3. Residential areas in response to residents' applications and other residential planting programs.

## 5.3 Planting Programs

Sources of trees planted to meet an average growth target of 200 trees/year are summarized in Table 5; each planting program is described below.

**Table 5: Planting Programs – projected no. of trees planted**

| Program | #Trees |
|---|---|
| Parks & Environment Division street tree planting program | 50 |
| Other City projects that include landscape development | 35 |
| Planting through private development or redevelopment | 75 |
| Resident/Neighbourhood planting program | 25 |
| Commemorative Trees | 5 |
| Special events to promote tree awareness | 10 |
| **TOTAL TREES PLANTED/YR** | **200** |

### 5.3.1 City-based Planting Initiatives

The Parks and Environment Division of the CNV is responsible for environmental protection and stewardship. The Division's Street Tree Planting Program would be organized to meet its street tree planting targets.

Other City projects that expand the CNV urban forest include:

- renovating or expanding civic facilities that include streetscape/landscape improvements,
- the Greenways Plan which includes the Green Necklace project,
- the City's Naturescape program, and
- park frontages at streets.

These landscape initiatives would be covered by specific project budgets, and would not be part of the Street Tree Planting Program capital budget.

### 5.3.2 Private Development/Redevelopment Projects

Currently there are two approaches to planting street trees that are part of private development projects in the CNV:

1. If the developer agrees, the City plants street trees on behalf of the developer, with the City charging developers a fee to select, plant and maintain street trees. No professional is required for this option. A fee of $400.00 per tree, paid prior to building permit issuance, is currently charged. This fee may be reconsidered from time to time.
2. If the developer has agreed to provide professional landscape architectural design and supervision, the City allows the developer to plant and maintain trees through the maintenance period. In these cases, the City uses a financial security (e.g., performance bond) to encourage success. There is often a significant draw on staff time to supervise this process, including cases where the trees are rejected due to improper planting or lack of maintenance. In these cases, the City does not return the security, and uses it to plant replacement trees or allows the applicant to replant and bonding is extended for another 2 year maintenance period. A bond of $600.00 per tree, paid prior to building permit issuance, is currently required. The security amount may be reconsidered from time to time.

CNV prefers to continue to allow private tree planting for larger projects, but place more onus on the hired professional to ensure the tree species are selected, planted and maintained correctly. In smaller projects, where the developer does not have to hire a professional, the trees shall be planted and maintained by the City at the developer's cost.

### 5.3.3 Resident/Neighbourhood Planting Program

There are many examples of successful planting incentive programs in cities like Ottawa, Calgary, Seattle, and Portland (see the *Municipal Comparisons Chart*, Table 1b). The CNV can support residents who want to contribute to the Urban Forest by setting up a volunteer program for planting trees in public streets. Guidelines for a public Planting Program are:

- Trees are provided free of charge or at cost to community associations, neighbourhood groups or individuals on application to the CNV.
- The planting application requires an acceptable plan (a sketch of where tree(s) would be placed in a boulevard or street allowance relative to houses, driveways, overhead and underground utilities) and a commitment to maintenance.
- Criteria for approving planting application include:
    1. Size of the boulevard or street allowance – is there sufficient space?
    2. Assessment of site limitations – for example overhead wires, underground utilities and driver sight lines. Refer to Section 7.3 “Minimum Tree Planting Clearances” for standard planting setbacks.
    3. Tree Species – tree species to be selected from the *Recommended Street Trees List* in Appendix 5 of this report. The City will choose the right tree based on site characteristics, such as neighbouring trees, species availability, site limitations, and species diversity objectives.
    4. Spacing – maximum number of trees are typically 1-2 trees per lot frontage, with exceptions for large lots, corner lots, or under power lines where several small trees could be planted instead of 1 or 2 large trees.
    5. Tree planting – may be done by the resident(s) with instructions provided, or by the City for a fee (cost of tree and/or labour). Planting instructions, including timing, must be provided; Appendix 6 provides tree-planting details.
    6. Commitment – a “stewardship pledge” to be established to ensure that new trees are maintained by residents (excluding pruning) for 3-5 years. The pledge would be an agreement between the City and resident/property owner that outlines responsibilities and provides instructions for new tree establishment. The agreement could require that the resident or neighbourhood representative attend a training session on tree care; e.g., Seattle offers landscape maintenance classes to neighbourhood groups as well as provides links to local community colleges, horticulture centers and related organizations (Plant Amnesty, International Society of Arboriculture, etc.).

### 5.3.4 Commemorative Tree Program

The current charge for commemorative tree planting and maintenance is $700/tree, which could be reviewed in comparison to regional norms. This fee is a tax-deductible donation. Donors receive a certificate of acknowledgement.

Traditionally, commemorative tree have been planted in parks. The program could be expanded by designating some streets for commemorative purposes. For example, Memorial drive in Calgary is a transportation corridor as well as a living memorial to fallen soldiers of the First World War. The majority of trees were planted in the mid 1920s. Now the historic trees are nearing the end of their life, and Calgary is replanting dedicated street trees to preserve the legacy and future character of the commemorative landscape.

### 5.3.5 Special Event - Arbour Day Program

Arbour Day started in the US in the late 1800s, and was adopted in Canada in the early 1900s as a special day in spring to celebrate the contribution of trees and forests to the Canadian way of life. Usually held during the first week of May, Arbour Day celebrations are focused in schools with tree seedlings and information distributed to children as part of teaching them about the benefits of trees.

To make this celebration an integral component and contribution to a Street Tree program, the following steps are suggested:

- Set a target number of trees (e.g., 10 trees) to be planted in schoolyards or near schools for each year.
- Issue an invitation to all school classes to apply to have one of those trees planted on their neighbouring street or in their schoolyard.
- Trees for planting could be distributed to schools on a first-come basis, based on a need for trees on that street or whether school has already received trees in the previous 3-5 years. The application for trees to plant could also be a contest that is fun – e.g., best drawings of tree, best short essay on why trees are important, best song about trees, a trivia contest, etc.
- Make Arbour Day plantings an event, with a local councilor attending each recipient school. City staff or contractors would prepare the planting sites ahead of time with students planting the tree, under supervision, at the event. School classes would be given information about the tree and its benefits, as well as instructions on watering and care.
- Seedlings could also be provided to school children to plant collectively in designated area at school, or be taken home to plant.

## 5.4 Street Tree Planting (Capital) Budget

Table 6 outlines estimates of costs and potential revenue sources for a Street Tree Planting Program.

***Costs:*** As presented in section 4.3, 35 of the total 200 trees/year are planted by other City landscaping projects, and covered by the budgets of those projects (i.e., not part of the Street Trees capital budget).

For the remaining 165 trees, the average cost of supplying and planting a small tree is $150 plus establishment maintenance. Therefore, the total cost for the Street Tree Planting Program is estimated at **$24,750.00** (165 trees x $150).

**Table 6: Street Tree Planting Program – Costs and Potential Revenues**

| Program | #Trees | Potential Revenue | Cost |
|---|---|---|---|
| Parks & Environment Division street tree planting program (new) | 50 | 0 | $7,500 |
| Other City projects that include landscape development | 35 | N/A | N/A |
| Planting through private development or redevelopment<br>- revenue from fee of $400/tree if planted and established by City | 75 | $30,000 | $11,250 |
| Resident/Neighbourhood planting program (new)<br>- assume ½ of trees (12) planted by City at request of owners @ $150/tree | 25 | $1,800 | $3,750 |
| Commemorative Trees @ $700/tree | 5 | $3,500 | $750 |
| Special events to promote tree awareness (new) | 10 | 0 | $1,500 |
| **TOTAL TREES PLANTED/YR** | **200** | **$35,300** | **$24,750** |

***Potential revenues:*** Assuming a charge of $400/tree and an average planting rate of 75 trees/year, street tree planting by the City as part of private development or redevelopment on its own would cover, with a surplus, the budget for Street Tree Planting. However, current practice in development approvals leads to many developers installing trees themselves, so that revenue would be foregone. If current practice continues, the City could:

- Build/augment a street tree planting/replacement item into its annual budget to cover shortfalls; and/or

- seek a corporate partner to assist in sponsoring tree planting in the City; e.g., BC Hydro's Community Greening program. Examples of corporate tree planting programs elsewhere include: Seattle–City Lights sponsors plantings to replace inappropriate trees under power lines; Calgary's Forever Green Program is co-sponsored by BP Canada, Golden Acre Garden Sentres, Calgary Health Region, and CPR (Table 1b).

## 5.5 Street Tree Maintenance Program

### 5.5.1 Component Activities

Recommended CNV street tree maintenance activities are as follows:

- Structural pruning of all street trees on a **7-year cycle.** This reflects current practice in the City of Vancouver in residential areas and in Portland, Oregon (see Appendix 4).
- Inspection and inventory maintenance – documenting the status of each tree when it is pruned, and entering that data to update the City's urban forest database.
- Replacement of hazardous, diseased or poorly located trees; average 1% of trees/year.
- Watering newly planted trees once a week for at least three years.
- Other activities associated with the upkeep of street trees on commercial streets - e.g., leaf removal, tree well/grate maintenance, fertilizing, and irrigation repair.

### 5.5.2 Staffing

Existing staff complement and recommended staffing to realize the planting and maintenance program includes:

1. The past compliment for the arboriculture crew is 2 persons including a field arborist and a tree worker. In this structure, when the field arborist is tied up with inspections, public and professional office work, the tree worker is left alone and can only carry out a limited number of field tasks that a single person can do safely. In 2004, using temporary funding, parks operations were able to increase the arboriculture crew from 2 persons to 3 persons (for only a 6 month period), adding one labourer to the crew. The 3 person structure has proven to be very effective – allowing the tree worker and labourer to work full time in the field, and freeing up the qualified arborist to work on tree assessments, responding to the public, and performing professional and development-related work. The 3 person crew reduced the City's response time to normal tree-related complaints from approximately 7 weeks to approximately 1 week. The crew was also able to do pro-active structural pruning, which will lead to reduced future problems and complaints.
2. In 2005 it is proposed that the arboriculture crew should have a compliment of 3 full-time staff. This would include the two existing positions of field arborist and tree worker, and add one position of labourer to support the tree worker.
3. The additional position would allow the 3 person crew to plant and maintain street trees as outlined in this Master Plan, including new work as follows:
   - oversee contracted work; watering, pruning and inspection/inventory (see below),
   - maintain street tree inventory,
   - conduct tree replacements,
   - conduct or oversee plantings on development/redevelopment sites, and
   - respond to site-specific complaints and requests.
4. A Part Time Coordinator – also proposed is the addition of a new staff position to cover public involvement programs, and to assist the City Arborist and field staff. This position could be part-time, or a shared position with the Environment and Parks division to coordinate both street tree projects and park-related public involvement programs such as park stewardship events, traffic circle garden volunteers, partnerships with NGOs etc.

### 5.5.3 Contractual Arrangements

The City may choose to contract-out some street tree maintenance activities such as watering, pruning, inspection and inventory. Contractual arrangements may be pursued because of opportunities to share tree maintenance budgets, equipment and expertise, and seasonal maintenance demands. Contractual options include:

- the City contracts directly with landscaping firms and/or,
- the City contracts in association with BC Hydro, to coordinate/cost-share on tree pruning for powerline protection and pruning for structural integrity.

Tree pruning personnel must be International Society of Arborists (ISA) Certified arborists; if contracted with BC Hydro, they must also be Utility Certified. A question with this arrangement is quality-control of the contracted services for tree pruning that is not related to utilities.

## 5.6 Street Tree Maintenance (Operating) Budget

Table 4 provides a projected street tree maintenance budget for 5 years. The budget accounts for pruning on a 7-year cycle, and that tree inspection and inventory maintenance would be done when the trees are pruned. Other activities included in the budget are watering for tree establishment, miscellaneous upkeep of trees on commercial streets, and replacement of hazardous and unhealthy trees. The budget provides for an additional field staff person and a ½ time coordinator. It is assumed that 1/3 of the City Arborist's time is available to spend on the street trees program, and that this time is cover under another existing budget. As well, there are funds allocated for an education program, with an emphasis on the first nine years of the program. In sum, the projected street tree maintenance budget for **2005 is $181,605, and grows to $192,519 at the end of 2009.**

The budgets provide straight-line projections ahead for 20 years, with an budget estimate of $228,448 by 2025. However, these longer range figures have neither an allowance for inflation, or an allowance for efficiencies created by economy of scale in staff resources. These budgets should be reassessed and the program re-evaluated at the end of a five year budget period.

**Table 4: Operations Budget Estimate (NEW Funds)- 20 years**

Assumes 1/3 of City Arborist time is covered under existing budget.

| Year | # Trees | Pruning, inspection, inventory - 1/7 trees/year @$85* | Watering + 1% tree replacement @$150 | Field staffperson | Coordinator part time | Education/ Information program | TOTAL NEW BUDGET EST. |
|---|---|---|---|---|---|---|---|
| 2005 | 5615 | $68,182 | $18,423 | $55,000 | $30,000 | $10,000 | $181,605 |
| 2006 | 5815 | $70,611 | $18,723 | $55,000 | $30,000 | $20,000 | $194,333 |
| 2007 | 6015 | $73,039 | $19,023 | $55,000 | $30,000 | $20,000 | $197,062 |
| 2008 | 6215 | $75,468 | $19,323 | $55,000 | $30,000 | $20,000 | $199,790 |
| 2009 | 6415 | $77,896 | $19,623 | $55,000 | $30,000 | $10,000 | $192,519 |
| 2010 | 6615 | $80,325 | $19,923 | $55,000 | $30,000 | $10,000 | $195,248 |
| 2011 | 6815 | $82,754 | $20,223 | $55,000 | $30,000 | $10,000 | $197,976 |
| 2012 | 7015 | $85,182 | $20,523 | $55,000 | $30,000 | $10,000 | $200,705 |
| 2014 | 7215 | $87,611 | $20,823 | $55,000 | $30,000 | $10,000 | $203,433 |
| 2015 | 7415 | $90,039 | $21,123 | $55,000 | $30,000 | $5,000 | $201,162 |
| 2016 | 7615 | $92,468 | $21,423 | $55,000 | $30,000 | $5,000 | $203,890 |
| 2017 | 7815 | $94,896 | $21,723 | $55,000 | $30,000 | $5,000 | $206,619 |
| 2018 | 8015 | $97,325 | $22,023 | $55,000 | $30,000 | $5,000 | $209,348 |
| 2019 | 8215 | $99,754 | $22,323 | $55,000 | $30,000 | $5,000 | $212,076 |
| 2020 | 8415 | $102,182 | $22,623 | $55,000 | $30,000 | $5,000 | $214,805 |
| 2021 | 8615 | $104,611 | $22,923 | $55,000 | $30,000 | $5,000 | $217,533 |
| 2022 | 8815 | $107,039 | $23,223 | $55,000 | $30,000 | $5,000 | $220,262 |
| 2023 | 9015 | $109,468 | $23,523 | $55,000 | $30,000 | $5,000 | $222,990 |
| 2024 | 9215 | $111,896 | $23,823 | $55,000 | $30,000 | $5,000 | $225,719 |
| 2025 | 9415 | $114,325 | $24,123 | $55,000 | $30,000 | $5,000 | $228,448 |

***Allowances in the Shaded Area are to be re-assessed based on a program evaluation at the end of the first five year period.***

* Ballpark estimate: Contractual arrangements for tree maintenance are typically established on a “set price” or lump-sum basis to cover pruning over a certain area and timeframe. Some specialty work is contracted on an hourly basis. Typical rate is $100-140/hour. The $85/tree estimate assumes structurally pruning a typical (“Morgan”) tree in ½ hour = $70/tree + $15 to do inspection and inventory entry. (Based on information from Rod Crothers, Vegetation Management Coordinator, BC Hydro).

# 6. Tree Protection

## 6.1 City Bylaws and Policies for Public Trees

Protection of existing trees within the CNV is addressed by the City's bylaws and current policy. The CNV's Parks Regulation Bylaw No. 6611 and Street and Traffic Bylaw No. 6234 regulate the removal and damage of trees in city parks and streets/boulevards respectively.

The City's "Tree Policy for the Management of Trees on City Property", revised in July 2003, also sets out a number of tree conservation measures, including (a copy of this Policy is included in Appendix 7, for reference):

- Requiring the City's permission to "plant, remove, prune or otherwise undertake activity" that may affect the health and welfare of trees on City property.
- Criteria for when tree removal will be considered (hazards, nuisance, visibility, etc.) and when it will not (e.g., views, shade, litter).
- A petition process for applying to the City for the removal of a tree.
- Maintenance priorities and standards – e.g., pruning trees to sustain good health, retain appropriate clearance from structures and private property, maintain stable and aesthetic form, and clear views of street intersections.
- Integrated Pest Management practices used to control insects and pests.
- Tree replacement criteria and planting standards.
- Trees on private property – no City regulations but federal and provincial legislation may apply.
- Retention of on-site trees during development.

## 6.2 Education

Public awareness and understanding is essential to the conservation of CNV's urban forest. Incorporating new part-time Coordinator position and supporting resources are key to establishing an effective public information and education program (see sec. 4.6 Street Tree Maintenance (Operating) Budget - Table 4).

A Coordinator, with the City Arborist's collaboration, will administer the education program and carry out activities such as:

- Compiling and presenting user-friendly information on the value and benefits of trees. See section 3 "The Benefits of Street Trees" for an overview.
- Creating guidebooks/brochures about tree selection, planting, care and maintenance. For example, Seattle Transportation Urban Forestry's Street Tree Planting Guide at http://www.seatle.gov/tranportation/treeplanting.htm/ encourages care for street trees by detailing planting procedures and considerations, providing contacts to find out about utilities, describing how to select trees, and maintenance responsibilities.
- Developing mechanisms for dissemination.

## 6.3 Heritage and Significant Trees and the Tree Fund – a Discussion

### 6.3.1 Existing Criteria – Heritage Trees

The existing Heritage Inventory 1994 identifies several 'heritage trees'. The criteria for their selection appears to be focussed on cultural significance rather than environmental signficance. Identified heritage trees are:

- Planted rather than native.
- Of specimen quality.

- Mature age.
- May show cultural modification (e.g. pollarding).
- Noteworthy within the City or neighbourhood.
- Often associated with a heritage building or property.
- May also be in public park or street.
- Sometimes associated with a ‘cluster’ of historic resources, e.g. Ottawa Gardens, Grand Boulevard, East 10th Cluster, Victoria Park, St. Andrews Church area.

The above trees are examples of ‘cultured ‘trees – and form a part of the ‘cultural heritage’ of the City of North Vancouver.

### 6.3.2 Natural Heritage Trees

Of equal signficance is the natural heritage of North Vancouver. The public interest has been focussed on the natural woodlands in the parks and ravines, but that is the subject of a separate report. In the street rights of way, and adjacent private property, the sprinkling of native conifers provides a signficant environmental benefit, and a significant visual and cultural connection to the natural environment. For these reasons, we suggest that the conservation of native conifers knitted into the urban fabric of the City is an important goal. These native trees grow to large size, and there is a point in their growth when some may be too large for the site on which they stand. It is therefore important to allow for a gradual removal and replanting of the native trees, which will often be triggered at the time of redevelopment of a parcel or street.

### 6.3.3 Recommended Criteria for Significant Trees

Under the provisions of the Local Government Act and Charter, trees can be defined as ‘Heritage’ or ‘Significant’. For simplicity, we suggest that trees of importance to the City of North Vancouver be described as ‘Significant Trees’.

We recommend a blending of heritage and natural environment criteria for determining what is a Significant Tree in the City of North Vancouver. Draft criteria would include:

- Planted or native.
- Of specimen quality, or sufficient health to not represent a hazard to adjacent land use.
- For non-native trees: greater than 50% of mature age.
- For native evergreen trees: all coniferous trees of good health and form over 150mm dbh (diameter breast height).
- Noteworthy within the City or neighbourhood.
- May show cultural modification (e.g. pollarding).
- May be associated with a heritage building or property.
- Sometimes associated with a ‘cluster’ of historic resources, e.g. Ottawa Gardens, Grand Boulevard, East 10th Cluster, Victoria Park, St. Andrews Church area.

### 6.3.4 Approach to Conservation and Replacement of Significant Trees

On public property, we would encourage that the existing tree protection policies recognize and conserve ‘Significant Trees’. Where it is necessary to remove existing native conifers, replacement of similar species in sizes as large as possible (say 10 cm cal.) should be sought.

Regarding Significant Trees on private property, careful balancing of public and private interest is necessary. Private property concerns need to be recognized, and it is important that actions taken ‘reward’ or at least to not ‘unfairly penalize’ those who have maintained large trees on private land. It should also be recognized that conservation of large native conifers on private land may, in some cases, preclude the potential for further subdivision or expansion of building footprints on the site, given the rooting and space needs of such large trees. Generally, trees towards the edges of sites provide the best chances for retention, and in many cases the roots and branches of these trees will extend over public property.

We suggest the following:

- That an expeditious vehicle for voluntary covenants be provided and advertised so that willing landowners are able to protect large trees on their property as a legacy beyond their property ownership.
- That public recognition be provided to those who enter such voluntary covenants, if the owner agrees to such recognition.
- That City awareness programs encourage owners to give careful consideration to retention of existing trees, while recognizing that some trees are either hazard, or badly interfering with overhead lines, or located so as to preclude site redevelopment. The education process should be co-ordinated with the zoning, subdivision and building permit processes so that tree issues associated with redevelopment are handled expeditiously.
- That tree replacement should be encouraged, including both provisions for replacement trees on the same property as the removal where that is desirable, and a financial vehicle such as a 'tree fund' which provides for replanting of replacements for Significant Trees on public land in conditions where space or conditions at the property in question preclude replacement planting on-site.
- That development proposals that involve two or more residential units be encouraged by design guideline to plant at least one native coniferous tree per given parent site area (e.g. 600 sq.m.) on a location on the site where the tree can grow to mature size. Where such conditions cannot reasonably be met given the site and development proposal, a contribution to the 'tree fund' or planting on public land should be encouraged.
- That the 'tree fund' be structured to accept bequests and donations related to tree planting, including issuing of charitable donation receipts.
- That the 'tree fund' also be capable of accepting and administering senior government grants, corporate donations, and other partnerships.

# 7. Tree Planting and Maintenance Standards and Specifications

The following standards and specifications, in addition to the BC Landscape Standard, 6th Edition (BCSLA and BCLNA), and The City of North Vancouver's Tree Policy for the Management of Trees on City Property, are the standard for all planting and maintenance of trees on public land in the City of North Vancouver. The standards apply whether the work is done by City staff or by individuals under contract to the City.

## 7.1 General Work

7.1.1 Public trees are defined as any tree located on City owned land. This will include the public right of way between the curb or edge of road and the property line along the sides of streets or in medians of all streets, avenues or ways within the City boundaries, tree in public parks or other City owner property and the City owned cemetery land. Trees are considered to be joint property when any part of the tree crosses a property line.

7.1.2 City staff is authorized to carry out work on City trees. No other person may plant, remove, prune or otherwise undertakes any activity that may affect the health and welfare of a tree located on City property without first obtaining permission from the Manager of Parks & Environment.

7.1.3 Authorized work on City trees neither expresses nor implies the right to violate any law of the land while in the process of performing such work.

7.1.4 Utility companies shall notify the City at least three days in advance before conducting trimming or pruning work on City trees. All such work must be complete following accepted arboriculture practices and standards (The American National Standard for tree pruning, ANSI – A300 Pruning Standards).

7.1.5 All tree work shall be completed in a manner which results in the least possible interference or disruption to others. Any damage to City property resulting from work to City trees must be reported to the Manger of Parks & Environment.

7.1.6 All affected persons or authorities must be contacted before beginning work whenever service lines of any type or other improvements, public or private, may be affected by proposed tree work.

7.1.7 Adequate barricades and warning devices shall be in place and flag persons shall be stationed as necessary for the safety of all vehicles and persons prior to proceeding with any work.

7.1.8 Penalties for the unauthorized removal or damaging of trees in City parks or boulevards are included in the Parks Regulation Bylaw No. 6611 and the Street and Traffic Bylaw No. 6234.

7.1.9 Residents can apply to have trees removed through the Tree Removal Petition Process set forth in the CNV's Tree Policy for the Management of Trees on City Property (see Appendix 4).

## 7.2 Location of Trees in Public ROW

Typically, there are four street situations with opportunity for street trees:

7.2.1 **Landscape boulevard**, between the back of curb and separated sidewalk. Typically trees should be centred in the boulevard. Trees should not be planted in boulevards with a width less than 1.2m.

7.2.2 **Behind the sidewalk**, where the sidewalk is next to the curb, and there is a landscape area in the public right-of-way.

7.2.3 **In a median or cul-de-sac**. Tree spacing will depend on size and width of planting area, as well as the tree species.

7.2.4 **Tree pit** in paved area. Look at ways to increase available soil volume to support root development wherever possible. The pits may be large, include break-out channels and/or structural soil. Table 3 in section 4.6 suggests tree species appropriate for paved areas.

## 7.3 Tree Spacing

7.3.1 Tree spacing is based on the mature size and form of the proposed tree in relation to site conditions. Tree placement should consider:

- growth requirements for optimum tree health,
- street amenities,
- utilities,
- growing medium volumes,
- architectural features and frontages,
- views, and
- tree pattern.

7.3.2 In general trees should be spaced accordingly:

- Small tree -- 4.5 to 9 m on centre.
- Medium trees -- 8 to 13 m on centre.
- Large trees -- 15 to 18 m on centre.

7.3.3 Problems associated with overplanting include: disease transfer, deformed or stunted growth, excessive shade, too much leaf clean-up, obstruction of views to signs and windows, conflicts with buildings and utilities.

## 7.4 Minimum Tree Planting Clearances

7.4.1 Street trees must not obstruct visibility of traffic signs, intersections, driveways, and pedestrians, or interfere with utilities, services or lighting.

7.4.2 Minimum tree planting clearances for road elements, underground and at-surface utilities and poles are listed below.

7.4.3 ***Setbacks shown are a guideline – distances can be customized to a site condition provided that professional advice is gained.***

| Road Element | Distance from Centre of Tree Trunk to Edge of Street Element |
|---|---|
| Curb face | 0.75 m |
| Sidewalk | 0.6 m |
| Driveway crossings | 0.6 m |
| Intersection corner | 8.0 m (8 m sight triangle) |
| Buildings (may vary according to species and building overhang) | 1.6 to 4.6 m |
| Bus Stops (clearance is from Curb face) | 2.0 m |
| Traffic circles | Shrubs no higher than 1m; not to obstruct visibility for traffic |

| Underground and Surface Utilities | Distance |
|---|---|
| Service connection/manholes and valves | 1.2 m |
| Catch basins | 1.5 m |
| Sewer services | 0.9 m |
| Utility mains | 2.0 m |
| Hydrants:<br>Front (facing the street)<br>Side | <br>1.8 m<br>0.9m |

| Poles | Distance |
|---|---|
| Lamp standards | 6 m |
| Steel/wood hydro poles | 3 m |
| Regulatory street signage (oncoming traffic) | 6 m |
| Parking meters | 0.9 m |

**Overhead Utilities and Transmission Lines**

Planting near power lines requires particular consideration because tree damage to power lines is a hazard and can create power outages. Trees can be planted near, or under, overhead hydro lines provided that they will not grow into, or are likely to fall onto power lines.

BC Hydro provides planting guidelines that categorize planting areas in three zones - low, medium, and tall.

- The low zone is the area directly under the lines. Trees planted under lines should have a mature height of 6m or less.
- The medium zone is a distance of 10 m from the hydro pole. The maximum tree height in the medium zone should be less than 12 metres.
- In the tall zone there are no planting restrictions.
- No trees are allowed under high voltage lines.
- Branch clearance from trees near transmission lines is 7.6 m, and 4.5 m from distribution lines.

The guidelines include lists of tree species suitable for each zone. Refer to BC Hydro's web site for their ***Vegetation and Powerlines*** online brochures at http://www.bchydro.com/safety/vegetation/vegetation660.html .

Table 3 in Section 4.6 provides tree list specifically for CNV that will fit into Constraint Class 3 - Overhead Lines.

## 7.5 Tree Selection

7.5.1 Tree selection must consider:

- the inclusion of native conifers and large trees,
- species diversity,
- costs,

- compatibility with the urban setting – constraints due to overhead lines, width of planting space, etc.
- compatibility with the location - hardiness, root structure, soil, moisture and light conditions,
- disease and pest resistance
- aesthetic compatibility with existing trees (habit, growth rate, texture, colour, and form),
- maintenance requirements, and
- availability in the nursery trade.

7.5.2 There is a wide range of appropriate tree species for use in the CNV. See section 4.2 for a discussion of constraint classes; Table 3 in Section 4.6 for Recommended Trees categorized by constraints. This tree list includes information about tree size, form, colour, growth rate, longevity, and benefits.

## 7.6 Tree Planting Methods and Techniques

7.6.1 All trees installed on City property, whether new or replacement, become the responsibility of the Manager of Parks & Environment.

7.6.2 Verify the location of all underground and overhead services before proceeding. No trees will be installed on City property where it is deemed that a safety issue may result. Trees that have growth characteristics likely to result in a hazard or maintenance problem will not be installed under hydro lines.

7.6.3 Refer to Planting Details in Appendix 5 for tree planting pit preparation. Larger pits may be required in areas with poor quality, compacted or poorly drained soils.

7.6.5 Determine if existing site soils may be used for backfill. Amend the soil to meet or exceed the requirements of the B.C. Landscape Standard. Imported backfill must be supported with a representative soil test report.

7.6.6 Trees shall be installed on the day they arrive at the site or appropriately stored in accordance with the BC Landscape Standard. Set tree in the centre of the planting pit on a compacted base. Tree shall be lifted by the rootball, never by the trunk. Ensure tree is placed at the correct planting grade. Rootball shall be placed so that the finished plating grade will be similar to the original nursery grown grade (refer to Planting Detail in Appendix 5). All non-perishable containers (including grow bags and sleeves), and tying materials shall be removed. Properly fitted wire baskets may remain in place. Over sized baskets and fiber tubs will require adjustment/removal as specified in the BC Landscape Standard. Fold back the top one-third of burlap on B&B plant material.

7.6.7 Backfill soil shall be tamped to remove air pockets. Install soil in lifts not to exceed 25 cm. Finished grade is to be even with adjacent existing grades. Finished grading shall include a 10cm water dike (berm around the outside of the tree pit), minimum diameter 1.2 m.

7.6.8 Mulch must be used around the base of trees whenever planting in a grass strip or exposed shrub bed. Mulch may consist of Fir/Hemlock bark chips or composted organic material. It must be free of rocks, gravel, salts or other harmful chemicals and other extraneous matter.

7.6.9 Stake all trees for a maximum of two growing seasons. Ensure stakes are firm and secure from easy movement in the soil. Do not drive stakes through root ball. Secure with fabric belt, as shown in the Planting Details in Appendix 5. Wire encased hose is not permitted.

7.6.10 Cleanup any soil, branches or other debris. Work area shall remain safe at all times until the cleanup is completed.

7.6.11 Water shall be applied to the finished tree planting pit in quantity sufficient to ensure the entire root ball is moist. Water newly installed trees twice within 24 hours of planting. Afterwards, a water thoughly once a week unless significant rainfall occurs.

## 7.7 Tree Maintenance

7.7.1 City trees shall be maintained in such a manner as to promote good general health through the provision of sound cultural practices, including insect and disease control, fertilization, irrigation, staking and pruning.

7.7.2 All newly installed trees shall be monitored for three years after installation to ensure survival. Application of regular watering during extended periods of dry weather is critical to the success of the new tree.

7.7.3 No tree shall be cut back in such a manner that its health will be affected. All cuts shall be made in such a manner as to favour the earliest possible covering of the wound by natural tree callus growth. Pruning cuts should be made just outside the branch collar. Cuts tat result in tearing of bark, leaving pegs, stubs or flush cuts are unacceptable pruning practices.

7.7.4 The use of tree-climbing spurs on City owned trees is prohibited without the approval of the Manager of Parks & Environment.

7.7.5 The City does not permit the topping of healthy trees for reasons of view preservation, shade or litter complaints.

7.7.6 Pruning work will be undertaken by the City where tree limbs originating from City owned trees are obstructing walkways or affecting vehicular egress or access.

7.7.7 Chemical and/or cultural methods of pest and disease control will be employed where beneficial to affected trees. Handling and application of all chemicals, including but not limited to herbicides, pesticides, fungicides and insecticides shall be done in accordance with provincial and federal regulations and bylaw NO.5972. Pesticide handling and application of schedule 1, 2 & 3 chemicals as defined by the pesticide act shall be done by applicators holding current certification under the BC Pesticide Control Act. Advance notification to all residents in the immediate area, including the posting of visible notices, shall be carried out prior to any spraying. Chemical control methods used within riparian zones shall utilize the recommendations in the “Handbook for Pesticide Applicators and Dispensers”, published by the Ministry of Environment, Lands and Parks.

7.7.8 Owners of trees located on private property that overhang any street or right of way within the City shall prune the branches so that such branches shall not interfere with the safe use of the street or sidewalk or obstruct the view of any street intersection.

## 7.8 Tree Removal

7.8.1 Preservation of existing trees is considered a priority and will be encouraged where conditions permit. Tree may be removed from City property only when the criteria set out in section 3.0 of the “City of North Vancouver Tree Policy for the Management of Trees on City Property” have been met (see Appendix 4).

7.8.2 The City does not permit the removal of healthy trees for reasons of view preservation, shade or litter complaints.

7.8.3 Value assessment of public trees shall be based on the “Guide for Plant Appraisal” (most recent edition) system as prepared by the Council of Landscape Tree Appraisers. Appraisals must be completed by a Certified Arborist with specific training in the use of the method prescribed.

7.8.4 All tree removals shall be completed so that the remaining stumps will be at least 25cm below ground level unless the City allows exemption.

7.8.5 Excavations resulting from tree removals must be made good to match existing with growing medium to a level consistent with surrounding grades. All fill material must be clean and free of debris.

## 7.9 Protection and Preservation

The following specifications are intended to protect City trees from unnecessary damage during development of adjacent sites:

7,9,1 Attachment of signs, cables, wires or other matter foreign to the natural form of the tree is prohibited.

7.9.2 No excavations within the drip line of a tree shall be allowed without the consent and approval of the City. No foreign material of any type that may affect the soil quality in any manner within the drip line area of the tree is permitted.

7.9.3 As part of the land development process, all developers are required to submit landscape plans. Landscape plans must show all existing trees on the plan, as well as trees to be preserved and those proposed for removal. Preservation of existing trees should be given high priority with all proposed development. Landscape plans require the City's approval before development will be authorized to proceed.

7.9.4 During construction periods, responsible management and maintenance of adjacent public/street trees will be required. All trees adjacent to development sites must be protected by means of a solid and durable protection fence prior to any development activity occurring on site. Tree protection shall remain in place and in good order throughout the development process. Operation of equipment or storage of materials within designated tree protection areas is prohibited.

7.9.5 New sidewalks through areas of existing trees shall be constructed in a manner sensitive to the protection of tree roots.

7.9.6 Do not change the existing grades in the immediate area of the tree. Where an increase in grade is required a tree well and aeration system must be provided. Design details of the tree well must be submitted to the City for approval prior to proceeding. Under no circumstances shall tree grades be lowered without permission of the Manager of Parks & Environment.

## 7.10 Structural Soils

A major obstacle to the establishment of healthy trees in paved urban areas is the lack of adequate soil. To construct sidewalks, parking lots, and streets, topsoil is removed, and the subgrade is compacted. The resulting poor growing medium prevents trees from thriving as the roots are forced to stay shallow, just beneath the paved surface. Trees that do survive this inhospitable environment die prematurely and /or lift sidewalks, creating safety hazards and ongoing maintenance.

*Engineered* or *Structural Soil* is a viable option for tree installation in urban landscapes because it safely bears pavement loads, while allowing roots to penetration under paving. Structural soil a mixture of aggregate (bearing stone matrix) with a non-compacted soil suspended in the voids of the stone. A soil stabilizer (organic binder) is used to hold the soil to the stone. The stone in the mixture compacts to meet construction needs, while the soil between the stones remains uncompacted -- these voids provide room for root growth.

Structural soil was developed at Cornell Urban Horticulture Institute, and published studies (refer to *http://www.hort.cornell.edu/uhi/outreach/csc/* for journal articles) as well as successful installations in cities throughout North America including the Greater Vancouver Region District have proven its reliability. The benefits of using structural soils for trees in close proximity to hard surfaces should prove to be cost effective.

See Appendix 5 for Planting Details and Appendix 6 Structural Soil Specification.

# APPENDICES

## Appendix 1: Public Information Materials for this Project

Street Tree Poster
Backgrounder
Summary of Survey Results

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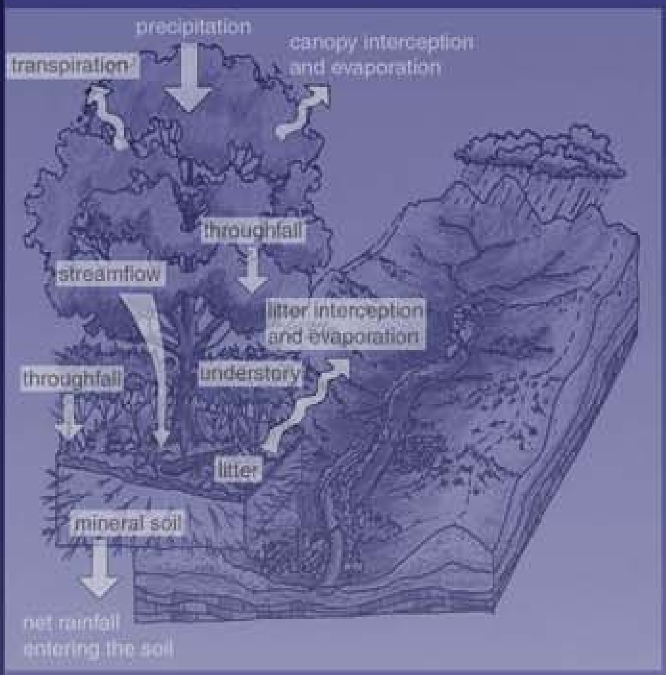
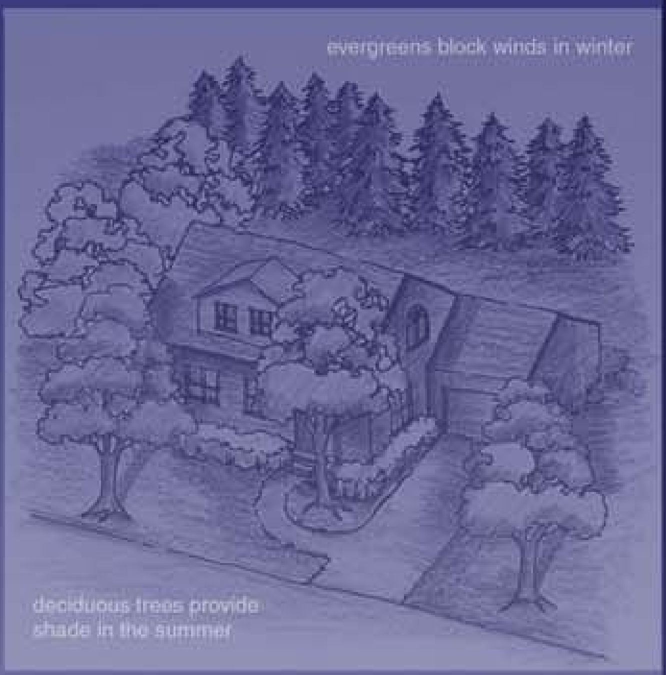



## Watershed Benefits

- Trees intercept rainfall.
- Trees increase soil infiltration.
- Reduced stormwater flows create less instream erosion and lower impacts on aquatic ecosystems.

## Property Benefits

- Trees increase 'curb appeal'.
- Trees increase property sale values when views are not impacted.
- Retail customers prefer shopping on streets with trees.




## Energy & Air Benefits

- Trees save energy by heat, shade and wind control.
- Trees reduce smog by reducing the 'urban heat island' effect.

Street Tree Benefit:Cost > 5:1

City Costs:

- Tree planting.
- Tree maintenance e.g. watering, pruning
- Tree removal.


## Aesthetic & Cultural Benefits

- Trees are beautiful, and increase civic pride.
- Trees create a more healthy and comfortable city.
- Trees provide links to the city's history and natural environment.


## Greenhouse Gas Benefits

- More carbon dioxide (the main greenhouse gas) is captured as trees grow than is released by tree maintenance and decomposition.

# Plant Your Ideas

In the

## Street Tree Master Plan

Plant more trees?
Better maintenance?
Different species?
How funded?

View the research & provide your input before April 30 at www.cnv.org

How should the City manage its investment in street trees ?

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CITY OF NORTH VANCOUVER

Urban Forest Master Plan Phase II

# Street Tree Master Plan

## BACKGROUNDER

LANARC CONSULTANTS LTD

Including excerpts from information by the

CENTER FOR URBAN FOREST RESEARCH
PACIFIC SOUTHWEST RESEARCH STATION
USDA FOREST SERVICE

SCOTT E. MACO
E. GREGORY MCPHERSON
JIM R. SIMPSON
QINGFU XIAO
PAULA J. PEPER

AND
ENVIRONMENT CANADA

APRIL 2004

## Introduction to the Street Tree Master Plan

The City of North Vancouver is an evolving leader in sustainable development. It has been developing one of the most highly dense and yet livable cities in the world. The ‘Urban Forest’ of the City of North Vancouver plays a key role in this sustainable future. The forested ravines and native conifers are a link to the natural environment and heritage of the City. Planted green spaces were also recognized in the 1907 Town Plan – which envisioned the ‘Green Necklace’ as the lungs of the City.

The Department of Engineering, Parks and Environment is responsible for managing the City’s Urban Forest. An Urban Forest Master Plan is being completed in several phases. Phase I in 2001 created an inventory of street trees in the City. The current Phase II will complete a Street Tree Master Plan. Future Phases will apply to parks and woodland collections in the City.

North Vancouver’s location makes it ideal for high density living, providing alternatives to suburban locations that trigger automobile-based commuting and associated pollution. High density development, poorly designed, can lead to a proliferation of roof, pavement, and hard surface – hardscape. In North Vancouver, there are many opportunities to ameliorate the problems associated with hardscape through strategic tree planting and stewardship of existing trees. A well-designed street tree program can reduce stormwater runoff, conserve energy and water, sequester $CO_2$, attract wildlife, and provide other aesthetic, social, and economic benefits.

The City has hired a consulting team led by Lanarc Consultants Ltd, Landscape Architects and Environmental Planners. They are assisted by the Centre for Urban Forest Research, a research arm of the USDA Forest Service, who have been customizing for North Vancouver a highly sophisticated computer program (STRATUM) to model the benefits and costs of urban street tree populations. Prior work by the Centre for Urban Forest Research has been completed for many western US Cities, including Sacramento and San Franscisco, as well as Western Washington state. This is the first application of this research in Canada.

## Summary of Street Tree Benefit:Cost Ratio

for City of North Vancouver citywide street tree collection, Year 2003

The City has over 5350 Street Trees

Average Annual Benefits: $501,000 per year total, $94 per tree per year

Provides Approximately $25,000,000 in benefits over 50 years

Annual Costs: $94,000 in 2003

Costs for managing street trees include pruning, tree and stump removal, watering, replacement planting, and associated costs.

**The results show that the existing Street Tree population in the City of North Vancouver has a benefit:cost ratio of greater than 5:1*.**

*See Appendix 1 for notes on methodology, and ‘STRATUM Application for the City of North Vancouver – Methodology and Procedures, Centre for Urban Forest Research, 2004” for details.

## Benefits of Existing Street Trees

for City of North Vancouver citywide street tree collection, Year 2003

The pages that follow introduce the annual benefits of the existing street tree collection for:
Energy Savings
Greenhouse Gas (CO2) Reduction
Air Quality Improvements
Watershed and Stormwater Savings
Aesthetic and Other Benefits
Property Value Increase

The research also reveals
Larger trees have higher benefits/tree than smaller trees.
Coniferous trees have the highest values for stormwater management.
Conifers with wide, high canopies (like Douglas Fir) have better energy and stormwater benefits than narrow conifers with needles to the ground (like Western Red Cedar).
Care should be taken to avoid overplanting or concentration of common species (e.g. Japanese Flowering Cherry and Red Maple), to guard against the impacts of disease.
There are many public streets in the City of North Vancouver that do not have street trees, and that could accommodate them.
Overhead power lines in many locations are a constraint to planting of large trees.

## Actions for Improving Street Tree Populations

in the City of North Vancouver

With such clear benefits for sustainability, the City is reviewing its options to invest in its street tree program. Potential actions include:

1. Improving maintenance of street trees, especially pruning and disease management.
2. Sustaining large coniferous trees in the City, either by stewardship of existing or planting new.
3. Designing planting so that the mix of species and tree types is resilient to disease.
4. Improving tree planting design for overhead utilities, views, and space available.
5. Planning for tree replacement, recognizing that living trees will eventually die.
6. Creating a 'tree bank' or other financial vehicle to allow a balance of funding among developers, landowners, and taxpayers.
7. Pursuing senior government assistance, in particular related to the regional environmental benefits of street trees.
8. Encouraging community and voluntary funding and planting of street trees.
9. Planting more street trees in the City.
10. Managing the street tree population with a 20 –50 year horizon.

**What do you think should be priorities? Please provide your input on these and other actions by responding at www.cnv.org .**

## Energy Savings / Yr

for Citywide street tree collection

Reduces Urban Heat Island Effect
Saves Electricity: 34.1 MWH
Saves Gas: 426.2 Mbtu
Dollar value $6,514 / yr
Equivalent to energy use of approximately 12 homes in North Vancouver

Buildings and paving, along with low canopy and soil cover, increase the ambient temperatures within a city. Research shows that even in temperate climate zones—such as those of the Pacific Northwest—temperatures in urban centers are steadily increasing by approximately 0.5°F (0.3°C) per decade. Winter benefits of this warming do not compensate for the detrimental effects of magnifying summertime temperatures. Because electric demand of cities increases about 1-2% per 1°F (3-4% per °C) increase in temperature, approximately 3-8% of current electric demand for cooling is used to compensate for this urban heat island effect of the last four decades (Akbari et al. 1992).

Warmer temperatures in cities, compared to surrounding rural areas, have other implications. Increases in $CO_2$ emissions from fossil fuel power plants, municipal water demand, unhealthy ozone levels, and human discomfort and disease are all associated with urban heat islands.

Street trees modify climate and conserve building-energy use in three principal ways:

1. Shading—reduces the amount of radiant energy absorbed and stored by built surfaces.
2. Transpiration—converts moisture to water vapor and thus cools by using solar energy that would otherwise result in heating of the air.
3. Wind speed reduction—reduces the infiltration of outside air into interior spaces and conductive heat loss where thermal conductivity is relatively high (e.g., glass windows) (Simpson 1998).

Trees and other greenspace within individual building sites may lower air temperatures 5°F (3°C) compared to outside the greenspace (Chandler 1965). At the larger scale of urban climate (10 km square), temperature differences of more than 9°F (5°C) have been observed between city centers and more vegetated suburban areas (Akbari et al. 1992).

For individual buildings, tree shade to protect east—and especially west—walls help keep buildings cool. In the winter, solar access on the southern side of buildings can warm interior spaces.

Trees can reduce wind speed and resulting air infiltration of homes by up to 50%, translating into potential annual heating savings of 25% (Heisler 1986).

## Greenhouse Gas ($CO_2$) Reductions / Yr

for Citywide street tree collection

Sequesters 1,264,752 lbs (569,138 kg) of $CO_2$ / year
Through reduced energy use, avoids production of 4,560 lbs (2052 kg) of $CO_2$ /year
Releases 334,379 lbs (150,471 kg) of $CO_2$ / year through decomposition & maintenance activities
Net Reduction is 934,933 lbs (420,719 kg) of $CO_2$ / year
Dollar value of $9,366 / yr
Equivalent to $CO_2$ emitted by about 78 lightweight vehicles (12,000 lb/year) in a year

Greenhouse gases including $CO_2$ act like a one-way mirror in the atmosphere, letting in much of the sun's light but trapping some of the infrared heat radiated by Earth. Carbon dioxide ($CO_2$) accounts for about 75 per cent of the enhanced greenhouse effect caused by human activities. Since the mid-1800s, carbon dioxide concentrations have increased by more than one quarter. Most of that increase was in the past half century. The Intergovernmental Panel on Climate Change predicts that if current trends in fossil fuel use are not changed, in this century $CO_2$ levels in the atmosphere will double from those before the industrial revolution causing a rise in global temperatures unprecedented in 10,000 years.

Greenhouse gases from fuel combustion accumulating in the atmosphere continue to raise global temperatures. The increases are greatest in northern latitudes, including Canada. A warmer atmosphere is more active, prone to weather extremes, such as floods, droughts and violent storms such as tornadoes and hurricanes. Warmer weather also brings ecological changes, moving species, including insect pests and disease-carrying organisms, further north. Hotter summers produce a variety of stresses and changes in the natural water cycle accompanying climate change will affect farmers, hydroelectric producers, tourist operators and many others (Environment Canada).

Urban forests can reduce atmospheric $CO_2$ in two ways:

1) Trees directly capture (sequester) $CO_2$ as woody and foliar biomass while trees grow.
2) Trees near buildings can reduce the demand for heating and air conditioning, thereby reducing emissions associated with electric power production.

On the other hand, vehicles, chain saws, chippers, and other equipment release $CO_2$ during the process of planting and maintaining trees. And eventually, all trees die and most of the $CO_2$ that has accumulated in their woody biomass is released into the atmosphere through decomposition. The combustion of gasoline and diesel fuels by vehicle fleets, and equipment such as chainsaws, chippers, stump removers, and leaf blowers is a relatively minor source of $CO_2$. Typically, $CO_2$ released due to tree planting, maintenance, and other program-related activities is about 2-8% of annual $CO_2$ reductions obtained through sequestration and avoided power plant emissions (McPherson and Simpson 1999).

## Air Quality Improvements / Yr

for Citywide street tree collection

Removes 1013 lbs (460 kg) of Ozone, Nitrous Oxide, Particulate Matter, and Sulphur Dioxide
Avoids production of 42.3 lbs (19 kg) of similar compounds by reduced energy use
Contributes Biogenic Volatile Organic Compounds (BVOCs)
In North Vancouver's airshed, air quality benefits are likely neutral or better, depending on tree species planted.

Urban trees provide air quality benefits in five main ways:

1. Absorbing gaseous pollutants (e.g., ozone, nitrogen oxides, and sulfur dioxide) through leaf surfaces.
2. Intercepting particulate matter (e.g., dust, ash, pollen, and smoke).
3. Reducing emissions from power generation by limiting building energy consumption.
4. Releasing oxygen through photosynthesis.
5. Transpiring water and shading surfaces, which lowers local air temperatures, thereby reducing ozone levels.

Emissions from burning of fossil fuels contribute to formation of smog in urban environments like North Vancouver. Tree leaves absorb some of these emissions, playing a part in air quality improvement.

Trees also act as air filters – collecting dust, smoke and other particulate matter on their large surface area.

In the absence of the cooling effects of trees, higher air temperatures contribute to ozone formation. Ground level ozone is one of the primary contributors to urban smog.

Most trees also emit various biogenic volatile organic compounds (BVOCs) such as isoprenes and monoterpenes that can contribute to ozone formation. The ozone-forming potential of different tree species varies considerably. A computer simulation study for the Los Angeles basin found that increased tree planting of low BVOC emitting tree species would reduce ozone concentrations and exposure to ozone, while planting of medium- and high-emitters would increase overall ozone concentrations (Taha 1996). However, the abundance of natural forest in the North Vancouver airshed provides plentiful background BVOCs, and ozone production in this airshed is governed more by nitrogen dioxide ($NO_2$) release. The impact of BVOC production on air quality in North Vancouver is thought to be insignificant.

Reductions in building energy use also result in reduced emissions of criteria air pollutants from power plants and space heating equipment. This analysis considered volatile organic hydrocarbons (VOCs) and nitrogen dioxide ($NO_2$)—both precursors of ozone ($O_3$) formation—as well as sulfur dioxide ($SO_2$) and particulate matter of <10 micron diameter ($PM_{10}$).

## Stormwater Savings / Yr

for Citywide street tree collection

Total Rainfall Interception: 521,948 US gallons, 1.98 million litres
Dollar value $66,362 / yr
Enough to fill up 20 swimming pools (6 x 12 x 1.36 meter backyard pool)

The amount of roof and pavement in cities, and the associated reduction of rainfall capture in vegetation and absorbent soils, leads to dramatically increased stormwater runoff. This frequent runoff changes the flow regimes in watercourses, leading to increased erosion of stream beds during rainfall events, and reduced summertime base flows. Pollutants in urban stormwater also reduce water quality in receiving waters. These changes have serious consequences for fish and aquatic ecosystems.

In an effort to protect threatened fish and wildlife, stormwater management requirements are becoming increasingly broad, stringent, and costly; cost-effective means of mitigation are needed. Healthy urban trees can reduce the amount of runoff and pollutant loading in receiving waters in three primary ways:

1) Leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes, delaying the onset of peak flows, and reducing instream erosion.
2) Root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and reduce overland flow.
3) Tree canopies reduce soil erosion and surface transport by diminishing the impact of raindrops on barren surfaces.

Studies that have simulated urban forest effects on stormwater report annual runoff reductions of 2-7%.

Annual interception of rainfall by Sacramento's urban forest for the urbanized area was only about 2% due to the winter rainfall pattern and predominance of non-evergreen species (Xiao et al. 1998). However, average interception on land with tree canopy cover ranged from 6-13% (150 gal [568 L] per tree on average), close to values reported for rural forests. In Seattle, WA, a typical large street tree was estimated to reduce stormwater runoff by 549 gal (2078 L) annually, with a benefit valued at CA$20.37 per tree (McPherson et al. 1999b). A typical street tree in San Francisco was estimated to intercept 1,370 gal (5,186 L) (CA$8.60) annually (Maco et al. 2003).

These studies showed that broadleaf evergreens and conifers intercept more rainfall than deciduous species where winter rainfall patterns prevail, but cost of treatment and control varies widely by city.

## Aesthetics & Other Benefits

Trees provide a host of aesthetic, social, economic, and health benefits that should be included in any benefit-cost analysis. One of the most frequently cited reasons that people plant trees is for beautification. Research on the aesthetic quality of residential streets has shown that street trees are the single strongest positive influence on scenic quality (Schroeder and Cannon 1983).

Consumer surveys have found that preference ratings increase with the presence of trees in the commercial streetscape. In contrast to areas without trees, shoppers indicated that they shop more often and longer in well-landscaped business districts, and were willing to pay more for goods and services (Wolf 1999).

Research in public housing complexes found that outdoor spaces with trees were used significantly more often than spaces without trees. By facilitating interactions among residents, trees can contribute to reduced levels of domestic violence, as well as foster safer and more sociable neighborhood environments (Sullivan and Kuo 1996).

Scientific studies confirm our intuition that trees in cities provide social and psychological benefits. Humans derive substantial pleasure from trees, whether it is inspiration from their beauty, a spiritual connection, or a sense of meaning (Dwyer et al. 1992; Lewis 1996). Following natural disasters, people often report a sense of loss if the urban forest in their community has been damaged (Hull 1992). Views of trees and nature from homes and offices provide restorative experiences that ease mental fatigue and help people to concentrate (Kaplan & Kaplan 1989). Desk-workers with a view of nature report lower rates of sickness and greater satisfaction with their jobs compared to those having no visual connection to nature (Kaplan 1992). Trees provide important settings for recreation and relaxation in and near cities. The act of planting trees can have social value, for community bonds between people and local groups often result.

A series of studies on human stress caused by general urban conditions and city driving show that views of nature reduce stress response of both body and mind (Parsons et al. 1998). City nature also appears to have an "immunization effect," in that people show less stress response if they've had a recent view of trees and vegetation. Hospitalized patients with views of nature and time spent outdoors need less medication, sleep better, and have a better outlook than patients without connections to nature (Ulrich 1985). Trees reduce exposure to ultraviolet light, thereby lowering the risk of harmful effects from skin cancer and cataracts (Tretheway and Manthe 1999).

Although urban forests contain less biological diversity than rural woodlands, numerous types of wildlife inhabit cities and are generally highly valued by residents. Street tree corridors can connect a city to surrounding wetlands, parks, and other greenspace resources that provide habitats that conserve biodiversity (Platt et al. 1994).

## Property Value Increase / Yr
for Citywide street tree collection

Increases property values by $419,728 per yr
Increase per tree averages $78.44 per yr
Based on U.S. studies of increased sale prices on parcels with trees.
Would apply in North Vancouver provided that views are not impacted.

Many benefits attributed to urban trees are difficult to translate into economic terms. The Aesthetic and Other Benefits listed - beautification, privacy, shade that increases human comfort, wildlife habitat, sense of place and well-being are products that are difficult to price. However, the value of some of these benefits may be captured in the property values for the land on which trees stand.

Well-maintained trees increase the “curb appeal” of properties.

Research comparing sales prices of residential properties with different tree resources suggests that people are willing to pay 3-7% more for properties with ample tree resources versus few or no trees.

One of the most comprehensive studies of the influence of trees on residential property values was based on actual sales prices and found that each large front-yard tree was associated with about a 1% increase in sales price (Anderson and Cordell 1988).

A much greater value of 9% ($15,000 [CA$20,000]) was determined in a U.S. Tax Court case for the loss of a large black oak on a property valued at $164,500 (CA$220,000) (Neely 1988).

Depending on average home sales prices, the value of this benefit can contribute significantly to cities’ property tax revenues.

For the City of North Vancouver, conservative judgements were made resulting in an average increase in property value of less than 0.88% per tree in the front yard. For example, it was estimated that a single growing Japanese flowering cherry tree (*Prunus serrulata*) adds about CA$52.63, annually, to the value of an adjacent home, condominium, or business property.

**Appendix 1: Notes on Methodology**

Annual benefits for the City of North Vancouver’s street trees were estimated for the year 2003. Growth rate modeling information was used to perform computer-simulated growth of the existing tree population for one year and account for the associated annual benefits. This “snapshot” analysis assumed that no trees were added to, or removed from, the existing population during the year. The approach directly connects benefits with tree size. Many functional benefits of trees are related to leaf-atmosphere processes (e.g., interception, transpiration, photosynthesis), and, therefore, benefits increase as tree canopy cover and leaf surface area increase.

Prices were assigned to each benefit (e.g., heating/cooling energy savings, air pollution absorption, stormwater runoff reduction) through direct estimation and society’s willingness to pay for the environmental benefits trees provide. This method of quantification was not intended to account for each penny. Rather, this approach was meant to be a general accounting of the benefits produced by urban trees; an accounting with an accepted degree of uncertainty that can, nonetheless, provide a platform on which decisions can be made (Maco 2003). Refer to the report ‘STRATUM Application for the City of North Vancouver – Methodology and Procedures, CUFR, 2004’ for details.

## City of North Vancouver – Street Tree Master Plan

# PUBLIC SURVEY RESULTS - SUMMARY

June 11, 2004

| | % of 18 Responses | % Total |
|---|---|---|
| General Goal | Support + Support with refinements | |
| To maintain and increase the long-term sustainability of the City of North Vancouver's urban forest assets | 55% + 17% | 73% |
| Guiding Principles {for Tree Planting & Maintenance} on Public Lands | Support + Support with refinements | |
| 1. Increase existing benefits of the urban forest, by planting more street trees on public land, with a target of 30% more in 20 yrs. | 83% + 11% | 94% |
| 2. Be sensitive to planting large trees in locations where they would conflict with views from existing residences to Burrard Inlet. | 72%+ 11% | 83% |
| 3. Increase environmental benefits, by striving to plant more trees that grow to larger size in locations without conflicts with views/utilities. | 83% | 83% |
| 4. Provide locations and methods to re-establish native trees so that the proportion of native to ornamental trees is at least as exists now. | 78%+ 6% | 84% |
| 5. Reduce risk of disease by aiming for a mix of species, with a target of no one species greater than 10% of the population. | 78%+ 17% | 95% |
| 6. Plan for a mix of tree ages and gradual tree replacement, recognizing that living trees will eventually die. | 100% | 100% |
| 7. In new plantings, focus on long-lived species that maximize benefits. | 67%+ 22% | 89% |
| 8. As a priority, plant in areas that drain to sensitive watercourses, rather than areas that drain to sea. | 78%+ 11% | 89% |
| 9. As a priority, plant in highly visible City "Gateways", such as Marine Drive, Westview, Lonsdale, Grand Crescent, Lynn Creek and Lower Lonsdale /Esplanade. | 67%+ 17% | 84% |
| 10. Develop scheduled maintenance pruning and disease control of existing and new street trees. | 83%+ 6% | 89% |
| Other Principles – private lands | Support + Support with refinements | |
| Protect, manage trees on private land | 67% | 67% |
| - via public education | 61%+ 11% | 72% |
| - via incentives such as awards, density bonus, etc. | 67%+ 6% | 73% |
| - via permits before removing trees | 33%+ 22% | 55% |
| - via require replacement during redevelopment, same site | 56%+ 17% | 73% |

| | | |
|---|---|---|
| - via require replacement during redevelopment, same or alternate site | 61%+ 17% | 78% |
| - option to contribute to a tree fund in lieu of replacement | 67%+ 6% | 73% |
| Protect wildlife or heritage trees | 61%+ 11% | 72% |
| Tree Maintenance | Very + somewhat | |
| Level of satisfaction on retail streets – very + somewhat | 6 + 67% | 73% |
| Level of satisfaction on residential streets – very + somewhat | 28 + 33% | 61% |
| Volunteerism | Yes + Yes with conditions | |
| Charitable donation | 22%+ 22% | 44% |
| Plant and maintain tree provided by city | 44%+ 17% | 61% |
| Maintain tree planted by city | 66%+ 11% | 77% |
| Organize block to plant and maintain street trees | 33%+ 0% | 33% |
| Adopt, plant, maintain traffic circle or boulevard under city guidelines | 33%+ 6% | 39% |
| Tax or fee for street trees and maintenance – per year | | |
| $10 | 22% | 67% |
| $20 | 28% | |
| $30 | 11% | |
| $50 | 6% | |

Notes:

See full summary for listing of comments that act as qualifiers to these percentages – go to http://www.lanarc.ca/cnvsurvey/resultsStats.asp.

1 respondent appears to be from BC Hydro who several times encouraged contacting him to explore partnerships in a tree planting program.

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# Appendix 2: STRATUM Report

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# STRATUM APPLICATION FOR THE CITY OF NORTH VANCOUVER—METHODOLOGY AND PROCEDURES

BY

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This STRATUM (Street Tree Resource Analysis Tool for Urban Forest Managers) application combines results of a citywide inventory for the City of North Vancouver with customized benefit modeling data to produce three types of information (Maco 2003):

1. Resource structure (species composition, diversity, age distribution, condition, etc.)
2. Resource function (magnitude of environmental and aesthetic benefits)
3. Resource value (dollar value of benefits realized)

This section describes the inputs and calculations used to derive the afore mentioned outputs: growth modeling, identifying and calculating benefits, estimating magnitude of benefits provided, assessing resource unit values, calculating net benefits and benefit-cost ratio, and assessing structure.

## GROWTH MODELING

Drawn from Longview, WA Parks and Recreation Department's municipal tree database, a stratified random sample of street and park trees was inventoried to establish relations between tree age, size, leaf area and biomass as a basis for estimating the magnitude of annual benefits derived from street tree resources in the Pacific Northwest climate region. Estimated to account for 76% of the total municipal street and park tree population, the sample was composed of the 22 most abundant species, and was used to infer growth of all public trees.

To obtain information spanning the life cycle of each species, the sample was stratified into 9 diameter at breast height (DBH) classes: 0-7.62 in (0-7.62 cm), 3-6 in (7.62-15.24 cm), 6-12 in (15.24-30.48 cm), 12-18 in (30.48-45.72 cm), 18-24 in (45.72-60.96 cm), 24-30 in (60.96-76.2 cm), 30-36 in (76.2-91.44), 36-42 in (91.44-106.68 cm), and >42 in (106.68 cm). Thirty-five to 70 randomly selected trees of each species were selected to survey, along with an equal number of alternative trees. Tree measurements included DBH (to nearest 0.1 cm by tape), tree crown and bole height (to nearest 0.5m by altimeter), crown diameter in two directions (parallel and perpendicular to nearest street to nearest 0.5m by tape), tree condition and location, and crown pruning level (percentage of crown removed by pruning). Replacement trees were sampled when trees from the original sample population could not be located. Tree age was determined from historical planting records provided by Bob Hunter (City Park Superintendent, Longview, WA, retired) and development dates obtained through a records search at the Longview Planning and Development Department. Fieldwork was conducted July through August 2001.

Crown volume and leaf area were estimated from computer processing of tree crown images obtained using a digital camera. The method has shown greater accuracy than other techniques (±20 percent of actual leaf area) in estimating crown volume and leaf area of open-grown trees (Peper and McPherson 2003).

Linear regression was used to fit predictive models—DBH as a function of age—for each of the 22 sampled species. Predictions of leaf surface area (LSA), crown diameter, and height metrics were modeled as a function of DBH using best-fit models (Peper et al. 2001).

## IDENTIFYING & CALCULATING BENEFITS

Annual benefits for North Vancouver's street trees were estimated for the year 2003. Growth rate modeling information was used to perform computer-simulated growth of the existing tree population for one year and account for the associated annual benefits. This "snapshot" analysis assumed that no trees were added to, or removed from, the existing population during the year. The approach directly connects benefits with tree size variables such DBH and LSA. Many functional benefits of trees are related to leaf-atmosphere processes (e.g., interception, transpiration, photosynthesis), and, therefore, benefits increase as tree canopy cover and leaf surface area increase.

Prices were assigned to each benefit (e.g., heating/cooling energy savings, air pollution absorption, stormwater runoff reduction) through direct estimation and implied valuation as environmental externalities. Implied valuation is used to price society's willingness to pay for the environmental benefits trees provide. Estimates of benefits are initial approximations—as some benefits are difficult to quantify (e.g., impacts on psychological health, crime, and violence). In addition, limited knowledge about the physical processes at work and their interactions makes estimates imprecise (e.g., fate of air pollutants trapped by trees and then washed to the ground by rainfall). Therefore, this method of quantification was not intended to account for each penny. Rather, this approach was meant to be a general accounting of the benefits produced by urban trees; an accounting with an accepted degree of uncertainty that can, nonetheless, provide a platform on which decisions can be made (Maco 2003).

### Energy Savings

Buildings and paving, along with low canopy and soil cover, increase the ambient temperatures within a city. Research shows that even in temperate climate zones—such as those of the Pacific Northwest—temperatures in urban centers are steadily increasing by approximately 0.5°F (0.3°C) per decade. Winter benefits of this warming do not compensate for the detrimental effects of magnifying summertime temperatures. Because electric demand of cities increases about 1-2% per 1°F (3-4% per °C) increase in temperature, approximately 3-8% of current electric demand for cooling is used to compensate for this urban heat island effect of the last four decades (Akbari et al. 1992).

Warmer temperatures in cities, compared to surrounding rural areas, have other implications. Increases in $CO_2$ emissions from fossil fuel power plants, municipal water demand, unhealthy ozone levels, and human discomfort and disease are all symptoms associated with urban heat islands. In North Vancouver, there are many opportunities to ameliorate the problems associated with hardscape through strategic tree planting and stewardship of existing trees allowing for streetscapes that reduce stormwater runoff, conserve energy and water, sequester $CO_2$, attract wildlife, and provide other aesthetic, social, and economic benefits through urban renewal developments.

Street trees modify climate and conserve building-energy use in three principal ways:

1. Shading—reduces the amount of radiant energy absorbed and stored by built surfaces.
2. Transpiration—converts moisture to water vapor and thus cools by using solar energy that would otherwise result in heating of the air.
3. Wind speed reduction—reduces the infiltration of outside air into interior spaces and conductive heat loss where thermal conductivity is relatively high (e.g., glass windows) (Simpson 1998).

Trees and other greenspace within individual building sites may lower air temperatures 5°F (3°C) compared to outside the greenspace (Chandler 1965). At the larger scale of urban climate (6 miles or 10 km square), temperature differences of more than 9°F (5°C) have been observed between city centers and more vegetated suburban areas (Akbari et al. 1992). The relative importance of these effects depends on the size and configuration of trees and other landscape elements (McPherson 1993). Tree spacing, crown spread, and vertical distribution of leaf area influence the transport of cool air and pollutants along streets and out of urban canyons.

For individual buildings, street trees can increase energy efficiency in the summer and increase or decrease energy efficiency in winter, depending on placement. Solar angles are important when the summer sun is low in the east and west for several hours each day. Tree shade to protect east—and especially west—walls help keep buildings cool. In the winter, solar access on the southern side of buildings can warm interior spaces.

Trees reduce air infiltration and conductive heat loss from buildings. Rates at which outside air infiltrates into a building can increase substantially with wind speed. In cold, windy weather, the entire volume of air in a poorly sealed home may change two to three times per hour. Even in newer or tightly sealed homes, the entire volume of air may change every two to three hours. Trees can reduce wind speed and resulting air infiltration by up to 50%, translating into potential annual heating savings of 25% (Heisler 1986). Reductions in wind speed reduce heat transfer through conductive materials as well. Cool winter winds, blowing against single-pane windows, can contribute significantly to the heating load of homes and buildings by increasing the temperature gradient between inside and outside temperatures.

### *Electricity and Natural Gas Methodology*

Calculating annual building energy use per residential unit (Unit Energy Consumption [UEC]) is based on computer simulations that incorporate building, climate and shading effects, following methods outlined by McPherson and Simpson (1999). Changes in UECs from trees (ΔUECs) were calculated on a per tree basis by comparing results before and after adding trees. Building characteristics (e.g., cooling and heating equipment saturations, floor area, number of stories, insulation, window area, etc.) are differentiated by a building's vintage, or age of construction: pre-1950, 1950-1980 and post-1980. Canadian Weather for Energy Calculation (CWEC) data for Vancouver International Airport were used (Numerical Logics 1999). Shading effects for each tree species measured were simulated at three tree-building distances, eight orientations and nine tree sizes.

Shading coefficients for tree crowns in leaf were based on measured data from Longview, Washington (McPherson et al. 2002). A photographic method is used that estimates visual density. These techniques have been shown to give good estimates of light attenuation for trees in leaf (Wilkinson 1991). Visual density was calculated as the ratio of crown area computed with and without included gaps. Crown areas were obtained from digital images isolated from background features using the method of Peper and McPherson (2003). Values for trees not measured, and for all trees not in leaf, were based on published values where available (McPherson 1984, Hammond et al. 1980). Values for remaining species were assigned based on taxonomic considerations (trees of the same genus assigned the same value) or observed similarity in the field to known species. Foliation periods for deciduous trees were obtained from the literature (McPherson 1984, Hammond et al. 1980) and adjusted for North Vancouver's climate based on consultation with the city forester (Bertram 2004).

Tree distribution by location (e.g. frequency of occurrence at each location), distance between trees and buildings (setbacks), and tree orientation with respect to buildings specific to North Vancouver were not available. Therefore, data from Longview, WA (McPherson et al 2002) were used to calculate average energy savings per tree as a function of distance and direction. Setbacks were assigned to four distance classes: 0-20 ft, 20-40 ft, 40-60 ft and >60 ft. It was assumed that street trees within 60 ft of buildings provided direct shade on walls and windows. Savings per tree at each location were multiplied by tree distribution to determine location-weighted savings per tree for each species and DBH class that was independent of location. Location-weighted savings per tree were multiplied by number of trees in each species/DBH class and then summed to find total savings for the city. Land use (single family residential, multifamily residential, commercial/industrial, other) was based on 2001 census data for North Vancouver (Penner 2004). The same tree distribution was used for all land uses.

Three prototype buildings were used in the simulations to represent pre-1950, 1950 and post-1980 construction practices for Vancouver (CREEDAC 2001). Building footprints were modeled as square, which was found to be reflective of average impacts for large building populations (Simpson 2002). Buildings were simulated with 1.5-ft overhangs. Blinds had a visual density of 37%, and were assumed closed when the air conditioner is operating. Summer and winter thermostat settings were 78° F and 68° F during the day, respectively, and 60° F at night. Unit energy consumptions were adjusted to account for saturation of central air conditioners, room air conditioners, and evaporative coolers (Table 1).

Table 1. Saturation adjustments for cooling.

| | Single family detached | | | Mobile Homes | | | Single family attached | | | MF 2-4 units | | | MF 5+ units | | | Commercial/ Industrial | | Institutional/ Transportation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | Small | Large | |
| Cooling equipment factors | | | | | | | | | | | | | | | | | | |
| Central air/heat pump | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Evaporative cooler | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% | 33% |
| Wall/window unit | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% |
| None | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Cooling saturations | | | | | | | | | | | | | | | | | | |
| Central air/heat pump | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 39% | 39% | 0% |
| Evaporative cooler | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Wall/window unit | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 7% | 7% | 0% |
| None | 89% | 89% | 89% | 89% | 89% | 89% | 89% | 89% | 89% | 89% | 89% | 89% | 89% | 89% | 89% | 54% | 54% | 100% |
| Adjusted cooling saturation | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 41% | 41% | 0% |

Single-Family Residential Adjustments

Unit energy consumptions for simulated single-family residential buildings were adjusted for type and saturation of heating and cooling equipment, and for various factors that modified the effects of shade and climate modifications on heating and cooling loads, using the expression,

$$\Delta UEC_x = \Delta UEC^{sh}_{SFD} \times F_{sh} + \Delta UEC^{cl}_{SFD} \times F_{cl}$$

where $F_{sh} = F_{equipment} \times APSF \times F_{adjacent\ shade} \times F_{multiple\ tree}$ Equation 1

$F_{cl} = F_{equipment} \times PCF$

and $F_{equipment} = Sat_{CAC} + Sat_{window} \times 0.25 + Sat_{evap} \times$ (0.33 for cooling and 1.0 for heating).

Total change in energy use for a particular land use was found by multiplying change in UEC per tree by the number of trees (N):

$$\text{Total change} = N \times \Delta UEC_x. \qquad \text{Equation 2}$$

Subscript *x* refers to residential structures with 1, 2-4 or 5 or more units, *SFD* to single family detached structures which were simulated, *sh* to shade, and *cl* to climate effects.

Estimated shade savings for all residential structures were adjusted by factors that accounted for shading of neighboring buildings, and reductions in shading from overlapping trees. Homes adjacent to those with shade trees may benefit from their shade. For example, 23% of the trees planted for the Sacramento Shade program shaded neighboring homes, resulting in an estimated energy savings equal to 15% of that found for program participants; this value was used here ($F_{adjacent\ shade} = 1.15$). In addition, shade from multiple trees may overlap, resulting in less building shade from an added tree than would result if there were no existing trees. Simpson (2002) estimated that the fractional reduction in average cooling and heating energy use per tree were approximately 6% and 5% percent per tree, respectively, for each tree added after the first. Simpson (1998) also found an average of 2.5 to 3.4 existing trees per residence in Sacramento. A multiple tree reduction factor of 85% was used here, equivalent to approximately three existing trees per residence.

In addition to localized shade effects, which were assumed to accrue only to street trees within 18-60 ft (5-18 m) of buildings; lowered air temperatures and wind speeds from neighborhood tree cover (referred to as climate effects) produce a net decrease in demand for summer cooling and winter heating. Reduced wind speeds by themselves may increase or decrease cooling demand, depending on the circumstances. To estimate climate effects on energy use, air temperature and wind speed reductions as a function of neighborhood canopy cover were estimated from published values following McPherson and Simpson (1999), then used as input for building energy use simulations described earlier. Peak summer air temperatures were assumed reduced by 0.4 °F for each percentage increase in canopy cover. Wind speed reductions were based on the canopy cover resulting from the addition of the particular tree being simulated to that of the building plus other trees. A lot size of 10,000 $ft^2$ (929 $m^2$) was assumed.

Dollar value of electrical (BC Hydro 2004) and natural gas (Terasen Gas 2004) energy savings were based on electricity and natural gas prices of CA$0.0577 per kWh and CA$1.0669 per therm, respectively. Cooling and heating effects were reduced based on the type and saturation of air conditioning (Table 1) or heating (Table 2) equipment by vintage. Equipment factors of 33% and 25% were assigned to homes with evaporative coolers and room air conditioners, respectively. These factors were combined with equipment saturations to account for reduced energy use and savings compared to those simulated for homes with central air conditioning ($F_{equipment}$). Building vintage distribution was combined with adjusted saturations to compute combined vintage/saturation factors for air conditioning (Table 1). Heating loads were converted to fuel use based on efficiencies in Table 2. The “other” and “fuel oil” heating equipment types were assumed natural gas for the purpose of this analysis. Building vintage distributions were combined with adjusted saturations to compute combined vintage/saturation factors for natural gas and electric heating (Table 3).

Table 2. Saturation adjustments for heating

| | Electric heating | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Single family detached | | | Mobile Homes | | | Single family attached | | | MF 2-4 units | | | MF 5+ units | | | Commercial/ Industrial | | Institutional/ Transportation |
| Equipment efficiencies | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | Small | Large | |
| AFUE | 0.75 | 0.78 | 0.78 | 0.75 | 0.78 | 0.78 | 0.75 | 0.78 | 0.78 | 0.75 | 0.78 | 0.78 | 0.75 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| HSPF | 6.8 | 6.8 | 8 | 6.8 | 6.8 | 8 | 6.8 | 6.8 | 8 | 6.8 | 6.8 | 8 | 6.8 | 6.8 | 8 | 8 | 8 | 8 |
| HSPF | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 | 3.412 |
| | Electric heat saturations | | | | | | | | | | | | | | | | | |
| Electric resistance | 25.10% | 25.10% | 25.10% | 30.80% | 30.80% | 30.80% | 22.20% | 22.20% | 22.20% | 49.80% | 49.80% | 49.80% | 49.80% | 49.80% | 49.80% | 21.00% | 21.00% | 0.00% |
| Heat pump | 2.90% | 2.90% | 2.90% | 6.90% | 6.90% | 6.90% | 2.00% | 2.00% | 2.00% | 1.10% | 1.10% | 1.10% | 1.10% | 1.10% | 1.10% | 6% | 6% | 0.00% |
| Adjusted saturations | 3.40% | 3.50% | 3.10% | 4.90% | 5.10% | 4.60% | 2.90% | 3.00% | 2.60% | 5.70% | 6.00% | 5.10% | 5.70% | 6.00% | 5.10% | 3.40% | 3.40% | 0.00% |
| | Natural Gas and other heating | | | | | | | | | | | | | | | | | |
| Natural gas | 59.30% | 59.30% | 59.30% | 38.60% | 38.60% | 38.60% | 67.20% | 67.20% | 67.20% | 43.40% | 43.40% | 43.40% | 43.40% | 43.40% | 43.40% | 78% | 78% | 0% |
| Oil | 6% | 6% | 6% | 7% | 7% | 7% | 2% | 2% | 2% | 5% | 5% | 5% | 5% | 5% | 5% | 0% | 0% | 0% |
| Other | 6% | 6% | 6% | 17% | 17% | 17% | 7% | 7% | 7% | 1% | 1% | 1% | 1% | 1% | 1% | 0% | 0% | 0% |
| NG saturations | 72% | 72% | 72% | 62% | 62% | 62% | 76% | 76% | 76% | 49% | 49% | 49% | 49% | 49% | 49% | 78% | 78% | 0% |

Table 3. Building vintage distribution and combined vintage/saturation factors for heating and air conditioning.

| | Siingle family detached | | | Mobile Homes | | | Single family attached | | | MF 2-4 units | | | MF 5+ units | | | Commercial/Industrial | | Institutional/ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | pre-1950 | 1950-1980 | post-1980 | Small | Large | Transportation |
| Vintage distribution by building type | 14% | 46% | 40% | 5% | 41% | 54% | 3% | 26% | 71% | 0% | 46% | 54% | 0% | 46% | 54% | 100% | 100% | 100% |
| Tree distribution by vintage and building type | 2.85% | 9.33% | 7.94% | 0.01% | 0.06% | 0.08% | 0.40% | 3.30% | 8.90% | 0.02% | 2.74% | 3.23% | 0.02% | 3.32% | 3.92% | 14.20% | 8.30% | 31.40% |
| Combined vintage, equipment saturation factors for cooling | | | | | | | | | | | | | | | | | | |
| Cooling factor: shade | 0.20% | 0.65% | 0.56% | 0.00% | 0.00% | 0.01% | 0.02% | 0.20% | 0.55% | 0.00% | 0.14% | 0.17% | 0.00% | 0.10% | 0.11% | 2.01% | 0.59% | 0.00% |
| Cooling factor: climate | 0.20% | 0.67% | 0.57% | 0.00% | 0.00% | 0.01% | 0.03% | 0.24% | 0.64% | 0.00% | 0.16% | 0.19% | 0.00% | 0.19% | 0.22% | 2.31% | 1.02% | 0.00% |
| Combined vintage, equipment saturation factors for heating | | | | | | | | | | | | | | | | | | |
| Heating factor, nat. gas: shade | 2.00% | 6.56% | 5.58% | 0.00% | 0.04% | 0.05% | 0.26% | 2.15% | 5.80% | 0.01% | 0.97% | 1.15% | 0.00% | 0.65% | 0.77% | 3.85% | 1.13% | 0.00% |
| Heating factor, electric: shade | 0.09% | 0.32% | 0.24% | 0.00% | 0.00% | 0.00% | 0.01% | 0.09% | 0.20% | 0.00% | 0.12% | 0.12% | 0.00% | 0.08% | 0.08% | 0.17% | 0.05% | 0.00% |
| Heating factor, nat. gas: climate | 2.05% | 6.71% | 5.71% | 0.00% | 0.04% | 0.05% | 0.30% | 2.50% | 6.74% | 0.01% | 1.08% | 1.27% | 0.01% | 1.30% | 1.54% | 4.42% | 1.94% | 0.00% |
| Heating factor, electric: climate | 0.10% | 0.33% | 0.25% | 0.00% | 0.00% | 0.00% | 0.01% | 0.10% | 0.23% | 0.00% | 0.13% | 0.13% | 0.00% | 0.16% | 0.16% | 0.19% | 0.09% | 0.00% |

## Multi-Family Residential Analysis

Unit energy consumptions from shade for multi-family residences (MFRs) were calculated from single-family residential UECs adjusted by APSFs to account for reduced shade resulting from common walls and multi-story construction. Average potential shade factors were estimated from potential shade factors (PSFs), defined as ratios of exposed wall or roof (ceiling) surface area to total surface area, where total surface area includes common walls and ceilings between attached units in addition to exposed surfaces (Simpson 1998). Potential shade factor=1 indicates that all exterior walls and roof are exposed and could be shaded by a tree, while PSF=0 indicates that no shading is possible (i.e., the common wall between duplex units). Potential shade factors were estimated separately for walls and roofs for both single and multi-story structures. Average potential shade factors were 0.74 for land use MFR 2-4 units and 0.41 for MFR 5+ units.

Unit energy consumptions were also adjusted for climate effects to account for the reduced sensitivity of multi-family buildings with common walls to outdoor temperature changes with respect to single-family detached residences. Since estimates for these PCFs were unavailable for multi-family structures, a multi-family PCF value of 0.80 was selected (less than single family detached PCF of 1.0 and greater than small commercial PCF of 0.40; see next section).

## Commercial and Other Buildings

Unit energy consumptions for commercial/industrial (C/I) and industrial/transportational (I/T) land uses due to presence of trees were determined in a manner similar to that used for multi-family land uses. Potential shade factors of 0.40 were assumed for small C/I, and 0.0 for large C/I. No energy impacts were ascribed to large C/I structures since they are expected to have surface to volume ratios an order of magnitude larger than smaller buildings and less extensive glazed area. Average potential shade factors for I/T structures were estimated to lie between these extremes; a value of 0.15 was used here. However, data relating I/T land use to building space conditioning were not readily available, so no energy impacts were ascribed to I/T structures. A multiple tree reduction factor of 0.85 was used and no benefit was assigned for shading of buildings on adjacent lots.

Potential climate factors of 0.40, 0.25 and 0.20 were used for small C/I, large C/I and I/T, respectively. These values are based on estimates by Akbari and others (1990), who observed that commercial buildings are less sensitive to outdoor temperatures than houses.

Change in UECs due to shade tend to increase with conditioned floor area (CFA) for typical residential structures. As building surface area increases so does the area shaded. This occurs up to a certain point because the projected crown area of a mature tree (approximately 700 to 3,500 $ft^2$ [65-325 $m^2$]) is often larger than the building surface areas being shaded. Consequently, more area is shaded with increased surface area. However, for larger buildings, a point is reached at which no additional area is shaded as surface area increases. Therefore, ΔUECs will tend to diminish as CFA increases. Since information on the precise relationships between change in UEC, CFA, and tree size are not known, it was conservatively assumed that ΔUECs don't change in Equation 1 for C/I and I/T land uses.

## Atmospheric Carbon Dioxide Reduction

Urban forests can reduce atmospheric $CO_2$ in two ways:

1) Trees directly sequester $CO_2$ as woody and foliar biomass while trees grow.
2) Trees near buildings can reduce the demand for heating and air conditioning, thereby reducing emissions associated with electric power production.

On the other hand, vehicles, chain saws, chippers, and other equipment release $CO_2$ during the process of planting and maintaining trees. And eventually, all trees die and most of the $CO_2$ that has accumulated in their woody biomass is released into the atmosphere through decomposition. The combustion of gasoline and diesel fuels by vehicle fleets, and equipment such as chainsaws, chippers, stump removers, and leaf blowers is a relatively minor source of $CO_2$. Typically, $CO_2$ released due to tree planting, maintenance, and other program-related activities is about 2-8% of annual $CO_2$ reductions obtained through sequestration and avoided power plant emissions (McPherson and Simpson 1999).

### *Sequestered and Released $CO_2$ Methodology*

Sequestration, the net rate of $CO_2$ storage in above- and below-ground biomass over the course of one growing season, is calculated by species using tree growth equations for DBH and height described above to calculate tree volume with equations from Pillsbury et. al (1998) (see McPherson and Simpson [1999] for additional information). Fresh weight ($kg/m^3$) and specific gravity ratios from Alden (1995) were applied to convert volume to biomass.

Carbon dioxide released through decomposition of dead woody biomass varies with characteristics of the wood itself, fate of the wood (e.g., amount left standing, chipped, or burned), and local soil and climatic conditions. Recycling of urban waste is now prevalent, and we assume here that most material is chipped and applied as landscape mulch. Calculations were conservative because they assume that dead trees are removed and mulched in the year that death occurs, and that 80% of their stored carbon is released to the atmosphere as $CO_2$ in the same year. Total annual decomposition is based on the number of trees in each species and age class that die in a given year and their biomass. Tree survival rate is the principal factor influencing decomposition. Tree mortality for North Vancouver was 3.5% for the first five years after out-planting and 2.0% every year thereafter (Bertram 2004). Finally, $CO_2$ released from tree maintenance was estimated to be 0.14 kg $CO_2$/cm DBH based on U.S. national average figures (McPherson and Simpson 1999).

*Avoided $CO_2$ Emissions Methodology*

Reductions in building energy use result in reduced emissions of $CO_2$. Emissions were calculated as the product of energy use and $CO_2$ emission factors for electricity and heating. Heating fuel is largely natural gas and electricity in Vancouver (Natural Resources Canada 2004). BC Hydro supplies North Vancouver with electricity. In fiscal year 2002/2003, fuel mix for this power was 90.6% hydroelectric, 4.8% natural gas, 3.3% imported from facilities outside British Columbia, 1.2% wood waste and 0.1% diesel (BC Hydro 2003). Imports vary from year to year in response to water supply levels in reservoirs and its effect on hydro capacity. For example, imports were 13.3% in 2001 (BC Hydro 2002). A value of 10% was used here based on BC Hydro projections (BC Hydro 2004).

Fuel mix for imports was estimated from BC Hydro imports (7,023 GWh) and domestic production (46,632 GWh) in 2001. Imports were associated with 3.7 million tons of $CO_2$ equivalents, while domestic production with 3.0 million tons (BC Hydro 2002). Imports were estimated to have emissions that were 8.25 greater (3.7*0.87/[3.0*0.13]) than domestic production. This multiplier was approximated here by assuming import fuel sources were 50% hydro and 50% natural gas.

Emissions factors for electricity (kg/MWh) and natural gas (kg/MBtu) weighted by the appropriate fuel mixes are given in Table 4. Implied value of avoided $CO_2$ was CA$0.022/kg based on average high and low estimates for emerging carbon trading markets (CO2e.com 2002) (Table 4). Values for criteria air pollutants were based on control-cost-based emissions for VOCs and damage-based emissions estimates for remaining pollutants using the methods of Wang and Santini (1995) (Table 4).

Table 4. Emissions factors and implied values for $CO_2$ and criteria air pollutants.

| | Emission Factor | | Implied |
|---|---|---|---|
| | Electricity[a] (kg/MWh) | Natural gas[b] (kg/MBtu) | value (CA$/kg) |
| $CO_2$ | 60.9 | 53.6 | 0.022[c] |
| $NO_2$ | 0.076 | 0.042 | 3.09[d] |
| $SO_2$ | 0.0005 | 0.0003 | 6.00[d] |
| $PM_{10}$ | 0.0145 | 0.0034 | 4.43[d] |
| VOCs | 0.0014 | 0.0025 | 3.77[d] |

[a]BC Hydro (2003; 2003; 2004)

[b]U. S. Environmental Protection Agency 1998

[c]$15/ton for $CO_2$ (CO2e.com 2002)

[d]Wang and Santini (1995)

## Improving Air Quality

Urban trees provide air quality benefits in five main ways:

1) Absorbing gaseous pollutants (e.g., ozone, nitrogen oxides, and sulfur dioxide) through leaf surfaces.
2) Intercepting particulate matter (e.g., dust, ash, pollen, and smoke).
3) Reducing emissions from power generation by limiting building energy consumption.
4) Releasing oxygen through photosynthesis.
5) Transpiring water and shading surfaces, which lowers local air temperatures, thereby reducing ozone levels.

In the absence of the cooling effects of trees, higher air temperatures contribute to ozone formation. Most trees emit various biogenic volatile organic compounds (BVOCs) such as isoprenes and monoterpenes that can contribute to ozone formation. The ozone-forming potential of different tree species varies considerably. A computer simulation study for the Los Angeles basin found that increased tree planting of low BVOC emitting tree species would reduce ozone concentrations and exposure to ozone, while planting of medium- and high-emitters would increase overall ozone concentrations (Taha 1996).

### *Avoided Emissions Methodology*

Reductions in building energy use also result in reduced emissions of criteria air pollutants from power plants and space heating equipment. This analysis considered volatile organic hydrocarbons (VOCs) and nitrogen dioxide ($NO_2$)—both precursors of ozone ($O_3$) formation—as well as sulfur dioxide ($SO_2$) and particulate matter of <10 micron diameter ($PM_{10}$). Changes in average annual emissions and their offset values were calculated in the same way as for $CO_2$, again using utility-specific emission factors for electricity and heating fuels (Table 4).

### *Deposition and Interception Methodology*

Trees also remove pollutants from the atmosphere. The hourly pollutant dry deposition per tree is expressed as the product of a deposition velocity $V_d = 1/(R_a+R_b+R_c)$, a pollutant concentration (C), a canopy projection (CP) area, and a time step. Hourly deposition velocities for each pollutant were calculated using estimates for the resistances $R_a$, $R_b$, and $R_c$ estimated for each hour for a year using formulations described by Scott et al. (1998). Data from 2001 were selected as representative for modeling deposition based on a review of mean ozone concentration for years 1996-2002 and mean $PM_{10}$ concentrations for years 2000-2002 from the Mahon Park monitoring station (T27) in North Vancouver.

Deposition was determined for deciduous species only when trees were in-leaf. Hourly concentrations for $NO_2$, $O_3$, $SO_2$ and $PM_{10}$ were obtained from the Greater Vancouver Regional District's Mahon Park monitoring station (T27) at 16th St and Jones Ave in

North Vancouver. A 50% re-suspension rate was applied to $PM_{10}$ deposition. Damage-based ($NO_2$, $O_3$, $SO_2$ and $PM_{10}$) estimates for the Greater Vancouver Regional District were used to value emissions reductions (Wang and Santini 1995); $NO_2$ prices were used for ozone since ozone control measures typically aim at reducing $NO_x$. Hourly meteorological data for wind speed and precipitation came from the same monitoring station.

*BVOC Emissions Methodology*

Emission of biogenic volatile organic carbon (sometimes called biogenic hydrocarbons or BVOCs) associated with increased ozone formation were estimated for the tree canopy using methods described by McPherson et al. (1998). In this approach, the hourly emissions of carbon as isoprene and monoterpene are expressed as products of base emission factors and leaf biomass factors adjusted for sunlight and temperature (isoprene) or temperature (monoterpene). Hourly emissions were summed to get annual totals. This is a conservative approach, since we do not account for the benefit associated with lowered summertime air temperatures and the resulting reduced hydrocarbon emissions from biogenic as well as anthropogenic sources. The cost of these emissions is based on control cost estimates and was valued at CA$3.77/kg for the Greater Vancouver Regional District (Wang and Santini 1995).

## Reducing Stormwater Runoff and Hydrology

Urban stormwater runoff is an increasing concern as a significant pathway for contaminants entering local riparian and surrounding Pacific coastal waters. In effort to protect threatened fish and wildlife, stormwater management requirements are becoming increasingly broad, stringent, and costly; cost-effective means of mitigation are needed. Healthy urban trees can reduce the amount of runoff and pollutant loading in receiving waters in three primary ways:

1) Leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows.
2) Root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and reduce overland flow.
3) Tree canopies reduce soil erosion and surface transport by diminishing the impact of raindrops on barren surfaces.

Studies that have simulated urban forest effects on stormwater report annual runoff reductions of 2-7%. Annual interception of rainfall by Sacramento's urban forest for the urbanized area was only about 2% due to the winter rainfall pattern and predominance of non-evergreen species (Xiao et al. 1998). However, average interception on land with tree canopy cover ranged from 6-13% (150 gal [568 L] per tree on average), close to values reported for rural forests. In Seattle, WA, a typical large street tree was estimated to reduce stormwater runoff by 549 gal (2078 L) annually, with a benefit valued at CA$20.37 per tree (McPherson et al. 1999b). A typical street tree in San Francisco was estimated to intercept 1,370 gal (5,186 L) (CA$8.60) annually (Maco et al. 2003). These studies showed that broadleaf evergreens and conifers intercept more rainfall than deciduous species where winter rainfall patterns prevail, but cost of treatment and control varies widely by city.

### *Stormwater Methodology*

A numerical simulation model was used to estimate annual rainfall interception (Xiao et al. 1998). The interception model accounts for water intercepted by the tree, as well as throughfall and stem flow. Intercepted water is stored temporarily on canopy leaf and bark surfaces. Once the leaf is saturated, it drips from the leaf surface and flows down the stem surface to the ground or evaporates. Tree canopy parameters include species, leaf area, shade coefficient (visual density of the crown), and tree height. Tree height data were used to estimate wind speed at different heights above the ground and resulting rates of evaporation.

The volume of water stored in the tree crown was calculated from crown projection area (area under tree dripline), leaf area indices (LAI, the ratio of leaf surface area to crown projection area), and water depth on the canopy surface, while species-specific shade coefficients and tree surface saturation values influence the amount of projected throughfall. Hourly meteorological data for 2003 from Vancouver International Airport (station T26) (latitude: 49°12' N; longitude: 123°10' W; Climate ID: 1108447; WMO ID: 71892) were selected to best represent a typical meteorological year and, consequently, used for this simulation. Annual precipitation during 2003 was 63.8 inches (1735 mm). A more complete description of the interception model can be found in Xiao et al. (1998).

To estimate the value of rainfall intercepted by urban trees, stormwater management control costs were used based on the Greater Vancouver Sewerage and Drainage District's *Best Management Practices Guide for Stormwater* (1999). For a 15 ha residential development, it costs approximately CA$4.49 per $m^3$ to provide conveyance, detention, and treatment for a water quality storm of 30 mm precipitation and a 10-year, 24-hour event for quantity control. Wet pond (collected runoff) and manhole sediment trap structural BMPs were chosen as the lowest cost alternatives producing the highest positive impact on watershed goals and objectives. Total capital costs were annualized over 40 years and summed with annual maintenance costs to derive total annual costs of stormwater management. Total water quality and flood storage volume ($V_t$) was 3,610 $m^3$.

To calculate water quality benefits, the management cost was multiplied by measured units of rainfall intercepted after the first 0.28 in (7.1 mm) had fallen for each event (24-hrs without rain) during the year. Based on surface detention calculations for North Vancouver, B.C., this initial abstraction of rainfall seldom results in runoff (NRCS 1986). Thus, interception is not a benefit until precipitation exceeds this amount.

## Aesthetics & Other Benefits

Trees provide a host of aesthetic, social, economic, and health benefits that should be included in any benefit-cost analysis. One of the most frequently cited reasons that people plant trees is for beautification. Trees add color, texture, line, and form to the landscape.

In this way, trees soften the hard geometry that dominates built environments. Research on the aesthetic quality of residential streets has shown that street trees are the single strongest positive influence on scenic quality (Schroeder and Cannon 1983). Consumer surveys have found that preference ratings increase with the presence of trees in the commercial streetscape. In contrast to areas without trees, shoppers indicated that they shop more often and longer in well-landscaped business districts, and were willing to pay more for goods and services (Wolf 1999).

Research in public housing complexes found that outdoor spaces with trees were used significantly more often than spaces without trees. By facilitating interactions among residents, trees can contribute to reduced levels of domestic violence, as well as foster safer and more sociable neighborhood environments (Sullivan and Kuo 1996).

Well-maintained trees increase the "curb appeal" of properties. Research comparing sales prices of residential properties with different tree resources suggests that people are willing to pay 3-7% more for properties with ample tree resources versus few or no trees. One of the most comprehensive studies of the influence of trees on residential property values was based on actual sales prices and found that each large front-yard tree was associated with about a 1% increase in sales price (Anderson and Cordell 1988). A much greater value of 9% ($15,000 [CA$20,000]) was determined in a U.S. Tax Court case for the loss of a large black oak on a property valued at $164,500 (CA$220,000) (Neely 1988). Depending on average home sales prices, the value of this benefit can contribute significantly to cities' property tax revenues.

Scientific studies confirm our intuition that trees in cities provide social and psychological benefits. Humans derive substantial pleasure from trees, whether it is inspiration from their beauty, a spiritual connection, or a sense of meaning (Dwyer et al. 1992; Lewis 1996). Following natural disasters, people often report a sense of loss if the urban forest in their community has been damaged (Hull 1992). Views of trees and nature from homes and offices provide restorative experiences that ease mental fatigue and help people to concentrate (Kaplan & Kaplan 1989). Desk-workers with a view of nature report lower rates of sickness and greater satisfaction with their jobs compared to those having no visual connection to nature (Kaplan 1992). Trees provide important settings for recreation and relaxation in and near cities. The act of planting trees can have social value, for community bonds between people and local groups often result.

The presence of trees in cities provides public health benefits and improves the well-being of those who live, work and recreate in cities. Physical and emotional stress has both short term and long-term effects. Prolonged stress can compromise the human immune system. A series of studies on human stress caused by general urban conditions and city driving show that views of nature reduce stress response of both body and mind (Parsons et al. 1998). City nature also appears to have an "immunization effect," in that people show less stress response if they've had a recent view of trees and vegetation. Hospitalized patients with views of nature and time spent outdoors need less medication, sleep better, and have a better outlook than patients without connections to nature (Ulrich

1985). Trees reduce exposure to ultraviolet light, thereby lowering the risk of harmful effects from skin cancer and cataracts (Tretheway and Manthe 1999).

Certain environmental benefits from trees are more difficult to quantify than those previously described, but can be just as important. Noise can reach unhealthy levels in cities. Trucks, trains, and planes can produce noise that exceeds 100 decibels, twice the level at which noise becomes a health risk. Thick strips of vegetation in conjunction with landforms or solid barriers can reduce highway noise by 6-15 decibels. Plants absorb more high frequency noise than low frequency, which is advantageous to humans since higher frequencies are most distressing to people (Miller 1997).

Although urban forests contain less biological diversity than rural woodlands, numerous types of wildlife inhabit cities and are generally highly valued by residents. For example, older parks, cemeteries, and botanical gardens often contain a rich assemblage of wildlife. Street tree corridors can connect a city to surrounding wetlands, parks, and other greenspace resources that provide habitats that conserve biodiversity (Platt et al. 1994).

Urban forestry can provide jobs for both skilled and unskilled labor. Public service programs and grassroots-led urban and community forestry programs provide horticultural training to volunteers across the U.S. Also, urban and community forestry provides educational opportunities for residents who want to learn about nature through first-hand experience (McPherson and Mathis 1999). Local nonprofit tree groups, along with municipal volunteer programs, often provide educational materials, work with area schools, and hands-on training in the care of trees.

*Property Value and Other Benefits Methodology*

Many benefits attributed to urban trees are difficult to translate into economic terms. Beautification, privacy, shade that increases human comfort, wildlife habitat, sense of place and well-being are products that are difficult to price. However, the value of some of these benefits may be captured in the property values for the land on which trees stand. To estimate the value of these “other” benefits, results of research that compares differences in sales prices of houses are used to statistically quantify the difference associated with trees. The amount of difference in sales price reflects the willingness of buyers to pay for the benefits and costs associated with the trees. This approach has the virtue of capturing what buyers perceive to be as both the benefits and costs of trees in the sales price. Some limitations to using this approach in North Vancouver include the difficulty associated with 1) determining the value of individual street trees adjacent to private properties, 2) the need to extrapolate results from studies done years ago in the United States to British Columbia, and 3) the need to extrapolate results from front yard trees on residential properties to street trees in various locations (e.g., commercial vs. residential).

In an Athens, GA study (Anderson and Cordell 1988), a large front yard tree was found to be associated with a 0.88% increase in average home resale values. Along with identifying the LSA of a typical mature large tree (30-year old red oak [*Quercus rubra*]) in the Pacific Northwest (5,000 $ft^2$ [464 $m^2$]) and using the average annual change in LSA per unit area for trees within each DBH class as a resource unit, this increase was the basis for valuing trees' capacity to increase property value.

Assuming the 0.88% increase in property value held true for the City of North Vancouver, each large tree would be worth CA$3,960 based on the average [2003] standard two-storey home sales price in North Vancouver (CA$450,000) (Royal LePage 2003). However, not all trees are as effective as front yard residential trees in increasing property values. For example, trees adjacent to multifamily housing units will not increase the property value at the same rate as trees in front of a single-family home. Therefore, a citywide reduction factor (0.73) was applied to prorate trees' value based on the assumption that trees adjacent to differing land-use—single home residential, multi-home residential, commercial/industrial, vacant, park and institutional—were valued at 100%, 75%, 50%, 25%, 50%, and 50%, respectively, of the full CA$3,960 (McPherson et al. 2001). For this analysis, the reduction factor reflects North Vancouver land-use distributions (Penner 2004) and assumes an even tree distribution.

Given these assumptions, a typical large tree was estimated to increase property values by \$6.22/$m^2$ of LSA. For example, it was estimated that a single Japanese flowering cherry tree (*Prunus serrulata*) adds about 11.59 $m^2$ of LSA per year when growing in the DBH range of 12-18 in (30.5-46.7 cm). During this period of growth, therefore, flowering cherry trees effectively added CA$52.63, annually, to the value of an adjacent home, condominium, or business property (11.59 $m^2$ x CA\$6.22/$ft^2$ x 73% = CA$52.63).

## ESTIMATING MAGNITUDE OF BENEFITS

Defined as *resource units*, the absolute value of the benefits of North Vancouver's street trees—electricity (kWh/tree) and natural gas savings (kBtu/tree), atmospheric $CO_2$ reductions (lbs/tree), air quality improvement ($NO_2$, $PM_{10}$ and VOCs [lbs/tree]), stormwater runoff reductions (precipitation interception [$ft^3$/tree]) and property value increases ($\Delta$ LSA [$ft^2$/tree])—were assigned prices through methods described above for model trees.

Estimating the magnitude of benefits (resource units) produced by all street trees in North Vancouver required four procedures: 1) categorizing street trees by species and DBH based on the city's street tree inventory, 2) matching significant species with those from the 22 modeled species in Longview, WA 3) grouping remaining "other" trees by type, and 4) applying resource units to each tree.

### Categorizing Trees by DBH Class

The first step in accomplishing this task involved categorizing the total number of street trees by relative age (DBH class). The inventory was used to group trees using the following classes:

1) 0-3 in (0-7.5 cm)
2) 3-6 in (7.6-15.1 cm)
3) 6-12 in (15.2-30.4 cm)
4) 12-18 in (30.5-45.6 cm)
5) 18-24 in (45.7-60.9 cm)
6) 24-30 in (61-76.2 cm)
7) 30-36 in (76.3-91.4cm)
8) 36-42 in (91.4-106.7 cm)
9) >42 in (106.7 cm)

Because DBH classes represented a range, the median value for each DBH class was determined and subsequently utilized as a single value representing all trees encompassed in each class. Linear interpolation was used to estimate resource unit values (Y-value) for each of the 22 modeled species for the 9 midpoints (X-value) corresponding to each of the DBH classes assigned to the city's street trees.

### Applying Benefit Resource Units to Each Tree

Once categorized, the interpolated resource unit values were matched on a one-for-one basis. For example, out of the 133 inventoried Norway maples (*Acer platanoides*) citywide, 36 were within the 6-12 in (15.2-30.4 cm) DBH class size. The interpolated electricity and natural gas resource unit values for the class size midpoint (9 in [23 cm]) were 10.6 kWh/tree and 162.8 kBtu/tree, respectively. Therefore, multiplying the size class resource units by 36 equals the magnitude of annual heating and cooling benefits produced by this segment of the population: 381.6 kWh in electricity saved and 5.86 MBtu natural gas saved.

### Matching Significant Species with Modeled Species

To infer from the 22 municipal species modeled for growth in Longview, WA to the inventoried street tree population of North Vancouver, each species representing over 0.5% of the population were matched directly with corresponding model species or, where there was no corresponding tree, the best match was determined by identifying which of the 22 species was most similar in leaf shape/type and habit; size was not necessarily determinant.

### Grouping Remaining "Other" Trees by Type

The species that were less than 0.5% of the population were labeled "other" and were categorized according to tree type classes based on tree type (one of three life forms and three mature sizes):

- Broadleaf deciduous - large (BDL), medium (BDM), and small (BDS).
- Broadleaf evergreen - large (BEL), medium (BEM), and small (BES).
- Coniferous evergreen - large (CEL), medium (CEM), and small (CES).

Large, medium, and small trees measured >40 ft (12.2 m), 20-40 ft (60.1-12.2 m), and <20 ft (<6.1 m) in mature height, respectively. A typical tree was chosen for each of the above 12 categories to obtain growth curves for "other" trees falling into each of the categories:

BDL Other = American elm (*Ulmus americana*)
BDM Other = little leaf linden (*Tilia cordata*)
BDS Other = Kwanzan cherry (*Prunus serrulata* 'Kwanzan')
BEL Other = American elm (*Ulmus americana*)
BEM Other = little leaf linden (*Tilia cordata*)
BES Other = Kwanzan cherry (*Prunus serrulata* 'Kwanzan')
CEL Other = douglas fir (*Pseudotsuga menziesii*)
CEM Other = scaled @ 2/3 douglas fir
CES Other = shore pine (*Pinus contorta*)

Broadleaf evergreen trees were not inventoried and modeled in Longview due to their regional insignificance. Therefore deciduous trees were used as surrogates and should be considered coarse estimates where applied. In North Vancouver there were no trees categorized as large broadleaf evergreen, while 32 and 101 trees were categorized as medium and small broadleaf evergreens, respectively, and accounted for approximately 2.5% of the total population.

## CALCULATING NET BENEFITS AND BENEFIT-COST RATIO

It is impossible to quantify all the benefits and costs that trees produce. For example, property owners with large street trees can receive benefits from increased property values, but they may also benefit directly from improved human health (e.g., reduced exposure to cancer-causing UV radiation) and greater psychological well-being through visual and direct contact with trees. On the cost side, increased health care costs may be incurred because of nearby trees, as with allergies and respiratory ailments related to pollen. The value of many of these benefits and costs are difficult to determine. We assume that some of these intangible benefits and costs are reflected in what we term "property value and other benefits." Other types of benefits we can only describe, such as the social, educational, and employment/training benefits associated with the city's street tree resource. To some extent connecting people with their city trees reduces costs for health care, welfare, crime prevention, and other social service programs.

North Vancouver residents can obtain additional economic benefits from street trees depending on tree location and condition. For example, street trees can provide energy savings by lowering wind velocities and subsequent building infiltration thereby reducing heating costs. This benefit can extend to the neighborhood, as the aggregate effect of many street trees is to reduce windspeed and reduce citywide winter energy use. Neighborhood property values can be influenced by the extent of tree canopy cover on streets. The community benefits from cleaner air and water. Reductions in atmospheric $CO_2$ concentrations due to trees can have global benefits.

## Net Benefits and Costs Methodology

To assess the total value of annual benefits (*B*) for each street tree (*i*) in each district (*j*) benefits were summed:

$$B = \sum_{1}^{n} j \left( \sum_{1}^{n} i \left( e_{ij} + a_{ij} + c_{ij} + h_{ij} + p_{ij} \right) \right)$$

where

$e$ = price of net annual energy savings = annual natural gas savings + annual electricity savings

$a$ = price of annual net air quality improvement = $PM_{10}$ interception + $NO_2$ and $O_3$ absorption + avoided power plant emissions - BVOC emissions (Equation 3)

$c$ = price of annual carbon dioxide reductions = $CO_2$ sequestered less releases + $CO_2$ avoided from reduced energy use

$h$ = price of annual stormwater runoff reductions = effective rainfall interception

$p$ = price of aesthetics = annual increase in property value

Total net expenditures were calculated based on all identifiable internal and external costs associated with the annual management of street trees citywide. Annual costs for public street trees (*C*) were summed:

$$C = p + t + r + d + e + s + c + l + a + q$$

where,

$p$ = annual planting expenditure

$t$ = annual pruning expenditure

$r$ = annual tree and stump removal and disposal expenditure (Equation 4)

$d$ = annual pest and disease control expenditures

$e$ = annual establishment / irrigation expenditure

$s$ = annual price of repair / mitigation of infrastructure damage

$c$ = annual price of litter / storm clean - up

$l$ = average annual litigation and settlements expenditures due to tree - related claims

$a$ = annual expenditure for program administration

$q$ = annual expenditures for inspection / answer service requests

Total citywide annual net benefits as well as the benefit–cost ratio (BCR) were calculated using the sums of benefits and costs:

$$\text{Citywide Net Benefits} = B\text{-}C \qquad \text{(Equation 5)}$$

$$\text{BCR} = B/C \qquad \text{(Equation 6)}$$

## ASSESSING STRUCTURE

Street tree inventory information, including species composition, DBH, health, total number of trees, were collected and analyzed using the City of North Vancouver's Street Tree Inventory.

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# Appendix 3: Overview of Related City Plans and Policies

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Table A3-1:

## Previous Urban Forestry Initiatives

| Project | Summary + Assessment of strengths/weaknesses |
|---|---|
| 1983 Street Trees of North Vancouver: A Review and Recommendations (Gardner, Pepre & Assoc.) | Provided recommendations for street tree planting focusing on Lonsdale, commercial districts and arterial roads.<br>Provided detailed planting specifications for the Lonsdale Corridor.<br>"Indicator" baseline: array of photos could provide basis for measuring streetscapes over time.<br>Focused almost exclusively on the commercial district, with little reference to residential and other areas of the City (which it acknowledges).<br>Tree species and planting specifications may be out of date; i.e., experience with species in urban situations and range of species available have increased; planting specifications have changed in some cases.<br>Operation and maintenance measures are recommended but no costs provided.<br>References to municipal authority regarding tree protection are out of date. |
| 1987 Street Tree Plan: Phase 1<br>(Christopher Phillips & Associates) | Focused on creating a street tree plan, again in the Lower Lonsdale and the Lonsdale Corridor and approximately three blocks east and west.<br>Provided suggested list of street trees based on mature size.<br>Provided tree plan for study area based on following criteria: views, character areas, engineering constraints, street scale, architecture scale, existing street trees, tree characteristics/desirability.<br>Recommended mono-culture plantings, typical for that era, for entire lengths of arterial streets. |
| 1992 Urban Forest Management Plan<br>(CNV Parks Planner Leesa Strimbicki) | Focused on the administration, care and maintenance of the City's Urban Forest and advocated a more complete Urban Forest Management Plan. Identified the following needs (gaps in current operation and administration):<br>• An accurate, comprehensive urban forest inventory – the current operations management system inventory was limited.<br>• A program and budget for regular maintenance (inspect, prune, fertilize, water) of street trees.<br>• An integrated management plan for control and treatment of pests and disease.<br>• A revised Street Tree Plan: the 1987 Plan is inadequate in that it supports monoculture planting, recommends species that are unavailable or inappropriate for specific sites, or address providing street trees in neighbourhood areas.<br>• No plan for addressing dangerous trees on private property or other private property issues (e.g., view enhancement).<br>• A plan to take advantage o f programs that fund planting of urban trees.<br>• A public relations program that promote community knowledge and involvement in street tree programs (e.g., adopt-a-tree, Arbour Day plantings, urban forestry displays, brochures, etc., neighbourhood consultations, resident watering programs for newly planted trees). |
| 1992 CNV Detailed Design Urban Forest Inventory | Described the design of spatial (GIS) and textual (RDB – Rational Data Base) databases for compiling and maintaining data required by the Parks Branch to track geographical location, physical attributes, maintenance and history of |

| Project | Summary + Assessment of strengths/weaknesses |
|---|---|
| CNV Management Information Systems | individual trees on City property, ROWs, parks and cemetery. Provided examples of database structures and entries. |
| 1993 Urban Forest Management Plan: Advanced Solutions (Davey Resource Group) | Presented a sustainability model for the City's urban forest based on:<br>• identifying planting sites (vacant of trees) by sizes and situations.<br>• Species diversity – limiting the number of species being planted for maintenance efficiency while still maintaining adequate diversity. General rule: no 1 species should comprise more than 10% and no single genus (e.g., *Prunus*) should comprise more than 30% of the population.<br>• Appropriate age mix – ideally 20% young, 60% mature, 20% overmature.<br>• Choosing trees according to macro- and micro-climatic conditions and soil conditions.<br>• Appropriate tree species – a planting guide that recommends appropriate tree types for particular site situations.<br>Recommended a 5-year plan for "bringing the urban forest to a sustainable level".<br>Detailed a sample tree policy suite (actually bylaw structure) covering: heritage tree designation; view protection; permitting process; tree retention and removal on private property; general regulations.<br>Made recommendations on funding sources.<br>Discussed and made recommendations to strengthen public education and relations regarding tree management.<br>Made recommendations regarding administrative and regulatory responsibilities; e.g., role of City Engineer.<br>Recommended a new/updated tree inventory, suggesting the use of TreeKeeper software.<br>Detailed tree maintenance recommendations and pest/disease control measures. |
| 2001 Urban Forestry Master Plan (DMG Landscape Architects) | Includes:<br>• Detailed street tree inventory (5365 street trees) with data re. Address, species, size, condition (health rating), surface treatment, street type.<br>• Management guidelines and/or specifications regarding:<br>o Site criteria.<br>o Tree design for commercial, industrial, high density residential and residential areas.<br>o Tree spacing.<br>o Tree location in rights-of-way (landscape boulevard, behind sidewalks, in a median, in tree pits or channels).<br>o Planting clearances from overhead utilities.<br>o Tree selection for parks and open spaces, roads ROW, and utility ROW.<br>o Species selection criteria.<br>o General standards and specification.<br>o Tree planting methods and techniques.<br>o Maintenance specifications.<br>o Tree removal criteria.<br>o Tree protection and preservation during development. |

| Project | Summary + Assessment of strengths/weaknesses |
|---|---|
| | o Structural soil. |
| 2003 Assessment of Tree Conditions in Selected Parks within the City of North Vancouver<br>(Dunster & Assoc.) | Covers 18 parks, identifying whole trees and component parks of trees that are in poor condition and pose hazards to park users or to property next to parks. Classifies each defect by risk level, action required and management priority.<br>Status of acceptance and implementation? |

Table A3-2

## Current Strategic Plans

| Current Strategic Plans | Analysis - Relevance to and Integration with UFMP |
|---|---|
| 1994 CNV Heritage Inventory | Includes “heritage landscape features”, inventorying 9 individual trees or tree groups, 4 streets of trees, and 6 parks and gardens. These should be re-surveyed, included, and heritage designation noted, in UFMP. |
| 1996 Bicycle Master Plan | Joint master plan with DNV. Among the objectives (page 5) is “Develop a network of bicycle routes to provide for safe, direct and comfortable bicycle travel throughout North Vancouver.” The urban forest can add to the comfort and enjoyment of cycling by providing shade, localized cooling and shelter from wind, and aesthetically pleasing routes. Potential conflicts with urban forest planning might include:<br>• Plans for road widening to accommodate bicycle lanes or paths that eliminate street/boulevard trees.<br>• Trees that block views around corners, at intersections, etc., thus posing a potential hazard to cyclists.<br>• Tree removal to accommodate hard structures for bicycle parking; or conversely, trees planted where bicycle parking or other facilities are required.<br>• Tree roots lifting bicycle lanes or paths. |
| 2000 Lonsdale Corridor Master Plan | Addresses phased redevelopment of public realm from 29th St south to the waterfront. Street trees are a dominant element of the detailed design for all three “precincts” – Upper, Central and Lower Lonsdale – as well as 2 of the 4 focal points. Recommendations in the master plan are intended to be phased in over 5-10 years. The UFMP should take the specific recommendations for street tree designs into account. |
| 2001 UFMP Phase 1 - Inventory & Management | |
| 2001 Traffic Calming Program | Goals are to make streets safe for everyone and preserve and enhance neighbourhood liveability. The report notes that enhancing liveability includes reducing congestion and vehicle speeds, but also reducing noise and air pollution – functions that trees provide. Traffic calming can also enhance the streetscape by providing opportunities for landscaping and public art (p.4).<br>The Technical Guidelines include traffic circles, 1-lane chicanes, and curb |

| Current Strategic Plans | Analysis - Relevance to and Integration with UFMP |
|---|---|
| | extensions, all of which may require landscaping. The use of trees in traffic circles is noted Appendix p.7). "Skinny streets" are also mentioned. Street trees can have a visual narrowing effect.<br>Neighbourhoods for traffic calming (TC) are identified, and priorities for TC plans are indicated (p.23). This definition and priorization of neighbourhoods should be considered in any neighbourhood-based planning under a UFMP; budgets for TC measures and tree planting/management should be coordinated to maximize benefits for each initiative. |
| 2001 Lighting Master Strategy Phase 2 – Concepts and Strategies | UFMP should be aware of lighting strategies for the 3 typical streetscapes, particularly where additional lighting is recommended (e.g., intersections and mid block along local streets, any new lighting along Lonsdale), to avoid conflicts with street tree planning.<br>Lighting of parks: other than 6 city parks that require existing or additional lighting, recommends that all other parks, especially natural wooded valleys, remain dark; avoid lights at path entrances to discourage use (p.36).<br>Note lighting strategy for Grand Boulevard (p.24-25). |
| 2001 Environmental Protection Program | • Focuses on protection and restoration of terrestrial and aquatic ecosystems in the CNV, and adaptation to a sustainable lifestyle.<br>• Encourages retention of public and private forested areas, increased connection between isolated forest habitat areas, and an increase in tree cover in street boulevards, parks and development areas to enhance wildlife values.<br>• Recognizes the role of trees and green space in buffering the impacts of impervious surface on watershed hydrology. |
| 2002 Official Community Plan | Ch.8 "Environment", sec.8.8 "Bird and Urban Wildlife Value Objectives" contains 4 objectives re.: protecting remaining public forested areas, increasing connectivity between forest habitat areas, retaining forested areas on private lands, and increasing tree cover and quality habitat in boulevards, parks and developed areas.<br>Ch.9 "Parks and Greenways" reiterates the goal and objectives of the Parks & Greenways Strategic Plan (see below). |
| 2002 Parks & Greenways Strategic Plan | • Has many elements that need to be incorporated into and/or reconciled with UFMP – e.g., UFMP needs to recognize same commitments, anticipate the same priorities:<br>• Providing additional street tree planting and wider sidewalks on designated greenway street; the UFMP needs to recognize these designations.<br>• Commitment to undertake a 'greenway street' demonstration project.<br>• Conduct demo projects for innovative stormwater management and low impact landscape maintenance on greenway streets.<br>• Incorporate the greenway street location and design objectives into the City's traffic calming and street improvement programs – should be incorporated into UFMP, too.<br>• Naturescape approaches that emphasize plantings to support diverse habitat.<br>• Look for opportunities to connect habitat along greenways.<br>• "no mow" zones to provide for meadows, etc.<br>• Consider acquiring 'pocket parks' at specified locations.<br>• Redefine DCCs formulas to balance funding between park acquisition and |

| Current Strategic Plans | Analysis - Relevance to and Integration with UFMP |
|---|---|
| | park/green street improvements (UFMP implementation/ management should be considered in this formula).<br>• Design of outdoor spaces that reflects and enhances the cultural vitality of the City, encourages positive social interaction, respect the City's history, provide integrated approach to public art, respect goals of the Public Art Master Plan.<br>• Identify existing viewpoints from public parks and streets, and create strategy for maintaining designated viewpoints.<br>• Priorities for a 10-year Capital Greenways Program is outlined that indicates connections, additions and completions of 4 trail systems:<br>o Necklace (central)<br>o Waterfront (south)<br>o Ravine (west)<br>o Upper Levels (north). |
| 2003 CNV Tree Policy | Focused on management of trees on City property.<br>Objective –"to ensure the long-term sustainability of its urban forest assets. Preservation of existing trees is therefore a priority…"<br>Trees will not be removed from City property:<br>o For maintaining/enhancing view corridors" (Pruning maybe).<br>o Because of shade of neighbouring properties.<br>o Due to leaf, flower or seed litter.<br>o Adjacent to streams.<br>o In contradiction of BC Wildlife Act.<br>Trees will be removed that are hazard, endangering other trees, extreme nuisance, encroaching into a highway, very low aesthetic value.<br>Provides for tree removal petition process (Attachment 1)..<br>Maintenance: standard shall be Level 3 "medium" of BCSLA standard.<br>– Pest and disease control in accordance with an IPM approach.<br>– Sets out tree replacement criteria (Attachment 2) and tree planting specifications (Attachment 3).<br>Tree issues on private property: to be resolved between property owners. |
| 2003 CNV Senior Park and Open Space Study<br>(PWL Partnership Inc.) | No mention or emphasis on significance of trees/urban forest to seniors' use and enjoyment of parks. 5 parks located along the "Green Necklace" greenway system are identified as priorities for improvements for seniors.<br>General design features to enhance these parks for seniors include (p.17): covered seating, signage, benches (with backrests), improved sidewalk access, public art, drinking fountains, footrests, trail variety for different physical abilities, improved pathway surfaces, materials that stimulate senses, map identification.<br>Specific recommendations are made for each of the 5 parks – these should be examined carefully for integration with management of trees in these parks. |
| Integrated Stormwater Management Plan (ISMP) | An annual program that adds information each year on stormwater management. Recent focus has been the Wagg Creek Watershed. |

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# Appendix 4: CNV Tree Policy for the Management of Trees on City Property

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*City of North Vancouver*

# *Tree Policy*

## *For the Management of Trees on City Property*

July 2003

## GLOSSARY OF TERMS AND DEFINITIONS

**Arborist:** Means a person certified by the International Society of Arboriculture (ISA) and designated by the Manager of Environment and Parks to undertake all aspects of amenity tree care.

**Boulevard:** Means that portion of the street lying between the curb and the adjacent street line; and for a street having two or more roadways, that portion of the street lying between the highways and which may be in solid construction or grassed.

**Diameter (DBH)** Means the diameter of the trunk of a tree, measured at 1.3 meters above the ground that surrounds the base of the tree.

**Drip Line** Means an imaginary line around a tree formed by the intersection of the ground and a vertical line extending down from the outermost branches.

**Easement:** Means all statutory rights-of-way or easements, meaning rights belonging to the City to utilize other land of different ownership in a particular manner, which can include ancillary rights as may be reasonable necessary to the exercise or enjoyment of the City's principal rights.

**Flush cuts:** Means the words used to describe damaging pruning cuts made close to the stem. This results in the loss of the trees natural defense mechanism used to limit the spread of decay.

**Hazard Tree:** Means a "Tree" identified in writing by an "Arborist" as having defects sufficient to significantly increase the likelihood that all or part of the "Tree" will fail, resulting in a risk of personal injury, death or property damage.

**Highway:** Defined by the Local Government Act of the Province of British Columbia as including a street, road, lane, and any other public way.

**Integrated Pest Management (IPM):** IPM is the term used to describe the best combination of cultural, biological, and chemical methods that are used in an environmentally sensitive manner to maintain and control pest populations below damaging levels.

**Park:** Means areas designated or dedicated by plan or bylaw as parkland or natural open space.

**Manager, Environment and Parks:** Means the person designated by Council to manage the City Parks.

**Residents:** Means the person or persons ordinarily residing within the municipal boundaries, or persons who own property used for business purposes in the City.

**Stream:** Means any natural depression with visible banks, or "wetland" with or without visible banks, which contains water at some time; and includes any lake, river, stream, creek, spring, swamp, gulch or surface source of water, whether containing fish or not; and includes intermittent streams; and includes surface drainage works which are inhabited by or provide habitat for fish.

**Street tree:** Means trees growing on City land adjacent to highways.

**Topping:** Means a term to describe the drastic reduction of a trees apical growth.

| | |
|---|---|
| **Tree(s):** | Means long lived perennial plant(s) that are woody. May be deciduous or evergreen and includes all living parts. |
| **Utility lines:** | Means all transmission lines for power, telephone and cable. |
| **Natural areas:** | Means areas that are typically made up of continuous tree cover in remnants of second growth forest or edgelands; continuous herbaceous cover with discontinuous tree cover, found along road, rail, waterfront and waterways. |

## 1.0 Protection of City Trees

- It is the objective of the City to ensure the long-term sustainability of its urban forest assets. Preservation of existing trees is therefore a priority and is required wherever conditions permit.

- The management of trees on City property is the responsibility of the City of North Vancouver Engineering, Parks and Environment Department.

- Only the City's staff or contractors approved by the Manager, Environment and Parks are authorized to carry out work on City trees.

- No other person may plant, remove, prune or otherwise undertake any activity that may affect the health and welfare of a tree on City property without first obtaining written permission from the Manager, Environment and Parks.

- Trees are considered to be joint property when any part of the tree trunk crosses a property line.

- Penalties for the unauthorized removal or damage of trees in City Parks are included in the Parks Regulation Bylaw, 1996, No.6611.

- Penalties for the unauthorized removal or damage of trees on City streets and boulevards are included in the Street and Traffic Bylaw, 1991, No. 6234.

## 2.0 Refusal to Remove Trees

- Trees will not be removed from City property for the purpose of maintaining or enhancing view corridors. Pruning work where required for the health or maintenance of trees will be carried out at the discretion of the Manager, Environment and Parks or designate.

- Trees will not be removed from City property where shade becomes an issue with properties close to parks or natural areas. In a street tree situation, pruning work where required for the health or maintenance of trees will be carried out at the discretion of the Manager, Environment and Parks or designate.

- Trees will not be removed from City Property due to issues of leaf, flower or seed litter. This is usually a naturally occurring, seasonal situation and does not justify tree removal.

- Trees adjacent to streams will not be removed from City property in contradiction to the federal *Fisheries Act*.

- Trees will not be removed from City property in contradiction to the *British Columbia Wildlife Act*.

## 3.0 Tree Removal Criteria

- Trees will be considered for removal from City property only when one or more of the following criteria have been met:

    1 The tree has been determined to be a "Hazard Tree", and the risk of failure cannot be mitigated by pruning or other practical means.
    2 The tree is endangering the health or stability of other trees.
    3 The tree is interfering with or inhibiting the normal development of a more desirable tree.
    4 The tree poses an extreme public nuisance due its species, size, location or condition.
    5 The tree is encroaching into a "highway" in such a way that visibility and pedestrian or vehicle clearance is reduced thereby causing a traffic safety problem.
    6 The aesthetic value of the tree is considered to be so low that the site will be enhanced by it's removal.

7 The tree's removal has been approved as part of a park plan.
8 The tree is impeding the development of highways, utilities, public works and facilities.
9 The tree is affecting overhead utility lines where pruning operations are not considered practical.

- Wherever possible, residents within a 60-meter radius of a tree proposed for removal by City staff, will be notified, either verbally or in writing, prior to the work being commenced. Tree removals for emergency purposes may be taken without notification.

**4.0 Hazard Trees**

- Trees on City property that have been assessed to be "Hazard Trees" will be removed at the City's expense.

- The cost of removal of a joint ownership "Hazard Tree" will be shared in proportion to the amount of the tree trunk situated on each property.

**5.0 Tree Removal Petition Process**

- Not withstanding the provisions described in Section 2, City trees, which meet one or more of the Tree Removal Criteria, are eligible for the "Tree Removal Petition Process", subject to the approval of the Manager, Environment and Parks.

- Residents can submit a "Tree Removal Application" (Attachment 1) to the Manager, Environment and Parks, requesting the removal of a City tree.

- At the discretion of the Manager, Environment and Parks, Tree Removal Petitions will be provided for Tree Removal Applications that meet one or more of the criteria described in Section 3.

- Applications which the Manager, Environment and Parks does not approve for the Tree Petition Process may be appealed through City Council.

- Completed petitions must be signed by 100% of the property owners within a 60-metre radius of the affected tree.

- Following submission of a completed Tree Removal Petition, a report will be prepared for consideration by City Council.

- If approved by Council, the applicant must bear the cost of the tree removal by an "Arborist" who has insurance indemnifying the City from all costs arising from the work, and who has a current business license in the City of North Vancouver.

- The applicant must bear the cost of supplying and installing replacement trees, as per the City's "Tree Replacement Guidelines" (Attachment 2), of species deemed appropriate by the Manager, Environment and Parks.

- In all cases the City retains absolute discretion to refuse removal of any tree from City Property.

**6.0 Maintenance**

- City trees shall be maintained in such a manner as to promote general good health, and to not endanger, interfere, or otherwise conflict with requirements of safe public use of an area.

- Any City tree that becomes a hazard to public safety due to its habit, growth, age, condition or disease shall be maintained to correct the problem. Trees that obstruct clear views of street intersections, signs, signals, or other street views that may affect safety shall be maintained to correct the problem.

- All pruning on City owned trees shall be completed by City staff or by contractors approved by the Manager, Environment and Parks. All tree pruning shall be completed to acceptable arboricultural practices and standards (ANSI – A300 Pruning Standards).

- "Topping" of City trees is not considered to be an acceptable pruning practice. Trees will only be considered for topping in the following circumstances:

    1. Where statutory clearance from overhead services is required and no other options are available.
    2. Where the decision has been made to remove a tree from a natural area, then a tree may be topped to provide habitat as a "wildlife tree".

- Excessive crown lifting is not considered to be an acceptable pruning practice. This describes a situation where too much of the lower branch structure has been removed, leaving an unstable or un-natural appearing tree form.

- Upon request, the City shall complete pruning work on City trees to ensure appropriate clearances from structures on private property.

- The maintenance standard for street trees shall be Level 3: "Medium" of the BC Society of Landscape Architects / BC Landscape and Nursery Association Landscape Standard (latest edition). The maintenance objective is generally neat, moderately groomed appearance with some tolerance for the effects of "wear and tear".

- Control of insects and pests on City trees will be conducted through an Integrated Pest Management (IPM) approach. Physical, cultural and biological control methods shall receive initial consideration for managing pests on City trees. Chemical controls will only be considered where a mix of other strategies has failed and the pest level is above established threshold levels.

- Trees in "natural areas" will be maintained in as natural state as possible. Tree management work will be undertaken to address the following issues:

    1. Safety: May involve falling or pruning. Where feasible, all resulting vegetation debris will be left on-site as habitat.
    2. Tree health: Trees may be pruned or removed where they are interfering with the health of other trees growing in the immediate area.
    3. Management Plans: Undertaken to achieve specific objectives as part of a park plan and may involve removals, pruning, or planting.

## 7.0 Damage to Property or Services

- Where it is deemed City trees may be responsible for damage to private property or services residents will be requested to outline their claims in writing to the City.

- Damage from tree roots is considered a "nuisance" and there is no liability upon Municipalities in B.C. on actions based on nuisance. Therefore, by virtue of the current Provincial Statute Law governing Municipalities, the City of North Vancouver is not responsible for such damage resulting from City trees.

## 8.0 Tree Planting

- Where trees are removed from City property, suitable replacement tree will be planted during the planting season where budget constraints allow. In a street tree situation the resident will be given a choice of appropriate species for the site, depending on the location, availability and landscape planning objectives. The final choice of species remains at the entire discretion of the Manager, Environment and Parks.

- All trees planted on City property must meet the standards outlined in City's *Tree Planting Specifications* (attachment 3).

- Members of the public may apply to the Manager, Environment and Parks, to plant a tree on City boulevards. The application process is outlined in the Street & Traffic Bylaw, 1991, No. 6234.

- Members of the public may apply, in writing to the Manager, Environment and Parks, to have a commemorative tree planted within a City park. The application process is outlined in the Parks Regulation Bylaw, 1996, No. 6611.

- Prior to the undertaking of either programmed or requested tree plantings on City property, the planting sites will be evaluated to assess restrictions imposed by services (overhead and underground) and sight lines for both traffic and pedestrian visibility.

  a) No trees will be planted on City property where it is deemed a safety issue may result.
  b) Trees that have growth characteristics likely to cause a hazard, will not be planted under Hydro lines.

**9.0 Trees on Private Property**

- The City of North Vancouver Tree Policy governs the management of trees on City property only. At this time the City does not have a Tree Protection Bylaw that governs private property.

- Residents are reminded that other regulations, including the federal *Fisheries Act*, and the provincial *Wildlife Act* can effect the removal of trees from private property, and appropriate approvals may be required.

- Where residents consider themselves impacted by a tree(s) located on private property, or where they consider such tree(s) to be dangerous or block views, they are to resolve their concerns with the property owner on whose property the tree(s) are located.

**10.0 Trees Impacted by Development**

- The City of North Vancouver encourages the development community to retain significant, on-site trees wherever possible, and to augment existing trees with additional trees where appropriate.

- Development applications requiring Council approval (Rezoning, Development Variance Permit, etc) must give consideration to the retention of significant trees. Existing trees should be noted on submissions for consideration of retention and protection.

**Attachment 1**

The Corporation of **THE CITY OF NORTH VANCOUVER**

**Application for**

# PETITION TO REMOVE TREES

Name ______________________________ Telephone ________________________

Address __________________________________ Postal Code _________________

Location of the tree(s) to be removed

______________________________________________________________________

*(please provide sketch below)*

It should be noted that it is the responsibility of the petitioner to:

* Petition **all** the property owners within 60m of the tree(s). All affected property must support the removal of the tree(s).
* Submit the **completed** petition to the Engineering Department. Upon receipt, a report will be prepared for consideration by City Council. In all cases the City retains absolute discretion to refuse to remove any tree.
* Bear the cost of the tree removal and replacement by a Certified Arborist who has insurance indemnifying the City from all costs arising from the work, and who has a current business licence.

**Attachment 2**

The Corporation of **THE CITY OF NORTH VANCOUVER**

# TREE REPLACEMENT CRITERIA

All trees removed from City property must be replaced based on the criteria described in this document, unless otherwise directed by the Manager, Environment and Parks. Replacement trees must meet the City standards detailed in the *Tree Planting Specifications* provided in Attachment 3.

## Street Tree Replacement:

| Diameter* of trees cut or removed | Replacement Criteria |
|---|---|
| Less than 300 mm | 1 replacement street tree |
| 301 mm to 600 mm | 2 replacement street trees |
| 601 mm or greater | 3 replacement street trees. |

## Natural Area Tree Replacement:

| Diameter* of trees cut or removed | Replacement Criteria |
|---|---|
| 100 mm to 151 mm. | 2 replacement trees (min. of 1.5 m ), or, 4 native shrubs (for up to 50% of trees being replaced in this range) |
| 152 mm to 304 mm | 3 replacement trees (min. height of 1.5 m.) |
| 305 mm to 456 mm. | 4 replacement trees (min. height of 1.5 m.) |
| 457 mm to 609 mm | 6 replacement trees (min. height > 2.0 m.) |
| 610 mm or greater | 8 replacement trees (min. height > 2.0 m.) |

*diameter measured from a height of 150 centimeters above the natural grade

| Species of native trees cut or removed | Alternative replacement species |
|---|---|
| Grand Fir *Abies grandis* | Douglas Fir or Western Hemlock |
| Bigleaf Maple *Acer macrophyllum* | Western Paper Birch or Trembling Aspen |
| Red Alder *Alnus runbra* | Big leaf Maple or Western Paper Birch |
| Western Paper Birch *Betula papyrifera* | Big leaf Maple or Trembling Aspen |
| Sitka Spruce *Picea sitchensis* | Shore Pine or Douglas Fir |
| Trembling Aspen *Populus tremuloides* | Black Cottonwood |
| Black Cottonwood Populus *trichocarpa* | Red Alder or Western Paper Birch |
| Shore Pine *Pinus contorta* | Douglas Fir |
| Douglas Fir *Pseudotusga menziesii* | Western Red Cedar |
| Western Red Cedar *Thuja plicata* | Grand Fir or Douglas Fir |
| Western Hemlock *Tsuga heterophylla* | Grand Fir or Douglas Fir or Western Red Cedar |

The Corporation of **THE CITY OF NORTH VANCOUVER**

## TREE PLANTING SPECIFICATIONS

- All tree installations shall adhere to these standards whenever public or private projects are required to supply and install trees on City property.

- Species selection will be taken from the City's recommended species list. The Manager, Environment and Parks shall approve all tree species selection and planting on City property.

- All plants, planting, and workmanship and materials shall meet or exceed the guidelines set forth in the BC Landscape Standard (latest edition) unless otherwise directed by the Manager, Environment and Parks.

- Trees should be provided by ball and burlap, tree spade or container grown methods. Bare root specimens are not allowed without permission from the City. All trees shall meet or exceed the requirements of the Canadian Standards for Nursery Stock (latest edition). Trees shall be of standard and quality, true to name and type, and representative of their species variety.

- All street trees shall be provided at the following minimum size:
  - Shade trees: 4 – 5 cm caliper
  - Ornamental trees: 4 – 5 cm caliper
  - Coniferous trees: 3.0 m height

- All street trees must have a minimum 2.0 m standard height, as measured from the top of the root ball to the first branch.

- Tree shall have normal, well-developed branch structure and vigorous root systems. They shall be free of defects, decay, sunscald, abrasions of the bark, insects and all forms of infestations or objectionable disfigurements.

- All trees installed are subject to rejection if they fail to comply with the standards referenced in this document.

- Refer to CNV Standard Drawing PL-04, *Street Tree – Turf Boulevard Application*.

# Appendix 5: Planting Details

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NOTES:

THIS TREE PLANTING DETAIL IS USED WHEN PLANTING A TREE IN A TYPICAL UNCOMPACTED OPEN SPACE AREA.

ALL PLANTS & PLANTING ARE TO CONFORM TO THE B.C. LANDSCAPE STANDARD.

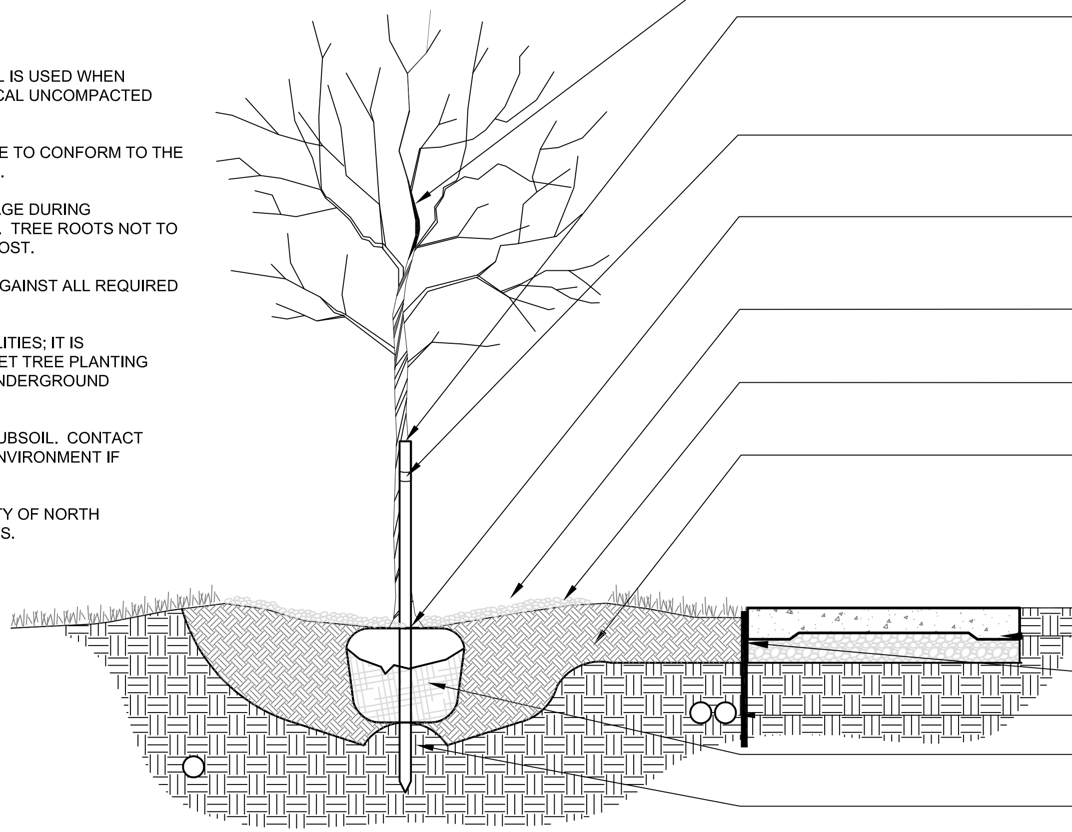
PROTECT TREE FROM DAMAGE DURING TRANSPORT AND PLANTING. TREE ROOTS NOT TO BE EXPOSED TO SUN OR FROST.

CONFIRM TREE LOCATION AGAINST ALL REQUIRED OFFSETS.

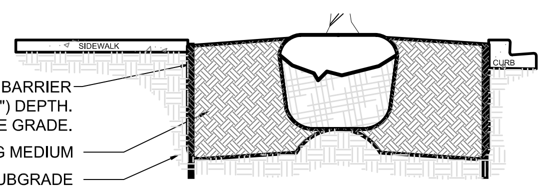
CONFIRM LOCATION OF UTILITIES; IT IS RECOMMENDED THAT STREET TREE PLANTING PITS BE DUG BY HAND AS UNDERGROUND SERVICES MAY EXIST.

CONFIRM FREE DRAINING SUBSOIL. CONTACT MANAGER OF PARKS AND ENVIRONMENT IF PROBLEMS ARISE.

PROVIDE IRRIGATION TO CITY OF NORTH VANCOUVER REQUIREMENTS.




1 PL-17 Linear Planting Channel
Planting Channels




2 PL-17 Root Barrier
Planting Channels

City of North Vancouver
Parks + Environment

| drawing title | | | | revised |
|---|---|---|---|---|
| **Planting Channels** | | | | |
| designed | drawn | H/D location | | drawing no. |
| scale n.t.s. | | date 1 Dec 2004 | plot scale | **PL-17** |

NOTES:

THIS TREE PLANTING DETAIL IS FOR LINEAR PLANTING CHANNEL PARALLEL TO STREET FOR USE IN BOULEVARD AREAS BETWEEN THE CURB AND SIDEWALK WHERE ADJACENT LANDSCAPE AREAS OCCUR ON FAR SIDE OF SIDEWALK.

ALL PLANTS & PLANTING ARE TO CONFORM TO THE B.C. LANDSCAPE STANDARD.

STRUCTURAL SOIL MATERIALS AND INSTALLATION MUST CONFORM TO MUNICIPAL STANDARDS AND PROJECT SPECIFICATIONS.

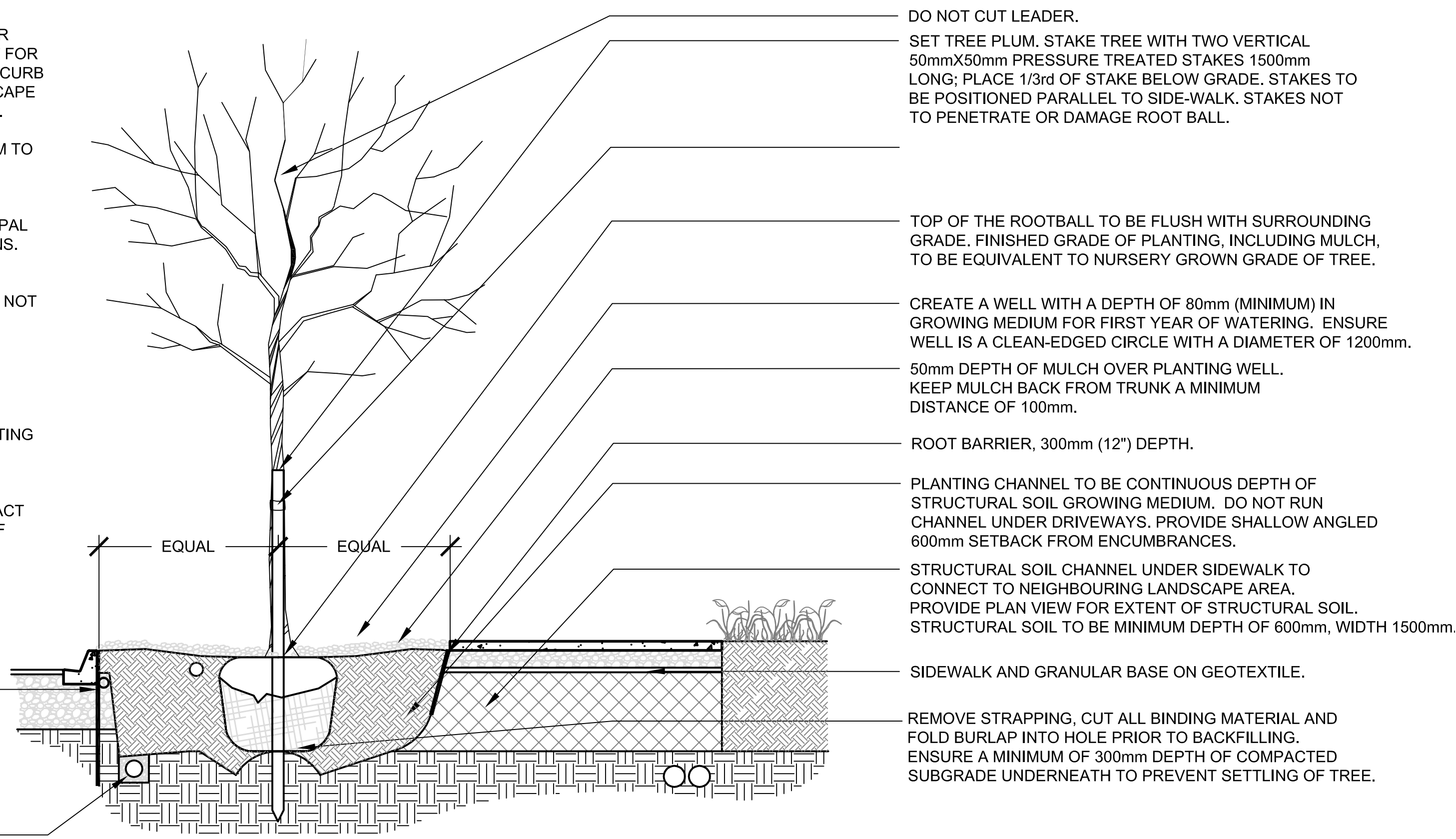
PROTECT TREE FROM DAMAGE DURING TRANSPORT AND PLANTING. TREE ROOTS NOT TO BE EXPOSED TO SUN OR FROST.

CONFIRM TREE LOCATION AGAINST ALL REQUIRED OFFSETS.

CONFIRM LOCATION OF UTILITIES; IT IS RECOMMENDED THAT STREET TREE PLANTING PITS BE DUG BY HAND AS UNDERGROUND SERVICES MAY EXIST.

CONFIRM FREE DRAINING SUBSOIL. CONTACT MANAGER OF PARKS AND ENVIRONMENT IF PROBLEMS ARISE.

PROVIDE IRRIGATION TO CITY OF NORTH VANCOUVER REQUIREMENTS.




City of North Vancouver
Parks + Environment

| | | | |
|---|---|---|---|
| drawing title: **Break Out Sections of Structural Soil** | | | revised |
| designed | drawn | H/D location | |
| scale | date: 1 Dec 2004 | plot scale | drawing no.: **PL-18** |

NOTES:

THIS TREE PLANTING DETAIL IS FOR A LINEAR PLANTING CHANNEL OF STRUCTURAL SOIL PARALLEL TO STREET FOR USE IN HARD SURFACE BOULEVARD AREAS.

ALL PLANTS & PLANTING ARE TO CONFORM TO THE B.C. LANDSCAPE STANDARD.

STRUCTURAL SOIL MATERIALS AND INSTALLATION MUST CONFORM TO MUNICIPAL STANDARDS AND PROJECT SPECIFICATIONS.

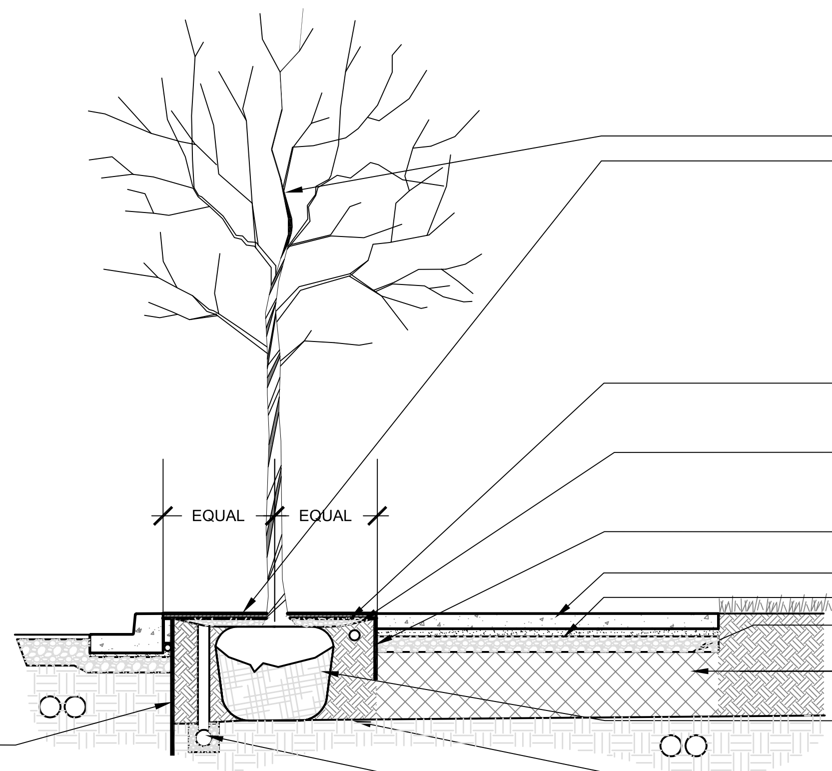
PROTECT TREE FROM DAMAGE DURING TRANSPORT AND PLANTING. TREE ROOTS NOT TO BE EXPOSED TO SUN OR FROST.

CONFIRM TREE LOCATION AGAINST ALL REQUIRED OFFSETS.

CONFIRM LOCATION OF UTILITIES; IT IS RECOMMENDED THAT STREET TREE PLANTING PITS BE DUG BY HAND AS UNDERGROUND SERVICES MAY EXIST.

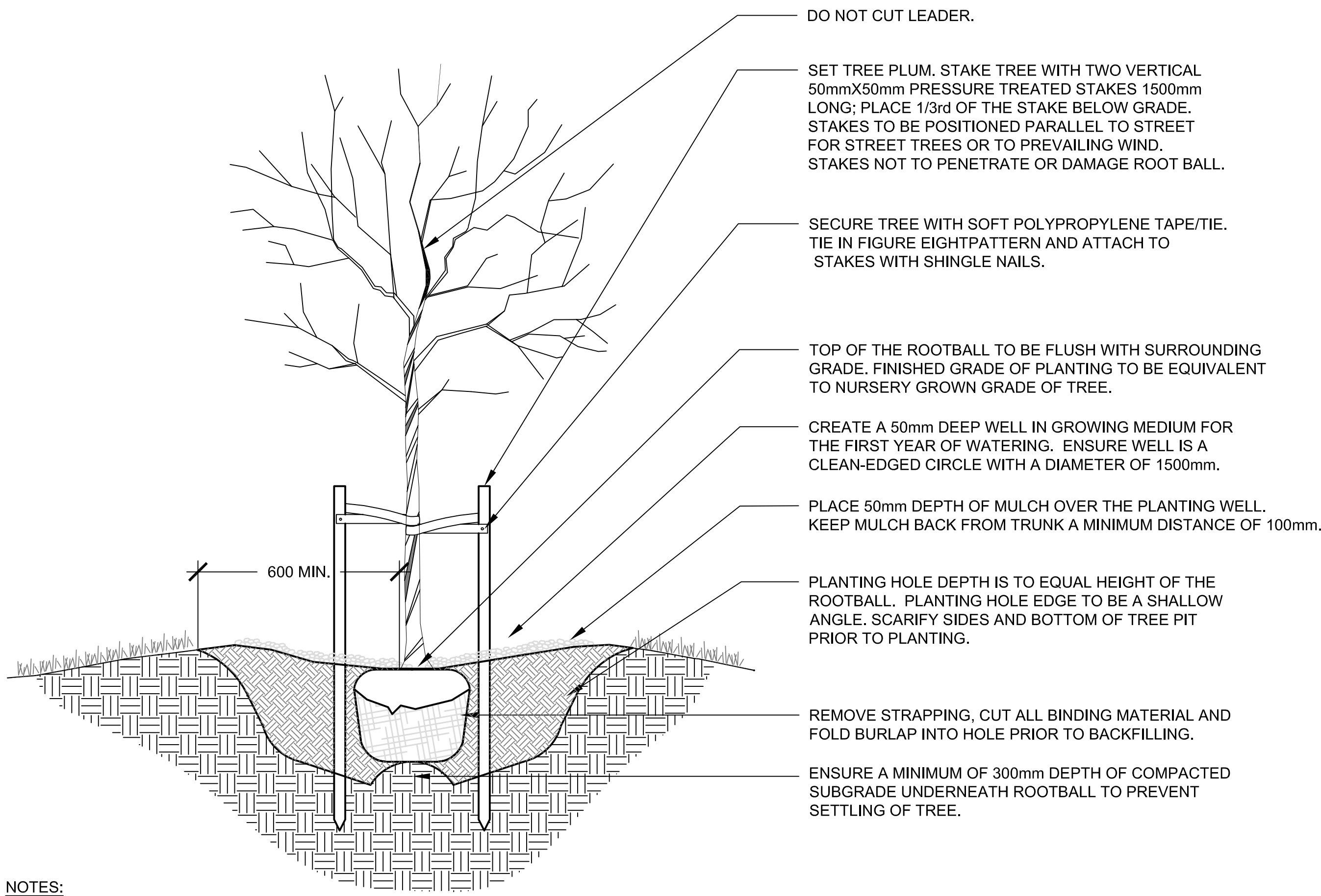
CONFIRM FREE DRAINING SUBSOIL. CONTACT MANAGER OF PARKS AND ENVIRONMENT IF PROBLEMS ARISE.

PROVIDE IRRIGATION TO CITY OF NORTH VANCOUVER REQUIREMENTS.




City of North Vancouver
Parks + Environment

| | | | | |
|---|---|---|---|---|
| drawing title: **Structural Soil Channel** | | | | revised |
| designed | drawn | H/D location | | |
| scale: n.t.s. | | date: 1 Dec 2004 | plot scale | drawing no.: **PL-19** |




NOTES:

THIS TREE PLANTING DETAIL IS USED WHEN PLANTING A TREE IN A TYPICAL UNCOMPACTED OPEN SPACE AREA.

ALL PLANTS & PLANTING ARE TO CONFORM TO THE B.C. LANDSCAPE STANDARD.

PROTECT TREE FROM DAMAGE DURING TRANSPORT AND PLANTING.  TREE ROOTS NOT TO BE EXPOSED TO SUN OR FROST.

CONFIRM TREE LOCATION AGAINST ALL REQUIRED OFFSETS.

CONFIRM LOCATION OF UTILITIES; IT IS RECOMMENDED THAT STREET TREE PLANTING PITS BE DUG BY HAND AS UNDERGROUND SERVICES MAY EXIST.

CONFIRM FREE DRAINING SUBSOIL.  CONTACT MANAGER OF PARKS AND ENVIRONMENT IF PROBLEMS ARISE.

PROVIDE IRRIGATION TO CITY OF NORTH VANCOUVER REQUIREMENTS.

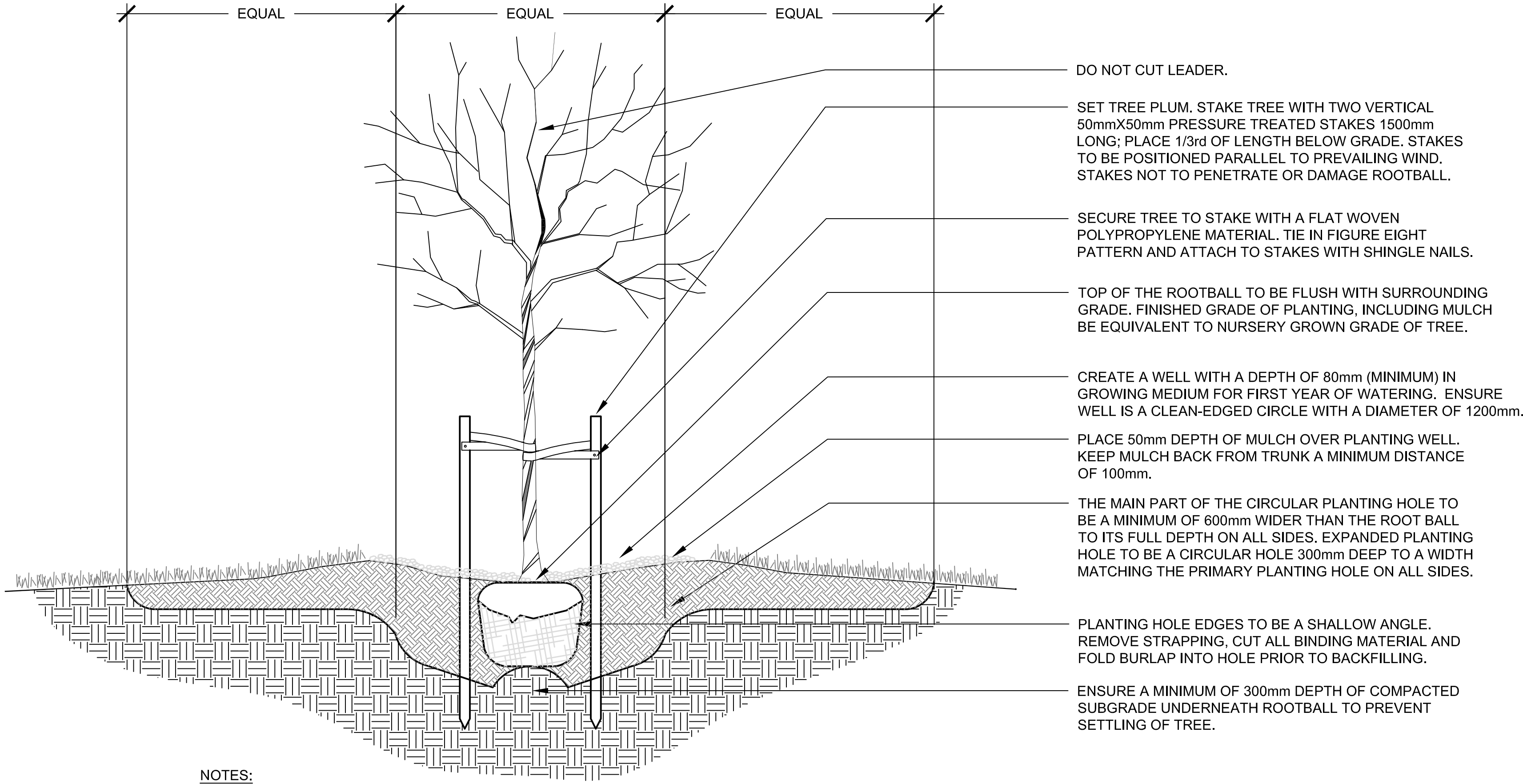
City of North Vancouver
Parks + Environment

CITY OF NORTH VANCOUVER — LION OF THE NORTH

drawing title
# Street Tree - Turf Boulevard Application
## (Open Space Planting)

| designed | drawn | H/D location | | revised |
|---|---|---|---|---|
| scale | | date 1 Dec 2004 | plot scale | |

drawing no.
**PL-20**




NOTES:

THIS TREE PLANTING DETAIL IS FOR A LINEAR PLANTING CHANNEL PARALLEL TO STREET; IT IS FOR USE IN OPEN SPACE AREAS WHERE SOILS HAVE BEEN COMPACTED OR WHERE POOR SOILS ARE ENCOUNTERED.

ALL PLANTS & PLANTING ARE TO CONFORM TO THE B.C. LANDSCAPE STANDARD.

PROTECT TREE FROM DAMAGE DURING TRANSPORT AND PLANTING. TREE ROOTS NOT TO BE EXPOSED TO SUN OR FROST.

CONFIRM TREE LOCATION AGAINST ALL REQUIRED OFFSETS.

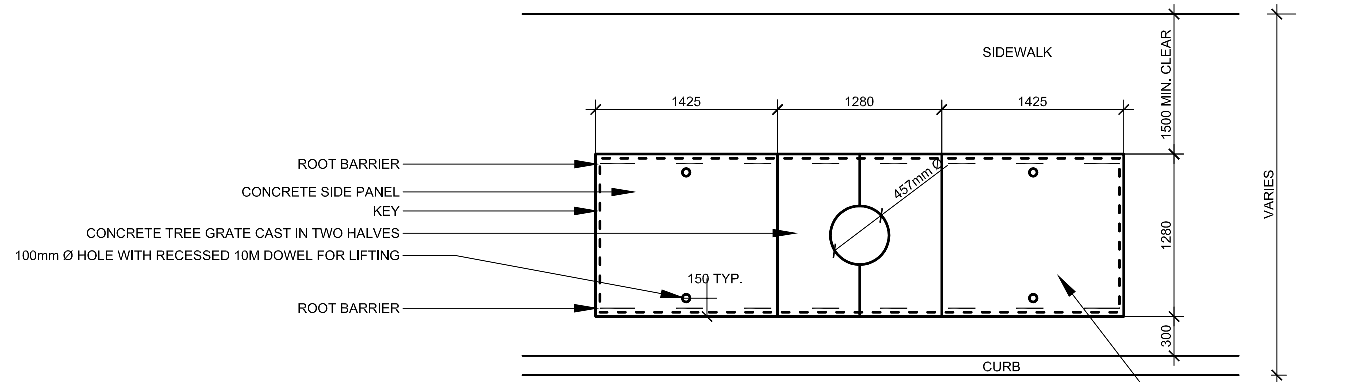
CONFIRM LOCATION OF UTILITIES; IT IS RECOMMENDED THAT STREET TREE PLANTING PITS BE DUG BY HAND AS UNDERGROUND SERVICES MAY EXIST.

CONFIRM FREE DRAINING SUBSOIL. CONTACT MANAGER OF PARKS AND ENVIRONMENT IF PROBLEMS ARISE.

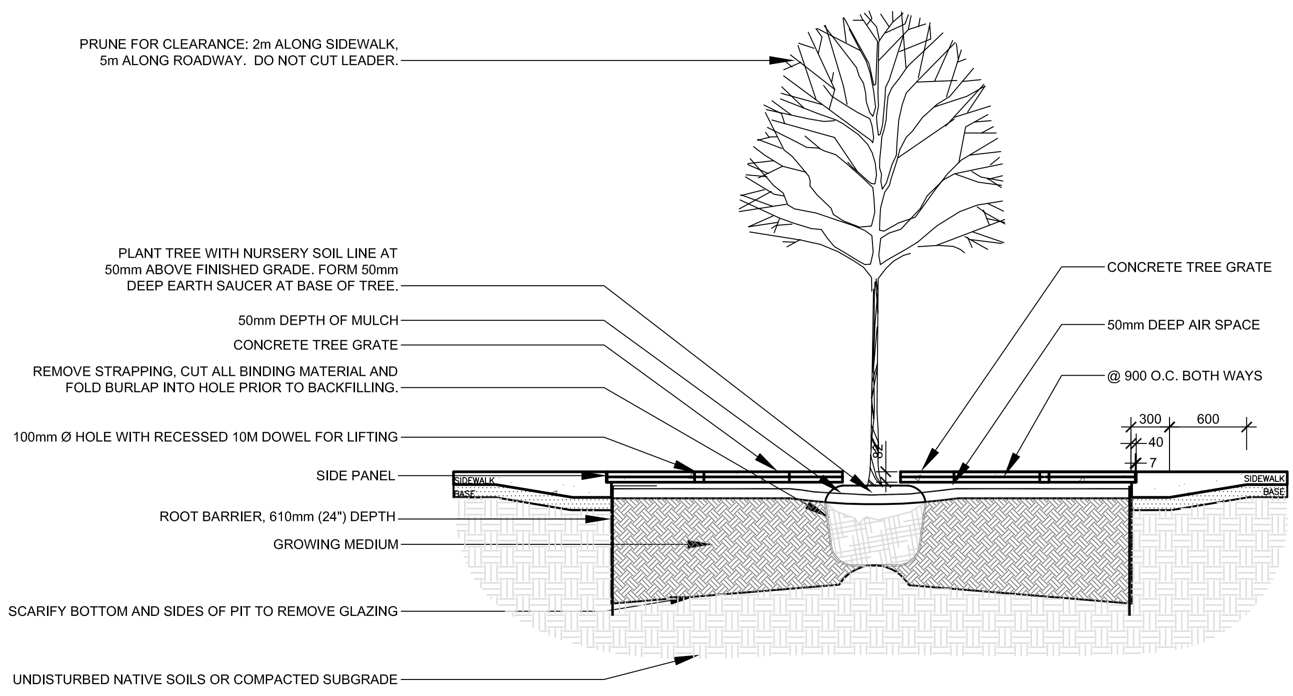
PROVIDE IRRIGATION TO CITY OF NORTH VANCOUVER REQUIREMENTS.

City of North Vancouver
Parks + Environment

| | | | |
|---|---|---|---|
| drawing title: **Street Tree in Compacted or Poor Soil Turf/Boulevard/Open Space Application** | | | revised |
| designed | drawn | H/D location | drawing no. |
| scale: n.t.s. | date: 1 Dec 2004 | plot scale | PL-21 |




1 PL-22 Plan View
Tree Planting in Pavement Type 1




2 PL-22 Section
Tree Planting in Pavement Type 1

NOTES:
THIS TREE PLANTING DETAIL IS USED WHEN PLANTING A TREE IN A HARDSCAPE SITUATION.

ALL PLANTS AND PLANTING ARE TO CONFORM TO THE B.C. LANDSCAPE STANDARD.

PROTECT TREE FROM DAMAGE DURING TRANSPORT AND PLANTING. TREE ROOTS NOT TO BE EXPOSED TO SUN OR FROST.

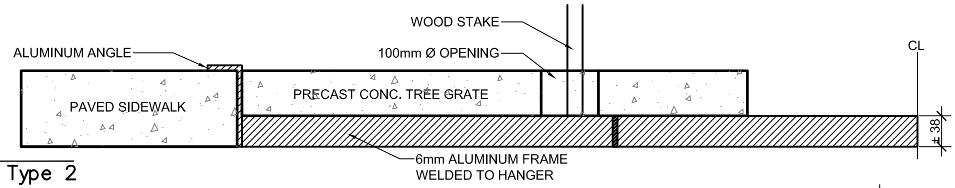
CONFIRM LOCATION OF UTILITIES; IT IS RECOMMENDED THAT STREET TREE PLANTING PITS BE DUG BY HAND AS UNDERGROUND SERVICES MAY EXIST.

CONFIRM FREE DRAINING SUBSOIL. CONTACT MANAGER OF PARKS AND ENVIRONMENT IF PROBLEMS ARISE.

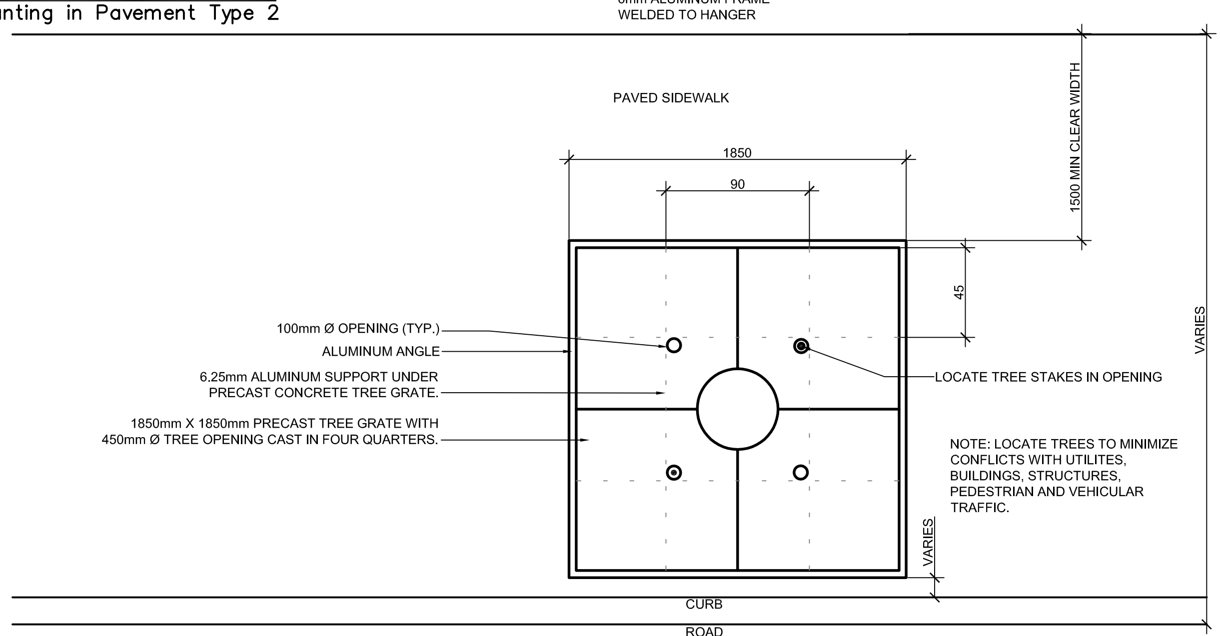
PROVIDE IRRIGATION TO CITY OF NORTH VANCOUVER REQUIREMENTS.

City of North Vancouver
Parks + Environment

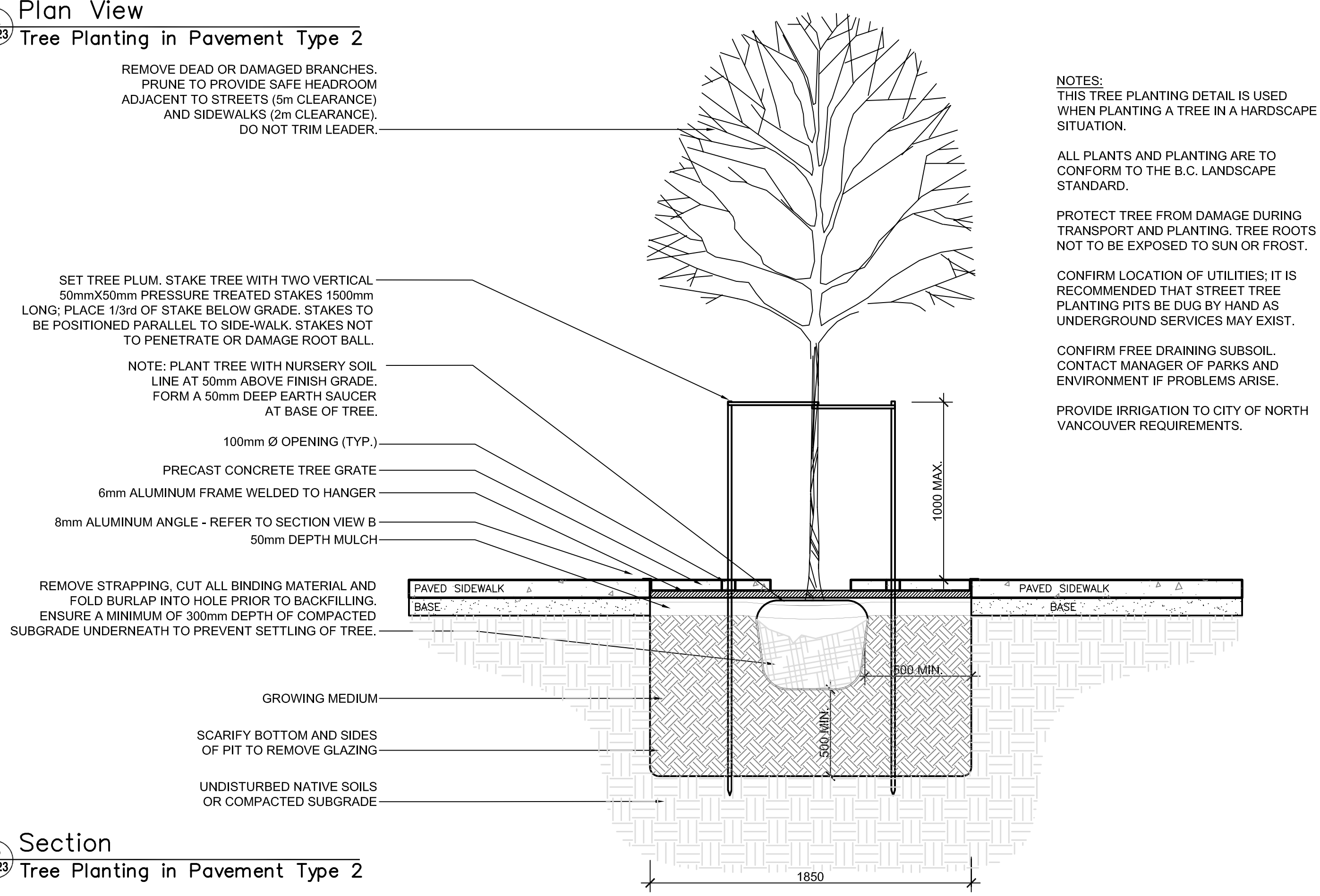
| drawing title | | | | revised |
|---|---|---|---|---|
| **Tree Planting in Pavement Type 1** | | | | |
| designed | drawn | H/D location | | drawing no. |
| scale n.t.s. | | date 1 Dec 2004 | plot scale | **PL-22** |




1 PL-23 Detail Section
Tree Planting in Pavement Type 2




2 PL-23 Plan View
Tree Planting in Pavement Type 2




NOTES:

THIS TREE PLANTING DETAIL IS USED WHEN PLANTING A TREE IN A HARDSCAPE SITUATION.

ALL PLANTS AND PLANTING ARE TO CONFORM TO THE B.C. LANDSCAPE STANDARD.

PROTECT TREE FROM DAMAGE DURING TRANSPORT AND PLANTING. TREE ROOTS NOT TO BE EXPOSED TO SUN OR FROST.

CONFIRM LOCATION OF UTILITIES; IT IS RECOMMENDED THAT STREET TREE PLANTING PITS BE DUG BY HAND AS UNDERGROUND SERVICES MAY EXIST.

CONFIRM FREE DRAINING SUBSOIL. CONTACT MANAGER OF PARKS AND ENVIRONMENT IF PROBLEMS ARISE.

PROVIDE IRRIGATION TO CITY OF NORTH VANCOUVER REQUIREMENTS.

3 PL-23 Section
Tree Planting in Pavement Type 2

City of North Vancouver
Parks + Environment

| drawing title | | | | |
|---|---|---|---|---|
| **Tree Planting in Pavement Type 2** | | | | |
| designed | drawn | H/D location | | drawing no. |
| scale: n.t.s. | | date: 1 Dec 2004 | plot scale | **PL-23** |

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# Appendix 6: Structural Soils

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# 1. Structural Soil Specification

## 1.1 General

Structural Soil is to be installed under hard surface paved areas where additional growing medium is required to provide adequate space for tree root development. Do not place Structural Soil in planting beds or planting pits.

## 1.2 Structural Soil Material Mix

1.2.1 Structural soil is a consistent even distribution of its components. The ratio of components may vary and require adjustment to ensure soil volume is adequate to fill all voids in the stone.

1.2.2 The following is a recommended base ratio of materials for structural soil:

- ❑ 4 cu metre of aggregate stone
- ❑ 1.5 cu metre of Growing Medium
- ❑ 2 kg Stabiliser
- ❑ water is required – the amount of water will vary according to moisture present in Growing Medium

1.2.3 The stone, growing medium and stabilizer product are to be combined into a homogeneous mixture.

## 1.3 Growing Medium

1.3.1 Table One

The growing medium within the structural soil mix to meet the following requirements:

| **Table One** – Properties of Growing Medium for Structural Soil | |
|---|---|
| **Texture**: particle size classes by the Canadian System of Soil Classification | |
| Gavel: greater than 2 mm – less than 75 mm | 0 |
| Sand: greater than 0.05 mm – less than 2 mm | maximum 60% |
| Silt: greater than 0.002 mm – less than 0.05 mm | maximum 35% |
| Clay less than 0.002 mm | maximum 15% |
| Clay & Silt Combined | maximum 40% |
| **Acidity** (Ph) | 6.0-7.0 |
| **Salinity**: saturated extract conductivity shall not exceed | 3.0 millimhos/cm at 25 degrees Celsius |
| **Organic Content**: percent of dry weight (%) | 8-12% |

## 1.4 Aggregate

1.4.1 Clean stone of high angularity is required.

1.4.2 Stone dimension aspect ratio should approach 1:1:1: with a maximum of 2:1:1 length:width:depth.

1.4.3 Single size stone, 60mm to 75mm clear sieve designation, blasted quarry rock.

1.4.4 Aggregate to be free of foreign elements or material.

1.4.5 Aggregate quality: material shall be sound hard, durable, free from soft, thin, elongated or laminated particles, organic material, clay lumps, or other substances that would act in a deleterious manner for use intended.

## 1.5 Soil Stabilizer

1.5.1 A non-toxic organic binder, for example *The Natural Solution* as available from Sport Turf Inc. Tel: (604) 850-7857.

## 1.6 Filter Fabric

1.6.1 After adequate compaction of the structural soil is confirmed, non-woven filter fabric is to be installed as a separation layer directly above the compacted structural soil mixture.

1.6.2 Filter fabric to conform to the following ASTM designations:

| | | |
|---|---|---|
| Grab Tensile Strength | ASTM-D-4632 | .400kN |
| Tensile Elongation | ASTM-D-4632 | 50% |
| Mullen Burst | ASTM-D-3786 | 1270 kPa |
| Flow Rate | ASTM-D-4491 | 6300l/min/sq.m |

## 1.7 Sub Drains

1.7.1 Sub drains connected to the municipal drainage system are to be provided prior to installation of the structural soil mixture as indicated on servicing landscape plans.

## 1.8 Irrigation

1.8.1 Install an automatic irrigation system in co-ordination with installation of the structural soils as indicated on servicing or landscape plans.

## 1.9 Sub Grade

1.9.1 Structural soil areas to be excavated to Master Municipal Specifications Section 0223, Trenching, Excavation and Compaction, allowing for design depth and width of structural soil mix.

1.9.2 The sub grade is to be graded to provide for trench depths as required. Sub grade of areas designated as structural soil are to be prepared to ninety-five percent (95%) Modified Proctor Density and shall be free of stones, debris, root branches, toxic materials, building materials and other deleterious materials.

1.9.3 Sub grade is to slope to subsurface drain lines where provided.

## 1.10 Mixing

1.10.1 Mixing is to be performed on a clean, flat, hard, level surface using appropriate soil mixing equipment.

1.10.2 Over handling can result in separation of the growing medium from the stone.

1.10.3 Mix ingredients to the proportions indicated in the table, section 1.2.

## 1.11 Placement

1.11.1 Structural soil should be moist, but not saturated when placed.

1.11.2 Structural soil is to be compacted as required to achieve the equivalent of 95% Modified Proctor Density.

1.11.3 After approval of structural soil mixture compaction, install filter fabric. A 600mm overlap of all fabric seams and beyond edge of structural soil to be provided.

## 1.12 Finish Treatment

1.12.1 Granular base and paving surface to be placed on filter fabric (on structural soil). Compaction of the structural soil base is to be consistent with surrounding granular base materials.

1.12.2 Install finish treatment to the requirements of the contract. Refer to construction documents for relevant sections.

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# Appendix 7: Powerpoint Presentation

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# Urban Forest Master Plan

Urban Forest Master Plan

# Agenda for Staff Workshop B

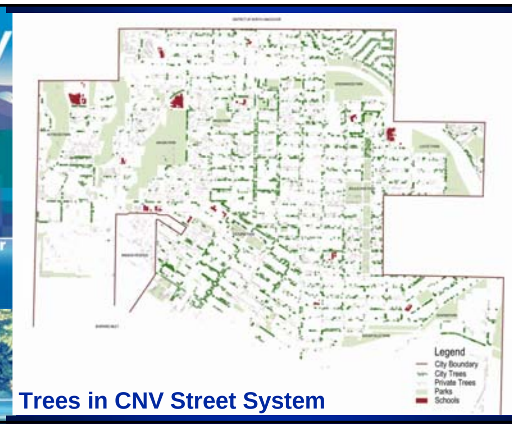
Urban Forest Master Plan

| | |
|---|---|
| 9:30 - 9:45 | Sign-In, Agenda |
| 9:45 - 10:15 | Existing Urban Forest Character/Features |
| 10:15 -10:45 | Benefit:Cost of the Urban Forest |
| 10:45 -11:15 | Guiding Principles and Alternatives |
| 11:15 -12:00 | Preparation for Public Process |

# Existing Urban Forest Features

Urban Forest Master Plan

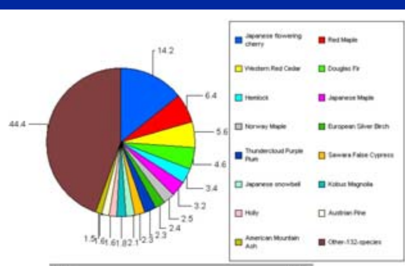
Urban Forest Master Plan




Trees in CNV Street System

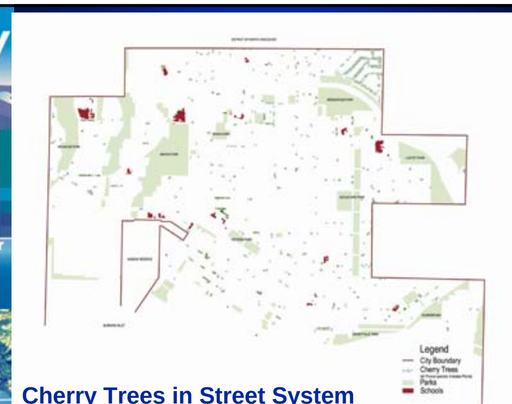
## Species Distribution

Urban Forest Master Plan

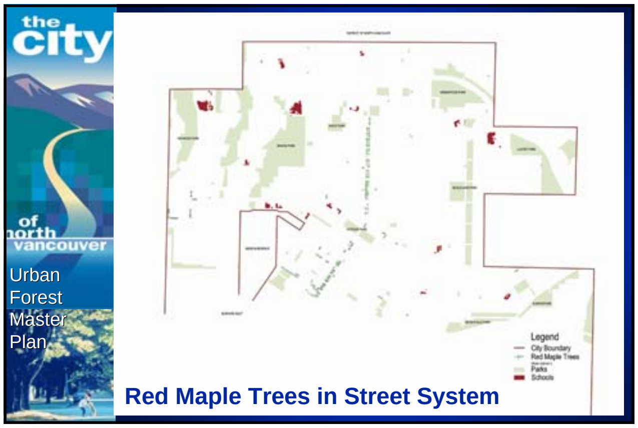


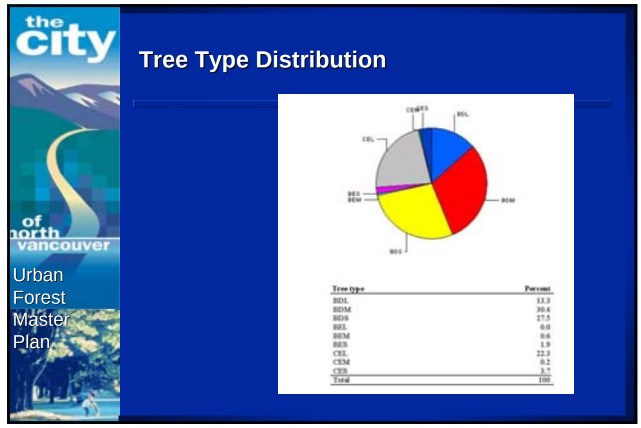

| Species | Percent |
|---|---|
| Japanese flowering cherry | 14.2 |
| Red Maple | 6.4 |
| Western Red Cedar | 5.6 |
| Douglas Fir | 4.6 |
| Hemlock | 3.4 |
| Japanese Maple | 3.2 |
| Norway Maple | 2.5 |

Urban Forest Master Plan

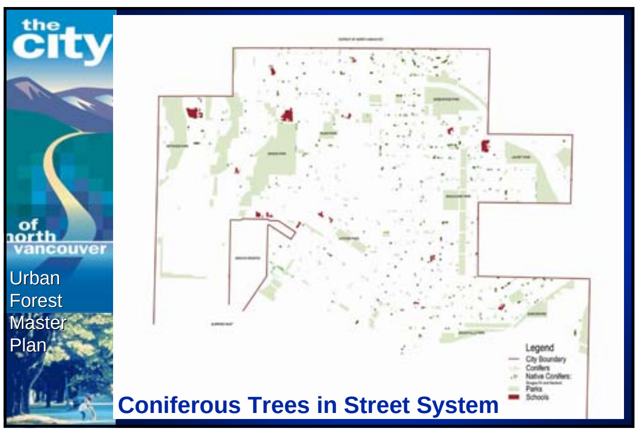


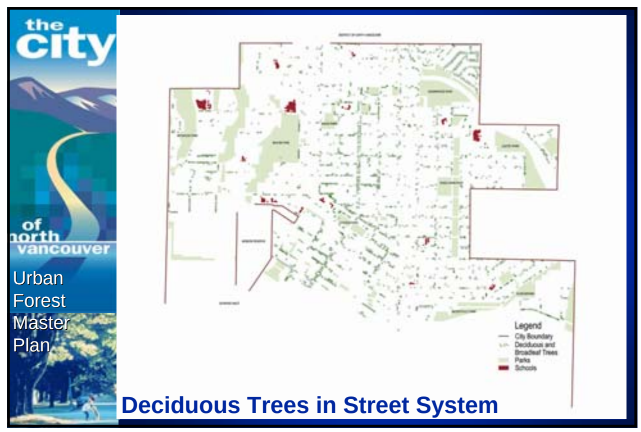

Cherry Trees in Street System

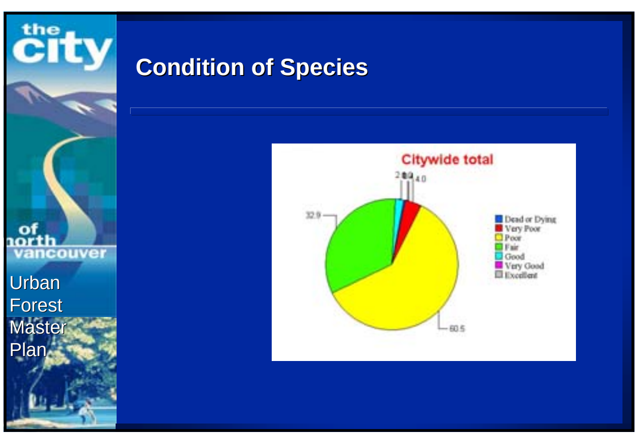


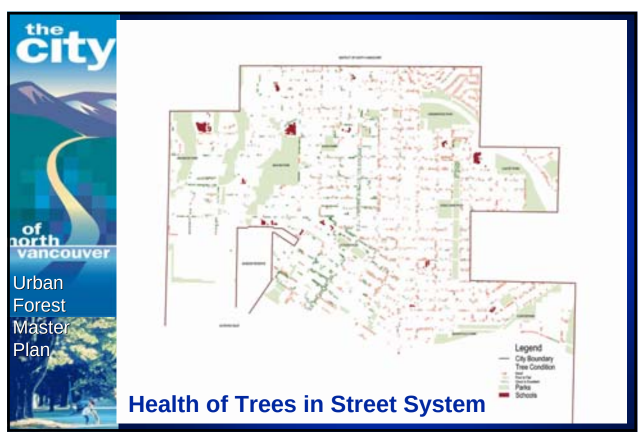



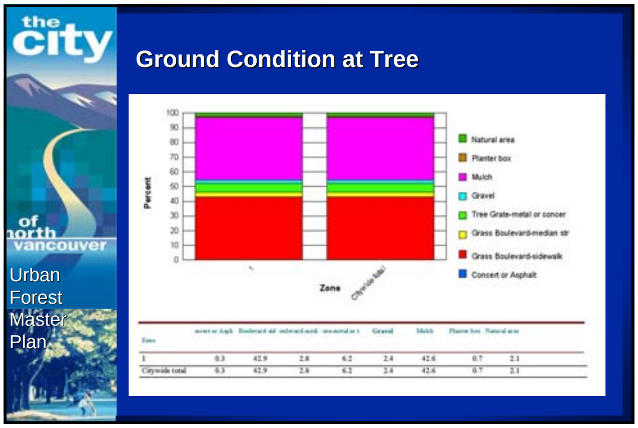

| Tree type | Percent |
|---|---|
| BDL | 13.3 |
| BDM | 30.4 |
| BDS | 27.5 |
| BEL | 0.0 |
| BEM | 0.6 |
| BES | 1.9 |
| CEL | 22.3 |
| CEM | 0.2 |
| CES | 3.7 |
| Total | 100 |



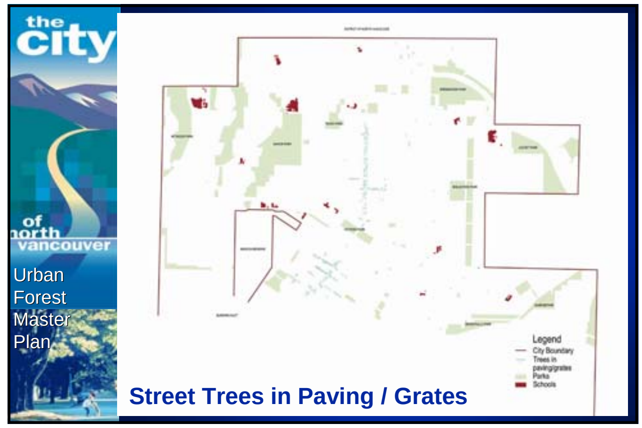



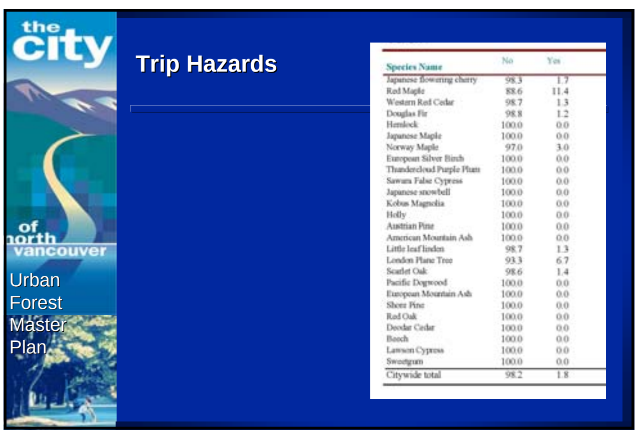



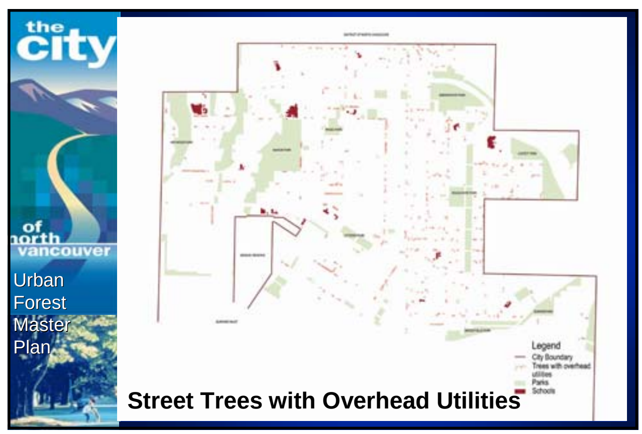


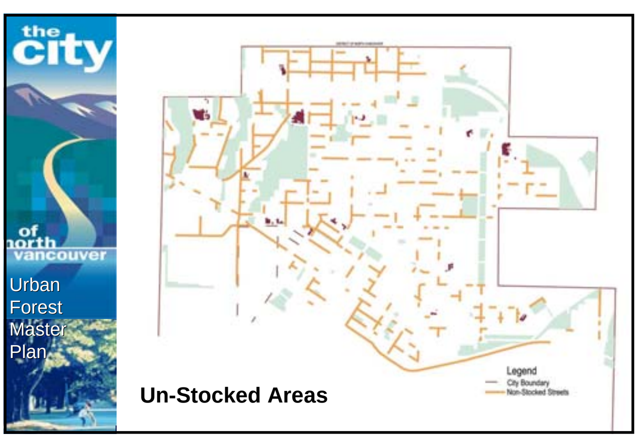

| Zone | [illegible] | [illegible] | [illegible] | [illegible] | Gravel | Mulch | Planter box | Natural area |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.3 | 42.9 | 2.8 | 6.2 | 2.4 | 42.6 | 0.7 | 2.1 |
| Citywide total | 0.3 | 42.9 | 2.8 | 6.2 | 2.4 | 42.6 | 0.7 | 2.1 |

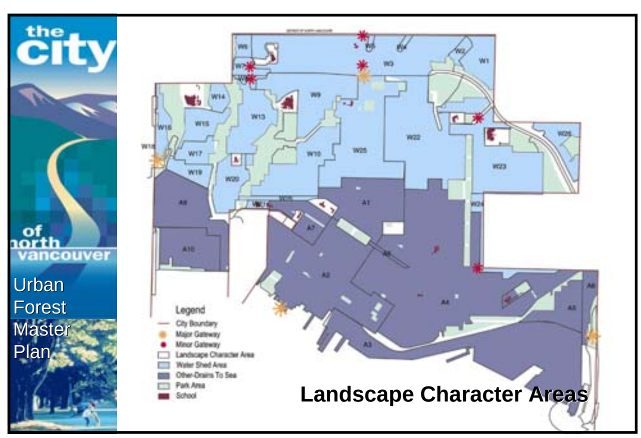



| Species Name | No | Yes |
|---|---|---|
| Japanese flowering cherry | 98.3 | 1.7 |
| Red Maple | 88.6 | 11.4 |
| Western Red Cedar | 98.7 | 1.3 |
| Douglas Fir | 98.8 | 1.2 |
| Hemlock | 100.0 | 0.0 |
| Japanese Maple | 100.0 | 0.0 |
| Norway Maple | 97.0 | 3.0 |
| European Silver Birch | 100.0 | 0.0 |
| Thundercloud Purple Plum | 100.0 | 0.0 |
| Sawara False Cypress | 100.0 | 0.0 |
| Japanese snowbell | 100.0 | 0.0 |
| Kobus Magnolia | 100.0 | 0.0 |
| Holly | 100.0 | 0.0 |
| Austrian Pine | 100.0 | 0.0 |
| American Mountain Ash | 100.0 | 0.0 |
| Little leaf linden | 98.7 | 1.3 |
| London Plane Tree | 93.3 | 6.7 |
| Scarlet Oak | 98.6 | 1.4 |
| Pacific Dogwood | 100.0 | 0.0 |
| European Mountain Ash | 100.0 | 0.0 |
| Shore Pine | 100.0 | 0.0 |
| Red Oak | 100.0 | 0.0 |
| Deodar Cedar | 100.0 | 0.0 |
| Beech | 100.0 | 0.0 |
| Lawson Cypress | 100.0 | 0.0 |
| Sweetgum | 100.0 | 0.0 |
| Citywide total | 98.2 | 1.8 |



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## Landscape Features

- Identified heritage trees.
- City Entrances
  - West side Marine Drive
  - East side Third
  - South side Lonsdale Quay/Esplanade
  - North side Lonsdale at Upper Levels
- Major Medians
  - Keith Road
  - Victoria Park
  - Grand Boulevard
  - Others?

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## City Gateways

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## City Gateways

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## Risks to the Street Tree System

- Lack of Maintenance of Existing Street Trees
- Poor Tree Pruning, leading to future costs
- Risk of Disease in monoculture plantings
- Improper planting design – leading to plant or sidewalk failure
- Need for on-going replacement plantings
- Loss of native evergreens

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## Pruning Risks

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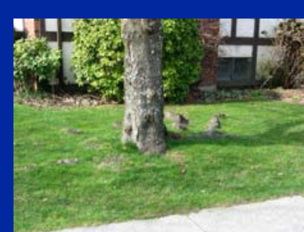
## Species Risks



## Site Constraints

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## Maintenance Risk


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## Benefit:Cost of the Urban Forest

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## Demonstration of Stratum Software

- Running the software
- Loading the software
- Reports
- Exporting data and printing
- Customizing/updating

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## Energy Savings / Yr
for Citywide street tree collection

- Electricity 34.1 MWH
- Gas 426.2 Mbtu
- Dollar value $6,514 / yr
- Equivalent to heating x?? homes in North Vancouver

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## Stormwater Savings / Yr
for Citywide street tree collection

- Total Rainfall Interception:
  521,948 US gallons,
  1.98 million litres
- Enough to fill up 20 swimming pools (6 x 12 x 1.36 meter backyard pool)
- Dollar value $66,362 / yr

## Air Quality Improvements / Yr
for Citywide street tree collection

- Removes 1013 lbs (460 kg) of Ozone, Nitrous Oxide, Particulate Matter, and Sulphur Dioxide
- Avoids production of 42.3 lbs (19 kg) of similar compounds by reduced energy use
- But contributes 1,440 lbs (653 kg) of Biogenic Volatile Organic Compounds (BVOCs) – contributors to ozone formation
- Dollar value of -$734/yr
- Could be neutral or better depending on species planted

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## Carbon Dioxide Reductions / Yr
for Citywide street tree collection

- Sequesters 1,264,752 lbs (569,138 kg) / year
- Through reduced energy use, avoids production of 4,560 lbs (2052 kg) /year
- Releases 334,379 lbs (150,471 kg) / year through decomposition & maintenance activities
- Net Reduction is 934,933 lbs (420,719 kg) / year
- Dollar value of $9,366 / yr
- Equivalent to CO2 emitted by about 78 lightweight vehicles (12,000 lb/year) in a year

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## Property Value Increase / Yr
for Citywide street tree collection

- Increases property values by $419,728 / yr
- Increase / tree averages $78.44 / yr
- Based on U.S. studies of increased sale prices on parcels with trees.

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## Average Annual Benefits by Tree Species ($)

| Species | Energy | CO2 | Air Quality | Stormwater | Property |
|---|---|---|---|---|---|
| Japanese flowering cherry | 1.28 | 1.29 | 0.11 | 1.29 | 43.55 |
| Red Maple | 1.10 | 1.52 | 0.00 | 4.14 | 83.19 |
| Western Red Cedar | -0.28 | 3.20 | 0.01 | 12.70 | 36.94 |
| Douglas Fir | 2.50 | 2.10 | -1.37 | 68.98 | 143.85 |
| Hemlock | 1.96 | 1.67 | -1.17 | 56.26 | 134.61 |
| Japanese Maple | 0.96 | 0.45 | 0.18 | 1.72 | 43.37 |
| Norway Maple | 1.35 | 2.67 | 0.23 | 9.87 | 98.88 |
| European Silver Birch | 1.37 | 3.00 | 0.24 | 9.89 | 105.55 |
| Thundercloud Purple Plum | 1.58 | 0.53 | 0.38 | 3.17 | 56.18 |
| Sawara False Cypress | 0.86 | 0.22 | -0.13 | 18.77 | 40.10 |
| Japanese snowbell | 0.09 | 0.44 | 0.00 | 0.70 | 26.20 |
| Kobus Magnolia | 0.34 | 0.15 | 0.00 | 1.72 | 50.57 |
| Holly | 1.83 | 0.76 | 0.45 | 3.76 | 60.84 |
| Austrian Pine | 0.91 | 1.59 | -0.75 | 23.55 | 124.16 |
| American Mountain Ash | 1.59 | 0.10 | 0.29 | 1.55 | 14.14 |
| Little leaf linden | 0.64 | 0.32 | 0.01 | 2.82 | 56.32 |
| London Plane Tree | 2.08 | 4.45 | -0.05 | 9.48 | 155.29 |
| Scarlet Oak | 1.15 | 2.32 | -0.12 | 2.76 | 99.72 |
| Pacific Dogwood | 1.96 | 2.50 | -3.65 | 24.14 | 156.83 |
| European Mountain Ash | 1.44 | 2.83 | 0.27 | 10.50 | 104.19 |
| Shore Pine | 0.62 | 0.42 | -0.17 | 10.34 | 49.67 |
| Red Oak | 1.56 | 3.07 | -0.16 | 4.80 | 126.63 |
| Deodar Cedar | 1.46 | 1.57 | -0.90 | 39.64 | 119.17 |
| Beech | 1.77 | 4.79 | -0.22 | 6.47 | 126.02 |
| Lawson Cypress | -0.32 | 4.07 | 0.01 | 13.26 | 40.65 |
| Sweetgum | 0.78 | 0.99 | -1.35 | 8.14 | 102.68 |

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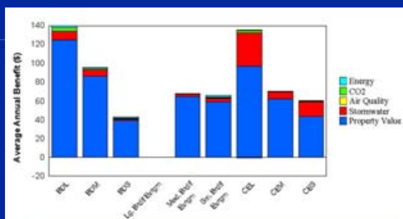
## Average Annual Benefits by Tree Type ($)




| Tree Type | Energy | CO2 | Air Quality | Stormwater | Property |
|---|---|---|---|---|---|
| BDL | 1.74 | 3.76 | -0.02 | 9.72 | 124.68 |
| BDM | 1.07 | 1.60 | -0.10 | 6.81 | 86.15 |
| BDS | 1.24 | 0.87 | 0.17 | 1.61 | 38.81 |
| Lg. Brdlf Evrgrn | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Med. Brdlf Evrgrn | 0.49 | 0.27 | -0.02 | 2.45 | 64.45 |
| Sm. Brdlf Evrgrn | 1.76 | 0.06 | 0.41 | 3.47 | 59.12 |
| CEL | 0.87 | 2.21 | -0.68 | 35.47 | 97.12 |
| CEM | 0.27 | 0.57 | -0.28 | 7.60 | 61.84 |
| CES | 0.76 | 0.29 | -0.15 | 15.54 | 43.51 |

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## Summary of Street Tree Values
for City of North Vancouver

- $501,000 / year $94 / tree / year
- Over 50 years

  $25 million $4,700 / tree

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## Management Costs($)

| Expenditures | Costs ($) |
|---|---|
| Contract Pruning | 0.00 |
| Tree & Stump Removal | 0.00 |
| Pest Management | 0.00 |
| Irrigation | 0.00 |
| Inspection/Service | 0.00 |
| Purchasing Trees and Planting | 0.00 |
| Administration | 0.00 |
| Litter Clean-up | 0.00 |
| Other Cost | 0.00 |
| Total Program Expenditures | 0.00 |
| Infrastructure Repairs | 0.00 |
| Liability/Claim | 0.00 |
| Total External Expenditures | 0.00 |
| Net Expenditures | 0.00 |

## Benefit:Cost Ratio

| Benefit | Total ($) | $/capita | $/tree |
|---|---|---|---|
| **Environmental** | | | |
| Energy | 6,514.00 | | 1.22 |
| CO2 | 9,366.00 | | 1.75 |
| Air Quality | -734.00 | | -0.14 |
| Stormwater | 66,362.00 | | 12.40 |
| | 81,508.00 | | 15.23 |
| **Other** | | | |
| Property Increase | 419,728.00 | | 78.44 |
| Grand Total: | **501,236.00** | | **93.67** |

| | Total ($) | $/capita | $/tree |
|---|---|---|---|
| Benefit | 501,236.00 | | 93.67 |
| Cost | 0.00 | | 0.00 |
| Net Benefits | 501,236.00 | | 93.67 |
| Benefit-Cost Ratio | 0.00 | 0.00 | 0.00 |

## Guiding Principles

## Overall Objective

To ensure the long-term sustainability of the City of North Vancouver's Urban Forest Assets.

## Guiding Principles

- Differentiate broad principles vs. policies
- Focus public discussion around broad principles
- Staff/Council deal with policy level issues

## Draft Guiding Principles

1. Ensure that existing benefits of the urban forest are sustained.
2. Enhance existing benefits by planting additional urban forest where feasible.
3. Plant smarter.
4. Pursue co-operative funding with senior agencies.

## Draft Guiding Principles

5. Follow the 'user pay' principle.
6. Balance taxpayer benefits and taxpayer support.
7. Encourage active roles for volunteers.
8. Expand the urban forest program to include other public properties and private property trees.

## Draft Policies (Staff) e.g.

- To maximize benefits, all streets should have a street tree component, subject to site constraints.
- Pursue planting of large trees to maximize benefits.
- Pursue retention/planting of evergreens for highest stormwater benefits.
- Protection of large remnant natives is a priority.

## Draft Policies (Staff) e.g.

- No single genus should exceed 30% of the program – restrict cherry planting.
- No single species should exceed 10% of the program – restrict red maple planting.
- Start a long-term fund for tree replacement, especially of cherries (short lived).
- Consider a variety of species in the replacement program.

## Draft Policies (Staff) e.g.

- Single Family Residential areas to be stocked and maintained in co-operation with neighbours.
- Multi-family, Commercial areas to be stocked and maintained by City.

## Draft Policies (Staff) e.g.

- For quality control in developments, on-street planting will be by City.
- Tree pruning/disease control of all street trees will be by City.
- Watering, and maintenance of grounds around tree will be by residents or strata in residential areas, by City in Commercial areas.

## Preparation for Public Process

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## Proposed Public Process

- Joint Committee Workshop (April 6)
- Focused on Earth Week / Arbour Day (April 22)
- Web-based Response Form
- Outreach through Press Release, Schools, Volunteers at Displays, and Council Presentation

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## Outline of Communication Materials

- Poster summarizing values of street trees
- Slide show for use by teachers, volunteers
- Visualization of one residential and one commercial street
- Press release and press kit
- Web backgrounder and response form

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## Joint EPAC / PRAC Meeting

- Review same material as today
- Unveil draft poster
- Present draft public response form
- Organize volunteers for School Liaison / Earth Week

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## Earth Week Public Process

- Advance information to key teachers, support materials (slides, poster, worksheets)
- News release and backgrounder
- Web backgrounder and response form
- Manned displays in key locations (malls, library / City Hall, high schools?)

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## Public Outreach Questions ?

1. Do you support the ‘General Objective’ and ‘Guiding Principles’ that have been generated?

*Choose one of* *Don’t Support* *Support* *Support with Refinements (name)*

List of guiding principles, eg.

- Ensure that existing benefits of the urban forest are sustained
- Enhance existing benefits where feasible, with a target of 30% gain.
- Plant smarter
- Pursue funding with senior agencies
- Etc.

Comments

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## Public Outreach Questions ?

2. For Street Trees on public land, the City should strive to:

*Choose one*

- ❑ Increase the number of planted trees;
- ❑ Maintain the same number;
- ❑ Reduce the number of planted trees (through die off/removals)

- Comments

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## Public Outreach Questions ?

3. The City should strive to protect and manage existing trees on <u>private</u> land by:

*Choose as many as you think should apply:*
- ❑ Public education;
- ❑ Incentives to keep/plant trees;
- ❑ Regulation to require permits before removing trees;
- ❑ Requirements for replacements during redevelopment.
- ❑ Other

- Comments

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## Public Outreach Questions ?

4. Given the comparison of potential benefits from large trees (like Douglas Fir or London Plane trees) and small trees (like Cherries or Magnolia), what do you think the City should strive to do in planting future street trees?

*Choose one:*
- ❑ Maintain the same balance of large to small trees as now;
- ❑ Increase the proportion of large trees;
- ❑ Increase the proportion of small trees.

- Comments

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## Public Outreach Questions ?

5.Street trees and their environs need maintenance at key stages for their long-term health and survival. Responsibilities for tree maintenance should be:

*Choose one:*
- ❑ City as sole maintenance provider for trees and boulevards;
- ❑ City maintains trees by pruning and disease control, adjacent residents/strata councils/businesses provide watering and adjacent landscape maintenance (e.g., grass cutting, planting and weeding of flower beds).
- ❑ All tree pruning, disease control, watering and adjacent landscape maintenance is provided by adjacent residents/strata councils/businesses.

- Comments

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## Public Outreach Questions ?

6. What is your level of satisfaction with the current level of tree and landscape maintenance on commercial streets/residential streets:

*Choose one:*
- ❑ Very satisfied;
- ❑ Somewhat satisfied;
- ❑ Not satisfied.

What improvements in tree-related services do you think are required? Please list.

- Comments

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## Public Outreach Questions ?

7. Would you or your family be interested in acting as a volunteer in support of street trees in the City of North Vancouver? Please indicate your interest:

*Choose any of the following:*
- ❑ Sorry, not able to volunteer
- ❑ Would provide charitable donation for tree(s)
- ❑ Would plant and maintain street tree provided by City
- ❑ Would maintain street tree planted by City
- ❑ Would adopt, plant and maintain a traffic circle or boulevard under City guidelines
- ❑ Other – your ideas

- Comments

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## Public Outreach Questions ?

8. Would you/your family pay a tax, rent or fee increase to support the planting and maintenance of street trees in the City of North Vancouver? Please indicate your level of support:

*Choose one:*
- ❑ $0 /yr
- ❑ $10/yr
- ❑ $20/yr
- ❑ $30/yr
- ❑ $40/yr

- Comments

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## Public Outreach Questions ?

9. Information About You

*Choose one:*
- Resident of City of North Vancouver (yes/no)
- If yes, home/business street address?
- Family is Owner, Renter or Business Occupier (choose one)
- Age Class

- Comments

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## Public Outreach Questions ?

10. General Comments on Street Trees in the City of North Vancouver

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