Draft - Stanley Park Forest Management Plan

"That Stanley Park's forest be a resilient coastal forest with a diversity of native tree and other species and habitats, that allows park visitors to experience nature in the city."

– Forest Vision Statement, Stanley Park Restoration Plan

November 24, 2008
Report to be presented to the Park Board

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Partial List of Appendices

Executive Summary

The Stanley Park Forest Management Plan is intended to provide an overview of the types of management activities that are required to realize the vision statement first published in the Stanley Park Restoration Plan (Vancouver Park Board, April 2007). This statement seeks to attain a balance between the safe enjoyment of the park and the continued functioning of the urban forest. Ecosystems function in complex ways at the best of times, but within the context of an urban park and shifting climatic norms the job of understanding their current and future condition becomes a difficult scientific challenge. Additionally, the interaction with park visitors and workers adds several more layers of complexity. It was therefore necessary to break down the management activities into modules which represent different disciplines of knowledge. In this preliminary document, each module has stated goals and objectives, and a brief sketch of their relevance to the achievement of the vision statement.

These modules pertain to three somewhat separate functional categories: forest maintenance, forest protection, and forest improvement. Forest maintenance modules speak of day to day activities not much different from what has been done for the past twenty years. They include the tree hazard management program and wood debris dispensation. Forest protection work modules, whose need was clearly demonstrated by recent storm events, outline essential objectives that seek to reduce the likelihood of large scale forest changes which would compromise the forests value to Stanley Park for many years. Rapid changes should also be guarded against because of significant costs association with their correction. The windthrow, fire, forest health, and invasive plant modules fit into this category. Finally, there are opportunities to enhance the forest by undertaking work which is beneficial to wildlife or forest development, as achieved through the practice of silviculture. A list of activities is generated from the combination of all eight modules, which are summarized in Appendix 3.

Three appendices are included as samples of the depth to which the final document will go with all modules. They are intended to provide operational level guidelines and instructions so that field work can be conducted to current standards; be they of the forestry or ecological professions. In size, the appendices will contain about one hundred pages of details. Adaptive management must be used to ensure that changing conditions and our increased understanding will allow for the modification and improvement of park management practices. Therefore, the appendix section is intended to be an actively changing resource as the professional knowledge base continues to develop.

As part of their consultative agreement, the University of British Columbia has conducted extensive forest survey and mapping work which is in an advanced stage of development. These maps will be a key component to the translation of ground data to field decisions and longer term planning and costing. The Park Board, and its consultants during the restoration work, have added to the library of maps; providing the necessary baseline work to manage future park forest operations work through a geographic information system (GIS).

Although the storms of 2006 / 07 were devastating, the extensive media coverage and subsequent community discussion forums generated a great deal of interest in the forest. The community now better understands the complexity of issues set before park managers, and their input should continue to be actively engaged. The Stanley Park Ecology Society has continued with its public education role, and become more participatory with its involvement in stewardship. The University of British Columbia, Faculty of Forestry, is a research and education body of international repute. Significant insights into the changing forest, and the impacts of forest management, can be gained through the continuance of this new relationship. The Forest

Management Plan will contain guidelines on how forest managers can structure future interactions with the public, park partners, and the academic community; in order to make the most of these available contributory resources.

Introduction

Stanley Park is Vancouver's oldest and largest park. The forest is a central feature within it. Close to 300 hectares of coastal temperate rainforest provides a place for Vancouverites and visitors to explore an impressive patch of nature within walking distance of the downtown core of the city. One can stroll down corridors of Douglas-fir trees fifteen stories tall, gaze at centuries old tree trunks larger than in any other municipal park in Canada, or witness eagles raising their young in the treetops. It is a place for learning, recreation, healthy exercise and mental relaxation. It is a remnant island of one of the largest and most ecologically productive forests on the planet.

While natural processes still sustain their vibrancy, urban encroachment has irrecoverably changed the complex pathways of ecological function. Keystone species such as elk and bear have long been extirpated from the park. Nobody knows for certain how many smaller creatures of importance have disappeared. Early logging removed many of the healthiest cedar spruce and fir, leaving behind conditions rife for an overabundance of hemlock, a much shorter-lived tree. Early park managers sometimes took very controlling measures in an attempt to enhance aesthetics and other anthropocentric values. Trails, roads, a provincial highway, and the city itself have fragmented ecosystems which have reliance upon connectivity. New species of animals, plants and fungi have become naturalized here, generally at the expense of those already present. Added to these stresses are air pollution, climate change, and ever increasing human activity penetrating the most remote corners of the forest. Incremental degradation from a combination of all these factors has occurred and will remain a threat to the parks ecosystems. Medium scale disturbances caused by wind storms or forest fires can threaten not only ecosystems, but park visitors and structures. Climate change and extreme air pollution, along with their accompanying biological shifts have the potential to cause the most harm.

Over seven million visitors come to the park each year – many more if you count people traveling through the park on Highway 99. Most come close to, or enter into the forest. It is the Park Board's duty of care to take reasonable measures to safeguard these people. The windstorms of 2006 – 07 were a clear reminder of the potential dangers posed by the forest. The subsequent threats of fire, insect damage, and invasive plants forced the Park Board to expend considerable time and money to rectify the damage. A forest fire, or another windstorm, could cause similar damage and risk to human life and property. There are several potential insect or disease outbreaks which, if reaching infestation proportions, could cause widespread setback of the forest canopy. Larger cleanup resources would have to be portioned if the park were to remain safe for visitors. More worrisome still is the considerable possibility that a highly invasive insect which is under federal quarantine protection might establish itself in the forest. International shipping is active all around the park. The mandated actions of the Canadian Food and Inspection Agency have resulted in several preemptive forest clearing operations in major centers such as Toronto and Halifax. The hardship and loss of park beauty would be devastating for a long time.

This management plan tried to 'walk the line' between maintaining a long term functioning ecosystem, and a park environment that is both safe and enjoyable. It contains recommendations for both the protection and enhancement of the surviving natural processes. It also recommends

the continuation and extension of forest management activities that help to guard against the dangerous and catastrophic changes to the forest, particularly its largest elements – the trees.

There will be times when the value of natural function and park management are consistent with one another, at other times they may be more or less contradictory. For this reason, the forest has been divided into 'management emphasis areas' (MEAs). They are termed; safety emphasis MEAs, resilience MEAs, wildlife MEAs, special value MEAs, and natural development MEAs. Within each zone; the value of forest safety, forest resilience, and biodiversity are given different priorities according to the usage of the area. As a basic example; snags may be left for cavity nesting birds in the area adjacent to Beaver Lake, but not if adjacent to the causeway. These values determine the goals and objectives for each area, which flow through to activities and even the timing of activities. They are not mutually exclusive, there will be activities appropriate for all emphasis zones; but the prioritizing of activities will be assisted by this categorization. All activities relate back to the fulfillment of the park forest Vision Statement:

"That Stanley Park's forest be a resilient coastal forest with a diversity of native tree and other species and habitats, that allows park visitors to experience nature in the city".

Module 1 - Tree Inspection and Safety Management

Goals

To reduce the risk of personal injury or property damage caused by failing trees or tree parts to a reasonable level, while sustaining a healthy forest ecosystem. Focus is to be on observable defects in trees.

Objectives

1) To thoroughly inspect all high usage areas at least once per year.

2) To remain vigilant to new tree hazards as they may occur throughout the season.

3) To efficiently correct known hazards on a priority basis.

Policy

The Park Board tree inspection policy (June 7, 1993) was approved by the Park Board in June 1993. It in part reads:

> 'Park trees in high usage areas (e.g. facilities, trails and roads) are inspected annually for signs of defects which could result in their failure. Trees that are evaluated as hazardous are prioritized and scheduled for corrective action.' (V.P.B. Tree Inspection Policy)

Inspection, record keeping, and mitigation

In order to prioritize tree hazard mitigation work, a hazard rating system is used that combines the assessed likelihood of tree or branch failure, with that of the likelihood of causing injury or damage should failure occur. Trained arborists walk the park and inspect every tree with the potential to fall into an area used by people. They look for defects which could indicate imminent

tree or branch failure. Those trees with a high combined hazard and target rating are tagged and mapped.

Information pertinent to the tree condition, as well as the recommended corrective action, is recorded and stored. Work sheets can be produced from these records. Photography or other forms of historic record keeping tools are used where appropriate.

Imminent hazards that come to the attention of arborists outside of the inspection program are attended to as soon as available resources allow.

Hazard abatement generally consists of designated crews which address listed trees by the order of their rating, attending to those in the highest hazard rating category first. Types of abatement activities consist of, but are not limited to; dead/ broken branch removal, crown weight reduction pruning, the attachment of metal reinforcements, or whole tree removal. Historically, a couple of dozen large trees are removed per year, and several hundred are pruned or dead-wooded.

Module 2 - Log and Debris Dispersal

Goals

To provide timely cleanup of debris on a balanced priority of need basis and balance efficiency with environmental, aesthetic, and community needs.

Objectives

After future storm events:

1) Quickly restore access throughout park on a prioritized basis,

2) In larger blowdowns, first assess the amount of coarse woody debris (> 12 cm diameter) resulting from both pre and post blowdown conditions. Retain between 8 and 12 kg / sq metre per hectare of coarse woody debris for reason of ecological integrity (Blackwell & Assoc.). Retain biomass on site when current levels are below target.

During routine work:

3) Maintain a level of cleanliness appropriate to the park locale.

Discussion

The responsive actions to be taken to the cleanup of fallen or felled trees, or tree parts, vary on a situational basis. Factors affecting these action types are: urgency of cleanup, location of debris, size and type of debris, amount of material, and community demand for specialized community uses. Tree parts can have environmental, monetary or social value. Other parts are a disposal liability. Where they exist along this scale is individually specific, so decisions on their dispersal should be situational and versatile.

The default value is environmental. Plant parts that are retained or returned to the forest are valuable for nutrient recycling, understory development, and habitat reasons. This action is appropriate wherever the benefit exceeds the damage and safety allows. Logs of merchantable quality are included. Smaller material is run through a chipper and blown into the forest

wherever appropriate. Factors limiting the retention or return of material are fire risk, safety, and equipment availability.

From time to time, unusual pieces of wood are brought down. They might be of rare size, shape, or species. Should they not constitute significant environmental value, consideration can be given to donating them to local first nations, wood craftsmen, or artists. Priority can be given to those projects with the greatest amount of public good, as judged by a management authority.

After larger storm events, there may come about a third circumstance where significant quantities of merchantable wood either falls from the forest, or must be removed for forest resilience reasons. This occurred in 2006/07. Extremely large storm events may require dedicated restoration plans; but more regular storm events could be managed within Park Board operations. The direct costs associated with this cleanup and subsequent forest recovery work can be offset by sales of merchantable logs, run through the established 'Stanley Park Forest Management' fund. Appendix 2 shows the recommended decision matrix for the dispersal of wood debris and logs.

Module 3 - Windthrow Management

Goals

To reduce the potential for additional wind damage to park visitors, staff, the park infrastructure and the forest at large, while maintaining natural forest function.

Objective

1) To assess the vulnerability of different parts of the forest to windthrow.

2) To prioritize those stands which pose the greatest threat, using knowledge of probable consequences in such an event.

3) To develop and implement stand specific strategies that are expected to reduce the likelihood of personal injury, property damage, and recurrence of catastrophic windthrow.

Discussion

Windthrow occurs when storm winds penetrate a forest to an extent rarely experienced, and exerts forces that cause healthy trees to topple. As trees fall and the canopy opens, more wind is allowed into the sensitive interior causing a progression of tree failures. Falling trees impact other trees causing them to break or fall in a sort of 'domino effect'. Windthrow stops when the spreading damage either encounters a wind resistant stand of trees, or the storm winds ebb. The damage of December 2006 is an example of this phenomenon.

The University of British Columbia researchers have made significant advances on the subject of identifying risk and its appropriate mitigating treatment. The complex of factors influencing the likelihood of tree and stand failure, and their relative weighting, are now understood well enough to be able to model and predict the probability of future events. The 'windfirming' tree work (pruning branches off to allow wind to blow through the tree crown) that was conducted as part of

the 2007 park restoration followed a prescription based upon the results of both field inspections and computer modelling.

The frequency and extent of windthrow can be diminished by taking a series of actions. These actions should be focused on two types of areas: near major roads and park features, and where the forest is deemed vulnerable. Appendix 1 provides an example of area specific actions.

Module 4 - Fire Management

Goals

To reduce the likelihood of uncontrolled fires burning the forest, and to minimize the extent of damage and risk to park visitors caused by escaped fires.

Objectives

1) Continue to strengthen and implement the existing Stanley Park Fire Management Plan.

2) Implement an ecologically sensitive fuel reduction program that is responsive to changes.

Discussion

While wildfire is an integral and necessary part of the functioning of many British Columbian ecosystems; it is less critical to the Stanley Park forest. Throughout the ecological history of the coastal temperate rainforest, fire has been relatively rare. Fire in the urban forest interface is a threat to persons, property, and the aesthetics of the forest. Smouldering ground fires will emit high levels of carbon monoxide, as well as potentially dangerous levels of airborne particulate matter. Depending on wind direction, smoke from a Stanley Park fire will disrupt air and vehicular traffic. Higher intensity fires can spread very quickly and spark new fires ahead of its front, and in buildings. Even if persons and property are protected, a wildfire could cause widespread devastation to the forest that would be an eyesore for many years.

It is for these reasons that fire in Stanley Park should be prevented and suppressed.

Fire Management Plan

The Park Board currently has a Fire Management Plan, albeit one that is distributed over several documents. Updating and repackaging the document is recommended. The three elements of the Fire Management Plan are: preparedness, prevention/detection, and suppression. The table below provides a brief overview of the activities associated with each element of the plan.

Preparedness	Prevention / monitoring	Suppression
-Fuel and fire risk mapping -Communication plan -Upgrades to infrastructure -Staff training -Fire Department familiarization exercises - Fire fighting equipment upgrades -Participation in regional planning committee	-Fire watch patrols -Prohibition schedules -Fire weather monitoring -Public awareness protocols -Communication with local air services	Park evacuation procedures Resources available -Staff level hand tools for extinguishing controlled fires. -Vancouver Fire & Rescue Services wildlands equipment -Metro Vancouver Rapid Attack Team -MoFR water bombers

Module 5 - Invasive Plant Management in Forested Ecosystems of Stanley Park

Goals

To promote resilient and diverse forest ecosystems in Stanley Park by managing and controlling alien invasive plant species in a timely, environmentally sensitive and effective manner.

Objectives

1) To regularly monitor forested areas and surroundings to ensure emergent invasive plant infestations are recognized before they have an impact on ecosystems.

2) To prioritize management efforts to focus on invasive species according to their potential and realized threats to forest ecosystems.

3) To apply best management practices for invasive plants while taking into account of legal requirements, impacts on the park ecosystems, as well as the safety of the park staff, volunteers and visitors.

Discussion

Invasive plants are non-native species that pose undesired or negative impacts on native biota and ecosystems, managed landscapes and/or human health. These species are able to spread quickly, grow rapidly, and thrive in their new environments, resulting in impacts to environmental, economic and social systems. (Examples include English Ivy, Japanese Knotweed and Himalayan Blackberry.)

Invasive species contribute to habitat loss. They are able to shade out, smother and displace native plants that provide valuable habitat in our ecosystems. Some of these plants also produce toxic substances that inhibit the growth of native species. Others can alter water flow, cause erosion, or increase fire hazard. Invasive plants causing each of these issues can be found in Stanley Park's forest today.

Management Strategies for Invasive Plants in Stanley Park:

Management of invasive plants should take a multi-pronged approach that recognizes the immediacy and extent of the threat. Some newly introduced plants should be eradicated quickly, while established plants should be contained.

Monitoring:

Stanley Park's ecosystems should be regularly monitored for changes in vegetation through on-going sample plots and mapping.

Targeting and Prioritizing Species for Removals:

Prioritizing actions to deal with potential or realized infestations is imperative to ensure timely and effective measures to manage invasive plants. The following table exhibits key traits to consider when developing these plans.

Factors	Lower priority	→	Highest priority
Size of area infested	Large	Medium	Small
Density in invaded areas	> 40% coverage	10-40% coverage	<10% coverage
Degree of establishment	Well-established	Somewhat established	New introduction/ just getting established
Potential negative impact to the park ecosystems or public safety	Low	Medium	High

Implementing Best Management Practices (BMPs):

By implementing BMPs in the management, control and removal of invasive plant species in Stanley Park, the Vancouver Park Board and its partners will be posed to successfully manage invasive species in a way that takes into consideration of legal requirements (such as the breeding bird season as legislated in the Wildlife Act), and promote practices that minimize impacts to Stanley Park's ecosystems and recreational values. This may include mulching and replanting after an invasive plant pulling exercise.

Long-term Monitoring, Maintenance and Re-evaluation of Management Practices:

Following treatment, it is important to monitor sites over the long-term. The successful removal of invasive plants from an area often requires multiple maintenance treatments. Depending on the success of treatments, different management techniques may need to be applied.

The Role of Collaboration, Information Sharing and Knowledge:

Throughout the management process, it is important to maintain strong ties with partners, researchers, regional groups and other agencies involved in invasive plant management to remain up-to-date on invasive plant concerns, share best management practices, and to contribute to initiatives at a regional level. In 1998, the Vancouver Park Board adopted a Volunteer Policy that

describes the relationship between volunteer work and union work. Invasive plant pulling in the park has been conducted within that policy since that time.

Stanley Park Ecology Society is also a member and active participant within the Vancouver Park Board Park Partners Program. Stanley Park Ecology Society staff and volunteers have worked alongside the park staff, providing background and physical assistance for invasive species control. The cooperative relationship between the Park Board and Stanley Park Ecology Society will help to ensure the strategies are applied effectively in Stanley Park.

Module 6 - Forest Health Factors

Goals

To manage the health of the forest such that severe insect or disease infestations, or abiotic disorders, do not cause tree losses constituting catastrophic changes to the ecology of the forest

Objectives

1) To identify and understand which forest health factors represent significant threats to Stanley Park, and to remain current as environmental conditions change.

2) To develop and implement monitoring protocols for threatening insects and diseases.

3) To implement biorational control strategies when population levels reach the point where damaging infestation is imminent.

Discussion

An unhealthy forest is one that is going through rapid change from its current condition to that of another which is less diverse, and less robust in its production of biomass and creatures. If the management plan is to improve resilience and diversity, it must be able to guard against agents of insects and diseases which bring about such rapid change.

The University of British Columbia has been conducting intensive studies within the park as part of the restoration work and consultative agreement. Insect trapping work by Dr John McLean has provided us with the good news that there have been no captures of the most serious quarantined pest insects. And what is further good news, there has not been a rapid increase in numbers of indigenous insects that can also pose a threat. Forest technicians found many of the well known pathogens that attack Hemlock or Cedar, but found no indications of Douglas-fir root rot.

Nevertheless, vigilance is required. The plethora of stumps in the park can be a source of energy for insects and diseases which may later move to healthy trees. Climate change and an aging tree population are preconditions for damaging infestations; both are factors at work in the Stanley Park forest. Monitoring is essential if there is to be hope of warding off a major problem before it exceeds our ability to control it. Species-specific monitoring protocols for all expected problems in our forest have already been developed but require customization.

Control strategies will need to be consistent with the biodiversity and habitat protection goals within the vision statement, and the City of Vancouver Pesticide Bylaw.

Expected threats

Insects	Diseases
Douglas-fir bark beetle	Mistletoe – hartigii stem rot
Hemlock looper	Butt rots (various)
Invasive insects (long horned beetle, gypsy moth)	Laminated, Shoestring root rot

Dwarf mistletoe (*Arceuthobium tsugense*) / *Phellinus hartigii*:
Very common in the park, primarily on Hemlock trees. Causes 'witches broom' disfigurements on branches and vectors a serious heart rotting fungus called *Phellinus hartigii*. This heart rot is responsible for many tree failures.

Butt rot (*Heterobasidion annosum*):
A root rotting fungus that attacks all conifers, primarily Hemlock. It is common throughout the park, and causes whole tree failure. It is difficult but possible to detect.

Laminated root rot (*Phellinus weirii*):
A root rotting fungus that attacks entire stands of Douglas-fir, spreading from tree to tree. Preemptive tree removal is considered necessary to cease its spread. Its presence has not been confirmed in the park, but the windthrow damaged forest is at higher risk.

Shoestring rot (*Armillarea* species):
Occasional in the park, on either hardwood or softwood trees. Causes mortality. There is likely to be a heightened risk since the blowdown.

Douglas-fir bark beetle (*Dendroctonus pseudotsugae*):
Pheromone traps confirm its presence at sub-infestation levels. It has the ability to breed in large numbers when there is a source of Douglas-fir logs, but most of these were removed during restoration work, according to the prescription by Blackwell & Associates. An infestation has the potential to cause mortality under high population pressure. See http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm for more information.

Western hemlock looper (*Lambdina fiscellaria*):
There have been periodic outbreaks of this foliage feeding caterpillar, with numbers building up over several years prior to widespread mortality. The last infestation was in1959, but the insect is present in the park and remains a potential threat. See http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/defoliat/chap4c.htm for more information.

Exotic insects

The Canadian Food Inspection Agency (CFIA) monitors for threatening invasive insects. None have been found in Stanley Park since the 1992 Asian Gypsy Moth discovery, but an eradication program would be mandated should certain insects or diseases be found. Significant threats include, but are not limited to:

Gypsy moth	(*Lymantria dispar*)
Asian longhorned beetles	(*Anoplophora glabripennis)*
Sudden Oak Death	*(Phytopthora ramorum)*

For more information see http://www.for.gov.bc.ca/hfp/gypsymoth/history.htm, http://www.inspection.gc.ca/english/plaveg/pestrava/anogla/asialonge.shtml and http://www.inspection.gc.ca/english/plaveg/pestrava/phyram/sodmsce.shtml

Module 7 - Managing for Wildlife and Habitat in Forested Ecosystems of Stanley Park

Goal

To manage for the stewardship and enhancement of wildlife species and their habitats within the park's forested areas.

Objectives

1) Establish Wildlife Management Emphasis Areas within the Stanley Park Forest Management Plan.

2) Ensure that the Forest Management Plan conforms with all applicable federal and provincial legislation related to wildlife and fisheries habitat.

3) Protect those species with special status (such as 'Species at Risk') and their habitat.

4) Facilitate projects that protect or enhance wildlife and their habitat.

Discussion

Wildlife Management Emphasis Areas represent those areas of the forest that are of high importance to the ecological integrity of the park. They may be areas of productive wildlife habitat or areas of unique or rare habitat. They may provide essential corridors for wildlife movement or be important habitat for Species at Risk. They may also be places of disappearing biodiversity, requiring protection. Maps are used to indicate designated areas.

Wildlife Management Emphasis Areas

1. Wetlands, Watercourses and Riparian Areas

These are essential habitat for many species of wildlife including waterbirds, migratory songbirds, small mammals, amphibians, fish and aquatic invertebrates. Riparian Zones are areas of mostly deciduous vegetation directly adjacent to watercourses. They are areas where several habitats can be found in close proximity and are important corridors for wildlife movement.

2. Bird Colonies and Raptor Nests

Stanley Park has important habitat features favoured by colonial nesting birds and birds of prey. Rocky cliffs, large stands of mature trees and veteran trees in close proximity to the seashore provide valuable breeding habitat for cliff nesting species such as pelagic cormorants, colonies of great blue herons, bald eagles, and other birds of prey.

3. Rare Forest Habitats

i) Remnant old growth forest features in the park are found adjacent to Tunnel trail and Pipeline Road. The veteran trees that have persisted in the Park since before logging provide essential habitat to many species including bald eagles, owls, bats, and flying squirrels.

ii) Skunk Cabbage Woodland Site Associations have very wet and nutrient rich soils which are particularly sensitive to compaction. They are also important habitat for many rainforest species including amphibians, shrews, and insects.

4. Rocky Outcrops - Surficial Geology

These areas of the park are found primarily along the steep slopes near Prospect Point and Siwash Rock. They provide protection to wildlife from predators and while many species, such as peregrine falcons may use these locations for only brief periods, others like cormorants, guillemots and gulls use them extensively.

5. Ecotones

These are edge habitats which provide special refuge, breeding and feeding opportunities for wildlife. Shrub-forest edges are the most productive for wildlife in Stanley Park but all edges are used preferentially by certain species of breeding birds, aerial predators, grazers and small mammals.

Monitoring Wildlife Activity

Long-term management will require that wildlife and habitats are inventoried, mapped, and monitored. During the restoration process inventories were completed in blowdown areas by professional biologists for Species at Risk. Stanley Park Ecology Society has been adding to this baseline information and continues to work on several wildlife inventory projects independently, and in collaboration with academic institutions and professionals in the field. Long-term wildlife monitoring projects in the park are undertaken by Stanley Park Ecology Society in cooperation with the Park Board.

Operations in Wildlife Areas

The Forest Management Plan must balance the needs of wildlife with other issues of the urban forest such as public safety or fire risk. For Wildlife MEAs, wildlife and habitat guidelines and practices will be given high consideration during regular park maintenance activities. Where Management Areas overlap, each area's recommendations will be considered and decisions will be prioritized. For example, if a safety MEA and wildlife MEA overlap, the priority may be determined to go to safety operations (such as hazard tree removal) but due to the sensitive nature of the habitat, special attention will be paid to the methodology and timing of these activities.

The Forest Management Plan appendix will describe a list of recommended activities and work precautions that will help to protect and enhance wildlife and their habitat.

Module 8 – Silviculture: Establishing New Stands

Goals

After a disturbance, establish a diversity of new trees which will be resilient against further disturbances, while protecting ecological values. Survival and growth rate should be enhanced by using a variety of tools and methods.

Establish new forest stands in small parcels of current forest edge that currently serve no recreational, aesthetic, or operational purpose.

Objectives

1) Plant trees that will start the area on a path toward achieving the stand objectives, which are determined by the site growing conditions and other specialized objectives.

2) Control the competing vegetation that would kill or slow the growth of planted trees.

3) After the trees are large and healthy enough to no longer require the brushing of competing vegetation, selectively thin their numbers to desired stocking levels and special arrangements. Transplanting to other locations may be considered.

Discussion

There are three basic categories of areas that will require stand establishment treatment; small stands established between 2002 and 2006, blowdown areas from the 2006 / 07 storms, and future stands that are yet to be planted.

All tree planting since the 2006 storms have been done according to prescriptions based upon the nutrient and moisture regimes, exposure, and light availability. These prescriptions had the following elements:

- native species mixtures suited to the site series and local conditions;
- suitable seed source, genetically adapted to current and future conditions;
- 615 container nursery stock, or 1 gallon containers;
- cluster planting using irregular clumpy or scattered spatial distribution;
- wide spacing between clusters to allow shrub and understory development;
- carefully selected sites for each tree;
- plants to brush (weed) and thin over crowded clusters as they grow.

Detailed Appendices for Forestry Staff (Example)

Appendix 1 – Windthrow Management (See Module 3 – Windthrow Management)

Recommended activities within varied management emphasis zones.

Within the *safety priority zones* – near major roads and park features:

a prevent wind vulnerable trees from reaching canopy height by removing pole sized trees, juvenile hemlock, and juvenile cedars rooted in organic substrate;

b where natural regeneration is hemlock, plant Grand fir, Douglas-fir, Red cedar or Bigleaf maple in secure substrate, then control hemlock until replacement trees are free to grow;

c consider ditching, draining, or culvert expansion as a means for improving soil conditions;

d windfirm canopy trees adjacent to new openings on the leeward side;

e thin densely growing, evenly aged plantation stands in order to allow the remainder of trees to increase in wind resilience, and prepare prescriptions following 'Stand Density Management Diagrams' (Mitchell, S. 2000).

Within the *resilience zones* – where the forest is vulnerable to windthrow:

See *a* above;

See *b* above;

See *e* above, but where pockets of disease-compromised trees are large enough to create a gap greater than canopy height, consideration should be given to removing the most vulnerable trees and replanting in secure substrate.

Observe the following silviculture recommendations to foster long term wind-resistant stands:

a planting trees in clusters of three to five, with gaps between clusters;

b using at least two species per cluster to increase wind dampening effect;

c brushing natural hemlock regeneration where it competes with more resilient species, to achieve stand target objectives.

Detailed Appendices for Forestry Staff (Example)

Appendix 2 - Objectives of Silvicultural Treatments (See Module 8 - Silviculture)

Stand Management Objectives

Current forest stands in Stanley Park have been heavily influenced by a long history of both natural and anthropogenic disturbances. Coupled with underlying variation in soil and terrain conditions, the result is a varying patchwork of tree species composition, age classes, spatial pattern and horizontal structure. Taken in its entirety, this variation contributes greatly to the biological diversity of the park and the corresponding opportunities for human enjoyment.

The tremendous variation that exists within stands cannot be captured completely in a set of stand management objectives. Instead, a set of archetypal descriptions has been developed that encompass the most common patterns of stand structure and development within the park. These descriptions cover a wide range of developmental stages, starting with the period immediately after a major disturbance. While relatively ephemeral and hopefully small in extent at most time periods in the future, very young stands are important to recognize as it is this stage in development where managers have the greatest opportunities to shape long term outcomes.

The philosophy behind these stand management objectives is the development of a diverse and resilient forest condition, with plant communities ideally suited to the underlying environmental conditions. The described targets emphasize a forest structure with a moderately open canopy, both to promote wind firmness of individual trees and to enhance opportunities for regenerating trees and a range of understory plant species such as vine maple, salmonberry, Sitka mountain ash and sword fern. It is expected that a rich diversity in floral composition will also lead to increased niche opportunities for faunal species.

In order to facilitate development of an appropriate range of stand diversity, the archetypal descriptions below are intentionally flexible. It is intended that stands as recognized by lines on a map will also contain considerable internal variability, and no one position within a stand will or should perfectly conform to the written descriptions. It is also important to recognize that stand boundaries are often indistinct, and become more so as stands age. The spatial gradation from one stand type to another is often a desirable feature that should be embraced through appropriate application of the stand management objectives.

Conifer Stands on Wetter Sites (CWHdm 07, 12)

Species Codes:

- Ac Black Cottonwood
- Bg Grand Fir
- Cw Western Redcedar
- Dr Red Alder
- Fd Douglas-fir
- Hw Western hemlock
- Mb Bigleaf Maple
- Plc Shore Pine
- Pw Western White Pine
- Ra Arbutus
- Ss Sitka Spruce

	Species Composition (% of Total Canopy Cover)	Structure
Juvenile Stands 0 to 20 yrs	50 to 70% Cw 0 to 25% Hw 5 to 10% Ss 0 to 15% Fd 0 to 15% Mb 0 to 5% Ac 0 to 20% Dr	Stands will be primarily even-aged with the exception of legacy trees left from stands that occurred prior to the last major disturbance. The spatial pattern will be moderately to strongly clumped and will be strongly influenced by micro-topography. Conifers will be distinctly clumped both to promote long term desired structural variation and to allow growing space for short-lived hardwoods and shrubs. Western redcedar prevalence will increase with increasing soil moisture. Douglas-fir, Western hemlock, bigleaf maple and grand fir will only occur on raised hummocks with well aerated soils. The Douglas-fir component can be increased where these patches are large in area.
Immature Stands 20 to 100 yrs	60 to 80% Cw 0 to 20% Hw 5 to 15% Ss 0 to 15% Fd 0 to 15% Mb 0 to 5% Ac 0 to 20% Dr	Stands will continue to be primarily even-aged, but will be stratified in height by species (Dr, Mb, Ac > Fd Ss > Cw Hw). Red alder may form a significant portion of the canopy at younger ages in a patchy distribution, but will start to disappear beyond 70 to 100 years of age. Total canopy cover may reach as high as 80 to 90% in areas dominated primarily by upland soil types, but may be as low as 40 to 50% where the water table is at or near the surface. These stands will have high levels of instability, particularly at higher stand densities.
Old Stands > 100 yrs	60 to 90% Cw 0 to 15% Hw 5 to 15% Ss 0 to 15% Fd 0 to 20% Mb 0 to 5% Ac	Stands ideally will be developing a multi-layered structure with the largest trees greater than 1 m diameter and ongoing patterns of gradual recruitment in the understory. The earliest gaps for new regeneration will occur in growing space recently vacated by windthrown conifers and dying red alder. Continuing patterns of natural random mortality will open further gaps over a period of many decades. Total canopy cover should range from 35 to 75%.

Conifer Stands on Mesic to Drier Sites (CWHdm 03, 01, 05)

	Species Composition (% of Total Canopy Cover)	Structure
Juvenile Stands 0 to 20 yrs	50 to 70% Fd 5 to 20% Cw 0 to 20% Hw 0 to 10% Bg 0 to 15% Mb 0 to 5% Ss 0 to 25% Decid*	Stands will be primarily even-aged with the exception of legacy trees left from stands that occurred prior to the last major disturbance. The spatial pattern of conifers will be moderately clumped based on planting pattern with natural regeneration of broadleaves between clumps. Clumps size will range from 4 to 20 trees.

Immature Stands 20 to 100 yrs	50 to 70% Fd 5 to 20% Cw 0 to 15% Hw 0 to 10% Bg 0 to 15% Mb 0 to 5% Ss 0 to 20% Decid*	Stands will continue to be primarily even-aged. Red alder and other broadleaves may form a significant portion of the canopy at younger ages in a patchy distribution, but will start to disappear beyond 70 to 100 years of age. Total canopy cover may reach as high as 80 to 90% at age 40 to 50, but should be starting to decline toward 65 to75% thereafter.
Old Stands > 100 yrs	50 to 80% Fd 5 to 20% Cw 0 to 15% Hw 0 to 10% Bg 0 to 10% Mb 0 to 5% Ss 0 to 5% Decid*	Stands ideally will be developing a multi-layered structure with the largest trees greater than 80 cm diameter and ongoing patterns of gradual recruitment in the understory. The earliest gaps for new regeneration will occur in growing space recently vacated by dying red alder. Continuing patterns of natural random mortality will open further gaps over a period of many decades. Total canopy cover should range from 65 to 75%.

* Decid refers to a mix of broadleaves such as bitter cherry, cascara, pacific crabapple, birch, pacific dogwood, vine maple, and willow.

Alder Dominated Stands on Mesic Sites and Upland Wetter Sites (CWHdm 05, 07)

	Species Composition (% of Total Canopy Cover)	**Structure**
Juvenile Stands 0 to 20 yrs	70 to 100% Dr 0 to 20% Ac 0 to 20% Conifer 0 to 20% Decid*	Stands will be primarily even-aged with the exception of legacy trees left from stands that occurred prior to the last major disturbance. The spatial pattern will be relatively uniform, with patchy distribution of conifers where they occur. A full canopy with near 100% cover will develop by age 10.
Mature Stands 20 to 70 yrs	70 to 100% Dr 0 to 20% Ac 0 to 20% Conifer 0 to 20% Decid*	Stands will continue to be primarily even-aged. The broadleaved canopy will maintain near 100% canopy cover until age 60 to 70, after which it will slowly decrease as trees start to die. A successional pattern toward a conifer stand will follow, possibly facilitated by planting.
Old Stands > 70 yrs	0 to 40% Dr/Ac/Decid* 60 to 100% Conifer	The slow transition to a shade tolerant conifer stand (Cw, Hw, Bg) will be underway, with most of the broadleaved trees dying by age 120 to 140.

* Decid refers to a mix of broadleaves such as bitter cherry, cascara, pacific crabapple, birch, pacific dogwood, vine maple, and willow.

Bigleaf Maple Dominated Stands on Rich, Moist, Well Aerated Slopes (CWHdm 07)

	Species Composition (% of Total Canopy Cover)	**Structure**
Juvenile Stands*	70 to 100% Mb 0 to 30% Conifer	Stands will be primarily even-aged with the exception of legacy trees left from stands that occurred prior to

0 to 30 yrs	0 to20% Dr 0 to 20% Decid.**	the last major disturbance. Bigleaf maple will develop rapidly from stump sprouts with a spatial pattern dictated by the previous stand. A full canopy with near 70 to 100% cover will develop by age 20. Shade tolerant conifers (Cw, Hw, Bg) will regenerate in a clumpy pattern either naturally or as facilitated by planting. Douglas-fir may be planted if large gaps occur in the maple cover.
Mature Stands 30 to 1000 yrs	70 to 100% Mb 0 to 30% Conifer 0 to 20% Dr 0 to 20% Decid.**	Stands will continue to be primarily even-aged, with height stratification by species. The broadleaved canopy will maintain near 100% canopy cover until age 60 to 70, after which it will slowly decrease as trees succumb to periodic wind breakage. Some conifers may make it to the upper canopy, but these will be susceptible to windthrow.
Old Stands > 1000 yrs	70 to 100% Mb 0 to 30% Conifer	Large bigleaf maple with vase shaped crowns and epiphytes will develop, but may be subject to periodic wind breakage at a wide range of severity levels. The stand may be dominated by bigleaf maple for a very long period of time, with gradual infilling of a conifer understory and recruitment of conifers into a canopy emergent layer.

* Fully juvenile stands of this type may be rare, as these stands will largely replace themselves through a process of coppicing as individual large trees are damaged by wind storms.

** Decid refers to a mix of broadleaves such as bitter cherry, cascara, pacific crabapple, birch, pacific dogwood, vine maple, and willow.

Dry, Exposed Ridge Forest (CWHdm 02/03 – CHWxm 02/03)

	Species Composition (% of Total Canopy Cover)	**Structure**
Juvenile Stands* 0 to 30 yrs	50 to 80% Fd 0 to 30% Ra 0 to 30% Plc 0 to 20% Cw 0 to 10% Mb 0 to 10% Pw	Stands will be primarily even-aged with the exception of legacy trees left from stands that occurred prior to the last major disturbance. The spatial distribution should be clumped to promote wind firmness, with trees in clusters of 5 to 20 trees. Open patches will promote development of tall shrubs. Arbutus in particular should be grown without close tree competition to avoid tall, slender trunks.
Mature Stands 30 to 1000 yrs	50 to 80% Fd 0 to 30% Ra 0 to 30% Plc 0 to 20% Cw 0 to 10% Mb 0 to 10% Pw	Stands will continue to be primarily even-aged with height stratification by species. Total canopy cover may reach as high as 60 to 70% at age 40 to 50, but should be declining toward 50 to 60% thereafter.
Old Stands > 1000 yrs	50 to 80% Fd 0 to 30% Ra	Stands ideally will be developing a multi-layered structure with the largest trees greater than 70 cm

	0 to 20% Plc 0 to 20% Cw 0 to 10% Mb 0 to 10% Pw	diameter and ongoing patterns of gradual recruitment in the understory. Continuing patterns of natural random mortality will open further gaps over a period of many decades. Total canopy cover should range from 40 to 60%.