APPENDIX 7 – Forest Health

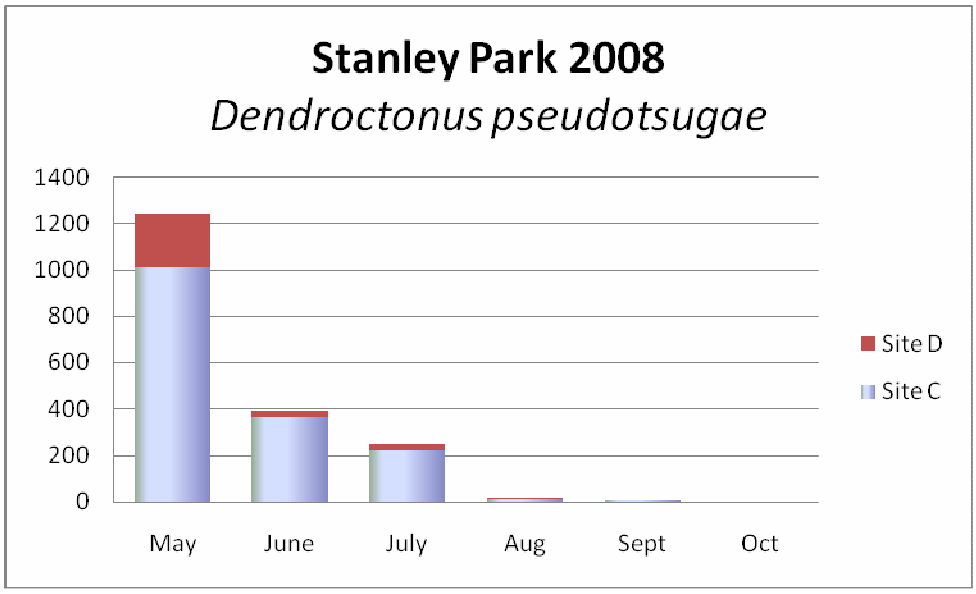
Management of Douglas-fir Beetle in Stanley Park

The data for 2008 shows that the major Douglas-fir beetle emergence occurs in the spring and early summer as is the normal case. The total catch in 2007 was 30 beetles in the undisturbed areas we trapped by the Aquarium and along Rawlings Trail near the Hollow Tree. The higher catch in 2008 was in the South Creek Trail area – see the data below.

Table 1 and Figure 1: Numbers of Douglas-fir beetle intercepted in pheromone-baited traps in Stanley Park 2008. Site C is South Creek Trail, Site D Merilees Trail.

Dendroctonus pseudotsugae - the Douglas-fir beetle

2008	May	June	July	Aug	Sept	Oct	Totals
Site C	1013	362	223	12	3	0	1613
Site D	230	29	28	2	0	0	289
Totals	1243	391	251	14	3	0	**1902**



During the summer, a close watch was kept on potential breeding material – stumps, wildlife trees and fallen logs. The activity of ambrosia beetles suggested that much of this material was prime for attack. Neither Tara nor ourselves (JM and AL) saw any bark beetle attacks (fresh brown frass on logs). Did our trap catch most of the beetles flying in the area? We will need to run the traps again next spring to track these numbers. Logs that I thought were prime for attack in the Aquarium site were not infested by bark

APPENDIX 7 – Forest Health

beetles in 2008 although the ambrosia beetles attacked them in the fall. Will DFB attack these logs in the spring of 2009?

What about plans for the stands east of the Hollow Tree field to thin from below as proposed by Craig Farnden? He is aware that the large diameter material (both Douglas-fir and western hemlock) is potential bark beetle habitat. Smaller stems (<20 cm) are not usually successfully colonized by the Douglas-fir Beetle but they would be suitable for secondary bark beetles such as *Pseudohylesinus nebulosus, Scolytus tsugae* and *S. unispinosus*. In times of drought these secondary bark beetles can kill young trees. A program of gradual release without removal of the thinnings would set up a bark beetle nursery. Some innovative marketing to help offset the cost of removing thinnings would probably be prudent (or alternatively, carry out the thinning when there is a market for the smaller diameter materials).

John McLean
November 17th, 2008

APPENDIX 7 – Forest Health

Towards a Management Plan for the Western Hemlock Looper in Stanley Park

The western hemlock looper (WHL), Lambdina fiscellaria lugubrosa (Lepidoptera: Geometridae) is the only native conifer defoliating insect that has reached epidemic tree-killing levels in Stanley Park in the past to warrant aerial spraying to protect the forest; once in 1930 and again in 1959 (Richmond 1986). This defoliator is a late summer flier, together with its closely related geometrid cousin, the phantom hemlock looper Nepytia phantasmaria. The biology of the WHL is well reviewed by Koot (1994).

In 2008 we set out three pheromone-baited high-capacity Unitraps for the WHL near the south end of Beaver Lake along the South Creek Trail and another three traps near the Hollow Tree at the southern end of Merilees Trail. The moths fly mainly in September. The Individual trap catches are shown in Figure 1. The traps were set out in September and October. Most moths (94%) were captured in September.

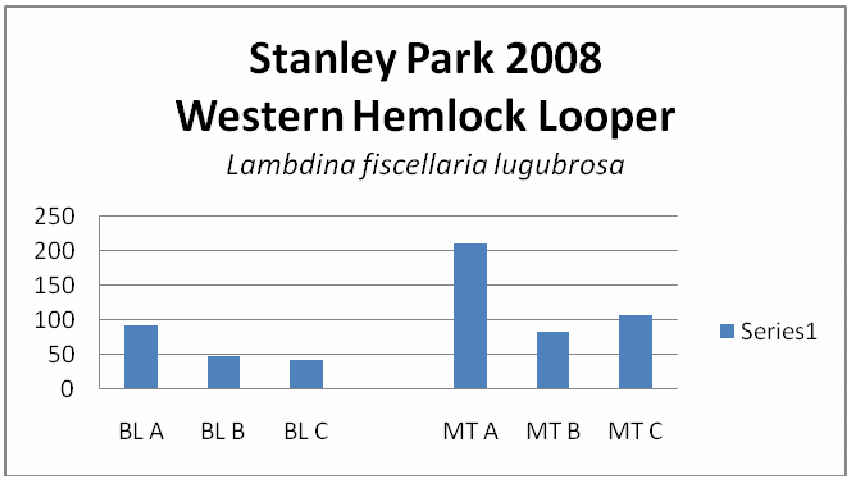


Figure 1: Catches of the western hemlock looper in each of three traps set out in September and October 2008 on the southern margin of Beaver Lake (BL) and near the Hollow Tree and Merilees Trail (MT).

Slightly higher numbers of male WHL were caught at the Hollow Tree site. A threshold of about 1200/trap would indicate a potential population level that might require intervention. If populations of WHL did rise to this level in Stanley Park, it is highly probable that the GVRD would also have populations irrupting in their watersheds. The Forest Health Unit (BC Ministry of Forests and Range) would be able to give advice on possible Btk spray options that could be approached collectively.

Possible Management Options:

1. It would be possible to carry out an annual survey for WHL at the same two sites we used this year. It would require purchasing 6 lures from Pherotech International and setting out three traps at each site at 50m to 100m spacing in the third week of August. These traps could be collected in early October and the average numbers of male WHL per trap calculated.

2. If the numbers are low, less than 400/trap, then no further action is required.

APPENDIX 7 – Forest Health

3. If the average number is greater than 400/trap then some consideration could be given to burlap trapping trees in the area the following summer to collect mature larvae/prepupae/pupae and having these reared to check for parasitism. UBC Forest Entomology could probably help out with a student project to do this. A high count in the fall trapping would trigger a proposal and give time for funding sources to be identified. Other areas in the GVRD would probably come on board for this also as their populations would also be building (or they should at least check for it).

A check of parasitism levels would provide useful support data for planning any additional action, which might need, in the extreme, a possible localized spraying with Btk (most effectively done from the air – check with Ministry of Forests and Range and their Gypsy Moth program that also uses Btk aerial spray programs).

Footnote: Should an aerial spray be carried out , it would be very interesting from a conservation/biodiversity point of view to repeat the light trapping exercise of 2007 to determine how many of the 191 species we recorded may have been locally extirpated. To my knowledge, no-one has ever done such a repeat trapping exercise mainly because there wasn't time to carry out the baseline survey before the aerial spray was applied. It would make a very interesting Masters or even a Ph.D. level project given the great facilitation the Bar Code of Life is giving in making identifications (check with Lee Humble at the Pacific Forestry Centre).

Koot, H.P. 1994. Western Hemlock Looper. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC. Forest Pest Leaflet 21, Copublished by the BC Ministry of Forests.

Richmond, H.A. 1986. Forest Entomology: From pack horse to helicopter. Pest management Report Number 8. BC Ministry of Forests and Lands. 44 pp.

John McLean
November 5th, 2008

APPENDIX 8 – Wildlife Management

8.1 Wildlife Management Emphasis Areas

	Wetlands, Watercourses and Riparian Areas	Bird Colonies, Raptor Nests, and Veteran Trees	Rare Forest Habitats - Deciduous Groves	Rare Forest Habitats – Old growth forest stand	Rare Forest Habitats – Skunk Cabbage Site Association	Rocky Outcrops - Surficial Geology	Ecotones
Description	Zones of vegetation directly adjacent to freshwater watercourses. Distinct wildlife and plant communities are supported by high soil moisture and nutrients. Important features may include snags, downed logs, deciduous plants, and uneven age canopy.	Bird nesting areas protected under BC Wildlife Act. Includes individual nest trees, as well as cliffs and stands of trees inhabited by colonial nesting birds. A 100m buffer should be maintained around nests.	Small patches of deciduous trees, and shrubs that provide habitat for birds and other wildlife Thickets of shrub communities and pioneering species.	One stand of old growth trees in close proximity that provide a picture of what the forest looked like prior to logging in the 1860's.	Areas with extremely wet and nutrient rich soils. Found in associated with high water tables and shallow soils, or in depressions. These areas are usually shaded and dominated by skunk cabbage in the forest understory. .	Cliffs and rock outcrops that form a unique habitat type in the Park.	The edges, or interfaces between two distinct forest habitats. Forest - clearing edges, conifer forest – deciduous forest edges, etc.
Locations in Stanley Park	-Lost Lagoon and the Biofiltration Pond -Beaver Lake and bog -Beaver Creek, North Creek, and all unnamed creeks - along all watercourses -small permanent ponds	GPS locations for all major nest sites in park. Nests may be found in several MEA's	Several areas in the Park including behind the Park Board works yard, south of Kinglet trail and in the old wildflower meadow	Located only in the area between Tunnel trail and Pipeline road (as indicated on forest cover maps)	Several areas throughout the Park with the largest sections found north of North Lagoon Drive, and adjacent to Beaver Lake.	Primarily found between, and including, Siwash Rock and the Prospect Point cliffs.	Edges of major blowdown areas, hard forest edges, and between highly structurally distinct forest types.
General Species Representations	Important habitat to all wildlife taxa. Habitat specialists include fish, aquatic invertebrates, amphibians, water shrews, river otter, and many species of migratory and resident waterfowl and songbirds.	Known raptor nests, and provincially protected bald eagle, peregrine falcon, and osprey nests. Great blue heron colony, and seabird nesting colony.	Forest birds, especially pine sisken, red crossbill, and woodpeckers. Small mammals and their predators.	Old growth dependant species such as owls, bats, and flying squirrels. Also contains a bald eagle nest.	Species associated with moist conditions such as amphibians and invertebrates. Critical habitat for Pacific water shrew and also used by other mammals such as raccoons.	Resting and breeding site for cormorants, falcons, gulls, and guillemots. Basking rocks are necessary for reptiles.	Small mammals, forest birds and their associated avian and mammalian predators. Also used by bats and opportunistic hunters such as jays.
Possible Red/Blue Listed SAR	Barn swallow, great blue heron, green heron, American bittern, coastal cutthroat trout, red-legged frog, Pacific water shrew	Great blue heron, western screech-owl, peregrine falcon	Band-tailed pigeon, Keens myotis	Johnson's hairstreak butterfly, western screech-owl, Keens myotis	red-legged frog, Pacific water shrew	Double-crested cormorant, peregrine falcon	Western screech-owl, Keens myotis, peregrine falcon, barn swallow.

APPENDIX 8 – Wildlife Management

Possible management activities on site	Brushing, thinning, coarse woody debris removal, mowing, hazard tree treatment / removal, spiral pruning, planting, trail surface maintenance, trail side brushing, culvert maintenance and/or replacement; special events and filming; forest fire suppression; invasive species removal; research, inventory, or monitoring activities. *** these activities can / will also occur in ecotones					Rock scaling, drainage alterations.	***
Potential Impacts/effects of Human Activity	Alteration of drainage pattern may cause drying of these sites; degradation, alteration or loss of habitat; pollution or siltation of watercourses; erosion, contamination or instability of soils; introduction or spread of invasive plants; disturbance or death of nesting birds; reduced educational / recreational value.	Unusual disturbance may result in nest or colony abandonment; removal of hazard trees means loss of potential habitat; reduced educational / recreational value.	Planting conifers in these areas will accelerate forest succession and will cause these areas to diminish sooner than normal; degradation, alteration or loss of habitat; introduction or spread of invasive plants; disturbance or death of nesting birds; reduced educational / recreational value.	Degradation, alteration or loss of habitat; introduction or spread of invasive plants; disturbance or death of nesting birds; reduced educational / recreational value.	Alteration of drainage pattern may cause drying of these sites; degradation, alteration or loss of habitat; pollution or siltation of water; erosion, contamination or instability of soils; introduction or spread of invasive plants; disturbance or death of nesting birds; reduced educational / recreational value.	Reduction in viability of the habitat for nesting birds; loss of rare and endangered plant species.	Degradation, alteration or loss of habitat; introduction or spread of invasive plants; disturbance or death of nesting birds; reduced educational / recreational value.

APPENDIX 8 – Wildlife Management

8.2 Classifications of Wildlife

1) Species at Risk
2) Protected Species
   - select raptor and great blue heron nests
   - Breeding Birds
   - Salmon
3) Species of Ecological Significance
   - Keystone species (beaver, pileated woodpecker, etc.) *"Species that interacts with a large number of other species in a community. Because of the interactions, the removal of this species can cause widespread changes to community structure."*- Dr. Michael Pidwirny, UBC
   - Winter waterfowl
   - Terrestrial Amphibians
   - Bats
   - Invertebrates

Identified Wildlife of Stanley Park

Introduced Wildlife

- Eastern Grey Squirrel
- Domestic Rabbit
- Norway rat, roof rat, house mouse
- Domestic chicken
- Birds (peacock, rock dove, mute swan, European starling, house sparrow, house finch)
- Carp, etc.

Extirpated Wildlife

- large mammals (deer, wolf, bear)
- small mammals (snowshoe hare)
- Painted Turtle
- Red-legged frog
- Tree frog
- Garter snakes

Mammals (bats, shrews, etc.)

- Coyotes
- Raccoons
- Mustelids (weasels, skunk, mink, otter)
- Chiroptera (Bats)
- Insectavores (shrews, moles)
- Seals
- Rodentia (Squirrels, mice, muscrat, beaver)

Birds

- Ducks, geese, swans, Auks (Anseriformes, Charadriiformes)
- Loons and grebes (Gaviiformes, Pocipediformes)
- Gulls, Terns, Storm-Petrels (Procellariiformes, Charadriiformes)
- Sandpipers (Charadriiformes)
- Cormorants (Pelicaniformes)
- Herons and Rails (Ciconiiformes, Gruiformes)
- Pigeons, Doves (Columbiformes)
- Owls (Strigiformes)
- Nightjars (Caprimulgiformes)
- Swifts and Hummingbirds (Apodiformes)
- Kingfishers (Coraciiformes)
- Woodpeckers (Piciformes)
- Hawks, Eagles, Falcons (Falconiformes)
- Perching Birds (Passeriformes)
  - Flycatchers
  - Swallows
  - Jays, crows
  - Chickadees
  - Nuthatches
  - Creepers
  - Wrens
  - Dippers

APPENDIX 8 – Wildlife Management

- Kinglets
- Thrushes
- Pipits
- Waxwings
- Shrikes
- Vireos
- Wood warblers
- Tanagers, buntings, grosbeaks
- Sparrows, towhees, buntings, juncos
- Meadowlarks, cowbirds, blackbirds, orioles
- Finches, redpolls, crossbills

Amphibians

- Frogs and toads
- Salamanders and newts

Reptiles

- Snakes and lizards
- Turtles

Fish

Freshwater:

- Salmon
- Trout
- stickleback

Marine

- Scorpion Fish (rock fish)
- Gunnel
- Greenling
- Sculpin
- Perch
- Ling cod
- Eel

Invertebrates

Marine

- Arthropods (crabs, shrimp, isopods)
- Cnidaria (jellyfish, anemones)
- Echinodermata (sea stars, urchins, sea cucumbers)
- Molluska (snails, chitons, limpets, clams, mussels, nudibranchs, squid, octopus)
- Porifera (sponges)
- Lophophorates (bryozoan, brachiopods)
- Worms (Platyhelminthes, Nematoda, Annelida, Chaetognatha, Hemichordata)

Fresh Water

- Arthropods (Caddisflies, Mayflies, Stoneflies, Dragonflies, Damselflies, mosquitoes, isopods, amphipods, riffle beetles)
- Mollusca (snails)
- Worms (planaria, nematodes, oligochaetes)

Terrestrial

- Insects (Springtails, Grasshoppers, Crickets, Earwigs, Termites, Bugs, Lacewings, Beetles, Butterflies and Moths, True Flies, Ants, Bees, and Wasps)
    - Arachnids (spiders)
    - Crustaceans
- Mollusca (snails, slugs)
- Worms (planaria, nematodes, annelids, platyhelminthes)

APPENDIX 8 – Wildlife Management

Wildlife Species Group	8.3 Habitat Requirements												
	Wildlife MEA's						Other Wildlife Habitats						
	Wetlands, Riparian areas, and Streams	Deciduous Patches	Old Growth Patch and Veteran Trees	Skunk Cabbage Swamps	Rocky Outcrops	Ecotones	Mature Coniferous Forest	Young Coniferous Forest	Mixed Forest	Wildlife Trees	Coarse Woody Debris	Fields	Foreshore
Birds													
Seabirds and Waterfowl	√		√		√	√	√			√	√	√	√
Raptors	√		√		√	√	√	√	√	√	√	√	√
Riparian Birds	√	√				√			√	√	√		
Wetland Birds	√	√					√			√	√	√	√
Forest Birds	√	√	√			√	√	√	√	√	√	√	√
Grazing Birds	√					√						√	√
Colonial Nesters	√	√					√						√
Mammals													
Small Mammals	√	√	√	√		√	√	√	√		√	√	
Carnivores	√	√	√	√	√	√	√	√	√	√	√	√	√
Bats	√		√		√	√	√		√	√		√	√
Herptiles													
Terrestrial Amphibians	√		√	√			√		√		√		
Aquatic Amphibians	√		√	√		√	√		√		√		
Reptiles	√	√	√		√	√	√		√	√	√		
Fish	√										√		
Invertebrates													
Pollinators	√	√	√	√	√	√	√		√			√	
Decomposers	√	√	√	√	√		√		√	√	√		
Tree borers		√	√				√	√	√	√	√		
Aquatic Invertebrates	√			√							√		
Soil Biota	√	√	√	√		√	√	√	√		√	√	
Consumers	√	√	√	√	√	√	√	√	√	√	√	√	√

APPENDIX 8 – Wildlife Management

8.4 Species at Risk in Stanley Park

Scientific Name	English Name	Species Code	Global Status	Provincial Status	Fedeal COSWEIC Designation	Provincial CDC Designation	Stanley Park Record
Species on record and may be inhabiting in Stanley Park							
Ardea herodias fannini	Great Blue Heron, fannini subspecies	B-GBHE-FA	G5T4	S3B,S4N	SPECIAL CONCERN	Blue	Yes
Falco peregrinus anatum	Peregrine Falcon, anatum subspecies	B-PEFA-AN	G4T4	S2B	SPECIAL CONCERN	Red	Yes
Rana aurora	Red-legged Frog	A-RAAU	G4	S3S4	SPECIAL CONCERN	Blue	Yes
Megascops kennicottii kennicottii	Western Screech-Owl, kennicottii subspecies	B-WSOW-KE	G5T4	S3	SPECIAL CONCERN	Blue	Yes
Patagioenas fasciata	Band-tailed Pigeon	B-BTPI	G4	S3S4B		Blue	Yes
Botaurus lentiginosus	American Bittern	B-AMBI	G4	S3B		Blue	Yes
Hirundo rustica	Barn Swallow	B-BASW	G5	S3S4B		Blue	Yes
Pachydiplax longipennis	Blue Dasher	IO-PACLON	G5	S3S4		Blue	Yes
Phalacrocorax penicillatus	Brandt's Cormorant	B-BRCO	G5	S1B,S4N		Red	Yes
Oncorhynchus clarkii clarkii	Cutthroat Trout (*clarkii* subspecies)	F-ONCL-CL	G4T4	S3S4		Blue	Yes
Phalacrocorax auritus	Double-crested Cormorant	B-DCCO	G5	S3B	NOT AT RISK	Blue	Yes
Butorides virescens	Green Heron	B-GRHE	G5	S3S4B		Blue	Yes
Callophrys johnsoni	Johnson's Hairstreak	IL-CALJOH	G3G4	S1S2		Red	Yes
Potamogeton nodosus	Long-leaved Pondweed	POTANOD	G5	S1		Red	Yes
Centaurium muehlenbergii	Muhlenberg's centaury	CENTMUH	G5?	S1	ENDANGERED	Red	Yes
Epilobium ciliatum spp. Watsonii	Purple-leaved Willowherb	EPILCIL3	G5T3T5	S2S3		Blue	Yes
Limnodromus griseus	Short-billed Dowitcher	B-SBDO	G5	S2S4B		Blue	Yes
Myodes gapperi occidentalis	Southern Red-backed Vole, *occidentalis* subspecies	M-MYGA-OC	G5T5	S1		Red	Yes
Melanitta perspicillata	Surf Scoter	B-SUSC	G5	S3B,S4N		Blue	Yes
Corynorhinus townsendii	Townsend's Big-eared Bat	M-COTO	G4	S3		Blue	Yes
Aechmophorus occidentalis	Western Grebe	B-WEGR	G5	S1B,S2N		Red	Yes
Sturnella neglecta	Western Meadowlark (Georgia Depression population)	B-WEME	G5 TNRQ	SXB		Red	Yes
Brachyramphus marmoratus	Marbled Murrelet	B-MAMU	G3G4	S2B,S4N	THREATENED	Red	Yes
Larus californicus	California Gull	B-CAGU	G5	S3B		Blue	Yes
Species not on Record in Stanley Park but may exist							
Allogona townsendiana	Oregon Forestsnail	IM-ALLTOW	G3G4	S1S2	ENDANGERED	Red	
Fissidens pauperculus	Poor pocket moss	FISSPAU	G3?	S1	ENDANGERED	Red	
Sorex bendirii	Pacific Water Shrew	M-SOBE	G4	S1S2	ENDANGERED	Red	
Lupinus rivularis	Streambank lupine	LUPIRIV	G2G4	S1	ENDANGERED	Red	

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Species on record but is extirpated or otherwise unlikely to be found in Stanley Park							
Chrysemys picta pop. 1	Western Painted Turtle - Pacific Coast Population	R-CHPI	G5 TNR	S2	ENDANGERED	Red	Yes
Eremophila alpestris strigata	Horned Lark, strigata subspecies	B-HOLA-ST	G5T2	SX	ENDANGERED	Red	Yes
Grus canadensis	Sandhill Crane	B-SACR	G5	S3S4B	NOT AT RISK	Blue	Yes
Melanerpes lewis pop.1	Lewis's Woodpecker (Georgia Depression population)	B-LEWO	G5 TXQ	SXB		Red	Yes
Asio flammeus	Short-eared Owl	B-SEOW	G5	S3B,S2N	SPECIAL CONCERN	Blue	Yes
Hydroprogne caspia	Caspian Tern	B-CATE	G5	S3B	NOT AT RISK	Blue	Yes
Uria aalge	Common Murre	B-COMU	G5	S2B,S4N		Red	Yes
Sterna forsteri	Forster's Tern	B-FOTE	G5	S1B	DATA DEFICIENT	Red	Yes
Ammodramus savannarum	Grasshopper Sparrow	B-GRSP	G5	S2B		Red	Yes
Falco rusticolus	Gyrfalcon	B-GYRF	G5	S3S4B	NOT AT RISK	Blue	Yes
Phalaropus lobatus	Red-necked Phalarope	B-RNPL	G4G5	S3S4B		Blue	Yes

RANKING CODES

Global Ranking

1 = critically imperiled
2 = imperiled
3 = vulnerable to extirpation or extinction
4 = apparently secure
5 = demonstrably widespread, abundant, and secure.
NR = unranked - Global Rank not yet assessed.

Provincial Status

1 = critically imperiled
2 = imperiled
3 = special concern, vulnerable to extirpation or extinction
4 = apparently secure
5 = demonstrably widespread, abundant, and secure.

COSEWIC Ranking

XX = EXTINCT: A species that no longer exists.
XT = EXTIRPATED: A species that no longer exists in the wild in Canada, but occurring elsewhere.
E = ENDANGERED: A species facing imminent extirpation or extinction.

T = THREATENED: A species that is likely to become endangered if limiting factors are not reversed.

SC = SPECIAL CONCERN: A species of special concern because of characteristics that make it is particularly sensitive to human activities or natural events.
NAR = NOT AT RISK: A species that has been evaluated and found to be not at risk.
DD = DATA DEFICIENT: A species for which there is insufficient scientific information to support status designation.

CDC Ranking

Red: Includes any indigenous species or subspecies that have- or are candidates for- Extirpated, Endangered, or Threatened status in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation.

Blue: Includes any indigenous species or subspecies considered to be of Special Concern (formerly Vulnerable) in British Columbia. Taxa of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events. Blue-listed taxa are at risk, but are not Extirpated, Endangered or Threatened.

APPENDIX 8 – Wildlife Management

8.5 Operations Worksheet

Park Operations Activities	Description	Impacts on Wildlife and habitat	Recommendations	Ideal Timing Recommendations												
				Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Plantation Brushing	The mechanical removal of shrubs and trees around plantings to promote increased tree growth	Decrease in species richness and abundance for understory plants and wildlife due to loss of habitat; increased spread of invasive plants.	Use hand tools wherever appropriate. Retain non-competing vegetation. Avoid brushing in April, May, June; and in wildlife areas in July. Conduct breeding bird survey sites and mark nests if brushing is to occur in May/June (handtools only in these months). Follow DFO guidelines for riparian areas.	General				Breeding Bird Season								
Trail side brushing	The mechanical removal of shrubs from trail sides	Decrease in species richness and abundance for understory plants and wildlife due to loss of habitat; increased spread of invasive plants.	Brush to a maximum of 1.5m from the trail and overhanging material; follow DFO guidelines for riparian areas.					Breeding Bird Season								
				Within 30m of a water-course	Fisheries window											
Thinning	The mechanical removal of trees from crowded plantations	Temporary disturbance to wildlife; short-term increase to plant and wildlife species diversity; long term increase to stand health.	Schedule outside breeding bird season; should not occur within 100m of active raptor nests.	General				No activity Breeding Bird Season								
				Within 100m of raptor nest	Raptor nesting season											
Coarse Woody Debris Removal	The removal of fallen trees and large woody debris from the forest floor	Decrease in species richness and abundance for understory plants and many species of wildlife due to loss of habitat.	Follow guidelines in log debris module (Appendix 3). Add mulch to exposed soil resulting from removal work.	General												
				Within 30m of a water-course	Fisheries window											
Hazard tree treatment / removal	The removal of fallen branches and small woody debris from the forest floor	Decrease in species richness and abundance for many species of wildlife due to loss of habitat.	Retain snags or create wildlife trees where appropriate. See (Appendix 8.6).	General				Breeding Bird Season								
Planting	Planting of conifer tree species in windthrow or other areas	Decrease in species richness and abundance for understory plants and wildlife. Long term increase to diversity of conifer species.	Plant a diversity of species to meet stand objective. Small blowdowns should be allowed to regenerate naturally where surrounding area meets stand objective. Cluster plant. Enhance *wildlife emphasis areas* by planting site enhancing species.	General												

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Spiral Pruning	Up to 1/3 of the total branches are removed to allow winds to move through the tree in response to new openings.	Temporary disturbance to wildlife; short term increase to stand resiliency.	If appropriate schedule outside of breeding bird season and avoid working within 100m of active eagle nests.										
Trail Maintenance	Regraveling, leveling, grading.	Temporary disturbance to wildlife; increased sedimentation near watercourses; decreased habitat from widening; increased spread of invasive plants; temporary increase in noise and air pollution.	Install temporary silt fencing near watercourses; follow DFO guidelines; avoid trail widening, and off-trail compaction. Close unauthorized trails.	General									
				Within 30m of a water-course	Fisheries window								
Special Events and Filming	Use of the forest by people, equipment and/or vehicles while filming an/or the construction of movie sets	Temporary disturbance to wildlife; soil compaction and erosion; increased spread of invasive plants.	Avoid disturbances within 100m of active raptor nests or in wildlife MEA ś (especially during the breeding season); not recommended on steep slopes or in wet areas.	General									
				Within 100m of raptor nest	Raptor nesting season								
Invasive species removal	The manual removal of alien invasive plants by Parks staff or Stanley Park Ecology Society staff and volunteers	Increase in species richness and abundance for plants and wildlife; temporary disturbance to habitat and loss of ground cover; temporary disturbance to wildlife.	No large scale removal during the breeding season (unless nesting surveys are completed); removed biomass and habitat should be replaced by adding mulch and/or planting species equivalent in wildlife value (i.e. salmonberry replaces blackberry, salal replaces ivy) especially where soil erosion or recolonization by invasives is a concern. Conduct pre and post removal site assessments, and ongoing site maintenance	General				Conditional activity Breeding Bird Season					
				Within 30m of a water-course	Fisheries window								
Rock scaling	Trained rock-climbing professionals rappel down on ropes to hand scale loose rock	Loss of species richness and abundance of delicate plants; temporary disturbance to wildlife.	Planned maintenance should avoid breeding bird season and undue disruption to plant communities.	General			No planned activity Breeding Bird Season for Cormorants						
Mowing	The use of lawn mowers on grassy areas	Loss of habitat for some invertebrate species; temporary noise and air pollution increase; temporary disturbance to wildlife; damage to trees and tree root systems	Leave buffer strips that are mowed infrequently along forest edges. Mowing near eagle nest trees should be restricted to at least 10 m from the tree base.	General									

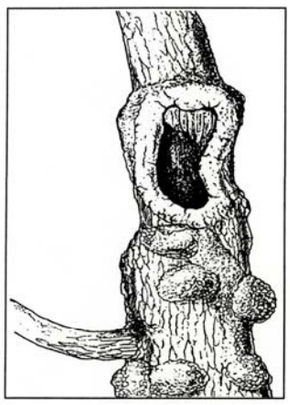
APPENDIX 8 – Wildlife Management

Drainage alterations	Creation or modification of natural or man-made waterways or wet areas	Decrease in species relying on wet environment; temporary or permanent disturbance to wildlife inhabiting the drainage; temporary siltation of waterway	Follow relevant excerpts from B.C. Ministry of Environment Ecosystem Standards and Planning Biodiversity Branch.	Within 30m of a water-course	Fisheries window
Culvert maintenance / replacement	The removal, addition, maintenance or replacement of culverts under roadways and trails	Temporary or permanent disturbance to wildlife inhabiting the drainage; temporary siltation of waterway	Culvert replacement should consider the fisheries window; culverts should be flush with or below the soil surface to allow movement of wildlife and fish.	General	
				Within 30m of a water-course	Fisheries window
Inventory, or monitoring activities	The systematic collection of data over time using recognized techniques and protocols	Increased understanding of Park ecosystems and increased ability to employ adaptive management.	Should follow RISC standards for timing and methods.	General	
Suppression of Natural Processes	The reduction of perceived ‟danger 'from natural forces by a variety of human interventions	Small scale disturbances enhance biodiversity.	Allow small scale disturbances when they enhance progress toward stand objectives, and meet public safety requirements.	General	
Pesticide, herbicide, or fungicide Use	The application of chemicals to kill animal and plant pests.	Toxic or deadly to wildlife; builds up in the food web; detrimental to streams and other watercourses.	If these must be used, City of Vancouver and MOE regulations should be followed.	General	
				Within 30m of a water-course	No activity
Machines and Vehicles	Trucks, cars, mowers, or other machinery.	Pollution (oil, gas, lubricant) can be toxic or deadly to wildlife and is detrimental to streams and other watercourses; increased noise and air pollution; increased spread of invasive plants.	Spill equipment should be kept in operations yard; oiling and refueling should occur away from forest soils and watercourses;	General	

APPENDIX 8 – Wildlife Management

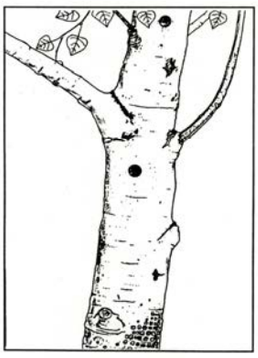
8.6 Wildlife Trees

Habitat Features in Wildlife Trees

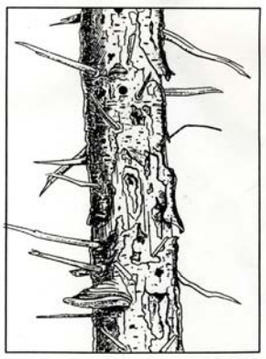


Natural cavity in bigleaf maple.

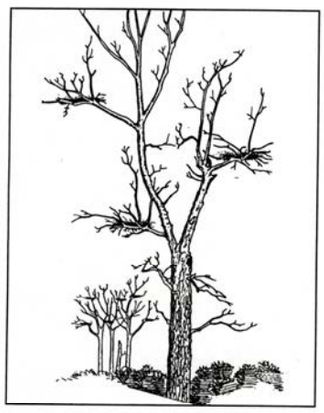
"Chimney effect" in western redcedar (a bat tree).



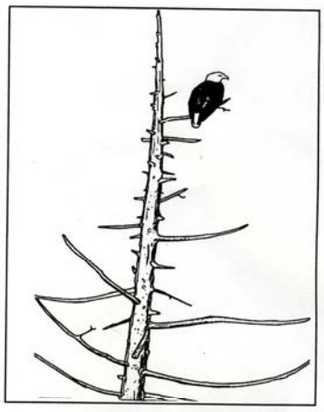
Live hardwood with primary cavity excavation and feeding holes.



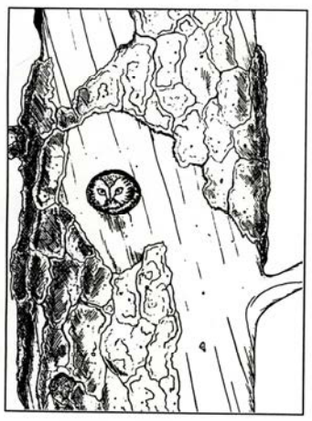
Heart rot and loose bark in grand fir, (used by birds such as Brown Creepers and nuthatches).



Branching in black cottonwood (nesting for Great Blue Heron).



Spike top snag (for perching birds such as Bald Eagle).



Secondary cavity in ponderosa pine (Saw-whet Owl) using old Northern Flicker cavity).

Douglas-fir snag (nesting and perching for owls).

APPENDIX 8 – Wildlife Management

Table 1. British Columbia's wildlife tree classification system

	LIVE		DEAD					DEAD FALLEN	
			Hard			Spongy	Soft		
Decay class	1	2	3	4	5	6	7	8	9
						approx. 2/3 original height 	approx. 1/2 original height 	approx. 1/3 original height 	
Description	**Live/healthy;** no decay; tree has valuable habitat characteristics such as large, clustered or gnarled branches, or horizontal, thickly moss-covered branches.*	**Live/unhealthy;** internal decay or growth deformities (including insect damage, broken tops); dying tree.*	**Dead;** needles or twigs may be present; roots sound.	**Dead;** no needles/twigs; 50% of branches lost; loose bark; top usually broken; roots stable.	**Dead;** most branches/bark absent; some internal decay; roots of larger trees stable.	**Dead;** no branches or bark; sapwood/ heartwood sloughing from upper bole; decay more advanced; lateral roots of larger trees softening; smaller ones unstable.	**Dead;** extensive internal decay; outer shell may be hard; lateral roots completely decomposed; hollow or nearly hollow shells.		**Debris;** downed trees or stumps.
Uses and users	Nesting (e.g., Bald Eagle, Great Blue Heron colonies, Marbled Murrelet); feeding; roosting; perching.	Nesting/roosting[1] —strong PCEs[2] (woodpeckers); SCUs[3]; large-limb and platform nests (Ospreys); insect feeders.	Nesting/roosting— strong PCEs; SCUs; bats.	Nesting/roosting —PCEs; SCUs; insect feeders.	Nesting/roosting— weak PCEs (nuthatches, chickadees); SCUs; bats; insect feeders.	Weaker PCEs; SCUs; insect feeders; salamanders; small mammals; hunting perches.	Insect feeders; salamanders; small mammals; hunting perches; occasionally used by weak cavity excavators such as chickadees.		Insect feeders; salamanders; small mammals; drumming logs for grouse; flicker foraging; nutrient source.
Decay value	2	1	1	1	1	2	3		

[1] Large witches' brooms provide nesting/denning habitat for some species (e.g., fisher, squirrels).

[2] PCE = primary cavity excavator

[3] SCU = secondary cavity user

* This classification system does not recognize root disease trees specifically. Such trees become unstable at or before death.

Wildlife Danger Tree Assessors Handbook, 1997.

APPENDIX 9 – Planting Prescription Sample

Stanley Park Blowdown Recovery Spring 2008 Planting Prescription

Date: March 10, 2008	Zone: North	Block Name: N-1	Area: ~4.9 ha

SAFETY

Concerns/Preventative Actions:

- Due to the overhead hazards, operations will shut down when winds exceed 30km/hr.
- Use caution crossing Park Drive.
- Planting Units 5 and 6 were not salvaged and have high levels of CWD. Be careful while moving around in these areas.

Overall Prescription Goals:

- Establish mixed to pure species plantations of Cw, Fd and (Bg, Ss) in irregular, **clumpy** or **scattered** distributions.
- Seven Planting Units have been established (PU's 1-7) with variable planting species compositions, distributions and expected densities.
- PU's 1-4 and 6-7 are mostly **non-wet sites** and will be planted with a **clumpy** distribution.
- PU 5 contains mostly **wet sites** and will be planted with a **scattered** distribution.

Prescription for Clumpy Distribution:

Densities:

Clumps: Target is 100 clumps per hectare. Minimum is 50 clumps per hectare.
Tree per Clump: Target is 4 trees per clump. Range is between 2 and 5 trees per clump. Trees to be planted in irregular distributions.

Inter-tree Distances:

Clumps: Target is 10m between clumps. Minimum distance between clumps is 4m.
Spacing within Clumps: Target is 3m, minimum is 2m between trees.

Species Composition, Distribution and Expected Planting Densities:

Planting Unit 1: Cw 70%, Fd 30%; uniform mix; 450 sph.
Planting Unit 2: Cw 50%, Fd 50%; uniform mix; 450 sph.
Planting Unit 3: Cw 100%, (Bg+F+); prioritize canopy openings- Fd only in largest openings; 250 sph.
Planting Unit 4: Cw 80%, Fd 20%, (Bg+); uniform mix; 450 sph.
Planting Unit 6: Cw 100%, (F+Bg+S+); 450 sph.
Planting Unit 7: Cw 70%, Fd 30%; uniform mix; 450 sph.

Prescription for Scattered Distribution:

Densities:

These are wet sites. Target raised, mounded microsites. First priority are mounds with stumps. Second priority is other raised mounds. Depressions are not to be planted.
Trees per Mound: Target is 3 trees per mound. Range is between 1 and 5 trees per mound.

Inter-tree Distances:

As existing mounds are to be planted, there is no target spacing between mounds.
Spacing within Mounds: Target is 2m, minimum is 1.2m between trees.

Species Composition and Expected Planting Densities:

Planting Unit 5: Cw 100%, (F+Bg+S+); 300 sph.

APPENDIX 9 – Planting Prescription Sample

Stanley Park Blowdown Recovery Spring 2008 Planting Prescription

Date:	March 10, 2008	Zone: North	Block Name: N-1	Area: ~4.9 ha

Other Planting Rules/Notes:
Roads, sidewalks and Trails: Stay 2m away from the edges.
Transmission line: Stay 5m away.
Existing Fd, Cw, Bg, Ss regeneration: Stay 3m away from existing, undamaged regen.
Existing Hw regeneration and vine maple: Stay outside the dripline. Stay 3m away from clumps of Hw regen or larger vine maple patches.
Big leaf maple (including coppicing stumps): Stay 5m away.
Residual, mature trees: Stay 2m away from the stems.
Block boundaries are marked with orange ribbon.
Planting Unit boundaries are marked with yellow, polka dotted ribbon.

AUTHORIZATION	
Prescribed by:	Jeff McWilliams, RPF B. A. Blackwell and Associates Ltd.

APPENDIX 10 – Thinning Prescription Samples

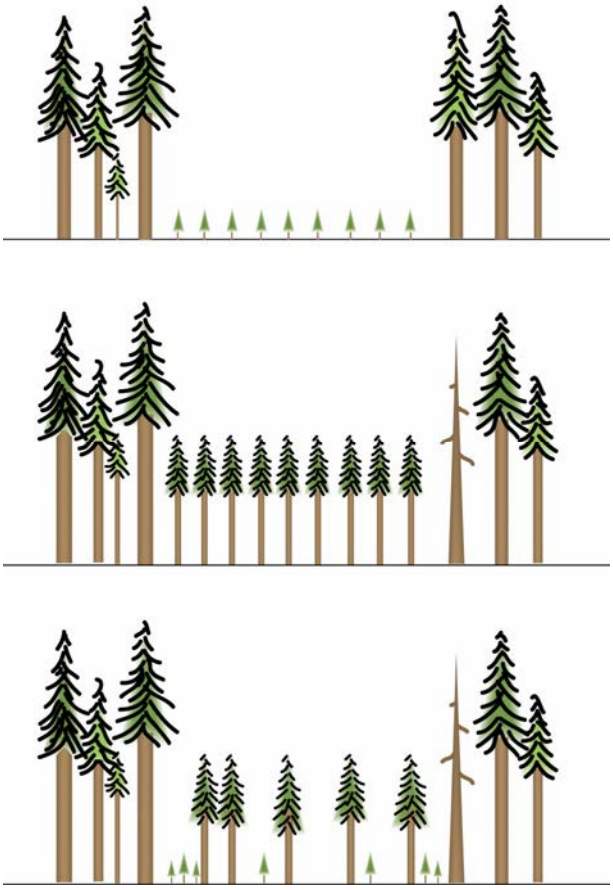
10. 1 A Thinning Prescription for 12- 20 Year Old Plantations in Stanley Park

Treatment Objective

The purpose of this prescription is to provide options to control long term stand structures in the park through judicious application of early thinnings. There are two objectives of these treatments. They are to promote increased resistance to wind damage as stands develop over the long term (up to hundreds of years). This will be achieved by avoiding excessive crowding of individual trees, a conditions which in turn leads to tall, slender trees that are highly susceptible to wind damage. They will also help foster the development of stands with a diverse array of structural types, which enhance wildlife and provide aesthetic interest.

Eligible Stands

This prescription is intended for application to a set of relatively small plantation areas established in the Park between the mid-1980's and 2006. These trees were planted in canopy gaps (see figure below) resulting from a wide range of disturbances where natural processes had failed to provide desired levels of regeneration in a timely manner. The size of these areas ranges from small groups of 10 to 30 trees up to approximately 1 ha.



Planted stand development in forest gaps. When trees are very young (a), they experience little crowding with other trees. Depending on planting density, eventually the crowns of adjacent trees will meet. Where crowding is intense (b), tree form can be severely affected, resulting in short, narrow crowns and slender stems. If such stands are thinned at an early age, trees will develop thicker stems with longer and broader crowns (c). The thinning treatment will also result in improved light penetration to the forest floor, thus allowing for development of a more vigorous and diverse shrub layer and initiation of further tree layers.

APPENDIX 10 – Thinning Prescription Samples

Thinning Prescription

The timing and intensity of thinning in these stands represents a balance between early treatment to maximize wind stability and waiting to promote crown lift, which is desirable for the creation of at least partially branch-free boles. Thinning planted trees to an average stand density of 250 trees/ha will provide enough growing space for individual trees to develop and maintain desired form characteristics (stem and crown) for the purpose of reducing long term risk of wind damage. Delaying thinning until self-pruning has resulted in at least 3 to 4 m of crown lift will improve long term mobility and sight lines through stands.

It is recommended that stands be thinned prior to reaching 12 m in height (or as soon thereafter as possible). Stands should be thinned earlier if crowding is so intense than the live crown ratio (distance from top of tree to lowest live branch whorl ÷ tree height) falls below 60%.

In selecting trees to leave, priority should first be given to trees of good health and form (no forks, scars or obvious signs of disease). Secondly, trees should be selected based on the maintenance of a desired species mix as outlined in the Stand Management Objectives for the Park.

Trees should not be thinned to a uniform density. While the ***average*** inter-tree spacing should be approximately 6.3 m, this distance should be varied considerably to promote development of structural diversity. Some trees can be left in clumps of 2 to 4 individuals, while occasional gaps of up to 10 m across are also desirable. Trees can be thinned either by felling or girdling. Trees that are felled should at least be limbed to promote rapid decomposition of fine branches, or chipped where the risk of increased fire hazard is unacceptable.

10. 2 A Thinning Prescription for 45-Year Old Douglas-fir Plantations in Stanley Park

Treatment Objective

The purpose of this prescription is to promote the development of increased windthrow resistance in stands that originated as plantations following storm damage and subsequent salvage operations associated with Hurricane Frieda in 1962.

Current conditions

After 46 years of growth these plantations range in height from 32 to 37 m, with stand densities from 350 to 650 trees/ha. Lower density portions of these stands are those where occasional large trees were left standing after the storms, or where the stochastic vagaries of nature have resulted in above normal patches of early mortality. In the densest portions of these stands (e.g. Figure 1a), the canopy is fully developed such that light levels reaching the forest floor are currently insufficient to support more than a minimal carpet of herbaceous vegetation. Trees are generally tall and slender, with long branch-free stems.

APPENDIX 10 – Thinning Prescription Samples

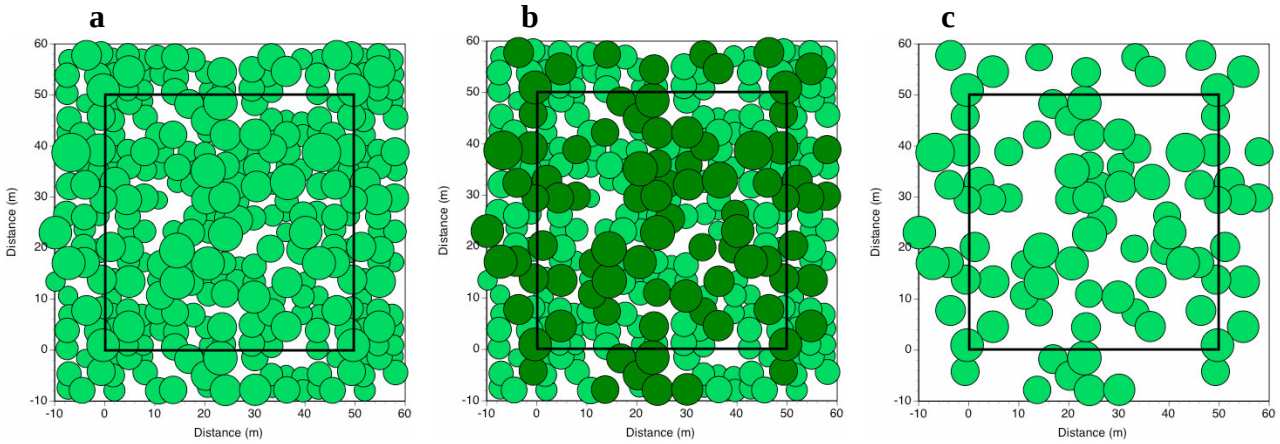


Figure 1. Simulated stem map of Douglas-fir plantation at 36 m height and 650 tree/ha, roughly corresponding to the conditions present in the most densely populated portions of the post-Frieda stands. The marked square in each image represents 0.25 ha. The image on the left shows all trees, the image in the center highlights the largest 200 trees/ha, and the image on the right represents a stand thinned strictly from below to leave the largest 200 trees/ha.

Treatment Rationale

Trees growing in dense, even-aged stands typically develop a slender form that predisposes them to wind damage. Under most conditions, the susceptibility of individual trees is largely overcome by the mutual support provided by close neighbors. However, under extreme conditions such as Hurricane Frieda in 1962 or the storms of 2006,failure of large patches of trees can occur once the initial group resistance is overcome by strong gusts.

Thinning in dense stands can, in the long run, improve resistance to wind damage. Reduced susceptibility is a combination of several factors:

1. the most slender and susceptible trees in the stand are removed in the thinning operation, leaving the most stable trees
2. the remaining trees will gradually expand their crowns and regain their mutually supportive roles, but in a stand where the average long-term susceptibility to wind damage is reduced
3. individual trees will be triggered to make adjustments to their growth form with increased growth in girth and volume of coarse roots

The hurricane Frieda plantations are past the ideal age for thinning treatments to promote increased wind firmness, but gains are stll available. If even a small portion of these stands can be preserved for an extra century, a positive contribution to the goals of the Park will have been made.

Beyond changes to wind-firmness, it is also important to recognize other changes that will result from this treatment:

APPENDIX 10 – Thinning Prescription Samples

1. The treatment will reduce the number of standing dead stems over the next 20 to 50 years, which may have implications for wildlife habitat locally in the treated stands. These effects will be relatively small in the larger landscape context.
2. The treatment will open the canopy to increased penetration by light, and allow the re-initiation of understorey development. This process would occur slowly over the next 4 to 5 decades naturally, but will occur sooner with treatment. Increased occurrence of mosses, ferns, herbs, low shrubs and understorey trees can be expected. This is expected to benefit any species of song birds.

Excessive overall density reductions in these stands should be also avoided. A diversity of stand structure types is desirable across the landscape for both biological and aesthetic reasons, and these types of even-aged stands are relatively uncommon in this age class.

Risks

Thinned stands will experience a temporary increase in susceptibility to wind damage in the first few years after each treatment. The risk of loss, however, will be greatest in the smallest, most slender trees that will be targeted in subsequent thinning treatments. These risks are a trade-off against a longer term reduction in overall stand susceptibility to wind damage. Rapid reductions in stand density due to thinning should be avoided, as they can have detrimental effects on windthrow susceptibility. A gradual reduction in density is therefore recommended.

There is also a risk that thinning operations could promote increases in Douglas-fir beetle populations. These insects are known to breed in freshly dead standing or fallen logs with diameters in excess of 18 to 20 cm and where the bark has begun to become thick and incised. Population increases resulting from high brood success in freshly killed logs could lead to successful attacks on live trees.

A third risk associated with this thinning prescription is related to the build-up of fine slash on the ground that can act as an ignition source and fuel for initial spread of fires. Accumulations of fine slash should be avoided.

Prescription

The recommended target density for this stand is 200 to 250 trees/ha (4 to 5 trees on average in a plot with a 7.98 m radius), to be reached over a period of 20 years. The following treatment guidelines are recommended:

1. Up to 4 treatment entries will be required in the most dense stands, with a 5-year interval between entries.
2. Remove no more than 1 in 4 live trees at each entry, in a roughly uniform distribution throughout the stand
3. In general the smallest trees will be removed first, with the following caveats:
    a. Preferentially remove seriously damaged or diseased trees regardless of size.
    b. Preferentially leave cedar to help maintain tree species diversity

APPENDIX 10 – Thinning Prescription Samples

c. Remove trees strategically – if trees are being felled, remove trees first that are easiest to drop through the remaining canopy, thus creating canopy gaps to facilitate additional fellings, future treatments and, if necessary, movement of equipment through the stand

d. Where two trees that might be removed are of similar size, preferentially save the tree with the best health, vigour and form (forked trees are less desirable than trees that are free of forks)

e. Where two trees are of similar size, preferentially remove the tree that is in closest proximity to those that will never be removed (the largest trees)

f. Perform follow up monitoring for Douglas fir Bark beetle

Trees can be felled or girdled. Girdling of at least some trees will improve worker safety in the short run and may reduce fire hazard, but may increase the risk for workers and the public in the long run, particularly where close to trails. Girdling of trees will result in a more natural decay sequence for killed trees, and could possibly result in opportunities for cavity nesting vertebrates. Girdling may also be an attractive option in cases where trees cannot be felled safely or where felling a tree introduces the risk of damage to a desired leave tree (e.g. felled tree becomes "hung up" in crown of leave tree, and both must be dropped to avoid leaving a cut tree partially standing).

Any portions of Douglas-fir stems (logs) where the cross sectional diameter exceeds 18 cm should be eliminated from the stands to avoid the risk of increased Douglas-fir beetle populations. .

Logs could be chipped in place with a mobile chipper, although large accumulations of chips may become problematic. Care must be taken to avoid thick blankets of chips through which ground vegetation cannot grow.

APPENDIX 11 - Management Emphasis Areas

STANLEY PARK FOREST MANAGEMENT PLAN

Management Emphasis Areas

Five Management Emphasis Areas have been identified for Stanley Park's forest.

Management emphasis areas are areas where park usage patterns, distinctive work requirements, or ecological preconditions suggest a similar emphasis placement on management objectives. They are not exclusive to each other and can act as a guide to making decisions. They may utilize unique sets of work practices or restrictions, or be used to set activity priorities.

Safety emphasis area
Areas located near enough to well used portions of the park for tree failures to cause damage or injury. The modification or removal of danger trees is on a higher priority level here than in other portions of the forest.

Regeneration emphasis area
Blowdown areas from the 2006/07 storms, or smaller openings created by other recent storms, where the emphasis is to ensure the successful colonization of a well adapted diversity of trees and understory.

Wildlife emphasis area
Riparian areas and wetlands, bogs, forest edges, deciduous stands, bluffs, veteran trees and ephemeral raptor nesting sites have been identified as having a particularly high value to wildlife. Protection and enhancement activities are given a higher level of consideration than in other areas of the forest.

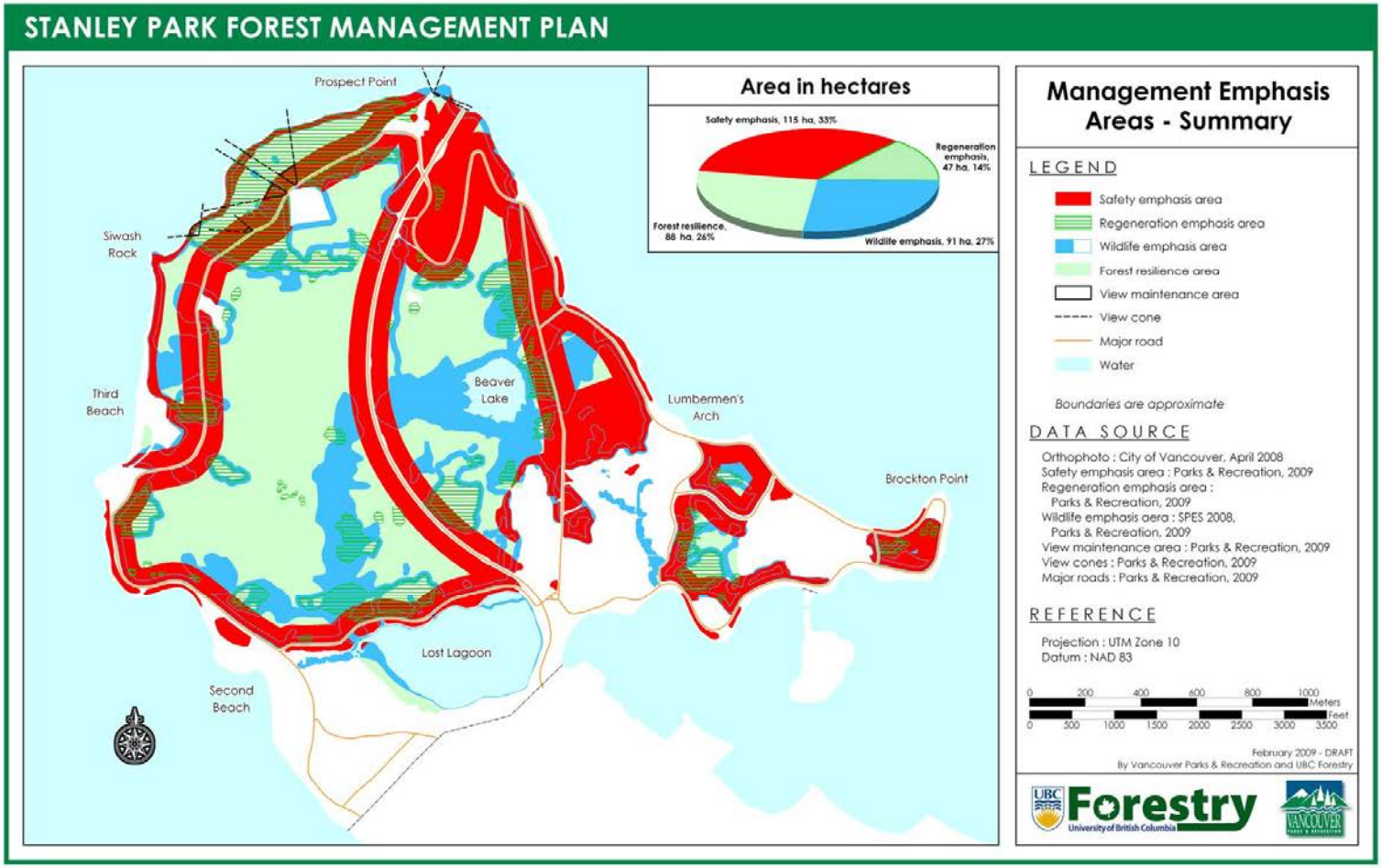
Forest resilience area
Areas where subtle interventions that improve forest resiliency are employed where most necessary, but the allowance of natural processes is generally favoured.

View cones
Three locations where the open views significantly enhance visitor enjoyment of the park will be protected by cutting back vegetation that grows to encroach upon it.

UBC Forestry University of British Columbia

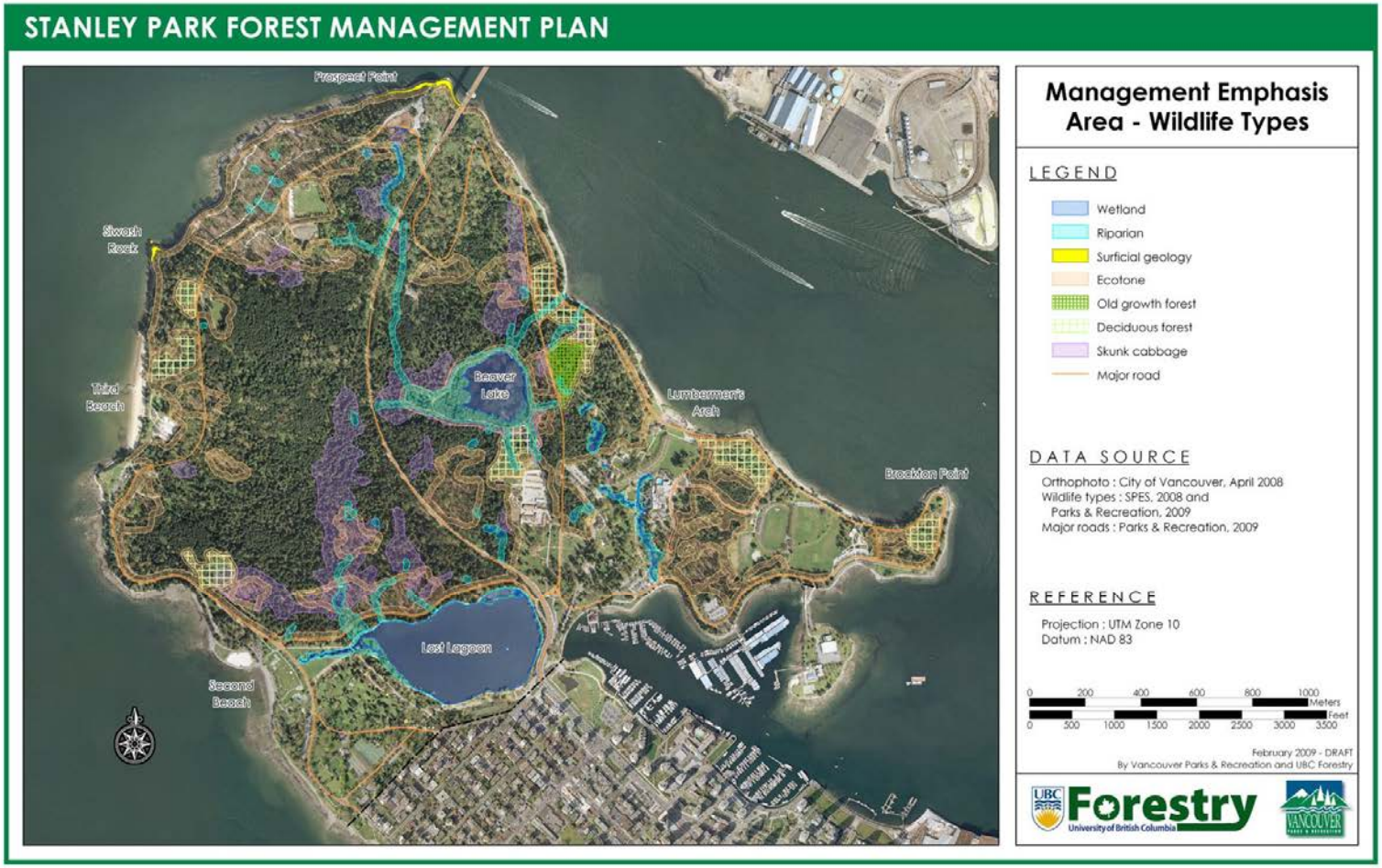
February 2009

APPENDIX 11 - Management Emphasis Areas



Map 11.1: Management Emphasis Areas Summary

APPENDIX 11 - Management Emphasis Areas



Map 11.2: Management Emphasis Area Wildlife Types

APPENDIX 12 – Target Conditions for Vegetation Zones

STANLEY PARK FOREST MANAGEMENT PLAN

Target Conditions for Vegetation Zones

Vegetation Zones are areas within the forest with similar tree species, age and size mixes, and understory composition. They typically develop from a similar point in time following a disturbance, and in response to growing conditions such as weather exposure, soil and drainage parameters, and the pre-existing community of other organisms.

There are 5 vegetation zones in Stanley Park's forest :

- Conifer dominated forest on moist soils
- Conifer dominated forest on well drained (mesic) soils
- Alder - early successional forest
- Mixed - maple/conifer forest
- Dry, exposed ridge forest

Each zone has three age-based sub-categories : juvenile, immature and mature.

A set of Target Conditions has been identified for each vegetation zone and maturity class. They are described by species composition and density. The Target Conditions have been prepared with the aim of mimicking what a healthy forest would produce along its developmental path.

Target Conditions are considered whenever conducting work in the forest. If an area is close to target conditions, then it will be allowed to continue naturally. However, if it is deviating from a normal and healthy path, then subtle corrections may be employed.

Forestry

February 2009

APPENDIX 12 – Target Conditions for Vegetation Zones

STANLEY PARK FOREST MANAGEMENT PLAN

Target Conditions for Conifer Mesic Forest

112 hectares - 43% of forest

Maturity Class	Photo	Species Composition (% of Canopy)	Understorey	Canopy
Juvenile 0 to 20 yrs 12 Ha (5 %)		40 to 70% Fd 5 to 20% Cw 10 to 30% Hw 0 to 15% Bg 0 to 15% Mb 0 to 5% Ss 0 to 25% Decid*	Red huckleberry is common, with salal becoming more dense and competitive on drier sites. Dull Oregon grape and rose species may occur. Common snowberry, black raspberry and trailing blackberry are likely on more disturbed soils. Bracken fern patches may occur, especially on more disturbed soils. Sword fern and tall shrubs (salmonberry, thimbleberry, red elderberry, currant species and vine maple) common on the more moist and nutrient enriched mesic sites. Herbaceous plants may include western starflower, twinflower, and bleeding heart.	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. Total trees/ha expected to progress beyond this stage will range from 400 to 1000, with a modal value of 500.
Immature 20 to 100 yrs 41 Ha (16 %)		50 to 70% Fd 5 to 20% Cw 10 to 30% Hw 0 to 15% Bg 0 to 15% Mb 0 to 5% Ss 0 to 20% Decid*	Shrubs and ferns (see Juvenile Stands, above), persist mainly in open gaps, or under broadleaf canopy. Understorey shrubs and herbs may almost totally excluded where a conifer canopy becomes tightly closed. Mosses such as step moss, Oregon beaked moss and flat moss tend to dominate under such conditions.	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. Total trees/ha expected to progress beyond this stage will range from 200 to 500, with a modal value of 250
Mature > 100 yrs 59 Ha (23 %)		50 to 80% Fd 5 to 20% Cw 10 to 30% Hw 0 to 15% Bg 0 to 10% Mb 0 to 5% Ss 0 to 5% Decid*	Red huckleberry is common, with salal increasing on drier sites. Mosses are abundant. Dull Oregon grape and rose species may occur. Sword fern and tall shrubs (salmonberry, thimbleberry, red elderberry, currant species, vine maple) are less abundant as compared to juvenile stage, but are replenished where previously excluded by closed conifer canopies. These species are common on relatively moist and nutrient enriched mesic sites, in open gaps with adequate light. Rattlesnake plantain and coral root may occur.	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 understorey. 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%. Ideally, these stands will have 50 to 200 very large trees/ha, and 300 to 700 trees/ha in smaller size classes

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

Species Codes :

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

Forestry

February 2009

Chart 12.1: Target Conditions for Conifer Mesic Forest

APPENDIX 12 – Target Conditions for Vegetation Zones

STANLEY PARK FOREST MANAGEMENT PLAN

Target Conditions for Conifer Moist Forest

89 hectares - 34% of forest

Maturity Class	Photo	Species Composition (% of Canopy)	Understorey	Canopy
Juvenile 0 to 20 yrs 12Ha (5 %)		50 to 70% Cw 10 to 35% Hw 5 to 15% Ss 0 to 15% Fd 0 to 15% Mb 0 to 5% Ac 0 to 20% Dr	Understorey will develop rapidly during stand establishment, and compete strongly with establishing trees. Dense tall shrub mixture will dominate wherever light levels are adequate. Shrubs reach 2-3m height (vine maple up to 10m). Common shrub species include salmonberry, red elderberry, thimbleberry, currant species, vine maple and beaked hazelnut. Sword fern may be common, with some spiny wood fern, lady fern and deer fern. Red huckleberry and salal may occur, but are confined to well decomposed, coniferous coarse woody debris substrates. Devil's club and skunk cabbage will occur on the wettest sites (depending on drainage and soil aeration).	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. Douglas fir, western hemlock, bigleaf maple and grand fir will only occur on raised hummocks with well aerated soils. 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. The Douglas-fir component can be increased where these patches are large in area. Total trees/ha expected to progress beyond this stage will range from 400 to 800 ,with a modal value of 500
Immature 20 to100 yrs 20 Ha (8 %)		60 to 80% Cw 10 to 30% Hw 5 to 15% Ss 0 to 15% Fd 0 to 15% Mb 0 to 5% Ac 0 to 20% Dr	The understorey will diminish during this stage where the conifer overstorey forms a closed canopy. The tall shrub mixture will persist only where understorey light levels remain adequate, and may remain dense and vigorous under deciduous patches. Shrub height 2-3m (vine maple up to 10m).	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. These stands will have high levels of instability, particularly at higher stand densities. 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. Total trees/ha expected to progress beyond this stage will range from 200 to 400, with a modal value of 250
Mature > 100 yrs 57 Ha (22 %)		60 to 90% Cw 10 to 30% Hw 5 to 15% Ss 0 to 15% Fd 0 to 20% Mb 0 to 5% Ac	Tall shrubs (salmonberry, thimbleberry, red elderberry vine maple) will be less prevalent than in juvenile stage, but will recover where previously diminished by closed conifer canopies. Diverse herbaceous plants increase over time in a patchy distribution. Common species include western trillium, false lily-of-the-valley, vanilla leaf, three-leafed foamflower, Indian pipe and twistedstalk. Sword ferns and mosses may establish over extensive areas. Red huckleberry and salal continue to be present only on large coniferous coarse woody debris. Devil's club and skunk cabbage persist on wettest sites.	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%. Ideally, these stands will have 50 to 150 very large trees/ha, and 200 to 600 trees/ha in smaller size classes

Species Codes :

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

Forestry

February 2009

Chart 12.2: Target Conditions for Conifer Moist Forest

APPENDIX 12 – Target Conditions for Vegetation Zones

STANLEY PARK FOREST MANAGEMENT PLAN

Target Conditions for Mixed - Maple/Conifer Forest

39 hectares - 15% of forest

Maturity Class	Photo	Species Composition (% of Canopy)	Understorey	Canopy
Juvenile* 0 to 30 yrs 15 Ha (6 %)		50 to 100% Mb 0 to 30% Conifer 0 to 20% Dr 0 to 20% Decid.**	Tall shrub mixture will develop, reaching 2-3m height. Salmonberry, red elderberry and trailing blackberry are common. Sword fern may occur, and may be accompanied by scattered spiny wood fern, lady fern and deer fern, depending on moisture and presence in the previous stand. Herbaceous plants may be present, such as western trillium, and bleeding heart.	Stands will be primarily even-aged with the exception of legacy trees left from stands that occurred prior to the last major disturbance. Mb will develop rapidly from stump sprouts with a spatial pattern dictated by the previous stand Shade tolerant conifers (Cw, Hw, Bg) will regenerated in a clumpy pattern either naturally or as facilitated by planting. Douglas-fir may be planted if large gaps occur in the maple cover. A full canopy with near 70 to 100% cover will develop by age 20. Total trees/ha expected to progress beyond this stage will range from 500 to 2500, with a modal value of 2000.
Immature 30 to 100 yrs 15 Ha (6%)		50 to 100% Mb 0 to 30% Conifer 0 to 20% Dr 0 to 20% Decid.**	Understorey species as above for Juvenile Stands; however tall shrub cover is often reduced over time. Swordfern will tend to persist. Licorice fern becomes established as an epiphyte on mature maple, and may occur on raised microsites underneath mature trees.	Stands will continue to be primarily even-aged, with height stratification by species. Some conifers may make it to the upper canopy, but these will be susceptible to windthrow. 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. Total trees/ha expected to progress beyond this stage will range from 300 to 700, with a modal value of 600.
Mature > 100 yrs 9 Ha (3 %)		50 to 100% Mb 0 to 30% Conifer	Understorey species as above for Immature Stands. Sword fern and Licorice fern are well established.	Large Mb 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 Mb for a very long period of time, with gradual infilling of a conifer understorey 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

Species Codes :

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

Forestry

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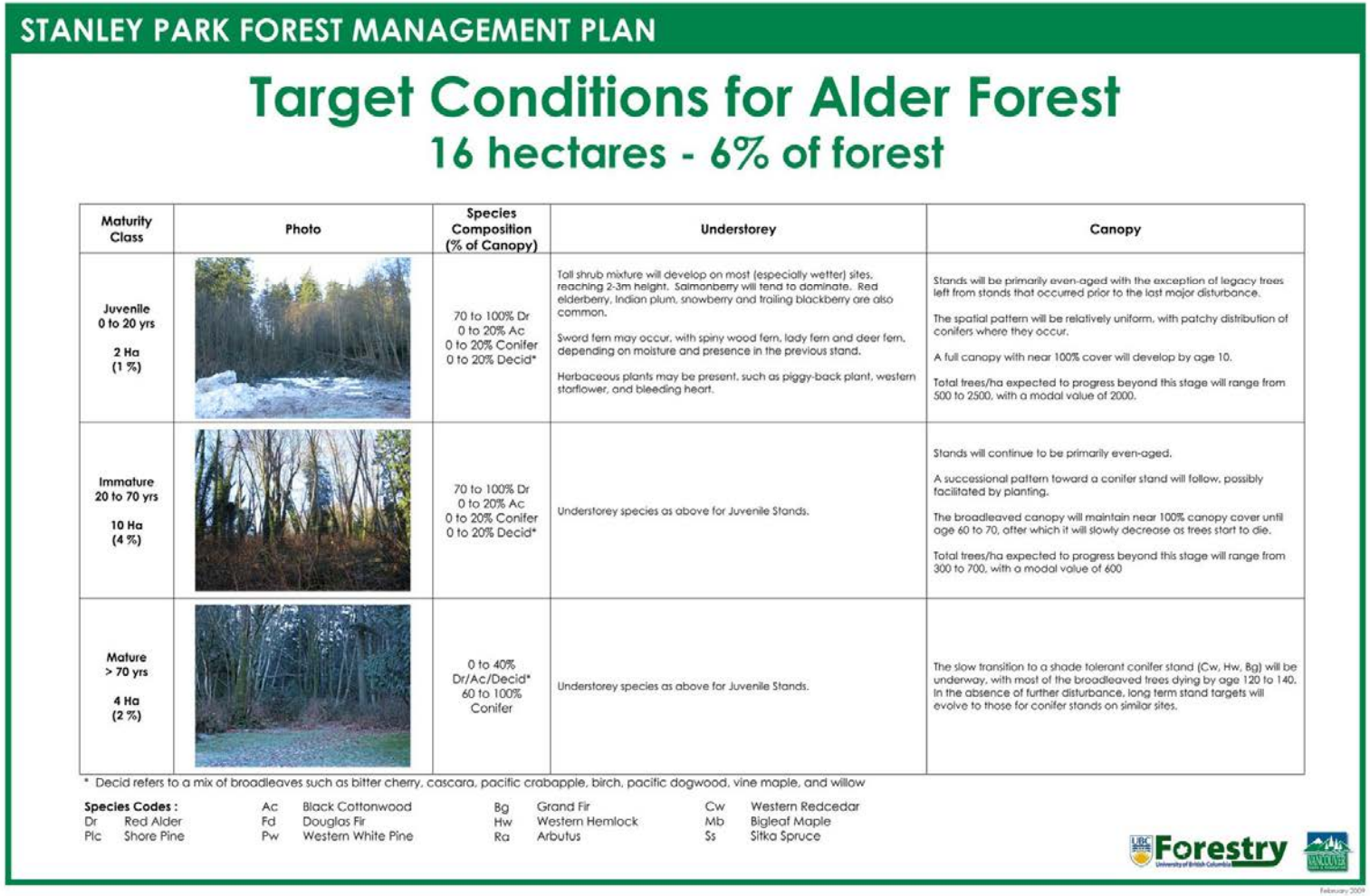
Chart 12.3: Target Conditions for Mixed – Maple/Conifer Forest

APPENDIX 12 – Target Conditions for Vegetation Zones



STANLEY PARK FOREST MANAGEMENT PLAN

Target Conditions for Alder Forest

16 hectares - 6% of forest

Maturity Class	Photo	Species Composition (% of Canopy)	Understorey	Canopy
Juvenile 0 to 20 yrs 2 Ha (1 %)		70 to 100% Dr 0 to 20% Ac 0 to 20% Conifer 0 to 20% Decid*	Tall shrub mixture will develop on most (especially wetter) sites, reaching 2-3m height. Salmonberry will tend to dominate. Red elderberry, Indian plum, snowberry and trailing blackberry are also common. Sword fern may occur, with spiny wood fern, lady fern and deer fern, depending on moisture and presence in the previous stand. Herbaceous plants may be present, such as piggy-back plant, western starflower, and bleeding heart.	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. Total trees/ha expected to progress beyond this stage will range from 500 to 2500, with a modal value of 2000.
Immature 20 to 70 yrs 10 Ha (4 %)		70 to 100% Dr 0 to 20% Ac 0 to 20% Conifer 0 to 20% Decid*	Understorey species as above for Juvenile Stands.	Stands will continue to be primarily even-aged. A successional pattern toward a conifer stand will follow, possibly facilitated by planting. 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. Total trees/ha expected to progress beyond this stage will range from 300 to 700, with a modal value of 600
Mature > 70 yrs 4 Ha (2 %)		0 to 40% Dr/Ac/Decid* 60 to 100% Conifer	Understorey species as above for Juvenile Stands.	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. In the absence of further disturbance, long term stand targets will evolve to those for conifer stands on similar sites.

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

Species Codes :

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

Forestry

Chart 12.4: Target Conditions for Alder Forest

APPENDIX 12 – Target Conditions for Vegetation Zones

STANLEY PARK FOREST MANAGEMENT PLAN

Target Conditions for Dry, Exposed Ridge Forest

4.5 hectares - 2% of forest

Maturity Class	Photo	Species Composition (% of Canopy)	Understorey	Canopy
Juvenile* 0 to 30 yrs 0.7 Ha (0.3 %)		50 to 80% Fd 0 to 30% Ra 0 to 30% Plc 0 to 20% Cw 0 to 10% Mb 0 to 10% Pw	Shrubs include salal and ocean spray, if present in the stand prior to disturbance. Oregon grape, red huckleberry, snowberry and rose species, kinnikinnick and hairy manzanita may be present. Grasses such as western fescue and common sweetgrass are typical, along with lichen species such as Cladina.	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. Total trees/ha expected to progress beyond this stage will range from 300 to 800, with a modal value of 400.
Immature 30 to 100 yrs 0.4 Ha (0.2 %)		50 to 80% Fd 0 to 30% Ra 0 to 30% Plc 0 to 20% Cw 0 to 10% Mb 0 to 10% Pw	Shrubs, grasses and lichen continue to be present (as above for Juvenile Stands), but may decrease in vigour where tree canopy and root systems increase. Lichens become well established, along with mosses including step moss and Oregon beaked moss.	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. Total trees/ha expected to progress beyond this stage will range from 200 to 400, with a modal value of 250.
Mature > 100 yrs 3.4 Ha (1.3 %)		50 to 80% Fd 0 to 30% Ra 0 to 20% Plc 0 to 20% Cw 0 to 10% Mb 0 to 10% Pw	Understorey species as above for Immature Stands.	Stands ideally will be developing a multi-layered structure with the largest trees greater than 70 cm diameter and ongoing patterns of gradual recruitment in the understorey. 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%. Total trees/ha is expected to range from 150 to 350 trees/ha, with only rare very large trees.

Species Codes :

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

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Chart 12.5: Target Conditions for Dry, Exposed Ridge Forest

APPENDIX 13 – Vegetation Inventory 2008

Introduction

In order to understand current conditions in Stanley Park, to project vegetation development over time, and to make decisions about desired future conditions and management activities it is necessary to have up-to-date information on the species composition, range of tree sizes, regeneration and understory development, presence of invasive plant species, presence of insect and disease agents, and presence of wildlife habitat features throughout forested areas of the park. The last formal survey of vegetation characteristics in the park was in the mid-1980's. This information was used to produce maps and tables of major vegetation types. Since that time, there has been considerable establishment and growth of young trees, loss of older trees from storm events and decay, regular planting and brushing activities, and damage, post-damage clean up, and regeneration activities following the December 2006 wind storm. Current conditions can be sampled using temporary sample plots (TSP's). However, permanent sample plots (PSP's) are more useful for monitoring long term changes. In this sampling, we used a combination of these two plot types. Given the high spatial variability within the park, our goal was to establish approximately 1 plot for every 2 hectares of forested area within the park. This information has uploaded into a Geographic Information System (GIS) and used to build a new vegetation map.

Methods

A 100m x 100m grid was overlaid on a GIS map layer of Stanley Park provided by the Park Board and forested vs. non-forested areas were identified. Global Positioning System (GPS) coordinates were obtained for all intersecting lines. From the coordinate locations, 130 TSP's and 58 permanent sample plots PSP's were randomly selected using a random number generator (Figure 1). These plots represented the forested area while an additional 20 randomly selected PSP's were chosen for the non-forested area. The plots were numbered 1-130 for forested TSP's, 301-358 for forested PSPs and 501-520 for non-forested PSP's.

Field cards were developed for collecting each of the following sets of plot attributes: i) center location, ecological site series, basal area using prism, germinants, ii) understory plants and tree regeneration, iii) trees, iv) and coarse woody debris. Plot centres were located in the field at the designated GPS coordinates using a GPS unit. A temporary plot centre stake was placed for the TSP's and a permanent stainless steel bar was installed for the PSP's. These stainless steel bars project just above the forest floor. This should aid in subsequent plot work, as it will indicate exact distance/azimuth measurement to trees and can be found with a metal detector if necessary. For PSP center locations that fell within a grass, road or trail area the stake was offset (as indicated on center plot location plot card data) but plot was carried out from actual center location.

Circular fixed area plots with a 1.78m radius were used for the germinant sample. Trees were sampled using 11.28m radius plots. Tree species, status, decay class (for dead standing trees), and breast height diameter were recorded for all 'in' trees. Heights were recorded for a sub-sample of trees in each plot. Where plots fell across non-forested types or recent windthrow areas, the area within each surface type was recorded. Line intersect sampling (LIS) was used for coarse woody debris (CWD). Two LIS transects were located at right angles commencing at the plot centre. Both were 20m long. The bearing of the first transect was randomly selected. The species, decay class, diameter at transect, and length of each intersecting piece of CWD was recorded. In addition, soil information and tree distances and bearings from plot centres were collected for PSP's. Plots were measured during the period from June to August 2008. Horizontal and vertical hemispheric photographs were taken of a selection of plots during September to November 2008.

APPENDIX 13 – Vegetation Inventory 2008

Analysis and Products

Collected data was entered into Microsoft Excel©. This data was imported into SAS statistical software for calculation of plot level summaries. Where summary values were calculated on a per hectare basis, these were first adjusted by the area of the plot that fell within forested area (e.g. the area of roads, trails etc was excluded). Plot locations were linked with plot summary tables in ArcView GIS software. Based on adjacency, similarity of plot summary characteristics, inspection of 2006 aerial photographs, and inspection of 1980's vegetation polygons and treatment polygons, a new set of vegetation polygons was identified. To simplify mapping and prescription development, the total number of vegetation polygons was limited to fewer than 100. To enable the development of general prescriptions and enable budget projections, these vegetation types were further aggregated into five broad vegetation types: 1) Conifer Stands on Wetter Sites (CWHdm 07, 12), 2) Conifer Stands on Mesic to Drier Sites (CWHdm 03, 01, 05), 3) Alder Dominated Stands on Mesic Sites and Upland Wetter Sites (CWHdm 05, 07), 4) Bigleaf Maple Dominated Stands on Rich, Moist, Well Aerated Slopes (CWHdm 07), and 5) Dry, Exposed Ridge Forest (CWHdm 02/03 – CHWxm 02/03).

Additional Notes on Methods

- Magnetic declination: 18.5° East
- GPS locations found using Garmin 60CSx with accuracy around +/- 7m
- Germinant count was restricted to 1.78m fixed radius plot
- All other plots were 11.28m fixed radius
- Cruisemaster prism: Basal Area factor (BAF) of 8
- Distances measured using Lufkin 30m tape measure
- Diameters measured using Lufkin 6.5m metal tape measure
- Tree heights measured using Laser Technology TruPulse 200B EDM
- All site series based on CWHdm as outlined in MoFR Field Guide for Site Identification and Interpretation for Vancouver Forest Region (1994)
- Plots with complicated boundaries (ex. numerous trails/edges) were estimated in terms of % area
- Began all tree measurements from LIS Transect 1 bearing and continued clockwise
- Height, azimuth and DBH measured from germination point
- Trees on same bearing were measured from closest to farthest from plot center
- Forks measured from closest to farthest from plot center and if they were at the same distance then taken from left to right as viewed from plot center
- If branch or other obstacle at DBH (1.3m) then measurement moved up to nearest available location
- DBH includes ivy if growing on tree for Permanent Sampling Plots and does not include ivy (removed) if on tree in Temporary Sampling Plot
- Stumps on angle or on side were included in LIS sampling and not in tree measurements
- Pieces on transects must be greater than or equal to 7.5cm in diameter to be included

List of Non-forested Permanent Sampling Plots

501: Seawall near Second Beach Pool
502: Lost Lagoon Trail
503: Robert Burns statue
504: Seawall in front of yacht club
505: Southeast corner of Theatre Under the Stars
506: Seawall; southwest of 9 o'clock gun

APPENDIX 13 – Vegetation Inventory 2008

507: Seawall at Ferguson Point
508: Grass area southeast of Stanley Park Dining Pavilion
509: Grass field near baseball diamond
510: Totem poles; parking lot to the southeast
511: see summary under forested PSP

512: Grass area northwest of totem poles; near seawall
513: Miniature Railway parking lot near bus loop
514: Brockton Point (Lighthouse)
515: Grass area north of Aquarium
516: Seawall near Girl in a Wetsuit
517: Beaver Lake
518: Inside Miniature Train area

519: Prospect Point picnic area
520: Seawall at intersection of Pipeline Road and Park Drive

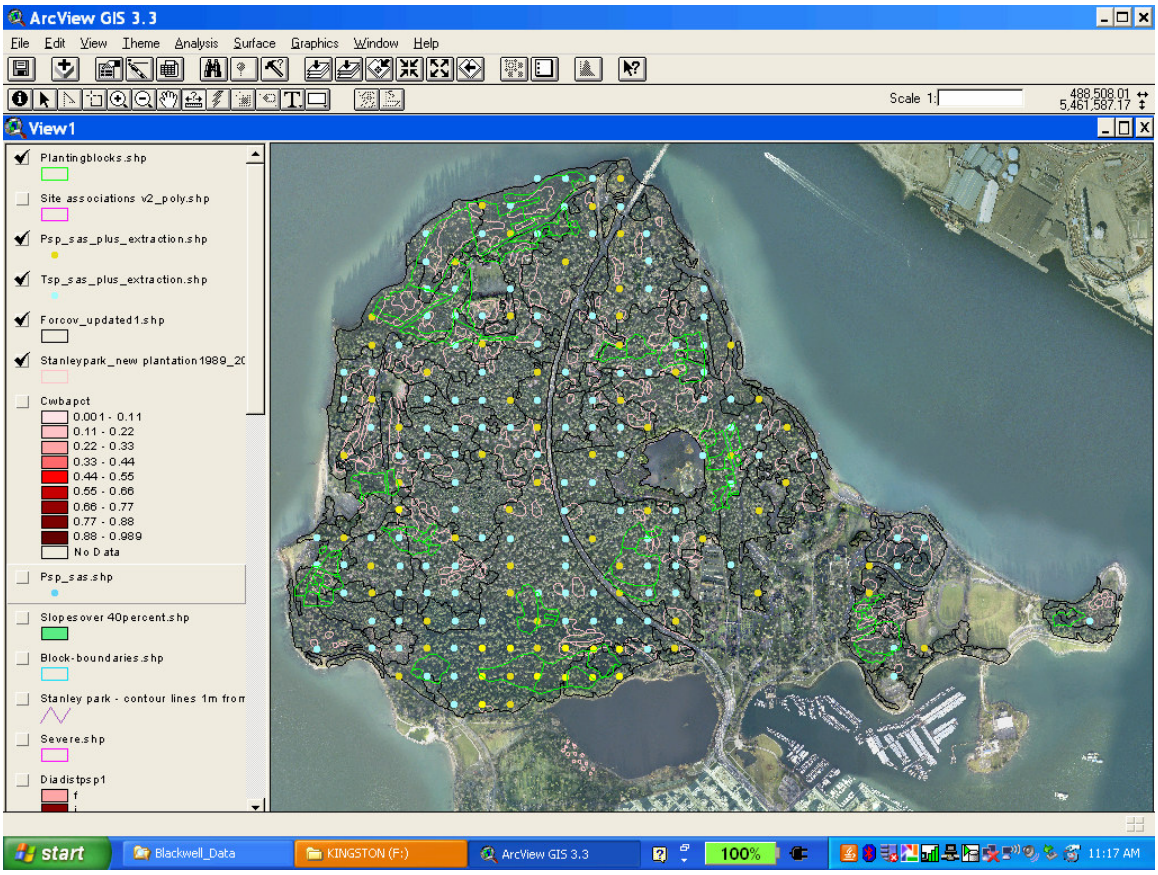

Figure 1. Location of Temporary Sample Plots (TSP's - blue dots), Permanent Sample Plots (PSP's – yellow dots), post-2006 storm plantations (green polygons), 2000-206 plantations (pink polygons).

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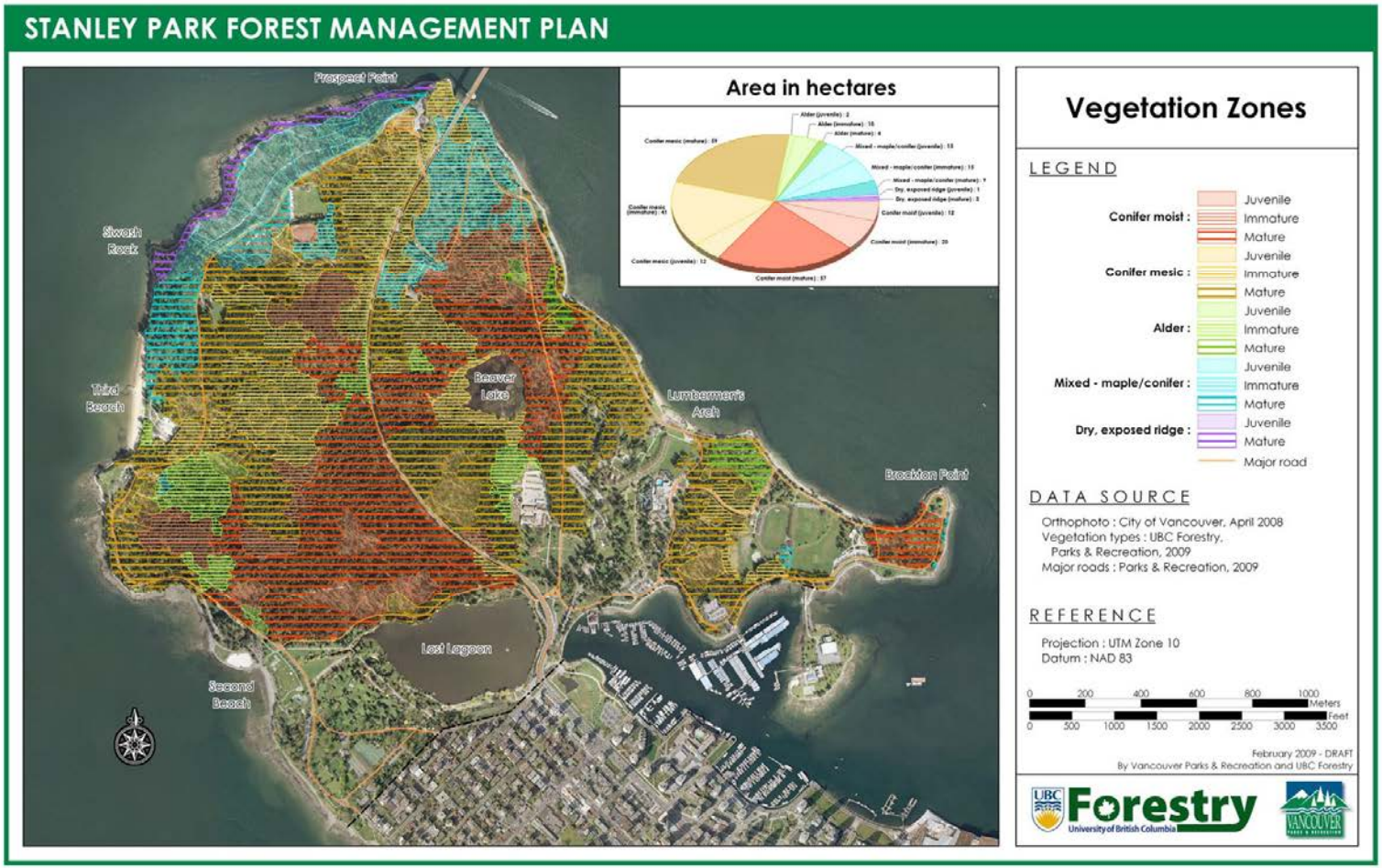
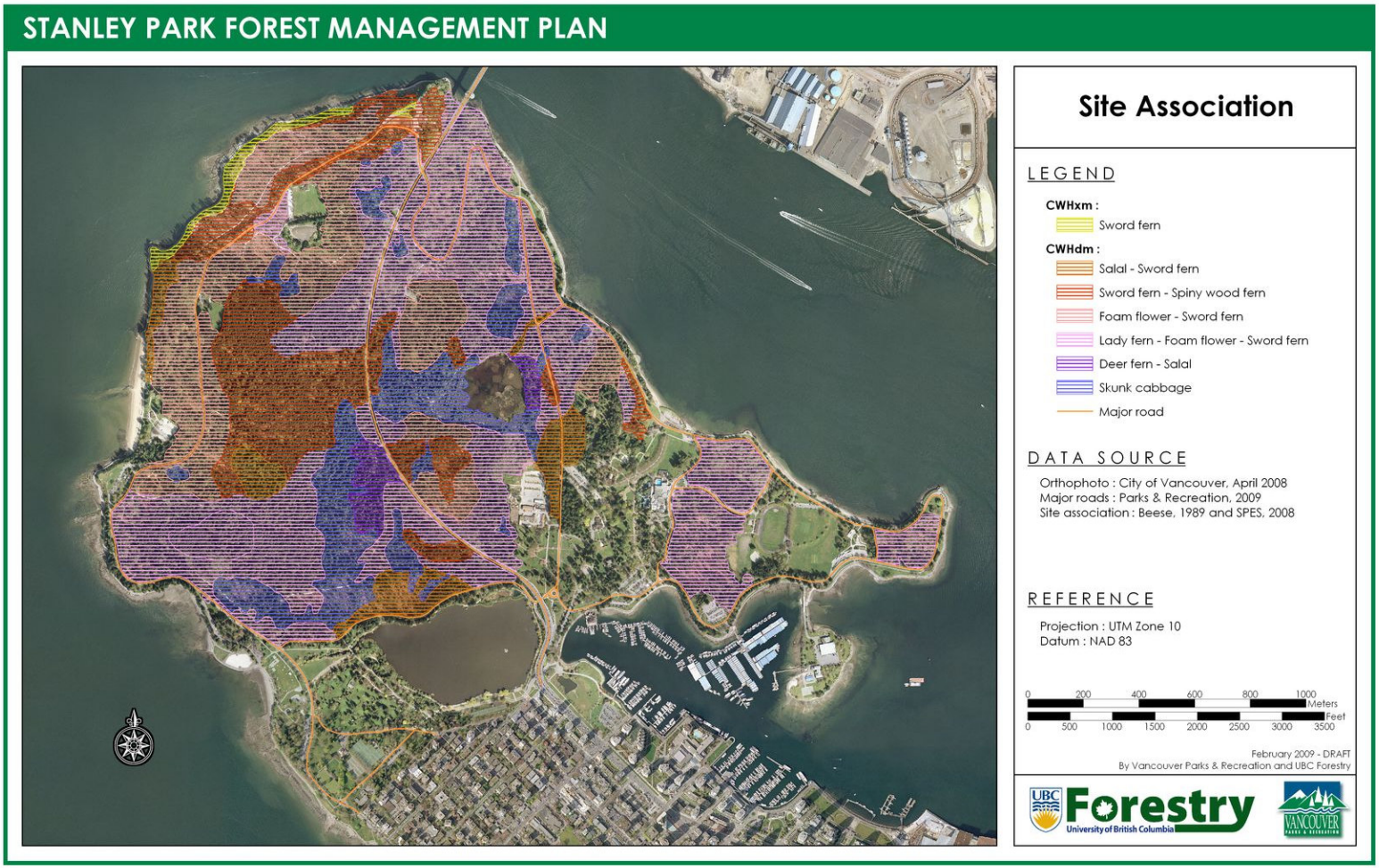


Map 13.1: Vegetation Zones

APPENDIX 13 – Vegetation Inventory 2008



Map 13.2: Site Association