PART TWO: MANAGEMENT RECOMMENDATIONS

University of British Columbia

Masters of Sustainable Forest Management

By Leah Ballin and Joanna deMontreuil

Executive Summary

This report is the second part of a two part report on the inventory and management of Jericho Park, Vancouver, B.C. It was prepared for the Vancouver Parks Boards in partnership with the Department of Forestry at the University of British Columbia. Part Two, Management Recommendations, follows Part One, the Baseline Inventory, and builds on the results found in terms of the vegetation composition and structure, and the goals and future desired conditions for the park. This set of management recommendations is intended to guide more detailed restoration prescriptions and management actions that are expected to be completed by future students of the Masters of Sustainable Forest Management (MSFM) program. The recommendations in this report follow careful data analysis, local expert advice, limited stakeholder consultation and extensive literature review, in combination with personal observations and experience. In the stakeholder consultations, a draft vision statement was proposed:

Jericho Park offers the urban community an experience of nature and green space, while simultaneously supporting a biodiverse and self-sustaining ecosystem that represents elements of the coastal forest that once stood there.

The achievement of this vision has been addressed in this report through a zone approach focused on four management action categories; invasive species management, restoring native flora, enhancing wildlife (especially song birds), and introducing coarse woody debris and old forest structures. Through these priorities biodiversity can be enhanced and maintained, and Jericho Park`s ecosystem, and in concert with surrounding parks and green spaces, can trend towards being self-sustaining. The intent of this document is to provide broad priorities and strategies that can guide site-level prescriptions in the near future.

Table of Contents

Introduction

This document offers management recommendations for Jericho Park that build upon the results of the Baseline Inventory report (Part 1) as guided by the goals and objectives for the Park. These management recommendations are intended to guide restoration activities and stewardship actions in the Park by prioritizing the most pressing issues, presenting feasible management options, and by dividing the park into management zones and setting a framework for long term stewardship.

Goals and Objectives for Jericho Park:

The goals and objectives were developed in coordination with the Vancouver Parks Board (VPB) and the Jericho Stewardship Group (JSG) (Isaac & Duncan, 2012; Appleton & Heinzelmann, 2012; Page & Stevens, 2013). They are to:

- provide increased access to nature in the city;
- increase biodiversity in the park;
- enhance the human-nature interface;
- maintain sightlines and open areas;
- maximize safety;
- generate public interest, involvement, and funding, and;

Future Projections and Desired Future Conditions

The baseline inventory describes the current vegetation and habitat condition of the park, and the expected successional trajectory of the forested areas. To prioritize restoration efforts, it is important to compare current (Figure 1) and projected conditions with desired future conditions (Figure 2; Table 1). To provide additional context for this comparison, a draft vision statement was developed by the authors, with input from VPB and JSG:

Draft Vision Statement - Jericho Park offers the urban community an experience of nature and green space, while simultaneously supporting a biodiverse and self-sustaining ecosystem that represents elements of the coastal forest that once stood there.

Desired conditions have been developed through meetings with the Vancouver Parks Board, members of the Jericho Stewardship Group and a few local residents (Table 1).

Table 1: Summary of current and desired future conditions at Jericho Park.

Current/Projected Conditions	Desired Conditions
Non-native deciduous canopy	A coastal forest that includes old growth characteristics such as large conifers, dead trees and downed wood, as well as patches of open native broadleaf-dominated woodland.
Blackberry thickets and knotweed patches	Open meadows
Reduced native biodiversity of flora and fauna	Increased diversity of native herbs, shrubs and trees, that provide habitat for an increased diversity of fauna
Small, young, deciduous coarse woody debris (CWD) only	Some large, long-lived CWD of mixed origin

Figure 1: Current/projected conditions. From left: a) ivy smothering aging red alder b) federal land across fourth avenue that was left be when Jericho became a park and is now thick with laurel, ivy and blackberry with a few conifers, c) expanding knotweed infestation

Figure 2: Future desired conditions. From left: a) natural canopy gap with big leaf maples and salmonberry, b) an old stump supporting shrubs and young trees, C) flats of false lily-of-the-valley and salmonberry. All photos taken in Pacific Spirit Park.

Ecosystem Services

In addition to the above listed goals and objectives, urban forests provide many services to the urban human population, which are directly or indirectly derived from ecosystem functions (Chen & Jim, 2008) including:

- biodiversity conservation;
- wildlife habitat;
- air pollution abatement;
- microclimate amelioration (urban heat island effect);
- noise reduction;
- rainwater retention;
- recreation and aesthetics;
- health and psychological benefits, and;
- education.

Maintaining and increasing the ecological integrity of the park will help to provide this broad range of ecosystem services.

Management Priorities

The baseline inventory has provided many insights into the current state of the Jericho Park forest, and informs the management actions that may be necessary to bring the forest to a more desired condition.

This report will address safety while focusing on four priority ecological management issues that are recommended to be addressed if the vision statement and target future desired conditions for the park are to be achieved. These are:

- **Invasive Species Management**
    - Japanese Knotweed;
    - Himalayan Blackberry;
    - sycamore maple, as well as;
        - ivy, holly, laurel, scotch broom
- **Planting to Restore Native Flora**
    - multi-age, multi-story, multi-species forest with gaps;
    - abundant, diverse and continuous shrubs to provide cover and food;
    - enhancing soils and ameliorating site conditions.
- **Wildlife Habitat**
    - reflected in restoration of native flora and old forest structure.
- **Snags and Coarse Woody Debris**
    - large trees and snags of different sizes, species and decay classes.

These priorities are addressed both in the context of zones, and individually. Several of the management recommendations in this report are linked to a simplified numbered management action table included in Appendix 1.

Management Emphasis Zones Approach

Target conditions and management priorities vary from place-to-place in Jericho Park. Accordingly, the Park has been divided into proposed management emphasis zones.

Safety Zone

The safety zone encompasses the areas alongside trails. These areas are not suitable for certain habitat features such as tall wildlife trees (snags). As well, if safety objectives are to be respected, managing for thick, dark vegetation that obscures sight lines directly adjacent to trails should be avoided. Therefore increased management may be necessary adjacent to trails as to both satisfy invasive species eradication efforts and open sight line objectives. These principles also apply to the meadow edges. Trails were buffered by 20m to reflect the tallest recommended snag creation height. This safe edge distance is a guideline based on current conditions and will need to be adjusted as taller trees naturally age and become at risk of falling.

Wildlife Tree Zone

The areas outside of the Safety Zone are suitable for creation of dead wildlife trees under 20 m tall (Figure 3).

Figure 3: Safe wildlife tree (snag) creation zones.

Edge Zone

Urban forests provide important islands of habitat for native species, but also suffer from the negative influence of edges (LaPaix, Harper, & Freedman, 2012). An edge effect occurs when there is "alteration of environmental conditions by the presence of a boundary between a forest and a non-forest area" (Cadenasso, Traynor, & Pickett, 1997), or where there is a difference in the species composition, structure and function between the edge and interior environments (LaPaix, Harper, & Freedman, 2012). Interior forest conditions generally have more stable environments, including moderated daily fluctuations in air temperature and humidity (Cadenasso, Traynor, & Pickett, 1997). On average, edge effects can be detected 50 m into the forest from the edge (LaPaix, Harper, & Freedman, 2012).

The forested area of Jericho Park is relatively small, with many edges and with significant impact from the urban environment. For example human visitors and their canine companions cause physical disturbances. There is a continual supply of non-native and potentially invasive seed from introduced species from the surrounding residential area. Road and marine traffic emissions contaminate the atmosphere. In Jericho Park there is little interior forest area that is more than 50 m from existing roadways, trails or meadows.

To reduce the influence of edges on interior forest conditions, it is important to have a physical 'side wall' made up of small trees, shrubs and the side branches of large trees (Figure 5) (Cadenasso, Traynor, & Pickett, 1997). At Jericho, the side wall is often composed of Himalayan blackberry that decreases in height and density along the gradient into the forested conditions. Creating side walls with dense native vegetation is a process known as 'edge-sealing' (LaPaix, Harper, & Freedman, 2012). This sealed edge can act to reduce the intensity of abiotic gradients, and reduce light availability and wind speed that in turn, may restrict invasion by exotic species in the interior forest area. Jericho already has extensive invasion throughout the forested interior of the park, however invasive species eradication efforts may be longer lasting with implementation of sealed edges composed of vigorous native vegetation (Figure 4).

Figure 4 Illustration of a portion of the meadow edge at Jericho Park that, although not a "sealed edge", naturally maintains open sight lines and an effective buffer to Himalayan blackberry.

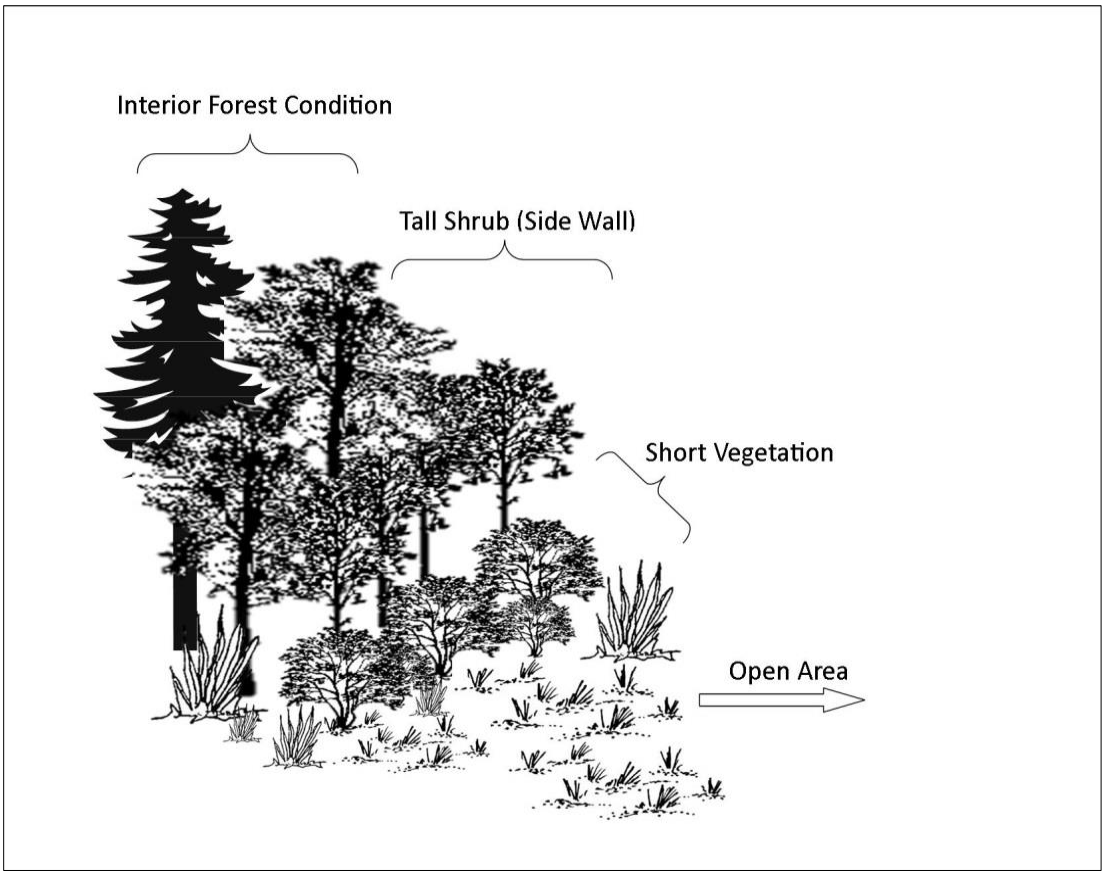


Figure 5: The edge zone concept. This diagram illustrates the interior forest, the side wall and the short vegetation zones. Figure created by J. deMontreuil using MS Publisher.

At Jericho, the forest edge adjacent to the meadow could be managed as two concentric bands (Figure 6). The first band would be planted with and/or managed for low-growing vegetation, and the adjacent ring for taller-growing vegetation. This strategy could also be applied adjacent to the trails of the park, as well as the external edges between the roads and the forest.

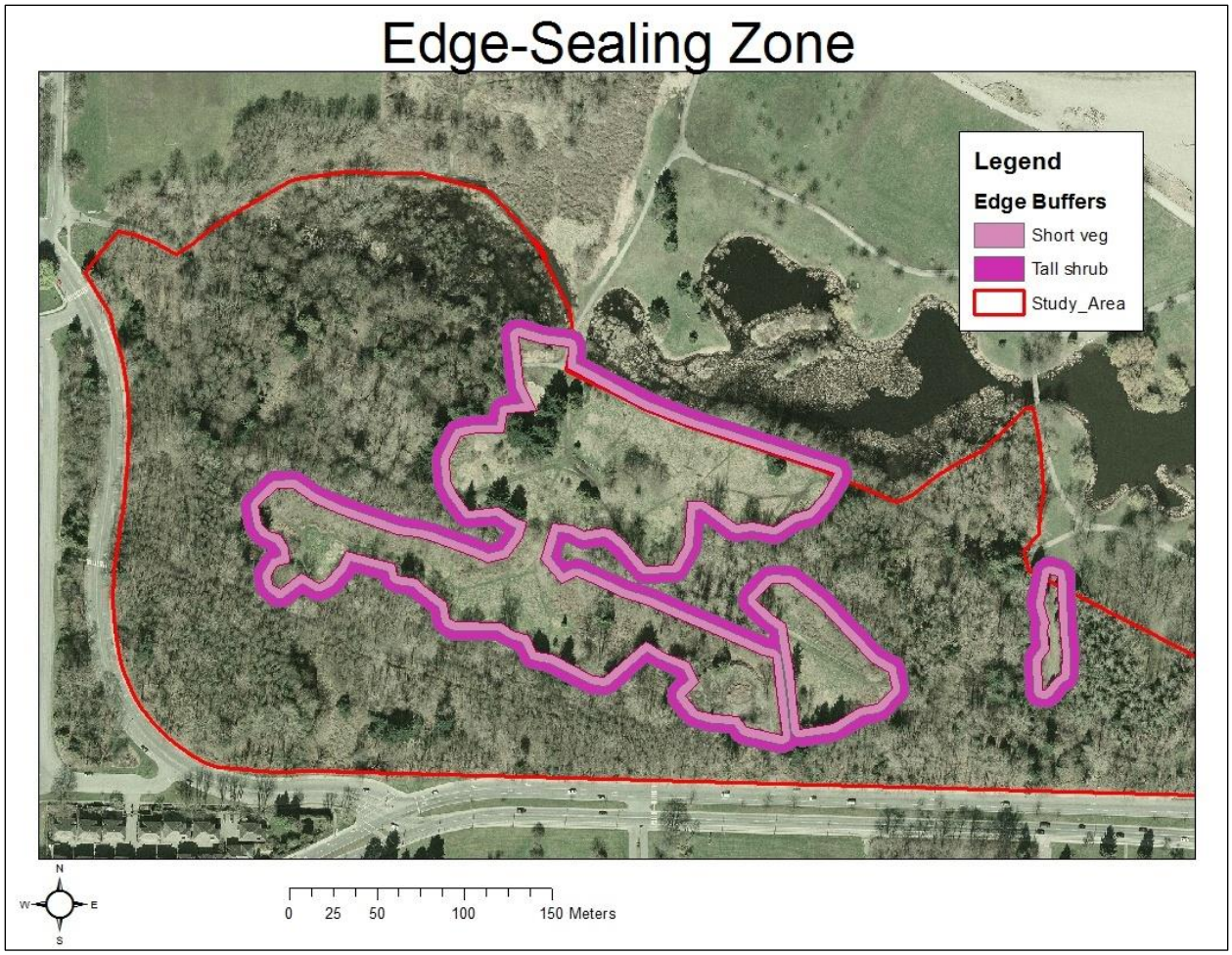


Figure 6: Edge-sealing bands around the open meadow areas

Recommendations for Edges:

- Reduce the number of unofficial interior trails that create more edge. This can be done via:
    - placing CWD across trails;
    - edge sealing by planting dense shrubs.
- Existing, permanent and desired edges need edge-sealing, but on more of a gradient in order to promote sight-lines (safety) within a few metres of trail edges.
- Remove non-native vegetation from the edges; re-build 'side-wall' zones with native species that are somewhat shade tolerant, and fast growing.

Table 2: Potential species for edge zone plantings. This sample list is expanded upon in Appendix 4: Suitable plant species for Jericho Park. Table 2`s information is from E-Flora BC (Klinkenberg, 2013).

	Desired species trait	**Species**	**Growth habit/height**	**Visual Density**
Meadow edge (short vegetation)	Short (ground level – 0-100cm)	Three-leaved foam flower (*Tiarella trifoliatia*)	Shade tolerant, common to moist forest environments 20-50cm	Good
		False-lily-of-the-valley (Maianthemum	Shade tolerant, common in moist forests 10-35cm tall.	Good
		Sword fern (*Polystichum munitum*)	Tall fern Grows on drier sites, in the open or in shade. 20-150cm	Good; dense at ground level, some tall leaves
		Large-leaved avens (*Geum macrophyllum*)	Grows well in fields and forest edges 30-100cm tall Dry, open areas.	Good
Tall Shrub (side wall)	Medium to tall (1-5m)	Western trumpet honeysuckle (*Lonicera ciliosa*)	Grows in mesic/dry thickets. Climbs other shrubs and trees Up to 6m	Good: Although potentially quite tall, widely branched
		Indian plum (*Oemleria cerasiformis*)	Moist, open to dry forest and forest edges. Common in Jericho. High shade tolerance. 1-5m	Medium: widely branched.
		Ocean spray (*Holodiscus discolor*)	Dry to mesic clearings and forest edges, medium shade tolerance. 1-4m	Medium: Thick flowers.
		Spirea/Hardhack (*Spirea douglasii*)	Grows in moist to wet streambanks and forest edges, low	Poor: Forms dense thickets, lots

			shade tolerance. 0.5-2.5m	of branches
Transition to interior forest condition	Tall shrubs, short trees (5m+)	Douglas maple (*Acer glabrum*)	Mesic to dry forests up to 10m	Good: wide branching pattern
		Flowering dogwood (*Cornus nuttalli*)	Mesic forests up to 20m	Good: tall, wide branching pattern

Invasive Species Management

The invasive species in Jericho Park of particular management concern are sycamore maple, Himalayan blackberry and Japanese knotweed. The densest patches of knotweed and blackberry are adjacent to trails and meadows (Figure 7).

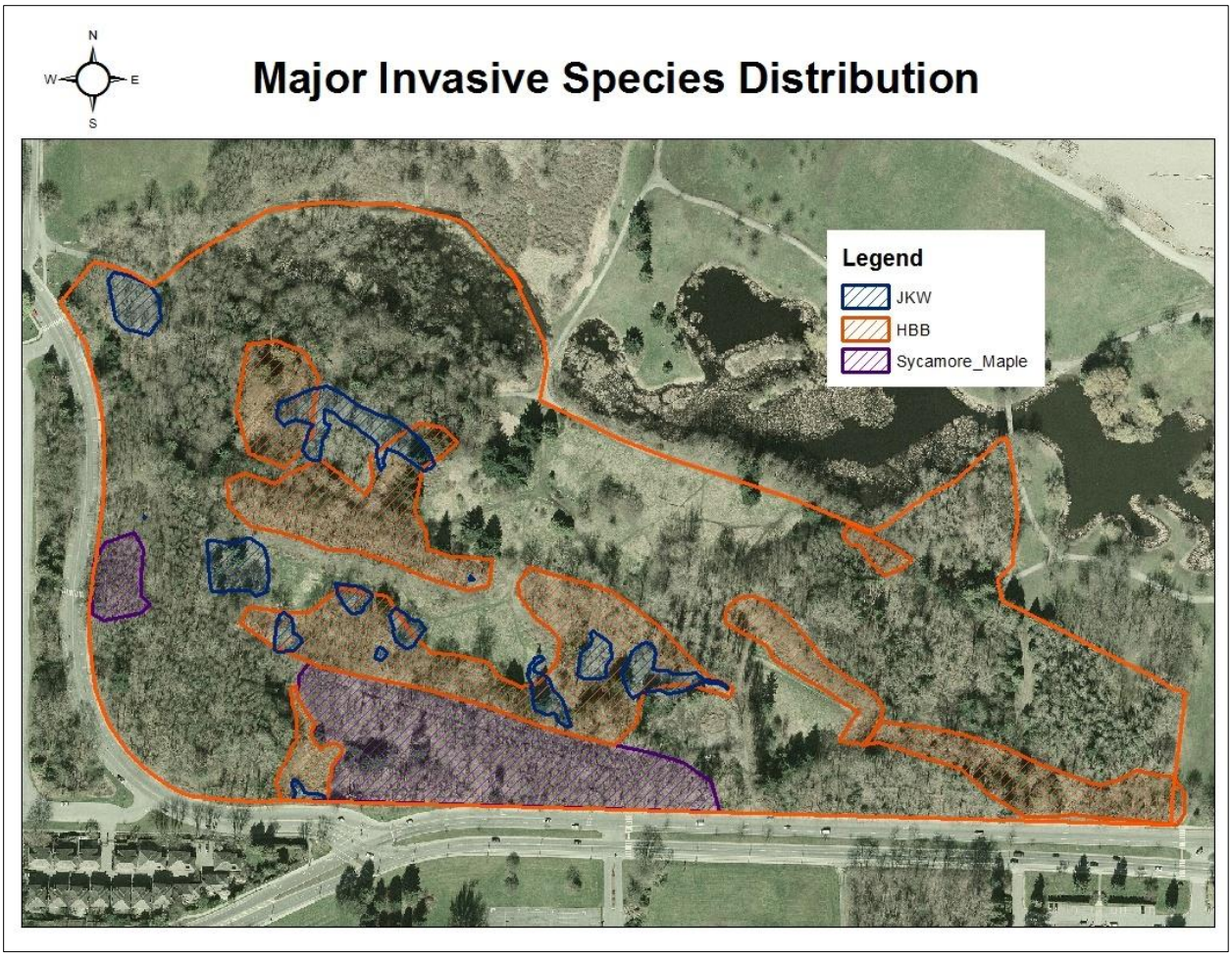


Figure 7: Distribution of the three major invasive species discussed in this document: Sycamore maple, Japanese Knotweed (JKW) and Himalayan Blackberry (HBB).

Invasive species profiles and control treatments are described in the following section. Management actions are further tabulated in brief in Appendix 1: Recommended Actions.

Sycamore maple

This exotic maple tree was introduced from eastern Europe and central Asia (University of Connecticut Horticulture). The sycamore maple has been flagged as an invasive species that is capable of overtaking native woodlands in many places around the world. In eastern North America, the states of Connecticut and Massachusetts have banned further planting of sycamore maple, due to its invasive tendencies and it is being actively removed from Central Park, New York (USDA, 2013). In Jericho Park, sycamore maple is regenerating in much higher densities than, and may be excluding, native species, especially close to 4th Avenue in the Young Deciduous and Alder Leading strata (Figure 7 and Figure 8).

Figure 8: Dense sycamore maple in understory.

Control Measures

Techniques for removing sycamore maple include both manual and chemical control methods:

- hand pulling seedlings;
- cutting and grinding stump or re-cutting stump sprouts;
- stump painting with glyphosate;
- girdling larger trees;
- stem injection (drill holes in trunk and fill with glyphosate).

Removal treatments are most effective in the fall, before the leaves change colour (Yarra Ranges Council), while girdling methods are best done in the spring (Department of Conservation and Natural Resources). These methods are labour intensive, and may not completely eradicate the species. Sycamore maple produces copious amounts of seed, and there are mature sycamore maples in the neighbourhoods adjacent to the park. It may be necessary to accept sycamore maple as part of the forest composition at Jericho Park, while at the same time, controlling its density enough to permit recruitment of native trees. Thinning treatments will likely result in stump sprouts, but may give other species an advantage.

Himalayan Blackberry

Himalayan blackberry is shade tolerant, and survives easily on disturbed sites, riparian areas, forest edges, and road and trail sides; in addition to the plentiful seed source provided by its wide distribution throughout the Lower Mainland and west coast (Invasive Species Council of BC, 2012). Himalayan blackberry is an aggressive competitor and creates dense thickets that prevent the regeneration of other species. Areas dominated by Himalayan blackberry tend to become stable blackberry communities with few trees (Bennett). These thickets are capable of producing 7000-13000 seeds per square metre (Invasive Species Council of BC, 2012). In addition to seeds, Himalayan blackberry can spread through rhizomes, as well as rooting from the tips of fallen canes (Bennett). It is listed by the Greater Vancouver Invasive Plant Council in the top 12 most problematic species in the Vancouver region (Klinkenberg, 2013).

Figure 9: Planted trees require maintenance to ensure they are not overtaken by competing vegetation.

Control Measures

Control of Himalayan blackberry requires digging, mowing or use of herbicides (Klinkenberg, E-Flora Atlas Page: Himalayan Blackberry, 2013). These methods are time consuming, expensive, and usually only temporarily effective.

A trial in southwestern Oregon examined methods of removing Himalayan blackberry (Bennett) (Appendix 3). The trials used variations of mechanical or hand cutting, herbicides and grubbing. It was found that the best treatment results were from the trials that used an initial mid-summer cutting followed by a herbicide treatment once the plants had resprouted to 'boot-height'. These trials determined that manual cutting alone would only temporarily reduce the cover of Himalayan blackberry; however this might be sufficient to allow desired vegetation to release. It was found that replacement vegetation

would need to attain heights of 1.8 to 2.4m before the blackberry resprouted to prevent it from being overtopped. Unless very large planting stock is used, blackberry control would be necessary for several years.

A strategy already employed by volunteers at Jericho is to dig out the roots and burls of blackberry thickets (Coope, 2012). This method is effective if done very thoroughly, but can result in site disturbance due to the amount of soil that must be dug up. This method is extremely labour-intensive and requires between 750-2500 hours of work per hectare (Bennett). The mapped area of blackberry thickets amounts to 1.74 hectares, which would require between 1305-4350 hours to remove manually. JSG volunteers estimate that they use about 800-1000 volunteer hours per year for all of their restoration work parties (Appleton & Coope, 2013) therefore intervention from the VPB may be necessary for more complete control of this species. The VPB also has rototilled some blackberry infestations and covered with chips. This appears to be an effective control method (Coope, JSG Management at Jericho, 2013).

The best strategy for Jericho will likely involve an initial mechanical removal treatment (either rototilling or digging up roots with an excavator), followed by a combination of manual and hand cutting, pulling and grubbing by volunteers and work crews, followed by maintenance of planted trees and shrubs that will create shade and competition to reduce the blackberry cover.

Significant areas of blackberry were recently removed as part of the foreshore restoration project in 2012 (Figure 10). All treated areas should be monitored to gauge treatment success and the need for further intervention.

Figure 10: Himalayan blackberry eradication treatment completed at Jericho Park as part of wharf removal project, 2013.

Japanese Knotweed

Japanese knotweed is an aggressive species native to eastern Asian countries such as Japan, China and Korea, and was imported to BC as an ornamental (Klinkenberg, 2013). It is an herbaceous perennial that spreads rapidly and forms dense thickets that are difficult to remove, and cause degradation of native plant communities by creating monocultures (Anon., 2013; British Columbia Ministry of Agriculture, n.d.) (Figure 11). Japanese knotweed is very difficult to eradicate from a site once established. So much so that in the United Kingdom there are legal restrictions and requirements for removal by site developers and property owners (Environment Agency, 2006). It reproduces vegetatively through rhizomes or by root fragments, and prefers open habitats along roadsides, edges of waterways and other unused areas, and often occupies disturbed sites

Figure 11: Japanese knotweed monoculture at Jericho Park in fall, 2012

(British Columbia Ministry of Agriculture, n.d.). A 0.7g piece of rhizome is sufficient to propagate a new plant. Rhizomes can remain dormant for up to 20 years, and may not regrow until disturbed (Environment Agency, 2006). Effective control relies on removal or death of the rhizome system, which could take several years.

Figure 12: Japanese knotweed monoculture in early spring, 2013. Note the absence of underlying vegetation.

Control Measures

There are currently 0.6 ha of knotweed patches in Jericho Park. Containing the existing knotweed and minimizing traffic through patches by people and pets is recommended as a first step in preventing further spread. This could be accomplished with temporary fencing combined with a public education program. It should be a priority for Jericho Park management to prevent the knotweed from reaching the small stream. It could spread to the lower ponds and degrade the pond and marsh habitats. Currently two of the mapped patches are just across the wide gravel path from the creek. These should be prioritized for control.

Chemical treatment, specifically glyphosate stem injection, is commonly used to control Japanese knotweed in B.C. The ideal time to treat with chemicals is in the growing season (March to October), before the shoots exceed 1m in height, or after cutting when they have re-grown to this height (Devon County Council). Cut stem applications and stem injections are confirmed to be effective (Crockett, 2005), however, due to the extensive rhizome system the effect may be temporary and will likely require repeat treatments or combinations with other treatments (Hagen & Dunwiddie, 2008).

Depending on public attitudes and city by-laws, non-chemical methods may be necessary at Jericho Park. Regular pulling over several years can eventually exhaust the rhizome. This may or may not provide a permanent solution, as some studies have found that even monthly cutting fails to eradicate even small and isolated patches unless continued for several years (Soll, 2004). Manual treatments are usually most effective for small or new plants, not for large, well established thickets (Devon County Council). It has been shown that four cutting treatments in one year, followed by annual cuttings will reduce plant vigour and underground biomass**.** (Devon County Council)**.** The main concern with cutting or pulling is the safe removal of the cut stems. All pieces of the plant should be sealed in a garbage bag, removed off site, and disposed of in a landfill, industrial compost or incinerator.

The most common methods of non-chemical control are hand cutting, mowing, digging/pulling, tilling, and covering (best used in combination with other treatments) (Soll, 2004).

Following chemical or manual treatments, re-planting the area with ecologically suitable native plants will create a competitive environment to help prevent re-establishment of the knotweed. If using chemical treatments, 2 years is recommended before planting with other species. Use of protective structures around desired vegetation will prevent damage during follow up treatments (Davenport, 2006). See Appendix 4: Suitable plant species for Jericho Park for suitable species to plant.

Integrated approaches will likely offer the most flexible solution in Jericho Park. Herbicides can only be applied by qualified individuals, whereas pulling and cutting could be done with volunteers. A combination of pulling and cutting prior to herbicide use can increase the plant's susceptibility to the herbicide. Replanting the area with desired vegetation is not advised while access to the knotweed shoots and roots is necessary during removal.

Restoring Native Flora

Site Conditions

An overarching problem at Jericho that will affect all other aspects of restoration work is the condition of the soil. The soils at Jericho have been damaged by site clearing and construction. The red alder is adding organic matter and nutrients, but it appears that in many locations, the soil is compacted and drainage is impaired. Adding large coarse woody debris would improve moisture retention and organic material input, in the long run. Mulching at the time of planting will suppress herbaceous weed competition while trees establish (Appendix 1: Recommended Actions).

Trees

Currently, the forest at Jericho Park is transitioning out of a relatively high density early successional stage. In a natural coastal western hemlock forest shade-tolerant conifers would occupy the understory and mid-canopy by this stage. At Jericho however, there has been insufficient seed source for these species, and much of the lower and mid-canopy space is occupied by sycamore maple and Himalayan blackberry. The Jericho Stewardship Group, Evergreen and other groups that have under-planted small areas with conifers. Most of these trees are surviving, although some are being suppressed by blackberry.

In Jericho, it makes sense to continue under-planting with shade tolerant species such as bigleaf maple, vine maple, western redcedar, grand fir and western yew in moist areas, sitka spruce in wet areas, and western hemlock in well drained areas – particularly where the overstory is beginning to break-up, and there are few saplings of desired species. Douglas-fir should only be planted in full sun, not where the broadleaf canopy is largely intact, or where there is a vigorous shrub layer.

While it may not be desirable to convert the entire forested area to conifers, it does make sense to expand the existing patches of conifer trees (Figure 13). Adding bands ten metres around existing 'conifer anchors' would be enough to create closed-canopy conifer patches, which are important habitat for roosting birds in the medium-term, and large emergent trees for raptor perches and nests and CWD in the long term. The conifer bands have the

highest priority for planting where the expansion zones occur in areas with low stocking of naturally regenerating trees (e.g. Stratum G).

The red star on Figure 13 highlights a priority location in the park where this treatment could be piloted. This area has a small opening, surrounded by mixed deciduous species and some conifers (Douglas-fir, excelsa cedar). The blackberry within 10 m of the existing conifers should be mowed or pulled, and then large stock conifer trees planted and mulched. While excelsa is not necessarily the most desirable variety of redcedar to be in the park long term, it does create dark shade underneath it with its thick branching pattern and can potentially exclude non-natives. There are conflicting opinions on the lifespan of this sub-species (Appleton & Heinzelmann, 2012; Worral, 2013). Consequently, we do not recommend removing it at this time or until other conifers are established.

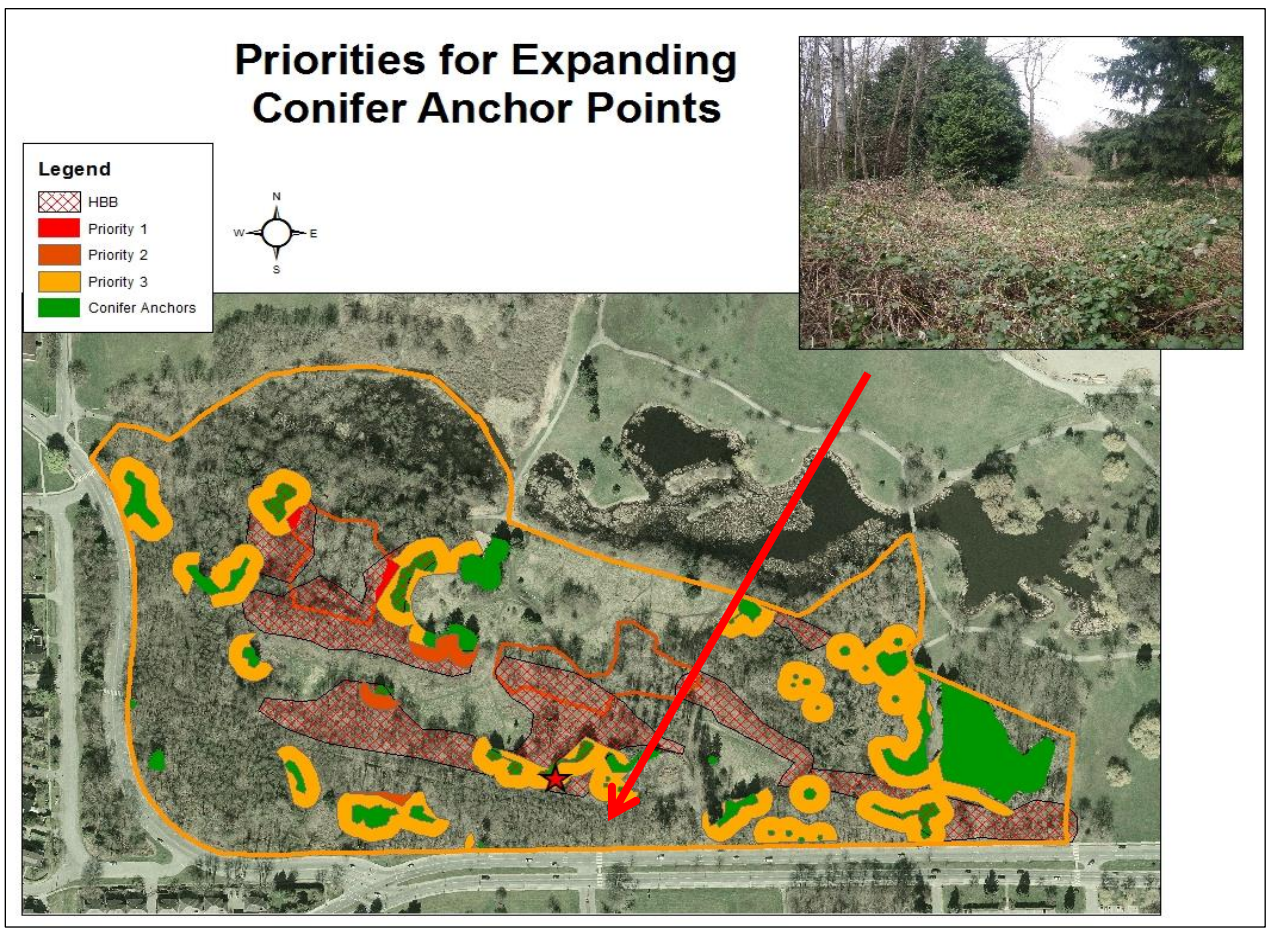


Figure 13: Priority areas for expanding conifer anchor points.

Understory

Planting to Exclude Non-Native Species

The planting strategies utilized in Jericho could focus on excluding non-native species through the use of fast-growing, native species. Shade tolerant species are preferred, but even these will require initial maintenance to ensure that they survive and occupy the growing space. Fast growing understory shrub species for this region include red osier dogwood (moist to wet sites), snowberry and salal (well drained sites), and salmonberry (moist sites) (Zevit, 2005-2009). Where canopy gaps provide higher light levels in the understory, less shade tolerant species such as willow, black twinberry and hardhack (wet sites), and rose species (well drained sites) can be planted. These are recommended as priority fast growing species. See Appendix 4: Suitable plant species for Jericho Park for additional species that are appropriate for specific growing conditions.

Wet and riparian areas would be good priorities for restoration. There is a wet area across the trail from the ponds that is covered with Himilayan blackberry and has no visible tree regeneration and is easily accessible that would be a good site for restoration (Figure 14). As well, the riparian area should be buffered from invasion and maintained as a priority. Similarly, planting moisture-loving, understory shrubs (along the edge of the stream) will help keep invasive species off the banks and from spreading into the wetlands via the creek.

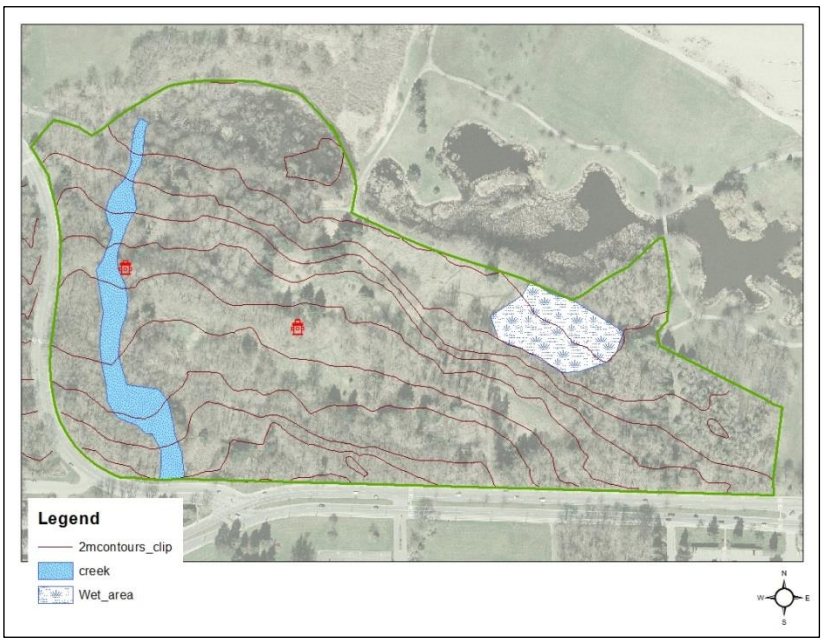


Figure 14: Wet areas in Jericho Park, including hydrant locations.

After destroying and/or removing invasive plant material from the site, mulch can be spread over the site to supress vegetation. Alternatively, the ground can be covered with

landscape fabric, coconut fibre, or cardboard for at least 1.5 years. These fabrics can serve different purposes and last different lengths of time. Black landscaping fabric, such as beltech, can be used for soil solarisation, a process of heating the soil to kill root systems (The Nature Conservancy, 2001; Ennis, 2013) but may last for over 20 years, while coconut fibre will last 5-10 years, and cardboard, up to 5 years (Ennis, 2013). Two common strategies exist: the first is to remove the ground cover once undesired plants are dead, plant desired species and continue to weed out any re-sprouted undesirable plants (Behrens, Fry, & Elman, 2007), the second is to leave the ground cover in place and plant through holes in the cover (Ennis, 2013). For extensive detail on similar stewardship projects, see Stewardship Reports and Guiding Principles from the Starflower Foundation (Washington Native Plant Society, 2013), based in Seattle, which does many urban forest restoration works.

When planting to exclude invasive vegetation, including planting over a recently removed patch of invasive vegetation, it is beneficial to plant species that will establish and spread quickly. Additionally, once the area is free of most of the target invasive species, treated areas can be seeded with local seed mixes suited for specific habitats, such as those that can be purchased from the Starflower Foundation (Washington Native Plant Society, 2013). Equivalent seed mixed are available in B.C. but are currently often of inconsistent provenances (Ennis, 2013).

Planting areas that are combined with invasive species removal should be planned carefully. If invasive species control is planned to occur over several years, hardier shrubs and woody plants should be planted that can resist damage by mowers and volunteers. Once invasive species control is achieved, or in areas that are free of invasives, planting more delicate herbaceous species should be considered.

Food-bearing Plants for Birds

Improving habitat for birds is a main objective of these recommendations. Resident birds need a variety of food sources that last throughout the year, migratory birds need a boost of food in spring and fall when they are passing by, and winter residents need a source that lasts throughout the harshest season. Prioritizing planting strategies that focus on berry or

fruit bearing plants that produce fruit at different times of the year will promote a continuous food supply. Flowers, berries and fruit also add colour and variety to the scenery and may increase public enjoyment of the park (Table 3, and Appendix 1, *Action 2.5*).

Table 3: Plants that produce food for birds, either as fruit or berries, the time of year the fruit is produced and the best growing conditions for that plant. List derived from NatureVancouver. Growing conditions from Plants of Coastal British Colunbia (Pojar & Mackinnon, 2004).

Species	Berry/fruit/nut Season	Best growing conditions
Sitka Mountain Ash (*Sorbus sitchensis*)	Late fall, early winter	Open, coniferous forest, clearings.
Salmonberry (*Rubus spectabilis)*	Early summer (May-June)	Moist to wet soils, riparian areas.
Red Elderberry (*Sambucus racemosa*)	Late summer-early fall.	Stream banks, swampy thickets, moist clearings, open forest.
Beaked Hazelnut (*Cornus corylus*)	Summer to fall	Mesic sites at low elevations
Thimbleberry (*Rubus parviflorus*)	Mid-late summer	Forest openings, roadsides, forest understories.
Indian-plum (*Oemleria cersiformis*)	Mid-late summer	Dry to moist, open woods, streambanks.
Pacific Yew	Summer to fall	Usually in Douglas-fir/hemlock old-growth forests, moist soils.

Most of these species require sunlight to produce fruits or berries. Accordingly, they would be good candidates for plantings in the 'side-wall' zone of the meadow and trail edges, or in larger canopy gaps.

Wildlife habitat

In conceptualizing of how to create wildlife habitat, it is helpful to think of the variety of habitats, structural attributes and food sources that the suite of native and migratory species require. In general, the greater the diversity of habitats available, the greater the diversity of wildlife species present. Key habitat elements that should be incorporated include (Green and Klinka 1994, Fenger *et al.* (2006):

- Multi-age forest with a multistory canopy with gaps;
- variety of tree, shrub, herb, bryophyte and lichen species;
- large trees with branches suitable for roosting and nesting, some with broken tops;
- snags and wildlife trees of various species and stages of decay;
- abundant shrubs and cover for small birds and mammals;
- large volumes of coarse woody debris in of various species and size, in all stages of decay.

Coarse Woody Debris

Snags/Wildlife trees

Few wildlife trees exist in Jericho Park, and those present are relatively small. Several species of birds as well as some small mammals (eg. red squirrels) nest in dead or dying trees. Many of these species require additional old forest characteristics, but several can survive in younger or fragmented stands provided snags and downed wood/coarse woody debris are present (Hartwig, 2002). Some examples of local birds that use dead or dying trees for feeding or nesting are downy woodpeckers, flickers, red-breasted sapsuckers, red-breasted nuthatches, chestnut-backed and black-capped chickadees and wood ducks. The Vancouver Natural History Society has a list of over 180 bird species that have been observed at the park and that should be considered in habitat creation planning (Vancouver Natural History Society, 2001), some of these are listed in Appendix 5: Bird species to consider when planning for habitat. Recently, pilot projects have successfully reintroduced western blue birds (another cavity nester) to sites on southern Vancouver Island. Jericho Park would likely be a feasible location for this type of reintroduction project.

Several techniques and patterns of snag creation are currently in use in B.C. However long term monitoring data and assessments of the effectiveness were only available for a few of them. Common treatments include girdling, topping (stubbing) or inoculating standing live trees in order to kill them. Others focus on "planting" standing partially decayed timber (Appendix 1*, Action 2.2*). "Starter holes" or nest boxes built into the tree or added outside

the tree can also be used to recruit wildlife if the specific needs of the target species are known (British Columbia Ministry of Forests). Several snag creation projects around Vancouver include imitation cavities and fancy top cut designs. These variations likely affect decay rate and therefore decrease the amount of time until the snag is useful to cavity nesters (Washington State University).

Snags should be over 25 cm dbh and preferably 30-100 cm. Created snags should be at least 5-12 meters tall, and up to 20 meters tall if there is space. Ensure all created snags are in areas sheltered from strong winds, are over a snag height away from trails (e.g. outside of the Safety Zone; Figure 3), and do not cause a threat to park visitors or infrastructure.

CWD

The baseline inventory indicates that the volume, piece size, percent ground cover, and decay class distribution of coarse woody debris in Jericho Park is very different, and much lower than that which would be found in a similarly located Coastal Western Hemlock forests (Feller, 2003). This lack of coarse woody debris in the range of decay classes and the range of sizes found in a natural forest will have long term consequences for biodiversity and ecosystem function (Chief Forester, 2010). Furthermore, the complement of species of flora and fauna, including regenerating trees, that rely on or use the variety of types of CWD (especially decay classes 3 and 4) in a natural forest will not (or have difficulty) repopulate or be able to effectively be restored without proper CWD habitat.

The types of CWD that are notably missing from Jericho Park are large pieces in late decay classes from slow decaying conifers. As there are few sources for this type of wood in the park now, and there will not be many more in the near future, it is recommended that logs and stumps be brought in. This would be done most efficiently, and with the least negative impact, in combination with other restoration treatments, or when the beach is being groomed and prepared for the summer season. Logs could easily be brought into the park from Jericho and Spanish Banks beaches;

Figure 15: Piles of washed up logs near Jericho Beach, 2013

however salt slows decay, and would take several rainy seasons to leach out (Figure 15). Other sources may be waste logs from log sorts, from city arborists, or other local companies. Some wood should be put in contact with the ground to accelerate decay, while other pieces could be stacked to create more structural diversity and habitat. If possible, bringing in wood in various stages of decay and from different species that decay at different rates, and that are as large as possible would be beneficial. CWD could be placed within underplanting areas to restrict pedestrian or bicycle access and to give these areas a more natural appearance. Getting creative with logs by bisecting them and cutting holes to plant trees in would further enhance their biodiversity value (Pollard, 2013)(Appendix 1, Action *1.2*). Strata A (Mixed Deciduous), C (Alder Leading) and F (Young Deciduous) have the lowest amounts of CWD, therefore restocking CWD should focus there.

The optimal amount of CWD needed is unknown (Feller, 2003). However Coastal Western Hemlock ecosystems typically have 35-59 pieces over a 20 cm diameter and 10 m length per hectare (Chief Forester, 2010).

Stewardship

Achieving the listed future desired conditions requires a lot of labour

The objectives of maintaining an open forest, meadows and sightlines, while reducing invasive species and trending towards a more natural forest are somewhat incompatible, and are inconsistent with the current trajectory of the site. Consequently achieving these objectives will necessitate ongoing, coordinated intervention and maintenance. Currently, the Jericho Stewardship Group, and other groups, as well as a few individuals have taken ownership of restoring and maintaining certain areas of the park, while other groups and individuals have partaken in one-off restoration activities. To maintain and convert/restore the park, both pulses of intensive restoration and ongoing maintenance are needed. There are several great examples of restoration in the park, and these should remain a focus and a model for ongoing maintenance (Appleton & Coope, 2013)(Appendix 2: Previous Treatment Map).

The need for self-organizing volunteers and the allotment system

Figure 16: Vancouver's *Green Streets Program* is a good example of an implemented allotment system

One approach to coordinating volunteer effort would be to engage groups or community members in a coordinated allotment system, or "adopt-a-" system, where they are responsible for the ongoing, inter-annual stewardship of a defined area, according to an agreed-upon plan. Groups and individuals would be responsible for coordinating their activities, and putting in time when it best fits their schedules. There are many examples of the success of this system around the greater Vancouver area, for example, "Adopt-a-highway" or the "Green Streets Program" (Figure 16). Allotment maintenance "positions" could be advertised at local community venues including Aberthau, Brock house, the Jericho Sailing Center and the Jericho Tennis Club. Initial time investment in engaging, organizing and orienting volunteers can be large, therefore it is important to emphasize the importance of a multi-annual, self-directed commitment, that is consistent with site level prescriptions.

People want to help, make it easy for them

Because of the large amount of effort required in coordinating volunteers and the seemingly huge willingness of communities around the City of Vancouver to be engaged in local volunteer activities, if the City employed one full-time volunteer coordinator it is likely a huge amount of work could get accomplished around the city for a nominal cost. Additionally, small stewardship groups often have to arrange and finance their own insurance and other costs (refreshments, tools etc.). Investment by the City in these small costs would relieve the burden on these small groups, and be highly leveraged by the work accomplished. Some local municipalities that may be used as an example of how this model can be employed are the City of Surry, the City of North Vancouver, and the City of Seattle.

Education

A few educational signs already exist along the trails at Jericho Park. Additional educational signage should focus on informing the public about the spread of Japanese knotweed, and how they should leave it onsite, and keep their pets and children out of it. If more visible restoration measures take place, signage explaining the restoration rationale and processes would be wise.

Restoration Prescriptions

Restoration prescriptions should be site specific, and address all phases from initial assessment, site preparation, planting, vegetation management and monitoring. They should be organized to take the site from its current condition, toward a target (desired future) condition, and include a budget, a timeframe, descriptions of the personnel and equipment needed for each phase of the project. The management recommendations given in this report, along with the baseline inventory, set the stage for the development of site-level prescriptions. However, detailed site assessment of priority areas, further discussion with stakeholders, and examination of budgets and treatment priorities are necessary before site-level prescriptions can be prepared.

Effectiveness Monitoring

Upon commencing any ecological restoration project, it is crucial to have goals and objectives, define a future target condition, and have a plan to get there. Success can be promoted by monitoring the effectiveness of the project and evaluating whether plans need to be amended in order to reach the pre-defined target (Machmer & Steeger, 2002). There are several examples of 'Effectiveness Monitoring' programs that could be used as models for Jericho (Machmer & Steeger, 2002; Hocking, Stolton, Dudley, Courrau, & Valentine, 2006; The Nature Conservancy of Canada, 2009; The Nature Conservancy, 2007), but in general the monitoring program has to be suitable given the scope and capacity of the project. Effectiveness monitoring should be planned during site level planning, and commenced before the first treatments are carried out.

Conclusion

Jericho Park provides a unique opportunity for locals and visitors alike to enjoy nature in the city. The recommendations offered in this report lay the basis for providing safe opportunities for this enjoyment, while enhancing the biodiversity, ecosystem services and ecological integrity of the Jericho Park forest. The challenge of enhancing the native biodiversity of Jericho Park is a large one, but not insurmountable, particularly in view of the capability and dedication of the Jericho Stewardship Group. The priority actions and techniques from this document can be used to build site specific restoration plans.

Future Directions

- Investigate municipality's models for using volunteer resources on city lands and recommend a feasible model for the City of Vancouver
- Map the "future desired condition" of all areas of Jericho Park with public consultation.
- Create reasonable prescriptions to meet "future desired condition".
- Design and implement effectiveness monitoring program

References

New Zealand Government. (2008). Technical Advisory Group Assessment of National Pest Plant Accord Species. New Zealand.

Vancouver Natural History Society. (2001). *The Birder's Guide to the Vancouver and the Lower Mainland.* Toronto: Whitecap Books.

Appleton, A., & Coope, J. (2013).

Appleton, A., & Heinzelmann, F. (2012, November). Goals and Objectives for JSG in relation to MSFM student project at Jericho. (L. Ballin, & J. deMontreuil, Interviewers)

Behrens, C., Fry, S., & Elman, E. (2007). *Pritchard Beach Natural Area Stewardship Report.* Seattle: Starflower Foundation.

Bennett, M. (n.d.). Managing Himalayan Blackberry in SW Oregon. Southern Oregon Forestry Note #7. *Extension Service Southern Oregon Research and Extension Center*.

British Columbia Ministry of Agriculture. (n.d.). *Aggressive Ornamentals: Japanese Knotweed*. Retrieved March 11, 2013, from http://www.agf.gov.bc.ca/cropprot/jknotweed.htm

British Columbia Ministry of Forests. (n.d.). *Wildlife Trees. Stand level components of biodiversity.* Retrieved April 6, 2013, from http://www.for.gov.bc.ca/hfp/training/00001/module03/tree-creation2.htm

Cadenasso, M. L., Traynor, M., & Pickett, S. T. (1997). Functional location of forest edges: gradients of multiple physical factors. *Canadian Journal of Forestry Research, 27*, 774-782.

Chen, W. Y., & Jim, C. Y. (2008). Assessment and Valuation of the Ecosystem Services Provided by Urban Forests. In M. M. Carriero (Ed.), *Ecology, Planning and Management of Urban Forests: International Perspectives* (pp. 53-83). Springer.

Chief Forester. (2010). *Chief Forester Guidance CWD Managment.*

Coope, J. (2013). JSG Management at Jericho. (L. Ballin, & J. deMontreuil, Interviewers)

Crockett, R. (2005). *Controlling Knotweed.* Vancouver, WA: Monsanto Co.

Davenport, R. (2006). Control of knotweed and other invasive species and experiences restoring native species in the Pacific Northwest US. *Native Plants Journal*.

Department of Conservation and Natural Resources. (n.d.). *Invasive Plants of Pennsylvania*. Retrieved April 11, 2013, from www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_010224.pdf

Devon County Council. (n.d.). *Control of Knotweed*. Retrieved April 11, 2013, from http://www.devon.gov.uk/index/environmentplanning/natural_environment/biodiversity/japanese_knotweed/control_of_knotweed.htm

Ennis, T. (2013, March). Director of Stewardship, Nature Conservancy of Canada.

Environment Agency. (2006). *Managing Japanese Knotweed on Development Sites.* Bristol: Environment Agency.

ESRI. (2012). ArcGIS 10.1:ArcMap. Redview, CA: ESRI Inc.

Feller, M. (2003, September 4). Coarse Woody Debris. *Environmental Review*.

Gerzon, M. (2009). *Modelling the Recovery of Old-Growth Attributes in Coastal Western Hemlock Forests Following Management and Natural Disturbance (Master of Science Thesis).* Vancouver: Faculty of Forestry, University of British Columbia.

Government of New Zealand. (n.d.). *Technical Advisory Group Assessment of national Pest Plant Accord Species*. Retrieved March 24, 2013, from http://www.biosecurity.govt.nz/pestsurv-mgmt/mgmt/prog/nppa/agreement

Green, R., & Klinka, K. (1994). *A Field Guide to Site Identification and Interpretation for the Vancouver Forest Region.* Victoria: B.C. Ministry of Forests Research Program.

Hagen, E. N., & Dunwiddie, P. W. (2008). Does Stem Injection of Glyphosate Control Invasive Knotweeds? A comparison of four methods. *Invasive Plant Science and Management, 1*(1), 31-35.

Hartwig, C. E. (2002). *Forest Age and Relative Abundance of Pileated Woodpeckers on Southeastern Vancouver Island.* USDA Forest Service.

Hocking, m., Stolton, S., Dudley, N., Courrau, J., & Valentine, P. (2006). *Evaluating Effectiveness: A framework for assessing managment effectiveness of protected areas 2nd ed.* Gland Switzerland: IUCN The World Conservation Union.

Invasive Species Council of BC. (2012). *Himalayan Blackberry*. Retrieved March 16, 2013, from http://www.bcinvasives.ca/invasive-species/invasive-plants/himalayan-blackberry

Isaac, K., & Duncan, A. (2012, September 17). MSFM Student Project at Jericho Park. (J. deMontreuil, L. Ballin, & S. Mitchell, Interviewers)

Janz, H., & Dave, R. (n.d.). Invasive Plant Species in the ACFL: Successful Methods of Removal. Anacortes, Washington, USA.

Klinkenberg, B. (2013). Retrieved 03 2013, from E-Flora BC: Electronic Atlas of the Flora of British Columbia. Lab for Advanced Spatial Analysis, Department of Geography, Univeristy of Victoria: http://www.geog.ubc.ca/biodiversity/eflora

Klinkenberg, B. (Ed.). (2013). *E-Flora Atlas Page: Himalayan Blackberry*. Retrieved March 16, 2013, from E-Flora BC: Electronic Atlas of the Flora of British Columbia: http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Rubus%20armeniacus

Klinkenberg, B. (Ed.). (2013). *E-Flora BC Atlas Page: Japanese Knotweed*. (L. f. Analysis, Producer, & Department of Geography, University of British Columbia) Retrieved March 11, 2013, from E-Flora BC: Electronic Atlas of the Plants of British Columbia: http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Fallopia%20japonica

LaPaix, R., Harper, K., & Freedman, B. (2012). Patterns of exotic plants in relation to anthropogenic edges within urban forest remnants. *Applied Vegetation Science, 15*, 525-535.

Machmer, M., & Steeger, C. (2002). *Effectiveness Monitoring Guidelines for Ecosystem Restoration.* Nelson: submitted by Pandion Ecological Research to B.C. Ministry of Water Land and Air Protection.

Nick Page, B. S. (2013).

Page, N., & Stevens, B. (2013, March 8). MSFM Student Project at Jericho Park. (J. deMontreuil, L. Ballin, & S. Mitchell, Interviewers)

Pojar, J., & Mackinnon, A. (2004). *Plants of Coastal British Columbia* (Revised ed.). Vancouver: Lone Pine.

Pollard, B. (2013, March).

Soll, J. (2004). *Controlling Knotweed in the Pacific Northwest.* The Nature Conservancy.

The Nature Conservancy. (2001). Manual & Mechanical Techniques. In Tu, M. Tu, C. Hurd, & J. Randall, *Weed Control Methods Handbook.* The Nature Conservancy.

The Nature Conservancy. (2007). *Conservation Action Planning: Developing Strategies, Taking Action, and Measuring Success at Any Scale, Overview of Basic Practices.* The Nature Conservancy.

The Nature Conservancy of Canada. (2009). *Property Management Plan Annotated Template Version1.* Victoria.

University of Connecticut Horticulture. (n.d.). *Acer pseudoplatanus*. Retrieved April 10, 2013, from http://www.hort.uconn.edu/plants/a/acepse/acepse1.html

USDA. (2013). *Plants Database*. Retrieved April 10, 2013, from Plants Profile: Acer pseudoplatanus:

http://plants.usda.gov/java/profile?symbol=ACPS&mapType=nativity&photoID=acps_001_ahp.tif

Vancouver Natural History Society. (2001). *The Birder's Guide to Vancouver and the Lower Mainland.* Vancouver: Whitecap Books.

Washington Department of Fish and Wildlife. (n.d.). *Living with Wildlife:Snags-The Wildlife Tree*. Retrieved April 6, 2013, from http://wdfw.wa.gov/living/snags/

Washington Native Plant Society. (2013 йил 7-February). *Starflower Restoration Stewardship Guidelines and Reports* . Retrieved 2013 йил 19-April from Washington Native Plant Society: http://www.wnps.org/restoration/index.html

Washington State University. (n.d.). *Creating Snags, Forest and Wildlife Extension*. Retrieved April 6, 2013, from http://www.for.gov.bc.ca/hfp/training/00001/module03/tree-creation2.htm

Worral, J. (2013, March). Identification and discussion of tree characteristics at Jericho Park for MSFM student project. (L. Ballin, & J. deMontreuil, Interviewers)

Yarra Ranges Council. (n.d.). *Environmental Weed Factsheet*. Retrieved April 11, 2013, from www.yarraranges.vic.gov.au

Zevit, P. (2005-2009). *Battling the Alien Invasion! An overview of invasive plant speices impacts in the Georgia Basin. .* Coquitlam, BC: Adamah Consultants.

Appendix 1: Recommended Actions

The following table outlines some of the recommended actions that can be taken for some of the priority management issues in Jericho Park. Please use the 'text reference number' to refer to the references used in this document to follow up for further details regarding these treatments.

Table 4: Current issues identified in Jericho Park, a proposed management solution and supporting details.

Text Reference Number	Issue	Proposed Solution	Description
1	Site Conditions		
1.1	Heavily disturbed soils	Bring in organic nutrients	Sea soil or nutrient rich organic soil around plantings, partially decomposed needle and leaf litter on top (if lacking alder and/or maple overstory) (Ennis, 2013). Confirm there is not a shallow or adjacent root restricting layer or materials where trees and large shrubs are planted. Several native species most often grow on decaying logs and stumps so try providing plantings with high amounts of organic material.

1.2	Lack of coarse woody debris (CWD)	1. Bring in CWD 2. Add structure to CWD	CWD can be brought in from the beach and distributed around the site. Better, but potentially more costly sources of wood are waste logs from a log sort (Pollard, 2013), or waste from city arborists or other local companies. Ideally wood would be of large size, of different species of origin, and in later stages of decay. CWD should focus on pieces larger than 20cm*10 m if possible (Chief Forester, 2010). Utility of CWD could be increased by cutting holes for planting trees, and stacking for habitat structure (Pollard, 2013)
2	Wildlife Habitat		
2.1	Single storied stand	1.Clear competing vegetation 2. Plant shade tolerant trees and shrubs.	Shade tolerant species includes western red cedar on all sites, western hemlock on medium sites, grand fir on medium to dry sites, and sitka spruce on wet sites.
2.2	Increase cavity nesting habitat	Snag creation	Create snags by topping trees with a diameter of over 25 cm dbh (but 30-100 cm dbh is better), at 5-12 meters, by girdling trees, or by inoculating with heart rot fungi (<20 meters tall depending on location).
2.3			Plant snags. Choose native species, preferably coniferous (eg. Douglas-fir, cedar) that show beginning stages of heart rot. Burry "snags" approximately 1/3 the height deep. Alternately planted snags can be anchored to existing trees or mounted on a metal post (Washington

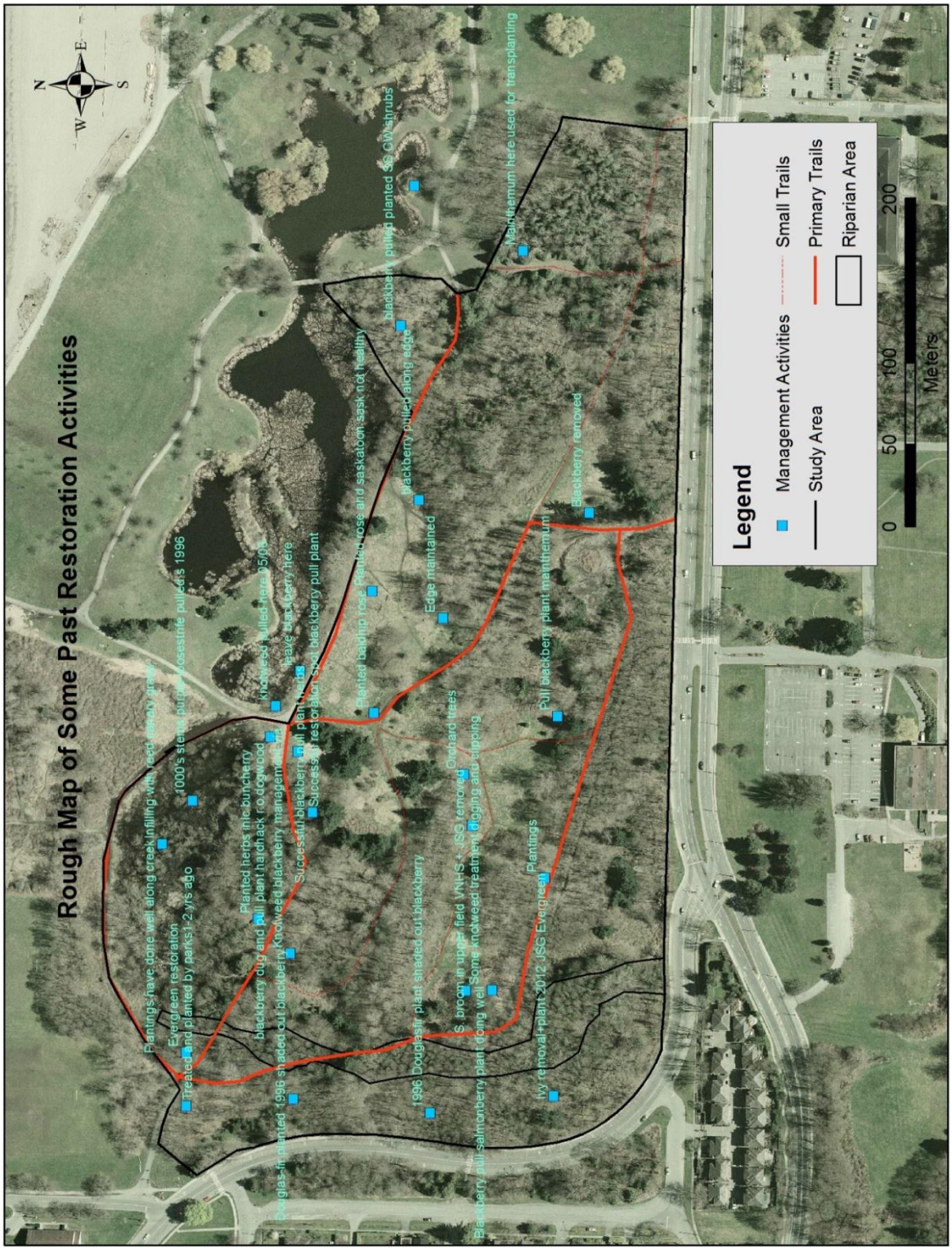
			Native Plant Society, 2013).
2.4		Nest Boxes	Create nest boxes of different varieties depending on target species, either on outside of tree or built into tree (British Columbia Ministry of Forests).
2.5	Increase songbird presence	Plant shrubby vegetation (especially with berries and seeds) Grow vegetation with a diversity of structure, species and life stages.	Ensure multiple species of vegetation that act as a food source and are temporally staggered. Connectivity of shrubs and/ or trees throughout the park (Jericho lacks this only in the grassy fields outside of the study area).
2.4	Attract large nesting birds	Grow large old trees	Focus on Douglas-fir, but include a diversity of species. Some of the Douglas-fir on site are quite large already, and should be preserved.
	Increase coarse woody debris	See above.	
3	Vegetation		
3.1	Underplant		Expand conifer anchor points. Plant in invasive plant restoration areas.
3.2	Build edges		Build edges according to “side-wall” concept Figure 5.
4	Invasive Species		

4.1	Overplant removed invasive plant infestation		Plant species that will establish and spread, shading out and competing with the invasive species. These may include: salmonberry, snowberry, roses, hardhack/spirea, sword fern, false lily-of-the valley.
4.2	**Himalayan Blackberry**	1. Remove A. Dig up with mini-excavator B. Chop roots and vegetation with rototiller C. Cut with loppers, dig up roots by hand 2.Cover (or not) and replant 3.Monitor and spot treat	Blackberry roots need to be dug up to temporarily remove the plant. Cover site with cardboard, coconut fibre slope stability cloth or wood chips. Replant suitable species in holes cut in fabric/cover. Cover with woodchips and partially decayed leaf litter if none naturally occurring. Monitor and manually pull new blackberry stems annually (preferably in the spring). Cuttings should be removed from site or burned if possible to prevent root fragments resprouting.
4.3	**Japanese knotweed**	1.Inject stems with glyphosate 2. Cover ground with beltech fabric	Plant stems should be injected and/or root system removed and destroyed at industrial facility. Technicians must be extremely careful not to distribute pieces of stem elsewhere or they will re-sprout. Ground should be covered with beltech fabric for at least a year before being

		1859 3. Remove and plant or plant through holes 4. Monitor, and retreat as necessary 5. Prevent spread	removed and densely planted over, or should be left, covered with woodchips and planted with trees and shrubs in holes in the fabric. Site must be monitored regularly and new stems pulled. Preferably every month during growing season, but at least once a year in mid-spring. Dead stems should be removed annually. If another chemical treatment is deemed necessary, cut, allow 1 meter of regrowth, and re-inject between March to October. If plants spread cut or mow four times a year between March and October.
4.4	**Sycamore maple**	Hand pull seedlings, frilling, bore holes, inject herbicide, treat stumps with vigilant	Hand pulling in spring when soils are soft and moist. Most effect removal treatment timing is early fall, just before leaves change colour. (Yarra Ranges Council; New Zealand Government, 2008)
		Girdling of larger trees.	Most effective in spring (Department of Conservation and Natural Resources)
		Chemical application to bark	Controls trees up to 4" (10.2cm) (Department of Conservation and Natural Resources)
		Drill and fill trunks	Use a power drill to drill shallow holes (2-3cm deep) in trunk, close to root zone, about 5-6cm apart. Fill holes with undiluted glyphosate (Yarra Ranges Council).

4.5	Ivy	Hand pull, remove roots.	Ivy will resprout from root fragments or pieces of stem, remove as much as possible from site (Janz & Dave)
4.6	Holly	Cut trunk below ground, dig roots.	Dig up the roots with a shovel if possible to prevent resprouting (Janz & Dave)
4.7	Scotch broom	Pull entire plant	Remove entire plant. It is recommended to pull broom in the spring or fall when the soil is moist and the deep roots are easier to remove from the soil. A weed wrench (example brand: extactogator) is necessary for large stems (personal observation, L. Ballin). Scotch broom used to be present in the upper fields at Jericho. Diligent pulling has removed the majority of the population (Coope, JSG Management at Jericho, 2013) but the seed bank lasts around 40 years and is likely still present.

Appendix 2: Previous Treatment Map



Appendix 3: Himalayan Blackberry Control Trials in SW Oregon

Trial # (name)	Methods	Season	Result
1: Tractor Mowing + herbicides, goat browsing	1. Mowed with tractor mower	May July	Does not eliminate the HBB from the site. After 3 years the HBB was reduced, planted trees were well above brush competition. HBB was still present, but a minor component of vegetation community. Goats can control new sprouts after mowing, in the short term only.
	2. Spot-sprayed with glyphosate	Late September	
	3. Mowed with tractor mower	Late fall	
	4. Planted	November	
	5. Spot sprayed	April	
	6. Hand weeded	July	
2: Manual/mechanical slashing of HBB +spot herbicide+intensive hand weeding	1. Cut with chainsaws, brushcutters and loppers (piled)	August	Variable results, some areas free of HBB, others still had dense cover. Hand weeding was 9 times in the season following planting, achieved results comparable to herbicide.
	2. Piles flail-mowed	Early September	
	3. Spot sprayed with glyphosate	Early October	
	4. Planted	Early November	
	5. Spot sprayed with glyphosate	April	
	6. Re-sprouts cut and immediately sprayed	July	
3a: Slashing+herbicides	1. Cut with hand tools, cuttings left on site	midsummer	Variable results
	2. Spray ½ with Roundup, ½ with	14 months after first cutting	

	Garlon3A	(early October)	
	3. Cut with hand tools	End of October	
	4. Planted	Mid November	
	5. Spray around each tree	April	
3b: Slashing+grubbing	1. Cut with hand tools, cuttings left on site	Mid-summer	HBB cover increased
	2. Cut with hand tools, cuttings left on site	One year later, and in late Oct same year	
	3. Planted	November	
	4. Grubbed	February and March	

Appendix 4: Suitable plant species for Jericho Park

This list was compiled from local guides (Pojar & Mackinnon, 2004; Green & Klinka, 1994) as well as personal observations of successfully established vegetation in Pacific Spirit Park and Jericho Park, consultation with local restoration experts (Ennis, 2013) and members of the JSG (Appleton & Coope, 2013).

Description of area (location, slope, current veg composition)	**Likely site series**	**Appropriate plants**
Upland areas, driest sites at Jericho, low to moderate slope. Existing vegetation may include Douglas-fir, alder, ivy, blackberry (eg young alder strata)	05	Full light: Douglas-fir, big leaf maple, salal, saskatoon
		Partial or full light: Grand fir, cedar, hemlock, cascara, Douglas maple, salal, red huckleberry, evergreen huckleberry, ocean spray, Oregon grape, foamflower, false-lily-of-the valley, western trumpet honeysuckle
Stream edge(eg creek strata)	unknown	Western yew, vine maple, false azalea, highbush cranberry
South, west, east park edges, edges of meadows and more open trails	05/07	Flowering dogwood, cascara, beaked hazelnut, vine maple, Douglas maple, red elderberry, Indian plum, black hawthorn, red current, mock orange.
Blackberry, knotweed, alder	05/07	Beaked hazelnut, cascara, vine maple, snowberry, red elderberry, cascara, roses, ocean spray, pacific ninebark,

Description of area (location, slope, current veg composition)	**Likely site series**	**Appropriate plants**
mesic –moist areas		raspberry, lady fern, sword fern, western trumpet honeysuckle, mountain sweet cicily, twinflower, large leaved avens, queen`s cup, starflower
Blackberry alder wet area	12/13/14 (5f/6f)	Plant cedar, spruce in wet microsites, bigleaf maple and cottonwood in light areas. Sword fern, salmonberry, some red-osier dogwood, black twinberry, willows, elderberry, vanilla leaf, mountain sweet-cicily, spiny wood fern, large leaved avens, queen's cup, palmate colts foot
Wet swamp areas (eg low elevation areas adjacent to northern path and wetland)	15/(7f), 12	Pacific willow, other willows, Sitka spruce, western red cedar, red-osier dogwood, salmon berry, hardhack/ spirea, stink current Standing water: skunk cabbage Ocean exposure: Pacific crab apple
Excelsa Cedar cottonwood (eg Cottonwood/Cedar strata)	07	Full light: Cottonwood, big leaf maple, Douglas-fir, thimbleberry
		Partial or full light: red cedar, hemlock, grand fir, snowberry, raspberry, salmonberry, sword fern
Meadow	n/a	Wildflower or native seed mix

Appendix 5: Bird species to consider when planning for habitat

These species lists were primarily derived from *The Birder's Guide to Vancouver and the Lower Mainland* (Vancouver Natural History Society, 2001), and supported by local residents observations. The Vancouver Natural History Society has a long running bird list that includes observations of over 180 species. The species listed below spend a considerable amount of time in the park. Additionally, several migrant songbirds frequent the area in spring and fall, therefore planting species that retain a food source through these times of year is important.

Known to Breed in the Park	
Willow Flycatcher	Common Yellowthroat
Cedar Waxwing	Mallard
Bushtit	American Coot
Song Sparrow	Pied-billed Grebe
White Crowned Sparrow	Barn Swallow
Spotted Towhee	Violet-green Swallow
American Robin	

Large birds	
Cooper's Hawk	Great-horned Owl
Sharp-shinned Hawk	Short-eared Owl
Merlin	Northern Saw-whet (occasional)
Red-tailed Hawk	Bald Eagle

Partially resident birds	
Vaux and Black swifts	Common Redpoll
White-crowned, Fox, Song and Golden Crowned Sparrows	Varied Thrush
Northern flicker	Pine Siskins

American Goldfinch	Cliff, Tree, Northern Rough-winged Swallows

Further to this list, target species should be decided upon and considered when creating wildlife habitat.

Appendix 6: Cumulative Plant List (Coope, 2012)

Please find excel spreadsheet attached.