Hamlin Park
Vegetation Management Plan

Prepared for: City of Shoreline

Prepared by:
Nelson Salisbury, Ecologist
Ella Elman, Ecologist
Sarah Zerbonne, Ecological Field Assistant

Seattle Urban Nature
5218 University Way Northeast
Seattle, WA 98105-4495

January, 2008

EXECUTIVE SUMMARY

Hamlin Park contains 80 acres of land, 59 of which are forested. In 2007, Seattle Urban Nature (SUN) mapped habitat types and conducted a vegetation inventory in Hamlin Park. The goals of the project were to:

1) Delineate and map habitats in Hamlin Park
2) Provide an inventory of current vegetation conditions in the park
3) Create a management plan based on data collected during the inventory

Seven forested and five non-forested habitat types were mapped within Hamlin Park. The majority of forests in Hamlin Park are conifer, with small pieces of conifer/deciduous forest, conifer/madrone forest, deciduous madrone/forest and landscaped forest also present. Of the 49 acres of conifer forest, 15 acres in the central core of Hamlin Park have a completely bare understory, lacking any groundcovers, shrubs or regenerating trees. This forest type was mapped as a unique habitat type within the park.

To study the current conditions within the forested areas of Hamlin Park, SUN installed 32 0.1 acre rectangular vegetation plots distributed throughout the park. The plots recorded information about trees, shrubs, vines, herbaceous plants, snags and downed wood present in the park. During the 2007 survey, a total of 75 plant species were found: 22 tree species (12 native and 10 non-native), 21 shrub species (13 native and 8 non-native) and 32 herbaceous and vine species (19 native, 11 non-native, and two species whose nativity is unknown).

The extent of the conifer forest without understory points to one of the major management concerns in Hamlin Park, which is the lack of a formal trail network and the presence of numerous social trails spanning the park area. This encourages trampling of bare areas and does not limit human activity to well-defined trail corridors. The City of Shoreline recognizes this problem and is currently working on developing an official trail plan for the park.

Invasive species also pose a significant challenge in Hamlin. Although the central core area of the park is free of invasive species, mostly due to lack of any understory or shrubs, the edges of the park are invaded with English ivy, Himalayan blackberry, Scotch broom (*Cytisus scoparius*) and invasive trees such as English holly, sweet cherry (*Prunus avium*), Norway maple (*Acer platanoides*) and European mountain ash (*Sorbus aucuparia*). The 2007 survey recorded an average of 1,083 non-native stems/acre compared to 184 native stems/acre. Other issues within the park include lack of a tall shrub layer, large snags and coarse woody debris.

To aid in conducting restoration activities, SUN identified and mapped management zones throughout the park. Specific recommendations were developed for each management zone as well as overall short-term, medium-term and long-term priorities for the entire park (see Management Recommendations and 15-year plan sections of the report).

Hamlin Park 15 year plan

Short term management priorities (Years 1-5)	
	These are actions that are of high importance and could be completed within the first five years
Year	**Action**
1	Conduct inventory of park assets and create Vegetation Management Plan (VMP) (complete)
2	Using information from VMP, create specific restoration action plans for each management zone. This type of information can include specific planting plans, specific invasive removal techniques to be used, specific maintenance activities that will be necessary, as well as a timeline for implementation, maintenance and monitoring
2-5	Implement specific goals identified as short-term priorities in the VMP
	1) Remove all discrete patches of ivy in zones 1-A, 1-B, 1-D, 3-A, 3-C and 4-C and replant with native species
	2) Create survival rings in all large ivy-infested areas throughout the park where trees are being threatened
	3) Remove discrete areas of scotch-broom in Zones 1B and 1D and replant with native species
	4) Remove small infestation of yellow archangel in Zone 1 before it spreads further and replant with native species
	5) Remove small, isolated patches of Himalayan blackberry located in management zones 1-A and 1-B, along with the isolated patch in zone 3-B and replant with native species
	6) Remove isolated patches of English holly and cherry laurel infestations throughout the park. A priority area is the infestation spanning zones 3-B, 1-B and 4-B in the center of the park (see the management discussion for zone 4-B for more information)
	7) Remove sweet cherry infestation in zone 4-A and replant with native species.
	8) Establish a scientific study comparing different treatments to re-establish understory in the conifer forest without understory forest type
	9) Establish exclosures to reduce human traffic in

	restoration areas.
	10) Define a permanent trail network and close off unnecessary social trails.
Yearly	Conduct monitoring and maintenance of areas in restoration
Medium-term priorities	
	These are actions that will take planning to complete and could be completed within five to ten years
Year	**Action**
6-10	1) Remove English holly and cherry laurel in zones 1-A, 1-D, 3-A, 3-B, 3-C, 4-B, 4-C and 8 and replant with native species
	2) Remove larger Scotch broom infestations in Zones 1-A and 5 and replant with native species
	3) Remove large, contiguous areas of English ivy in zones 1-A, 1-D, 3-A, 3-B, 4-A and 6 and replant with native species
	4) Remove large, contiguous infestations of Himalayan blackberry in zones 1-A, 1-D,
	3-C, 4-A, 4-C, 5 and 6
	5) Remove Norway maple from Zone 3-C and replant with native maple species
	6) Remove sweet cherry from Zone 4-C and replant with native bitter cherry
	7) Re-establish understory in the conifer forest without understory forest type using results from the scientific study (number 8 in short-term priorities)
Yearly	Conduct monitoring and maintenance of areas in restoration
Long-term priorities	
	These are on-going activities that will take many years to accomplish and can be integrated into other restoration efforts
Year	**Action**
2-15	1) Increase CWD component in the park by retaining existing logs and bringing in additional wood when possible
	2) Provide on-going maintenance of restored areas
	3) Underplant tall shrubs throughout the park
16	Conduct park inventory and reassess management strategies

Table of Contents

List of Tables

List of Figures

List of Maps

1. INTRODUCTION

The purpose of this report is to assist the City of Shoreline in their planning efforts for the ongoing stewardship and maintenance of Hamlin Park. Because of the increasing use and pressure from human impact, natural areas require active management to maintain and improve their aesthetic and ecological values. This project provides a survey of forested areas and also establishes baseline information with which future surveys and monitoring may be compared. Specific goals of the project are to:

1) Delineate and map habitats in Hamlin Park
2) Provide an inventory of current vegetation conditions in the park
3) Create a management plan based on data collected during the inventory

In 2007, the City of Shoreline contracted with Seattle Urban Nature (SUN) to survey and map four parks owned and managed by the City. SUN is a non-profit organization, whose mission is to create tools to empower stewards for healthy urban ecosystems. SUN assists community groups, governments, non-profit organizations and private citizens in their efforts to survey, map, restore and maintain urban forests in the Puget Sound region.

1.1 Overview of Park

Hamlin Park is an 80.4 acre park located in Shoreline, WA. It is considered the "oldest official park" in the King County park system (City of Shoreline 2007). In 1995 when the City of Shoreline was established, it acquired this parcel of land from King County. Today, Hamlin Park includes a large coniferous forest that is enjoyed by people from the surrounding communities and provides an important natural open space for native plants and wildlife species.

Hamlin Park consists of a wooded natural area with a network of trails and a small intermittent stream, multiple baseball fields and bleachers, a children's play area, picnic tables and a shelter, and restroom facilities (City of Shoreline 2007). Hamlin Park is used for passive recreational activities such as walking, hiking, and biking, as well as for organized sports such as baseball, softball, and ultimate frisbee. The open space contains more than 60 acres of natural forested habitat, a unique asset to the surrounding neighborhoods.

Two branches of Hamlin Creek, an intermittent tributary of the north branch of Thornton Creek, run through Hamlin Park, both as an open stream and a piped water course. The Thornton Creek watershed is a drainage basin of approximately 11.6 square miles in northeast Seattle and southeast Shoreline. It is Seattle's largest watershed, and drains to Lake Washington at Matthews Beach (Thornton Creek Alliance 2007).

Hamlin Park has a diverse history after the arrival of the first European settlers arrived to the area in the late 1800s. Over the course of the 20th century, the land has had numerous owners and the borders have been expanded on multiple occasions.

2. SITE LOCATION AND CONTEXT

2.1 Area Description

Hamlin Park is located in the southeastern corner of the City of Shoreline in the Ridgecrest neighborhood, which consists of mostly single-family residences (City of Shoreline 2007). The central portion of Hamlin Park is bound to the north by Northeast 165th Street, to the south by Fircrest School, to the east by Kellogg Middle School, and to the west by 15th Avenue Northeast (Map 1). A portion of Hamlin Park, containing ball fields south of Northeast 160th Street, is bound to the north by Kellogg Middle School, to the south by Shorecrest High School, to the east by 25th Avenue Northeast, and to the west by the Fircrest School. Lastly, the 8.3 acre portion of land newly acquired by the City of Shoreline is bound to the north by Northeast 168th Street, to the south by the central portion of Hamlin Park, to the east by 18th Avenue Northeast, and to the west by 16th Avenue Northeast (Map 1). South Woods, a 16 acre open space acquired by the City in 2006, is located just a few blocks south of Hamlin Park and is connected by a thin strip of forested property along the western edge of Shorecrest High School.

2.2 Hydrology

There are two small, intermittent branches of Hamlin Creek flowing through the park property. The west branch arises from a piped water course between 18th Avenue Northeast and 21st Avenue Northeast and runs as an open water course along the trail corridor through the central portion of the park (Map 1). This branch is diverted through a pipe when it reaches the parking lot. A second creek flows as an open stream and enters the park from the Kellogg Middle School property from the north east (Map 1). This branch flows into a low depressional area along the eastern boundary of the park, where it appears to seep into the ground. It re-emerges from culverts near the northeast corner of the upper ball field complex and flows as an open water course along the eastern edge of the ball fields before entering into a pipe in the southeastern corner of the park, just north of Northeast 160th Street (Map 1).

2.3 Topography, Geology, and Soils

The geology of the Puget Sound lowland, including Hamlin Park, is heavily influenced by glacial processes which ended 15,000 to 20,000 years ago in this area. Layers of sands, gravels, and silts were distributed by the movement or compaction from glacial ice and glacial outwash (streams generated from the melting of glacial ice). The terraces above Puget Sound are landforms created by these glacial processes. The ravines and valleys present today are the results of post-glacial stream actions cutting down through these glacial terraces.

The underlying geology of Hamlin Park consists of three general units (Pacific Northwest Center for Geologic Mapping Studies 2007). The central and eastern portions of the park are made up of Vashon ice-contact deposits. This normally consolidated material is made up of generally poorly sorted stratified sand and gravel with a silt-rich matrix. These deposits transition into Vashon advance outwash deposits, made up of well-sorted sand and gravel deposited by streams issuing from advancing ice sheets. These deposits are located in the northern and west central areas of the park. The far western edge of the park, the south-eastern section below Northeast 160th Street, and a narrow strip along the northern border are made up of Vashon till, a mixture of rounded silt, sand and gravel particles, which were glacially transported and deposited under ice.

The soils in Hamlin Park are made up of the Alderwood series and can be generally classified as gravelly-sandy loam (MacLeod Reckord 1986). This series is made of moderately well drained soils with a substratum that can be weakly to strongly consolidated at depths of 24 to 40 inches. In areas with little to moderate slopes, internal water movement can be limited by the consolidated substratum and lead to potentially saturated soil conditions in the winter and early spring. Flatter areas are also prone to slower surface water runoff which can lead to soils in these areas remaining saturated for prolonged periods of time. In these areas, the roots of trees can become horizontally matted as they are unable to penetrate the consolidated substratum (MacLeod Reckord 1986).

The primary topographical feature of the park is a prominent north-south ravine that roughly bisects the park from the southern parking lot through the center of the park north to Northeast 168th Street (Map 1). A smaller ravine also running north-south is present in the west-central portion of the park and ends in a shallow basin south of Northeast 165th Street. A third prominent ravine extends along the eastern boundary of Hamlin Park, sloping down towards Kellogg Middle School. Side slopes of these ravines range from 15-25%. The topography between these ravines is gently rolling with slopes ranging from 5-15% (MacLeod Reckord 1986). The elevation ranges in Hamlin Park from 372 feet above mean sea-level near the upper ball field complex north of Northeast 160th Street, and increases to a height of 450 feet in the northern portion of the park (Shoreline 2001). The lower ball field complex below Northeast 160th Street sits on a small plateau at approximately 410 feet above mean sea level (Shoreline 2001).

2.4 History of Hamlin Park and the Surrounding Community

The area that is now north Seattle and south Shoreline was settled in the early 1900s, encouraged by the interurban street car and rail lines that extended north during 1906-1913. However, it wasn't until 1944 that the name 'Shoreline' first used (City of Shoreline website. 2007a). Today, Shoreline has more than 50,000 residents.

Hamlin Park, along with the surrounding area, was originally part of the Hamlin homestead acquired circa 1895 from Marshall Blinn, a well known logger of the late 1800's (Stiles 2007). The Hamlin family logged and farmed portions of the property and then sold most of the land after the turn of the century (South Woods Preservation Group 2007; MacLeod Reckord 1986). In 1938, a 7-acre undeveloped parcel north of Northeast 165th St. was donated to King County under the name 'Hamlin Park' (MacLeod Reckord 1986). In 1952, approximately 60 acres to the south of this parcel that had previously been reserved for recreational purposes was divided between King County and the City of Seattle, while the area to the east was acquired by the Shoreline School District (MacLeod Reckord 1986).

In the 1960s, King County expanded its playfield development into the 10 acres between what is now Kellogg Middle School and Shorecrest High School, resulting in the construction of the ball fields south of Northeast 160th Street (MacLeod Reckord 1986). At this time, the acreage north of Northeast 165th Street (the original Hamlin Park property) was transferred from King County to the City of Seattle Water District, now Seattle Public Utilities (MacLeod Reckord 1986).

The City of Seattle transferred ownership of its holdings of Hamlin Park to King County in 1981 (MacLeod Reckord 1986). It wasn't until the City of Shoreline was established in 1995 that ownership

of Hamlin Park (excluding the 8.3 acres north of Northeast 165th Street) was transferred from King County to the City of Shoreline.

On May 16, 2006, the City of Shoreline held its first Parks and Recreation Bond Election. Seventy percent of Shoreline voters approved the $18.5 million bond levy to purchase open space properties, make park improvements and develop trails. $3.3 million of the bond levy went to purchase the 8.3 acres north of Northeast 165th Street (the original Hamlin Park), $6 million to purchase the remaining 12.6 acres of South Woods property, and $950,000 to purchase and improve the 4 acres that make up Kruckeberg Botanic Garden (City of Shoreline 2007). In October 2007, the City of Shoreline was finalizing the purchase with Seattle Public Utilities. With this purchase, Hamlin Park now totals 80.4 acres of land.

3. FOREST ASSESSMENT METHODOLOGY

The purpose of the forest inventory is to:

1) Delineate and map habitats in Hamlin Park
2) Provide an inventory of current vegetation conditions in the parks

The following section describes methodology used in this forest assessment.

3.1 Habitat Type Delineation

The project area was initially divided into areas of similar habitat types based on dominant plant species associations. Prevailing habitat types were delineated in the field using recent aerial orthoimagery maps and utilized a GPS unit to locate boundaries and principal reference points. This information was used to create a GIS base layer of the property in order to geographically represent the arrangement of each habitat type and to quantify the spatial area of each individual habitat. The initial delineations were revised and updated during the course of the plot-level survey. The final map displays the locations and distributions of each habitat type accompanied by the corresponding combined acreage for each habitat (Map 1).

3.2 Sampling intensity

Vegetation management plans generally aim to sample three to ten percent of the forested area of interest. Using this guideline, SUN surveyed 32 plots in the summer of 2007. These sample plots (0.1 acre each, with a combined coverage of 3.2 acres) represent approximately 5% of the total forested area (excluding landscaped forests) of the park (59.5 acres). Non-forested portions of Hamlin Park were not included in the survey. Approximately 20.9 acres of developed, landscaped, grassland, or invasive-dominated shrub-land were not sampled.

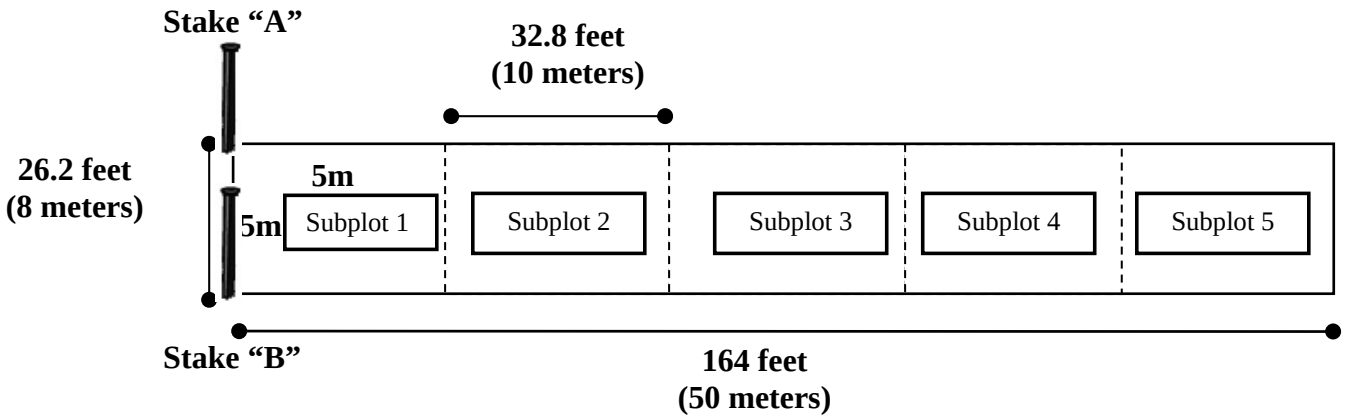
3.3 Plot Layout

Plots were distributed proportionately among all forest types and randomly located within a particular forest type. Of the 32 sample plots, 17 were located in the conifer forest, seven in the conifer forest without understory, four in the conifer/deciduous mixed forest, three in the conifer/madrone mixed forest, and one was located in the madrone/deciduous mixed forest (Appendix E).

The plots are rectangular belt transects and cover an area 26.2 feet (8 meters) wide and 164 feet (50 meters) long (Figure 1). These dimensions equal approximately 0.1 acre in size, which has been a standard area for sampling units in all recent vegetation management plans (VMPs) written for other parks within the City of Seattle (Jones and Stokes 2002, Sheldon and Associates, Inc. 2003, Seattle Urban Nature 2006). Long rectangular plots provide a more accurate sampling of the naturally occurring variation that occurs within clumped distributions of plant species, thereby producing more accurate estimates than round or equal sided plot shapes, particularly for density-related measures (Elzinga et al. 1998).

The majority of plots are either oriented along the north/south or east/west geographical axis. If orientation along these axes did not allow the plot to be fully included in a particular habitat type, the orientation was modified to sample in one specific habitat type. The starting point of each plot was marked with a 1"x 2" x 12" wooden stake driven into the ground and labeled with the plot number followed by "A". A second stake was placed 26.2 feet from, and perpendicular to the bearing and to the right of the first stake and labeled with the plot number followed by "B". The belt transect extends 164 feet along the transect bearing from stake "A" and 26.2 feet to the right (Figure 1). GPS point locations have been recorded to within one meter accuracy at each of the "A" stakes (Appendix D).

Figure 1. Dimensions and layout of sampling plots in Hamlin Park*



* not drawn to scale

3.4 Assessment Procedures

Two general categories of attributes, tree density and vegetation cover, were recorded at each plot. The average slope and aspect for each plot was also estimated and recorded.

Tree density: All trees with trunks occurring within the $1/10^{th}$ acre plot were identified and enumerated including non-native tree-like species such as cherry laurel (*Prunus laurocerasus*), English holly (*Ilex aquifolium*) and European mountain ash (*Sorbus aucuparia*). In order for a tree to be included in the sampling plot, more than half of its rooted trunk had to occur inside the plot. Height and diameter at breast height (dbh – breast height is defined as 4.5 feet from the ground surface) were recorded for each tree. In addition, trees were assessed for colonization by English ivy. For trees smaller than 4.5 feet in height, average stem diameter was recorded to the nearest ½ inch.

Snags and coarse woody debris (CWD) greater than 5 inches in diameter, consisting of standing and downed logs and stumps, were measured and placed into one of three decay classes, I, II, or III. Decay class I indicated a branch or trunk that recently died and frequently had intact bark and branches and hard wood. Decay class III characterizes wood in an advanced state of decay with little to no bark or branches left intact, softened crumbling wood and extensive epiphytes. Decay class II provides an intermediate designation between these two extremes. CWD measurements from sampling plots were used to extrapolate an estimate of cubic feet of wood per acre (ft^3/acre) for further analysis.

Tree density was considered a key measure in this survey, as it allows for analysis of several aspects of forest functionality, including tree regeneration, forest structure, conifer to deciduous ratios, and the presence and frequency of exotic tree species.

Vegetation cover: All plant species occurring in, or with foliage overhanging the $1/10^{th}$ acre plot, were identified and percent cover was visually estimated for each species. Vegetation cover was estimated by dividing the 50m x 8m sample area into five 10m x 8m quadrats and randomly sampling five 5m x 5m subplots, one within each quadrat (see Figure 1). These five quadrats represent 31% of the entire $400m^2$ area within the plot. Within each subplot, percent cover was visually estimated for all species present, and then these subtotals were combined to derive an estimate of cover for the entire sample area. Species that were present in trace amounts were given a minimum value of 0.1%. This allowed for a comprehensive floristic survey (i.e. species richness) for each plot location.

Cover and richness were chosen as measurable attributes in order to provide an estimate of species and structural diversity. These attributes can be extrapolated to provide an estimate of the extent that an area has been invaded by non-native species.

3.5 Data Collection and Management

Data collection was conducted by two staff ecologists at Seattle Urban Nature. Data was recorded using a TDS Recon PDA. Information from the PDA was transferred to a Microsoft Access Database, which was used for data analysis. A Trimble GeoXT unit with a ProXR antenna was used to collect GPS information in the field. Maps were produced using ESRI ArcMap version 9.1, which connects geographic information (e.g., maps, aerial photographs, topography) with tabular information (e.g., data plot information in Access database).

4. RESULTS AND FINDINGS

The results and findings section provides a summary and analysis of collected field data for five individual forested habitat types: conifer forest; conifer forest without understory; conifer/deciduous mixed forest; madrone/conifer mixed forest; and madrone/deciduous mixed forest. For each forested habitat type, the following information is presented: overstory tree composition and structure (section 4.2); regenerating tree composition and structure (section 4.3); snags (section 4.4), coarse woody debris (section 4.5), shrubs (section 4.6); and herbaceous and vine percent cover (section 4.7). Map 1 shows the locations and extents of mapped habitat types. Locations of established assessment plots are found in Appendix E.

4.1 Park-wide Vegetation Trends

Like most of Lowland Puget Sound, the majority of Shoreline's forests were logged during initial settlement of the area in the late 1800s. Aside from turn of the century logging, the natural areas of Hamlin Park have endured additional disturbances over the years. For example, the southeast area that is presently developed into ball fields was used as a marching and parade ground for the Fircrest Naval Base during WWI and WWII. The current park area was subsequently used for a variety of military maneuvers. It has also been suggested that the central portions of the park were used by motorized vehicles in the more recent past. These disturbances, as well as the introduction of non-native invasive species, have shaped the current structure and composition of the remaining forest present today.

Habitat Types

During a survey of Hamlin Park in 2007, SUN staff identified four major forested habitat types throughout the park: conifer forests, conifer/deciduous mixed forests, conifer/madrone mixed forests, and a small stand of deciduous/madrone mixed forest (Table 1). The conifer forest was further divided into areas devoid of understory vegetation and those with a well-developed understory. SUN identified four distinct areas totaling 15.3 acres throughout the central portion of the park without substantial cover of shrubs, herbaceous plants, or regenerating trees (Map 1).

The results of the 2007 survey indicate that approximately 62 of the 80 acres (77%) of the total area of Hamlin Park are forested, including 1.3 acres (2%) of landscaped forest surrounding the play area and picnic shelters (Map 1). The natural areas of the park are dominated by second growth pure conifer forests, 42% with a developed understory and 19% devoid of understory vegetation (Table 1). Approximately 9% of the park consists of conifer/deciduous mixed forest. The most significant of these forests is situated in the shallow ravine in the western portion of the park. Less intact fragments of deciduous mixed forest can also be found along the edges in the northern section and adjacent to the ball fields in the southernmost part of the park (Map 1).

Madrone/conifer mixed forests make up approximately 4% of the park and are located in three distinct areas (Map 1). One stand of madrone/deciduous forest is located in the southeastern most corner park and covers 1% of the total park area.

Three areas of the park appear to have been cleared and are now in an unmanaged state of invasive shrub regrowth. These shrublands can be found in the clearing north of Northeast 165th St., a small area

next to Northeast 18th Ave, and the lowland adjacent to the Kellogg Middle School track (Map 1). All of these areas comprise approximately 2.5% of the total park area and are heavily invaded with Himalayan blackberry (*Rubus armeniacus*), Scotch broom (*Cytisus scoparius*), and English ivy (*Hedera helix*).

The remaining 16 acres (20%) of the total area of the park have no overstory canopy cover. These areas consist of ball fields, developed roads and parking lots, and the Shoreline Parks and Public Works maintenance facility (Map 1).

Table 1. Habitat types mapped in Hamlin Park during the 2007 survey.

Habitat Type	Acres	Percentage of Total Area	Number of Plots Sampled
Forested Habitats			
Conifer Forest	33.9	42%	17
Conifer Forest - No Understory	15.3	19%	7
Conifer/Deciduous Mixed Forest	7.0	9%	4
Landscaped Forest	1.3	2%	
Madrone/Conifer Mixed Forest	2.8	4%	3
Madrone/Deciduous Mixed Forest	0.4	1%	1
Trail Corridor	1.5	2%	
Subtotal	**62.3**	**77%**	**32**
Non-Forested Habitats			
Developed	7.1	9%	
Grassland	0.7	1%	
Landscaped Grassland	7.6	9%	
Landscaped Shrubland	0.3	<1%	
Shrubland	2.5	3%	
Subtotal	**18.2**	**23%**	
Total	**80.4**		**32**

Map 1

Hamlin Park
Habitat Delineations

168TH ST
166TH ST
165TH ST
18TH AV
21ST AV
22ND AV
23RD AV
165TH ST
25TH PL
163RD ST
Hamlin Park
Kellogg Middle School
25TH AV
26TH AV
160TH ST
160TH ST
15TH AV

N
W
E
S

Feet
0 200 400 800
1:3,150

Map produced by Seattle Urban Nature 2007. Park boundaries, water course data, and orthoimagery provided by the City of Shoreline, WA.

No warranties of any sort, including accuracy, fitness, or merchantability accompany this product.

Legend

- Park Boundaries (80.4 Acres)
- Hamlin Creek
- Piped Water Course

Habitat Types (Acres)

- Conifer Forest (33.9)
- Conifer-No Understory (15.3)
- Conifer-Deciduous Forest (7.0)
- Conifer-Madrone Forest (2.8)
- Deciduous-Madrone Forest (0.4)
- Trail Corridor (1.5)
- Grassland (0.7)
- Shrubland (2.5)
- Landscaped Shrubland (0.3)
- Landscaped Forest (1.3)
- Landscaped Grassland (7.6)
- Developed (7.1)

CITY OF SHORELINE

Seattle Urban Nature

Species Composition

The conifer forests of Hamlin Park are dominated by Douglas-fir (*Pseudotsuga menziesii*) with substantial components of western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), and Pacific madrone (*Arbutus menziesii*) trees. Western white pine (*Pinus monticola*) is also present scattered throughout the park at lower densities. Conifer/deciduous mixed forests are generally dominated by red alder (*Alnus rubra*) with lesser components of the coniferous trees mentioned above. Pacific madrone trees make up the dominant tree component of the madrone mixed forests.

The distribution of understory species is a major feature of concern in Hamlin Park. Extensive areas with suitable habitat for native understory species are completely devoid of and herbaceous, shrub, or regenerating tree species.

The regenerating tree layer of most of the forested areas of the park is dominated by invasive English holly; with stem densities averaging greater than 1000 stems/acre where understory vegetation is present (Table 2). High densities of invasive regenerating sweet cherry (*Prunus avium*), especially in the madrone forests, is also of concern. There is considerable conifer regeneration (approximately 168 trees/acre), predominantly western red cedar and western hemlock, throughout the forested areas where understory vegetation is present. There is considerably less regeneration, native or non-native, occurring in the forests devoid of understory.

Areas with developed shrub layers are generally dominated by native species including salal (*Gaultheria shallon*), low Oregon grape (*Mahonia nervosa*), and creeping blackberry (*Rubus ursinus*) with red huckleberry (*Vaccinium parvifolium*), sword ferns (*Polystichum munitum*), bracken fern (*Pteridium aquilinim*), and starflower (*Trientalis borealis ssp. Latifolia*) also present.

A number of species of non-native plants have invaded the forest and several areas of the park have become heavily impacted. Areas that are most affected by invasive species establishment are concentrated along the edges and borders of the park. Without concentrated efforts of active management, these species will continue to spread and affect other areas of the park.

Dominant non-native invasive tree species found in Hamlin Park include English holly, cherry laurel and sweet cherry (*Prunus avium*). Other invasive tree species found at low densities include European mountain ash, Norway maple (*Acer platanoides*), Portugal laurel (*Prunus lusitanica*), horse chestnut (*Aesculus hippocastanum*), sycamore maple (*Acer pseudoplatanus*), and one-seed hawthorn (*Crataegus monogyna*).

Dominant invasive shrubs include Himalayan blackberry and Scotch broom, with isolated patches of evergreen blackberry (*Rubus laciniatus*). Invasive herbs and vines include English ivy, herb Robert (*Geranium robertianum*) and yellow archangel (*Lamiastrum galeobdolon*).

Scotch broom, English ivy, herb Robert, and yellow archangel are listed as Non-designated Noxious Weeds in King County. These weeds are listed as noxious weeds on the Washington State Weed List but are so widespread in King County that control is highly recommended but not required by law (King County 2006).

Himalayan blackberry, evergreen blackberry, English holly and cherry laurel are designated as Weeds of Concern by King County. Weeds of Concern are widespread, unregulated species which impact and degrade native plant and animal habitat. Control and containment of existing populations is highly recommended but not required by law (King County 2007).

During the 2007 survey, a total of 75 plant species were found: 22 tree species (12 native and 10 non-native), 21 shrub species (13 native and 8 non-native) and 32 herbaceous and vine species (19 native, 11 non-native, and two species whose nativity is unknown). Appendix A lists the scientific and common names of all plants identified during the survey, as well as the native/non-native status of each species.

4.2 Overstory tree composition and structure

The forest overstory refers to the upper canopy of a forest. Only trees with a diameter measuring greater than 5 inches (a standard measure for overstory) were considered for the purposes of this overstory analysis.

Tree density can be used to draw inferences about overall forest development and succession. In general, older stands tend to have lower densities due to self-thinning through the process of competitive exclusion. These forests generally exhibit a variety of tree heights and diameters which creates a canopy with high structural diversity (trees of differing ages and size classes). Younger forests, on the other hand, generally have higher tree densities and limited structural diversity (Spies and Franklin 1991).

Based on the above criteria, the forests of Hamlin Park exhibit many of the structural characteristics of a maturing forest. By late1897, the area north of Seattle to the King/ Snohomish county line had been logged and classified in a state of "restocking" (Gannett 1900). This would indicate that the forests present in Hamlin Park could be classified as second-growth stands that are approximately 100 years old. Today, the forests are dominated by conifer trees which make up approximately 78% of the overstory at 125 stems/acre (Figure 2). The rest of the canopy is made up of native deciduous trees (10% of all trees) and Pacific madrone trees (8%). Less than four percent (an average of six stems/acre) of overstory trees are non-native (Figure 2).

Overstory tree densities throughout all forest types average 160 stems/acre with an average dbh of 14.2 inches. Densities are similar for the pure conifer forests and the madrone/deciduous mixed forests. Madrone/conifer forests have the highest overstory density with 210 stems/acre, while conifer/deciduous mixed forests exhibit the lowest with 113 trees/acre (Table 2). The conifer forest devoid of understory has a slightly higher average density (188 stems/acre) when compared to the normal conifer forest habitat (151 stems/acre) (Table 2).

<u>Conifer Forest</u>

The density of overstory trees in the conifer forest average 151 total stems/acre. Overstory trees in this forest type exhibit larger average diameters when compared to other forests in the park with an average dbh of 14.9 inches. The overstory is predominantly coniferous, composing 84% of the canopy. The conifer trees are dominated by Douglas fir which represents nearly half of all trees at 48% (Table 2). Western hemlock (15%), western red cedar (11%) and western white pine (10%) comprise an additional 36 % of the canopy. Approximately 6% of the canopy is composed of Pacific madrone at nine

stems/acre. The remaining 6% of the native canopy is made up of red alder (3%), big-leaf maple (*Acer macrophyllum*) (1%), black cottonwood (Populus balsamifera ssp. trichocarpa) (1%), and Pacific dogwood (*Cornus nutallii*) (1%). This forest type has the highest native overstory species richness compared to other forest types in Hamlin Park with 9 different species present (Table 2). A small number of non-native invasive trees were recorded with greater than five inch diameter: six stems/acre (4%) of English holly and one stem/acre of horse chestnut (*Aesculus hippocastanum*) (Table 2). The majority of overstory trees (approximately 52%) in this forest type are between 11 and 20 inches dbh. Close to 20% are greater than 20 inches dbh, the highest proportion of large diameter trees in the park (Figure 4). The trees in this forest type exhibit considerable structural diversity, as evident from the distribution of native trees at different height classes (Figure 3). Approximately 21% of all trees measured were between 80 and 120 feet tall, with sizable densities in both the 16 to 45 (12%) and 46 to 80 (13%) foot height classes (Figure 3).

Conifer Forest without Understory

The overstory of the conifer forest devoid of understory forest type has an average of 188 stems/acre with an average diameter of 13.9 inches. The trees in this forest type are nearly all coniferous (99%), with only a single Pacific dogwood stem measured in one of the seven plots. The conifers are dominated by western hemlock comprising 48% of the total density (Table 2). The remaining canopy is made up of Douglas fir (21%) and western red cedar (16%), with a substantial component of western white pine (14%). A total of only five native overstory species were recorded for this forest type, which is the lowest in the park. No invasive or non-native trees were measured in the overstory. Approximately 57% of overstory trees fall between 11 and 20 inches dbh, with 12% being greater than 20 inches dbh. Approximately 30% of trees are between five and 10 inches dbh. Although having a slightly higher overall density, this forest type has a similar distribution of tree diameters as compared to the conifer forest (Figure 4). Nearly half of all native trees measured in this forest type (117 stems/acre) were between 80 and 120 feet tall, exhibiting less structural diversity when compared to the conifer forest type (Figure 3).

Conifer/Deciduous Mixed Forest

The conifer/deciduous forest overstory exhibits the lowest stem density among forest types with just 113 stems/acre and average diameter of 12.7 inches. A total of seven native overstory tree species were recorded in this forest type, along with two non-native species. This forest type is dominated by deciduous trees with red alder making up half of the overstory (Table 2). There are also 2% each of Pacific dogwood and black cottonwood present. The conifer component comprises approximately 35% of the canopy, with the majority being equal proportions of Douglas fir and western red cedar at 14% each. Seven percent, or eight stems/acre, of western hemlock is also present. Non-native invasive species account for 9% of the overstory with cherry laurel (7%) and sweet cherry (2%) present at relatively low densities. Proportionally, the overstory in this forest type has a high percentage of small diameter trees with 44% being less than 10 inches in diameter (Figure 4). Forty percent of the overstory is between 11 and 20 inches in diameter, with approximately 15% of stems being greater than 20 inches in diameter.

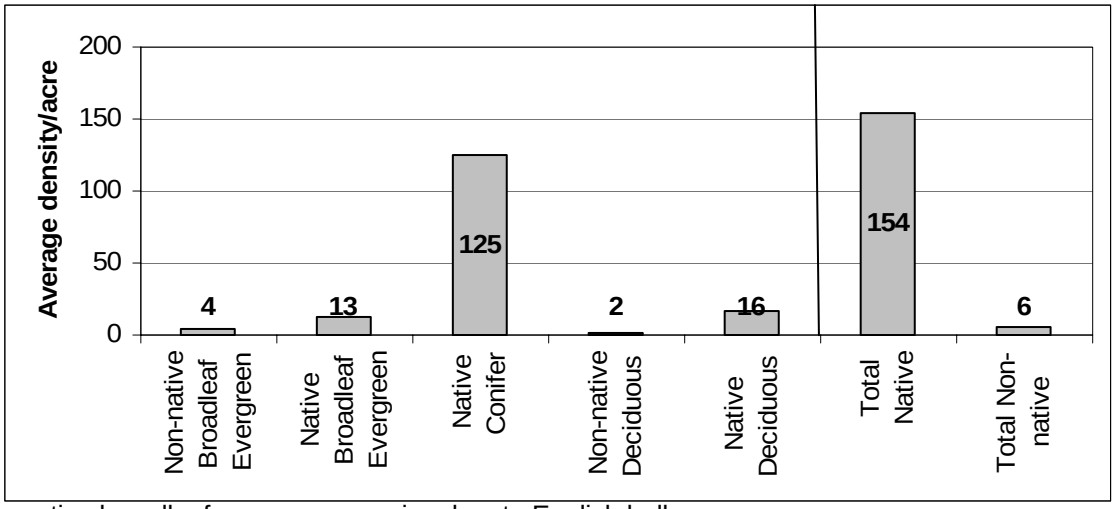
Madrone/Conifer Mixed Forest

The overstory of the madrone/conifer mixed forest has the highest density compared to other forest types with 210 stems/acre (Table 2). These forests also exhibit the second largest average diameter at 14.0 inches. The overstory is dominated by Pacific madrone, which contributes 33% of the total stem density. Conifer trees combine to total nearly 60% of the canopy, with Douglas fir accounting for 30%. Western white pine makes up 13 % of the canopy with 27 stems/acre, the highest average density in the park for this species. Only the conifer forest devoid of understory has a comparable western white pine element. The remaining conifer component is composed of 10% western hemlock and 6% western red cedar (Table 2). Red alders were found at the relatively low average density of seven stems/acre or 3% of the canopy. A single invasive tree species, sweet cherry, accounts for 5% of the canopy at an average density of 10 trees/acre, the highest parkwide. Nearly half of all trees in the overstory (49%) are between 11 and 20 inches dbh with 38% of stems falling between five and 10 inches dbh. 13% of trees in the madrone/conifer mixed forest have diameters greater than 20 inches dbh. Three of the 13% (seven trees/acre) have diameters greater than 30 inches dbh, the highest of any forest type in Hamlin Park (Figure 4). The vertical structure of native trees within this forest type is also complex, with high densities of short and medium statured trees ranging from 15 to 80 feet tall (Figure 3). The madrone/conifer mixed forest also has high densities of tall trees ranging between 80 and 100 feet tall, as well as the highest density in the park of trees greater than 120 feet tall at 27 stems/acre (Figure 3).

Madrone/Deciduous Mixed Forest

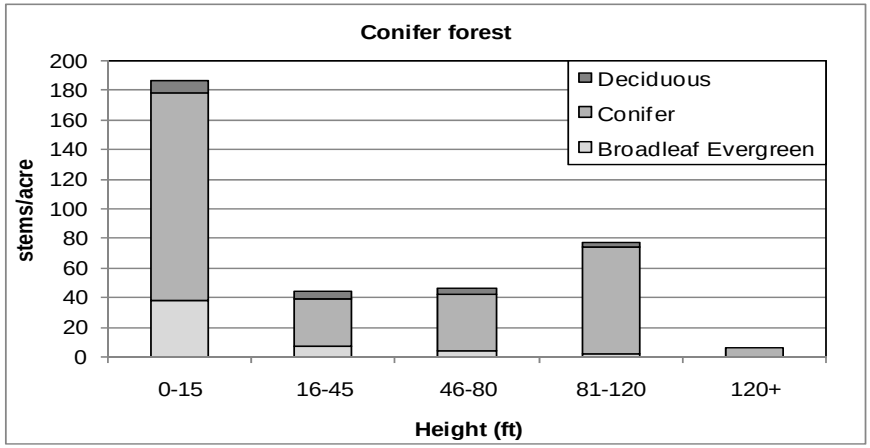
The overstory density of the madrone/deciduous mixed forest averages 150 total stems/acre (Table 2). This forest is dominated by red alder at 100 stems/acre, or 67% of all overstory trees. The species richness of overstory trees is the lowest in the park with only four species measured, one of which (Norway maple) is considered invasive (Table 2). The majority of trees (80%) have small diameters ranging between five and 10 inches dbh, and 20% of trees having diameters between 10 and 15 inches (Figure 4). No trees in this forest type were measured with diameters greater than 20 inches dbh. Furthermore, the majority of trees (81%) had heights between 15 and 80 feet, with few trees greater than 80 feet tall (Figure 3).

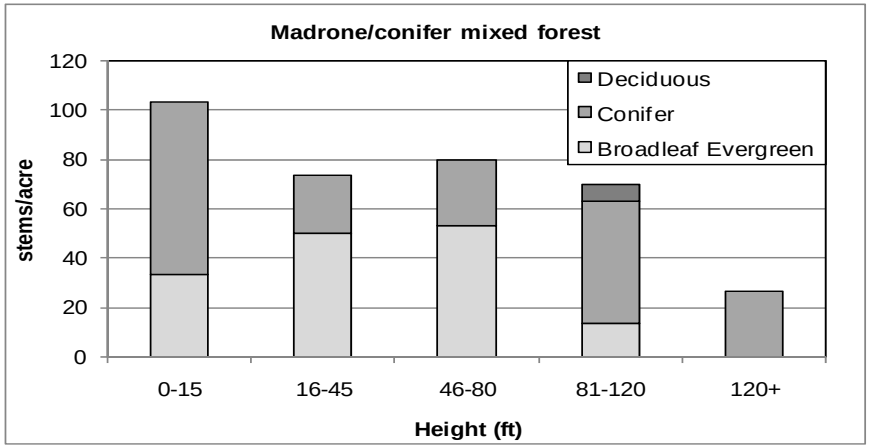
Figure 2. Average density (stems)/acre of overstory trees in Hamlin Park. Values represent averages from 32 plots across five habitat types[1].

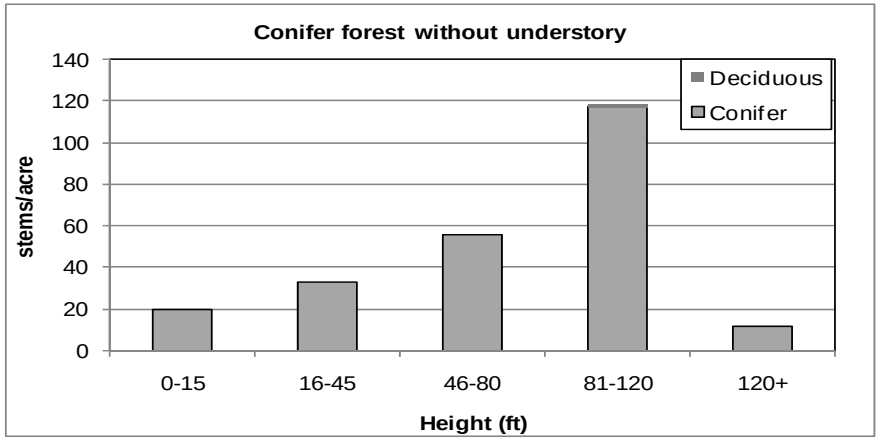


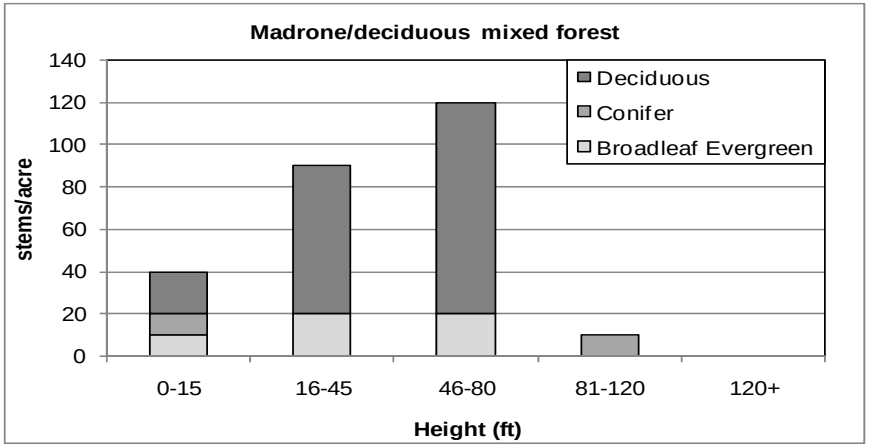
[1] Non-native broadleaf evergreen species denote English holly.

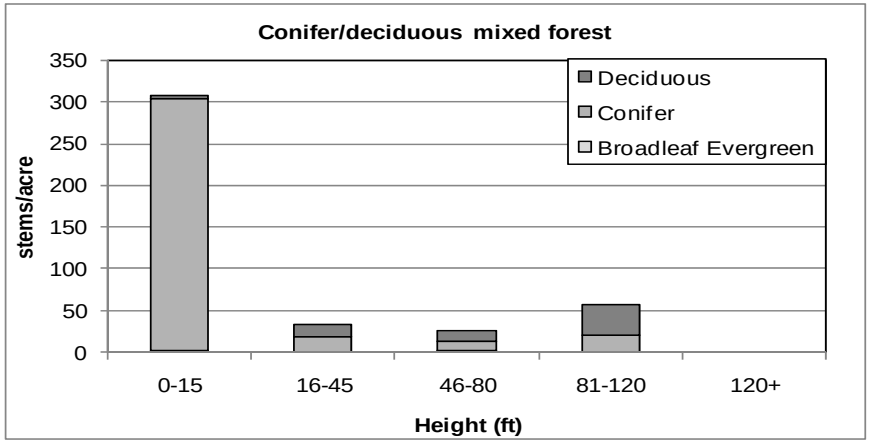
Figure 3. Native overstory and regenerating tree density/acre by height size class in all forest types found in Hamlin Park.











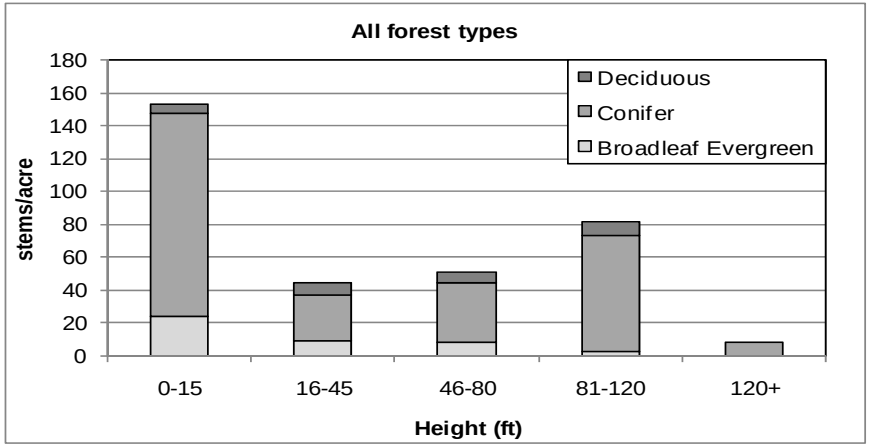


Figure 4. Overstory tree density (stems)/acre by diameter size class for sampled habitat types in Hamlin Park. Values represent averages from 32 plots across five habitat types.

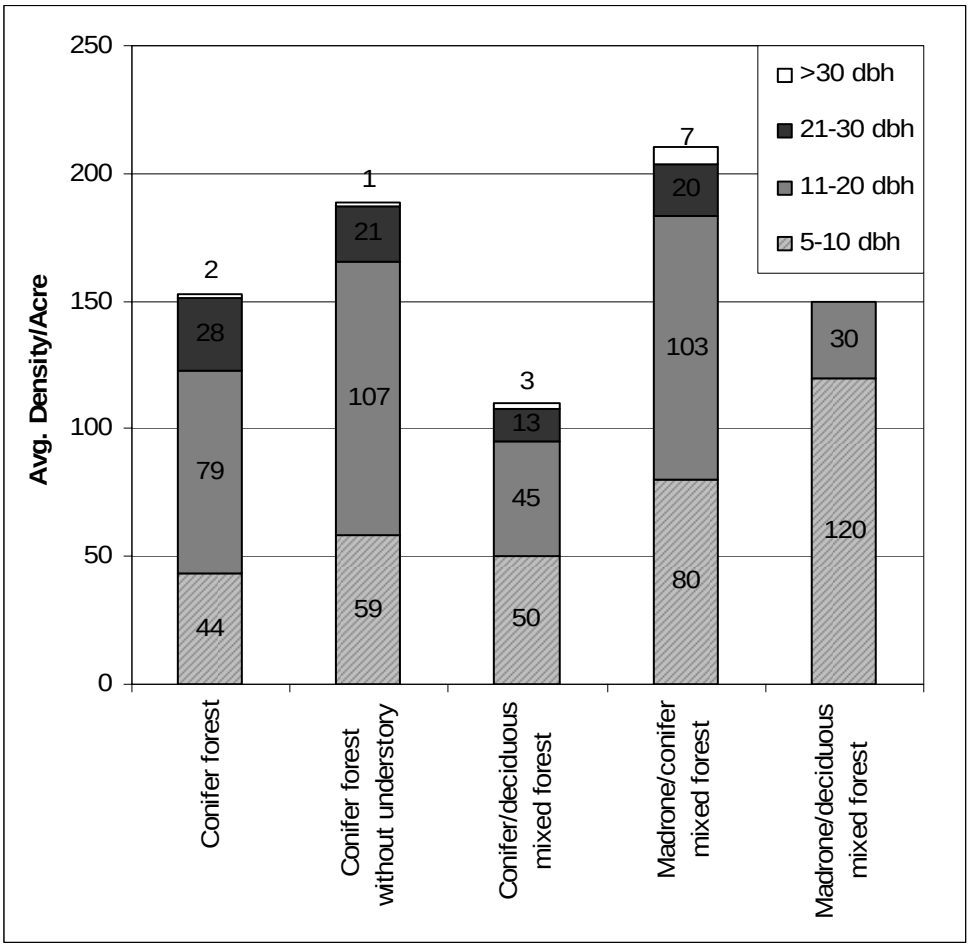


Table 2. Overstory and regenerating tree species found in each of the sampled habitat types in Hamlin Park. Values represent density (stems/acre) and proportion (in parenthesis) of each species present in each habitat type.

Scientific Name[1]	Common Name	Conifer Forest	Conifer forest without understory	Conifer/ deciduous mixed forest	Madrone/ conifer mixed forest	Madrone/ deciduous mixed forest
OVERSTORY TREES (Density/acre)[2]						
Acer macrophyllum	big-leaf maple	1 (1%)				
Acer platanoides**	Norway maple					10 (7%)
Aesculus hippocastanum**	horse chestnut	1 (T%)				
Alnus rubra	red alder	5 (3%)		55 (50%)	7 (3%)	100 (67%)
Arbutus menziesii	Pacific madrone	9 (6%)		3 (2%)	70 (33%)	30 (20%)
Cornus nuttallii	Pacific dogwood	1 (1%)	1 (1%)	3 (2%)		
Ilex aquifolium*	English holly	6 (4%)				
Pinus monticola	western white pine	15 (10%)	26 (14%)		27 (13%)	
Populus balsamifera ssp. trichocarpa	black cottonwood	1 (1%)		3 (2%)		
Prunus avium**	sweet cherry			3 (2%)	10 (5%)	
Prunus laurocerasus*	cherry laurel			8 (7%)		
Pseudotsuga menziesii	Douglas fir	74 (48%)	40 (21%)	15 (14%)	63 (30%)	10 (7%)
Thuja plicata	western red cedar	16 (11%)	30 (16%)	15 (14%)	13 (6%)	
Tsuga heterophylla	western hemlock	22 (15%)	91 (48%)	8 (7%)	20 (10%)	
Average density		**151/acre**	**188/acre**	**113/acre**	**210/acre**	**150/acre**
REGENERATING TREES (Density/acre)[2]						
Acer macrophyllum	big-leaf maple	5 (T%)				10 (1%)
Acer platanoides**	Norway maple	22 (2%)		170 (8%)	20 (1%)	50 (4%)
Acer pseudoplatanus**	sycamore maple			23 (1%)		
Aesculus hippocastanum**	horse chestnut	2 (T%)		8 (T%)	10 (T%)	20 (2%)
Alnus rubra	red alder	1 (T%)		3 (T%)		10 (1%)
Arbutus menziesii	Pacific madrone	42 (3%)		3 (T%)	80 (2%)	20 (2%)
Cornus nuttallii	Pacific dogwood	3 (T%)				
Crataegus monogyna**	one-seed hawthorn	2 (T%)		3 (T%)	3 (T%)	10 (1%)
Frangula purshiana	cascara	2 (T%)		5 (T%)		
Ilex aquifolium*	English holly	716 (58%)	2 (3%)	1065 (52%)	1930 (59%)	760 (59%)
Pinus monticola	western white pine	3 (T%)				
Prunus avium**	sweet cherry	156 (13%)		115 (6%)	873 (27%)	310 (24%)
Prunus emarginata	bitter cherry	2 (T%)				70 (5%)
Prunus laurocerasus*	cherry laurel	54 (4%)	3 (5%)	190 (9%)	150 (5%)	
Prunus lusitanica**	Portugal laurel	2 (T%)		15 (1%)	7 (T%)	10 (1%)
Pseudotsuga menziesii	Douglas fir	19 (2%)		3 (T%)	3 (T%)	10 (1%)
Quercus sp.	oak	1 (T%)				
Salix scouleriana	Scouler's willow	1 (T%)				
Sorbus aucuparia**	European mountain ash	64 (5%)		130 (6%)	107 (3%)	10 (1%)
Thuja plicata	western red cedar	70 (6%)	33 (53%)	305 (15%)	63 (2%)	
Tsuga heterophylla	western hemlock	68 (6%)	25 (39%)	5 (T%)	7 (T%)	
Average density		**1235/acre**	**63/acre**	**2043/acre**	**3253/acre**	**1290/acre**

[1] Species in bold are non-native species. Species denoted by * are species which have been given a legal designation by the King County Noxious Weed Program (King County 2007). Species denoted by ** are non-native invasive species which do not have a legal designation at this time.

[2]T=Trace presence of species (less than 1%).

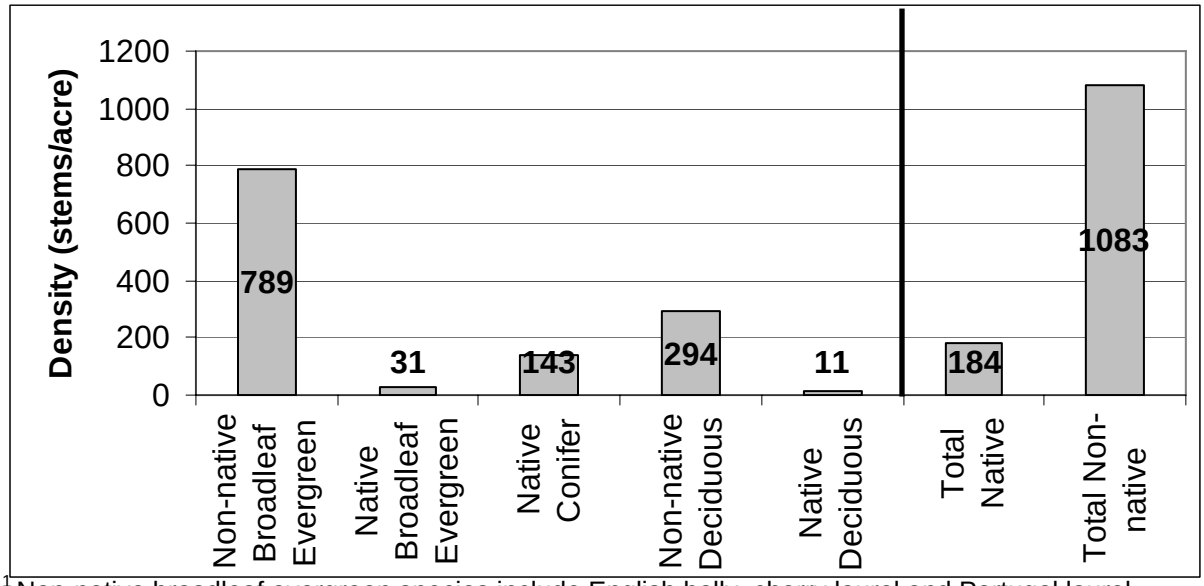
4.3 Regenerating tree composition and structure

This survey considered trees five inches or less in diameter at breast height to be regenerating tree species. The amount and composition of current tree regeneration will substantially influence the future makeup of the forest.

The forested areas of Hamlin Park average 1267 regenerating stems/acre across all five forest types with a total of 21 species: 11 native and 10 non-native, of which nine are considered to be invasive (Table 2). Common to an increasing number of urban forests in the lowland Puget Sound region, the regenerating tree layer in Hamlin Park has become dominated by English holly. This introduced Eurasian species has naturalized and is now widespread throughout our region. Capable of rapidly establishing and colonizing forested habitats, its increasing presence and abundance pose a serious threat to the structure, composition and function of our remaining urban forested habitats.

The forests in Hamlin Park have, on average, 789 stems/acre of non-native invasive broadleaf evergreen trees, accounting for 62% of all regeneration (Figure 5). English holly makes up the majority of this density contributing 718 stems/acre, with cherry laurel and Portugal laurel adding 67 and four stems/acre respectively. If areas devoid of understory vegetation are excluded, the density of non-native broadleaf evergreen trees increases to average 1,009 stems/acre with 919 stems/acre of English holly.

Figure 5. Average density (stems)/acre of regenerating trees in Hamlin Park[1]



[1] Non-native broadleaf evergreen species include English holly, cherry laurel and Portugal laurel.

Also of concern is the high density of non-native deciduous trees present in the regenerating tree layer. A total of six species of invasive deciduous trees were recorded during the survey accounting for 23% of the park-wide regenerating layer. Sweet cherry is the dominant of these making up 189 stems/acre park-wide and 242 stems/acre in areas with a developed understory. Other species invading the regenerating layer include European mountain ash (61 stems/acre park wide), Norway maple (37 stems/acre), horse chestnut (3 stems/acre), sycamore maple (3 stems/acre), and one-seed hawthorn (2 stems/acre).

Conifer Forest

The conifer forest has 1235 stems/acre of regenerating trees five inches or smaller in diameter. Of these, native trees account for approximately 18% and are made up predominantly of western red cedar (70 stems/acre) and western hemlock (68 stems/acre). Pacific madrone was measured at 42 stems/acre and

accounts for nearly 20% of native tree regeneration (Table 2). Six deciduous tree species make up the remaining native regeneration and account for a total of 14 stems/acre. Nearly half of all native trees measured in this forest type were less than 15 feet tall, with conifers the most common small statured native tree (Figure 3). Non-native trees dominate the regenerating layer with a total of 1018 stems/acre (82% of all regeneration), with broadleaf evergreen trees accounting for 771 stems/acre (62%). English holly is the most pervasive of these with stem densities measuring 716 per acre, or 58 % of all regeneration (Table 2). Non-native deciduous trees are also frequent in the understory at a combined stem density of 247 per acre, or 20% of overall regeneration. The second most dominant invasive tree found in the regenerating layer of the conifer forest is sweet cherry, which accounts for 156 stems/acre. Five other non-native deciduous trees were also recorded at lower densities, with European mountain ash being the second most prevalent with 64 stems/acre (Table 2).

Conifer Forest without Understory

The areas of conifer forest devoid of a substantial shrub layer exhibit very little tree regeneration with only 63 stems/acre measured across seven plots. Western red cedar is the most prevalent with 33 stems/acre followed by western hemlock with 25 stems/acre. These native conifers combine to account for 92% of all measured regeneration. Low densities of cherry laurel (3 stems/acre) and English holly (2 stems/acre) are also present (Table 2).

Conifer/Deciduous Mixed Forest

The conifer/deciduous mixed forest has the second highest density of regenerating trees with 2043 stems/acre. Only 16% of this density is composed of native trees, with western red cedar making up the vast majority at 305 stems/acre. Low densities of western hemlock (5 stems/acre) and Douglas fir (3 stems/acre) were also measured (Table 2). There was very little native deciduous regeneration measured in this forest type, despite the proportionally high densities of red alder found in the overstory. Cascara (*Frangula purshiana*) (5 stems/acre) and red alder (3 stems/acre) combine to account for less than one percent of the total regeneration. This forest type has the highest density of native trees less than 15 feet tall compared to all other forest types in Hamlin Park (Figure 3). Eighty-four percent of all regeneration measured in the conifer/deciduous mixed forest is non-native with a combined density of 1718 stems/acre. Non-native broadleaf evergreen trees account for 1270 stems/acre and are dominated by English holly. Cherry laurel was measured at 190 stems/acre, the highest density compared to other forests in Hamlin Park (Table 2). Non-native deciduous trees account for a combined 22% of all tree regeneration. Of particular concern is the relatively high density of Norway maple, measuring at 170 stems/acre, by far the highest in the park (Table 2).

Madrone/Conifer Mixed Forest

The madrone/conifer mixed forest has the highest measured regenerating density of any forest type with 3253 stems/acre. This figure is particularly alarming considering that less than five percent of the measured regeneration is native. However, this forest type does have the highest density of regenerating Pacific madrone trees at 80 stems/acre. The remaining native regeneration is composed of western red cedar (63 stems/acre) with lower densities of western hemlock (7 stems/acre) and Douglas fir (3 stems/acre). English holly dominates the regenerating layer with 1930 stems/acre and accounts for 59% of all regeneration (Table 2). Additionally, sweet cherry accounts for 27% of regeneration with 873 stems/acre and European mountain ash adds 107 stems/acre (3%). The madrone/conifer mixed forest has a combined non-native species density of 3100 stems/acre, substantially higher than all other forest types sampled in Hamlin Park (Table 2).

Madrone/Deciduous Mixed Forest

The madrone/deciduous mixed forest has 1290 regenerating stems/acre, 91% of which are non-native. The regenerating layer in this forest type is again dominated by English holly with 760 stems/acre and accounting for 59% of the trees measured. This forest also has comparatively high densities of sweet cherry with 310 stems/acre (24% of all regeneration), second only to the madrone/conifer mixed forest (Table 2). The total native tree regeneration was measured at a total of 120 stems/acre and is made up mostly of bitter cherry (*Prunus emarginata*) with 70 stems/acre. Low densities of Pacific madrone (20 stems/acre), big-leaf maple, red alder, and Douglas fir (10 stem/acre each) are also present (Table 2).

4.4 Snags

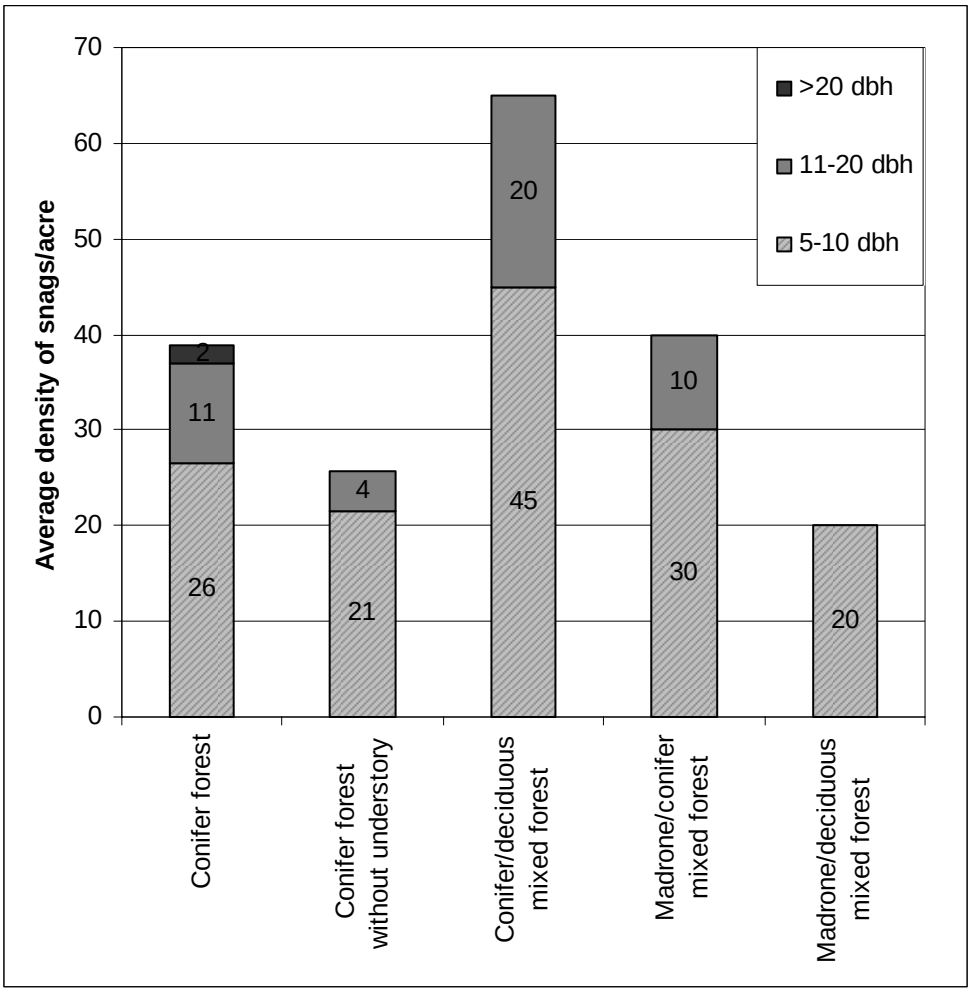
Standing dead trees (snags) play a crucial role in the structure and function of a forest system. Snags provide important habitat for wildlife, birds, insects, non-vascular plants such as mosses and fungi, and are a store of nutrients for the forest. In the Pacific Northwest, 69 vertebrate animal and bird species commonly use cavities excavated in snags (Bunnell et al. 2002).

Snags are found on all but one of the 32 plots sampled in Hamlin Park at an average density of 39 stems/acre across all plots. The average snag height is 36 feet with a diameter of 9.2 inches. Snag densities vary by habitat type from 20 stems/acre in the madrone/deciduous mixed forest to 65 stems/acre in the conifer/deciduous mixed forest (Figure 6). The conifer forest devoid of understory has the second lowest density with 26 stems/acre. Average snag diameters range from 6.0 inches in the madrone/deciduous forest to 9.6 inches in the conifer forest. In comparison, a study of old-growth Douglas fir forests in Washington and Oregon found densities from 13 to 24 snags/acre, with diameters ranging from 16 inches at 250 years old to 25 inches at over 850 years (Franklin et al. 1981). This suggests that while snag densities are comparably high in Hamlin Park, the recruitment of larger diameter snags is currently lacking.

The majority of measured snags (75%) are smaller than 10 inches in diameter (Figure 6). These small snags are generally short-lived and quickly become downed woody debris which rapidly decays on the forest floor. The conifer/deciduous mixed forest has a comparably high density of small diameter snags present at 45 stems/acre. This forest type also has the highest density of snags greater than 10 inches dbh (Figure 6). Twenty-four percent of snags park-wide were measured between 11 and 20 inches in diameter. Less than one percent of snags (three total snags, less than one stem/acre across all plots) were measured with diameters greater than 20 inches, all of which are found in the conifer forest type (Figure 6).

Large diameter snags are an important factor in providing wildlife habitat. A study by Mannan et al. (1981) found that hole-nesting birds usually use snags over 24 inches in diameter and over 50 feet tall. It may be many years before snags of a suitable size are present in Hamlin Park. However, the fact that there are approximately 25 stems/acre of living trees greater than 20 inches dbh suggests that future large diameter snag recruitment will be possible. Preserving large snags when practicable will improve the structural diversity of the forest and provide wildlife habitat in the park that could help to attract species which are currently not present.

Figure 6. Average snag density and diameter by forest type in Hamlin Park



4.5 Coarse Woody Debris (CWD)

Coarse woody debris (CWD) can be defined as "sound and rotting logs and stumps that provide habitat for plants, animals and insects and a source of nutrients for soil structure and development" (Stevens 1997). CWD plays a vital role in forests by adding organic material and nutrients to the soil and providing habitat for decomposer fungi, animals, birds, bacteria and insects. In the Pacific Northwest, 47 vertebrate bird and animal species utilize downed wood for foraging, shelter and cover (Bunnell et al. 2002). CWD also acts as nurse logs for seedlings of plants such as western hemlock and red huckleberry (*Vaccinium parvifolium*), retains sediment and prevents erosion (Stevens 1997).

Conifer Forest

The average volume per acre of CWD in the conifer forest is 627 ft^3/acre with an average diameter of 9.6 inches. This represents the highest volume per acre for any forest type in Hamlin Park. In comparison, Douglas fir /western hemlock forests over 250 years old typically contain approximately 6400 ft^3/acre of CWD (Harmon et al.1986). The conifer forest has a total of 112 pieces/acre of coarse woody debris when averaged across all 17 plots sampled in this forest type.

Conifer Forest without Understory and Conifer/Deciduous Mixed Forest

In the conifer forest devoid of a substantial understory, the average volume of CWD per acre is comparable to levels found in the conifer forest with 624 ft^3/acre. Diameters and quantities are also similar averaging 9.8 inches and 157 pieces/acre. The conifer/deciduous mixed forest additionally

exhibits similar volumes of CWD at 611 ft^3/acre but with the slightly smaller average diameter of 7.8 inches. Conifer/deciduous mixed forest plots average 128 CWD pieces/acre.

Madrone/Conifer Mixed Forest and Madrone/Deciduous Mixed Forest

The madrone/conifer mixed forest has a substantially lower average volume of CWD at 414 ft^3/acre and only 60 pieces/acre. The diameter of these pieces, however, is slightly larger averaging 10.9 inches. The single plot measured in the madrone/deciduous mixed forest has the smallest volume of CWD with only 63 ft^3/acre and averaging a mere 6.3 inches in diameter, despite having a slightly higher density (70 pieces/acre) than the madrone/conifer mixed forest.

4.6 Shrubs

A total of 21 shrub species were recorded in Hamlin Park during the 2007 survey, of which 13 are native to the Puget Sound lowlands and eight are considered to be non-native invasive species (Table 3). The most dominant shrub park-wide is salal, found in all but one of the 32 sampled plots with an average cover of 23% across all plots. Other dominant shrubs include low Oregon grape (*Mahonia nervosa*) found in 94% of sampled plots with an average cover of 16% and creeping blackberry found in 81% of plots at 8%. Himalayan blackberry, a non-native invasive shrub, had the fourth highest average percent cover park-wide with 7% and is found in just under half of all plots (44%) (Appendix A).

Conifer Forest

A total of 17 shrub species were identified in the conifer forest, of which salal and low Oregon grape are the most prevalent with average covers of 31% and 20%, respectively (Figure 7). Creeping blackberry (6%) and red huckleberry (3%) are present in smaller amounts, with six additional species present at one percent or less (Table 3). This forest type has the highest native shrub species richness with 10 species present and has an average combined native shrub cover of 62%. The only dominant invasive shrub in the conifer forest is Himalayan blackberry, present at an average percent cover of 6%. Evergreen blackberry (*Rubus laciniatus*), a Noxious Weed of Concern with similar growth habits, is found in trace amounts in Hamlin Park only in the conifer forest type. Trace amounts of several species of cotoneaster (*Cotoneaster sp.*) shrubs were also identified, as well as trace amounts of Scotch broom, which is listed as a Non-designated Noxious Weed in King County (King County 2007).

Conifer Forest without Understory

Only six species of shrubs were found in the conifer forest devoid of understory, five of which are native (Table 3). Combined native shrub cover for all plots in this forest type averages only 9.5% and is dominated by low Oregon grape (6%), salal (2%) and red huckleberry (1%) (Table 3). A trace amount of spurge laurel (*Daphne laureola*), a King County Non-designated Noxious Weed, was measured in only one plot in Hamlin Park located in this forest type (King County 2007).

Conifer/Deciduous Mixed Forest

The conifer/deciduous mixed forest has 11 species of shrubs, nine of which are native and average 60.5%. The most dominant shrub species are creeping blackberry (22%) and salal (21%), with moderate amounts of low Oregon grape (13%) (Table 3). Beaked hazelnut (*Corylus cornuta*) is found at an average of only three percent, still the highest compared to other forest types in Hamlin Park (Table 3). Salmonberry (*Rubus spectabilis*) averages one percent cover here, the highest in the park. This forest type has six percent cover of Himalayan blackberry, similar to the amount present in the conifer and conifer/deciduous mixed forests.

Madrone/Conifer Mixed Forest

Despite having fewer overall shrub species present, the cover and composition of dominant shrubs in the madrone/conifer forest is very similar to that of the conifer/deciduous mixed forest. The three plots in

this forest average the highest native shrub cover with 75.5%, dominated again by salal with 28% average cover across all plots (Table 3). Low Oregon grape (25%) and creeping blackberry (21%) cover is also high in this forest type. Himalayan blackberry is present in the madrone/conifer forest at an average percent cover of seven percent, slightly higher than the conifer and conifer/deciduous forest types (Table 3).

Madrone/Deciduous Mixed Forest

The madrone/deciduous mixed forest has only six shrub species present, five of which are native. The single plot sampled in this forest type is dominated by Himalayan blackberry with 81% cover (Table 3). While this forest type has comparable levels of salal, it has substantially lower covers of low Oregon grape (2%) and creeping blackberry (6%). Next to the conifer forest devoid of understory, the madrone/deciduous forest had the lowest overall cover of native shrub species at a combined average of 36%. A small presence of Indian plum (*Oemleria cerasiformis*) (1%) was also recorded in this forest type, the only measurement in the park.

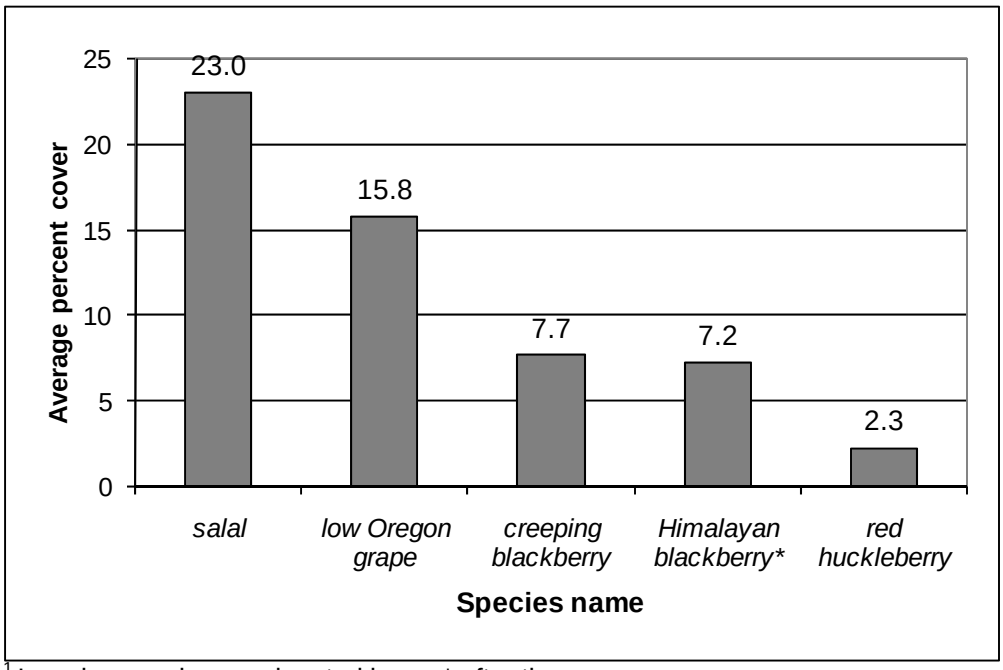
Table 3. Shrub species found in each of the sampled habitat types in Hamlin Park. Values represent the percent cover of each species.

Scientific Name[1]	Common Name	Conifer Forest[2]	Conifer forest without understory[2]	Conifer/ deciduous mixed forest[2]	Madrone/ conifer mixed forest[2]	Madrone/ deciduous mixed forest[2]
Corylus cornuta	beaked hazelnut	1		3		
Cotoneaster bullatus **	hollyberry cotoneaster	T				
Cotoneaster salicifolius **	willowleaf cotoneaster	T				
Cotoneaster simonsii **	Simons cotoneaster	T				
Cotoneaster sp. **	cotoneaster	T		T		
Cytisus scoparius*	scotch broom	T				
Daphne laureola **	spurge laurel		T			
Gaultheria shallon	salal	31	2	21	28	26
Mahonia nervosa	low Oregon grape	20	6	13	25	2
Oemleria cerasiformis	Indian plum					1
Ribes sanguineum	red-flowering currant	T				
Rosa gymnocarpa	baldhip rose	1				
Rosa nutkana	Nootka rose			T		
Rubus armeniacus*	Himalayan blackberry	6		6	7	81
Rubus laciniatus*	evergreen blackberry	T				
Rubus leucodermis	blackcap	T		1		
Rubus spectabilis	salmonberry	T		1	T	
Rubus ursinus	creeping blackberry	5	T	22	21	6
Sambucus racemosa	red elderberry	T		T		
Vaccinium ovatum	evergreen huckleberry		T			
Vaccinium parvifolium	red huckleberry	3	1	1	2	1

[1] Species in bold are non-native species. Species denoted by * are species which have been given a legal designation by the King County Noxious Weed Program (King County 2007). Species denoted by ** are non-native invasive species which do not have a legal designation at this time.

[2] T=Trace presence of species (less than 1%).

Figure 7. Distribution of the five most prevalent shrubs in Hamlin Park across all plots (N=32)[1]



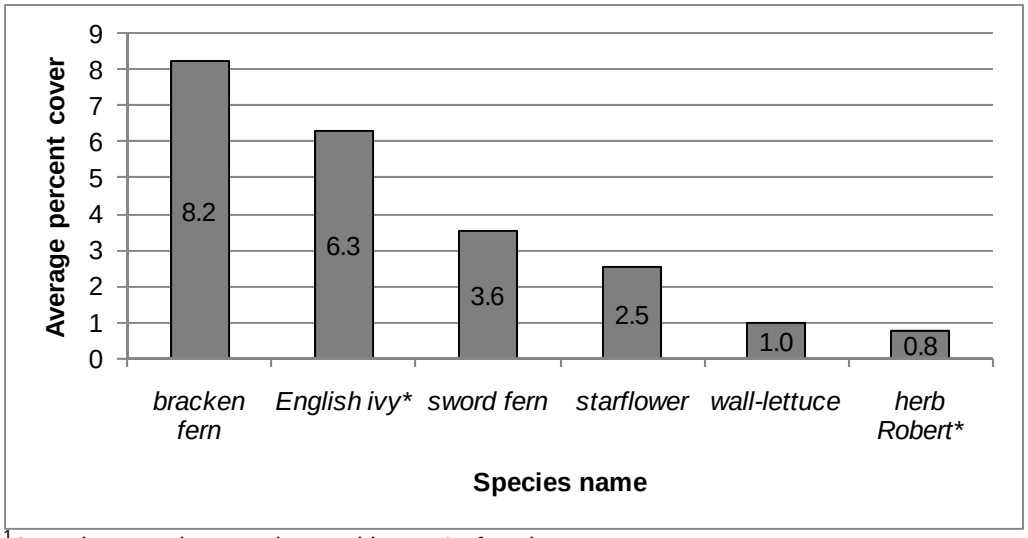
[1] Invasive species are denoted by an * after the name.

4.7 Herbaceous Vegetation and Vines

A total of 32 herbaceous species, including forbs and vines, were recorded in Hamlin Park during the 2007 survey, of which 19 are native, 11 are non-native (of which five are considered to be invasive), and two were not identified to species (Table 4). Bracken fern is the most common and dominant species, present in all 32 plots at an average cover of 8% park-wide (Figure 8). The second most common species is English ivy which was found in 63% of plots with an average cover of six percent. Sword fern was found in 66% of plots at the relatively low average cover of 3.5%. Other common species measured at low covers include wall lettuce (*Mycelis muralis*), a non-native aster found in 78% of plots, starflower (found in 69% of plots), and herb Robert (found in 32% of plots) (Appendix A).

The conifer forest has the highest native herbaceous species richness with a total of 12 different species. The conifer/deciduous mixed forest has eight native species while the madrone/conifer mixed forest and the madrone/deciduous mixed forest each have a native species richness of seven species. There are only four native species present in the conifer forest without understory forest type (Table 4). In forests where understory vegetation is present, average cover of sword fern ranges from 2% in the conifer forest to a high of 15% in the conifer/deciduous mixed forest (Figure 8). Substantial amounts of starflower are present in the madrone/conifer mixed forest (8% average cover) and the conifer forest (3% average cover), with lesser amounts measured in other forest types (Table 4). Other notable native species include summer coralroot (*Corallorhiza maculata*) found in both the conifer forest and the conifer forest devoid of understory forest types, and deerfern (*Blechnum spicant*) found only in the conifer forest (Table 4). Wood fern (*Dryopteris expansa*) was measured in only one plot found in the conifer/deciduous mixed forest type, as was Pacific trillium (*Trillium ovatum*). Combined average cover of native herbaceous species is highest in the conifer/deciduous mixed forest at 25% and averages 16% in both the conifer and madrone/conifer forest types. Average native cover is 12% in the madrone/deciduous mixed forest and averages only 5% in the conifer forest without understory forest type.

Figure 8. Distribution of the most prevalent herbs and vines in Hamlin Park across all plots (N=32)[1]



[1] Invasive species are denoted by an * after the name.

English ivy is the most dominant invasive species found in the herbaceous and vine layer of the forested areas of Hamlin Park. It was measured in all forest types, but is particularly prevalent in the conifer/deciduous mixed forest and the conifer forest types at 12% and 9% average covers respectively (Table 4). Deadly nightshade (*Solanum dulcamara*), another invasive vine species of concern, is found at low covers in the conifer forest and madrone/conifer mixed forest types. Herb Robert is found at low cover in all but the madrone/deciduous forest type (Table 4). English ivy and herb Robert are classified as Non-designated Noxious Weeds in King County (King County 2007). Deadly nightshade is classified as a Noxious Weed of Concern in King County (King County 2007).

Table 4. Herbaceous species and vines found in each of the sampled habitat types in Hamlin Park. Values represent the percent cover of each species.

Scientific Name[1]	Common Name	Conifer Forest[2]	Conifer forest without understory[2]	Conifer/ deciduous mixed forest[2]	Madrone/ conifer mixed forest[2]	Madrone/ deciduous mixed forest[2]
	bare dirt	3	7	2	4	
Agrostis sp.	bentgrass	T		T	T	T
Blechnum spicant	deerfern	T				
Cardamine hirsuta	hairy bittercress	T			T	
Carex deweyana	Dewey sedge			T		
Carex sp.	sedge	T				
Chamerion angustifolium ssp. angustifolium	fireweed	T				1
Circaea alpina	small enchanter's nightshade				T	T
Corallorhiza maculata	summer coralroot	T	T			
Dryopteris expansa	wood fern			T		
Elymus glaucus	blue wildrye	T			T	
Galium aparine	cleavers				T	1
Geranium robertianum*	herb Robert	1	T	T	T	
Geum macrophyllum	bigleaved avens			T		
Hedera helix*	English ivy	9	T	12	1	1
Hieracium albiflorum	White-flowered hawkweed	T				
Holcus lanatus	velvetgrass	T			T	
Hypochaeris radicata	hairy cat's-ear	T				
Lapsana communis	nipplewort	T			T	T
	litter		10			
Lonicera ciliosa	orange honeysuckle					T
Luzula parviflora	small-flowered woodrush	T		T		
Mycelis muralis	wall-lettuce	1	T	1	5	T
Polystichum munitum	sword fern	2	T	15	5	9
Pteridium aquilinum	bracken fern	11	4	9	3	1
Ranunculus repens*	creeping buttercup					T
Rumex obtusifolius	bitter dock					T
Solanum dulcamara*	deadly nightshade	T			T	
Taraxacum officinale	dandelion	T				T
Trientalis borealis ssp. latifolia	starflower	3	1	T	8	T
Trillium ovatum	trillium			T		
	unknown grass species					T
Viola glabella	stream violet	T				
Viola sempervirens	evergreen violet	T			T	

[1] Species in bold are non-native species. Species denoted by * are species which have been given a legal designation by the King County Noxious Weed Program (King County 2007). Species denoted by ** are non-native invasive species which do not have a legal designation at this time.
[2]T=Trace presence of species (less than 1%).

5. MANAGEMENT RECOMMENDATIONS

Eight main management zones have been identified in Hamlin Park and are shown on Map 2. Management goals within the park are to:

1) Reduce invasive species concentrations
2) Increase conifer regeneration within many areas of the park
3) Create an official trail network and block off and revegetate unnecessary trails within the park
4) Revegetate bare areas within the "conifer forest without understory" forest type
5) Increase the amount of tall shrubs and multiple shrub strata in the park
6) Preserve large snags and increase levels of coarse woody debris in many park areas

The forested areas of Hamlin Park offer a valuable cultural resource to the community of Shoreline and provide important habitat for a variety of wildlife species. These forests represent a significant area of contiguous undeveloped habitat in an otherwise built-up environment. As urban pressures continue to intensify, areas of natural habitat within the urban growth boundary are becoming increasingly vital.

Population growth and expansion in the Puget Sound area has led to increased pressure from development on the remaining open spaces, resulting in fewer intact forests and greater habitat fragmentation. Shoreline's open spaces provide important recreational opportunities and vital ecosystem services to residents. The parks and open spaces are subject to intense pressures from the urban environment such as heavy recreational use, pollution and invasion by exotic species.

Forested areas provide numerous benefits to city residents including improved water quality and filtration of pollutants from the air. In addition, the many diverse habitats present in urban forests harbor an abundant variety of bird and animal species. Forests and wetlands within the city clean and store stormwater runoff, retain sediment, provide groundwater recharge and discharge services, and provide important habitat for a variety of plant and animal species (Guntenspergen and Dunn 1998).

The forests of Hamlin Park exhibit many of the characteristics of a maturing forest with substantial structural complexity. Most of the canopy is heavily dominated by a variety of coniferous tree species, which is a positive indication of an intact Pacific Northwest forest. This alone is in contrast to the deciduous-dominated state of much of the forests found within the urban environment of Seattle, adjacent to Shoreline to the south (Seattle Urban Nature 2004). There is also considerable natural regeneration occurring in some areas of the park (Table 2). Similar studies conducted in Seattle parks found, on average, much less conifer regeneration in comparison to Hamlin Park (Seattle Urban Nature 2005, Seattle Urban Nature 2006). Furthermore, a variety of native shrub and herbaceous species are found in much of the park with substantial cover.

Unfortunately, encroachment of invasive species, human activity and other disturbances make active stewardship vital to maintaining and increasing the natural function of the forests in Hamlin Park. Invasive species in particular pose a serious threat to the future composition of the forest. In addition, the substantial areas of the forest currently lacking a significant shrub or herbaceous layer will need to be addressed with proactive management.

While invasive trees, shrubs and understory plants pose a serious and immediate management concern, the lack of structural complexity and conifer regeneration in many areas of the park and the low levels of large diameter snags and CWD also need to be considered. These issues are interrelated, as CWD and snags provide critical substrate for the regeneration of coniferous species, particularly western hemlock and western red cedar. These two species are also the most likely to regenerate under the intact conifer canopy present throughout much of the park. Also of concern is the apparent lack of a substantial tall shrub component throughout all forested areas. These problems point to the need for a comprehensive strategy to actively manage the forest structure and species composition in Hamlin Park. Furthermore,

much of the non-forested areas of the park are also heavily invaded by non-native species. Unless these areas are addressed, they will continue to compromise the integrity of the surrounding natural habitats.

Specific recommendations for each of the eight identified management zones will be discussed later in the report. Several park-wide management issues have been identified, and include social trails, invasive species, inadequate conifer regeneration, and supplementing coarse woody debris throughout the park. These issues are discussed below.

Specific management recommendations for the park are presented in section 5.1, *Management Priorities*.

5.1 Management Priorities

Management recommendations for Hamlin Park have been separated into three categories:

- Short-term priorities. These are actions that are of high importance and could be completed within the next two years
- Medium-term priorities. These are actions that will take planning to complete and could be completed within the next three to five years
- Long-term priorities. These are on-going activities that will take many years to accomplish.

Short term priorities

1) Removal of all discrete patches of ivy in zones 1-A, 1-B, 1-D, 3-A, 3-C and 4-C and replanting with native species
2) Creation of survival rings in all large ivy-infested areas throughout the park where trees are being threatened
3) Removal of discrete areas of scotch-broom in Zones 1B and 1D and replanting with native species
4) Removal of small infestation of yellow archangel in Zone 1 before it spreads further and replanting with native species
5) Removal of small, isolated patches of Himalayan blackberry located in management zones 1-A and 1-B, along with the isolated patch in zone 3-B and replanting with native species
6) Removal of isolated patches of English holly and cherry laurel infestations throughout the park. A priority area is the infestation spanning zones 3-B, 1-B and 4-B in the center of the park (see the management discussion for zone 4-B for more information)
7) Removal of sweet cherry infestation in zone 4-A and replanting with native species.
8) Establishment of a scientific study comparing different treatments to re-establish understory in the conifer forest without understory forest type
9) Establish exclosures to reduce human traffic in restoration areas.
10) Define a permanent trail network and close off unnecessary social trails.

Medium-term priorities

11) Removal of English holly and cherry laurel in zones 1-A, 1-D, 3-A, 3-B, 3-C, 4-B, 4-C and 8 and replanting with native species
12) Removal of larger Scotch broom infestations in Zones 1-A and 5 and replanting with native species
13) Removal of large, contiguous areas of English ivy in zones 1-A, 1-D, 3-A, 3-B, 4-A and 6 and replanting with native species
14) Removal of large, contiguous infestations of Himalayan blackberry in zones 1-A, 1-D, 3-C, 4-A, 4-C, 5 and 6
15) Removal of Norway maple from Zone 3-C and replanting with native maple species
16) Removal of sweet cherry from Zone 4-C and replanting with native bitter cherry

17) Re-establish understory in the conifer forest without understory forest type using results from the scientific study (number 8 in short-term priorities)

Long-term priorities

18) Increase CWD component in the park by retaining existing logs and bringing in additional wood when possible
19) Provide on-going maintenance of restored areas
20) Underplant tall shrubs throughout the park

Map 2

Hamlin Park

Management Zones and Invasive Species Locations

NE 168TH ST
NE 166TH ST
NE 165TH ST
NE 163RD ST
NE 160TH ST
NE 158TH ST
18TH AV NE
21ST AV NE
22ND AV NE
23RD AV NE
25TH PL NE
15TH AV NE
25TH AV NE
26TH AV NE

5
4-A
1-A
3-B
2-A
4-B
2-D
3-A
7
1-B
6
2-C
2-B
8
Ball Field Complex A
1-D
1-C
Roads
1-A
1-D
1-D
1-D
4-C
3-C
Ball Field Complex B

N
W
E
S

Feet
0 200 400 800
1:3,150

Map produced by Seattle Urban Nature 2007. Park boundaries and water course data provided by the City of Shoreline, WA.

No warranties of any sort, including accuracy, fitness, or merchantability accompany this product.

Legend

- 1-A — Management Zones
- Park Boundaries (80.4 Acres)
- Hamlin Creek
- Piped Water Course
- Trails

Invasive Species

Contiguous Areas (Acres)

- English Ivy (4.7)
- Himalayan Blackberry (4.5)
- Holly and Laurel - Heavy (6.5)
- Holly and Laurel - Moderate (17.5)
- Scotch Broom - (0.8)

Isolated Ocurrences

- Yellow Archangel
- Creeping Buttercup

CITY OF SHORELINE

Seattle Urban Nature

5.2 Trails and Human Impacts

Hamlin Park has several major trail corridors, an extensive network of unofficial social trails, and several areas (those lacking understory vegetation) in which foot and/or bicycle traffic is apparently extensive. One main trail bisects the park from south to north following the predominant valley from the parking lot and exiting the park at Northeast168th Street (Map 1). A secondary trail system begins from the north-west corner of the ball field complex and winds its way up the eastern half of the park to 18th Avenue Northeast. A number of unofficial trails branch from these main corridors and create a complex network throughout the property. The associated areas lacking understory are shown in Map 2.

In addition to being conduits for invasive species such as herb Robert and wall lettuce, social trails are a major cause of habitat fragmentation, soil compaction and erosion. It is recommended that whenever possible, social trails be blocked off and replanted with native species. Those social and unpaved trails that are heavily utilized should be converted to an official trail system.

The actions of visitors to Hamlin Park also affect conditions within the forest. The park is popular for dog-walking and other recreational activities such as jogging and mountain biking. These actions have the potential to trample native vegetation and can cause and exacerbate the detrimental effects of soil erosion and compaction and should be limited to designated areas when plausible.

5.3 Regeneration and Coarse Woody Debris

Conifer regeneration is limited in certain areas of the park, particularly in areas outside the conifer/deciduous mixed forest where considerable western red cedar regeneration was measured (Table 2). It is recommended that shade-tolerant species such as western red cedar, western hemlock and grand fir (*Abies grandis*) be planted throughout the park to promote conifer regeneration. Strategic placement of downed wood in these areas would further support the regeneration of coniferous species. Large snags and large diameter CWD should be retained whenever possible, both as substrate for conifer regeneration and to provide wildlife habitat for numerous bird and mammal species. Coordination with the parks department or Seattle City Light to bring CWD into the park is recommended, particularly from nearby projects.

5.4 Invasive Species

During the 2007 forest habitat delineation, locations of invasive species infestations were mapped within Hamlin Park. Most of the invasive species problems seem to be concentrated along the park edges (Map 2). The newly acquired area north of Northeast 165th Street is particularly invaded with substantial infestations of both Himalayan blackberry and Scotch broom. Most of the English ivy has become established in the conifer and conifer/deciduous mixed forests along the western edge of the park, combining to cover nearly five acres park-wide (Map 2). The highest concentrations of English holly and cherry laurel are found in the northwest corner of the park, the northeast portion bordering Northeast 156th Street and the strip of forest to the west of the lower ball fields. Areas with high densities of these species account for approximately 6.5 acres of the park, with surrounding areas that are moderately invaded adding an additional 17.5 acres. Aside from the large infestations in the northern section of the park, Scotch broom has also established along the borders of both ball field areas and accounts for approximately 0.8 acres. Himalayan blackberry is also present in the clearing adjacent to the Kellogg Middle School track as well as between the southern ball field and the parking lot along 25th Avenue Northeast, totaling approximately 4.5 acres (Map 2).

The following information describes the most common methods for removing the most prevalent invasive species in the park.

English Ivy

English ivy is one of the most invasive species in the Pacific northwest. This evergreen climbing vine is capable of forming dense mats in the forest understory and excluding all other understory species. It can also climb up trees, preventing light from reaching the leaves and adding weight to the tree canopy, causing trees to weaken and fall during wind storms.

The most effective method for controlling English Ivy is manual removal. Because English ivy can impact tree health by growing vertically, the first priority is to remove any vines growing on tree trunks and in the canopy. Install "survival rings" around trees by cutting or prying vines at shoulder height with the aid of a hand tool, killing any upper vines on the tree. Lower vines then need to be cleared, along with roots and vines found within at least a five foot radius of the base of the tree. For ivy growing along the ground, use hands or a small tool such as a hand tiller to pull or dig out the leaves and vines growing above the soil, as well as the woody roots growing just below the surface of the soil.

For disposal of hand-removed English ivy, several options are available. Disposal at a municipal vegetation waste facility is preferred. If the site will be monitored regularly, ivy can be piled on site on top of a paved area or tarp to prevent stems from re-rooting. Allow the pile to dry out, flipping periodically to ensure complete decomposition. Chemical methods of controlling English ivy are typically ineffective. The waxy leaves of the plant do not easily absorb herbicides, and herbicide run-off from the leaves results in risk to non-target plants (King County 2004). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix C.

English holly, cherry laurel and horse chestnut

Cherry laurel and English holly are evergreen trees that can reach up to 50 feet in height, but are usually shorter when present in the forest understory. Horse chestnut is a deciduous tree which can grow to heights of over 100 feet. All three species can form thickets in the forest understory, reproducing in low-light conditions and excluding native plant species. These trees can be difficult to control as they form extensive root sprouts after being cut down. The most effective method of control is to remove the entire root while the plant is small and can be pulled. If the plant is larger, it is possible to remove it using a weed wrench. If the tree is too large to be either hand pulled or removed with a weed wrench, cutting the stem as close as possible to the ground and applying an herbicide such as Roundup directly to the cut portion of the stem as soon as possible is usually effective. Due to the fact that these trees tend to root spout and have many seedlings, monitoring around the infested areas on a regular basis will be necessary for several years after removal. It is very important not to cut the trees down without herbicide application, as this can lead to numerous root sprouts and re-growth from the stem (King County 2007a, USDA Forest Service 2005). Fact sheets including plant descriptions, distribution information and best management practices for control can be found in Appendix C.

Herb Robert

Herb Robert is a fall and spring annual flowering plant in the geranium family. This low growing ground cover can spread vigorously in the forest understory and displace native plants. It is most often found along trail corridors and other disturbed areas. Herb Robert is most successfully controlled throughout several growing seasons. In order to prevent spreading, it is necessary to remove the plant before it produces any flowers or seeds. Due to the weak root system of Herb Robert, manual removal methods are often effective. Wearing gloves to prevent skin irritation from the sticky oils of the plant, pull gently at the base to pull up the roots. A mechanical method such as a string trimmer can also be

effective if used before the plant sets seed. Do not dispose of Herb Robert in on site compost piles, as seeds can survive and spread from composting. Utilize municipal yard waste facilities, as commercial high heat composting prevents germination of seeds. Chemical methods such as a systemic herbicide can be effective, especially if combined with monitoring for surviving plants. Such herbicides are absorbed by the foliage of the plant and travel through the plant to kill the roots. It is important to select an herbicide that is appropriate for the particular site, either aquatic or terrestrial. Take care to properly identify the plant prior to removal, because bleeding heart (*Dicentra formosa*), a Pacific Northwest native, is a strong look-alike (King County 2007b). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix C.

Himalayan blackberry

Himalayan blackberry is a vigorous evergreen shrub armed with prickles on the stem. This plant thrives in open, disturbed areas but can also invade forested areas on both wet and dry sites. Himalayan blackberry often forms large thickets that exclude all other species and can also climb and smother trees. Control of Himalayan blackberry requires management over a number of years. Based on the size of the site, various strategies can be effective. For small infestations of Himalayan blackberry, manual removal is appropriate. For larger infestations, mechanical methods such as mowing or brush cutting can be effective. Manual control consists of cuting blackberry canes with loppers or pruners one foot above the ground. Depending on the size of the plants, dig up the root balls using tools such as a hand tiller, shovel, pulaski, or pick mattock. Canes can be piled on site on top of cardboard and left to decompose. Place any root balls on top of the pile to avoid re-rooting. Due to possible vigorous re-sprouting from the root crown, monitoring the infested area on a regular basis will be necessary for several years after removal. Removal procedures are repeated as necessary for complete control. After removing Himalayan blackberry, the area should be replanted with natives and mulched to help deter future invasive growth (King County 2005).

Biological methods of controlling blackberry are also an option. The introduction of animals such as goats or pigs can be useful in controlling infestations from one to four years old. Chemical methods of controlling large blackberry infestations are also known to be effective, especially if combined with other methods such as mechanical control and monitoring (King County 2005). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix C.

Scotch broom

Scotch broom is a deep-rooted deciduous shrub, reaching up to 10 feet in height. This aggressive plant can rapidly colonized open, disturbed areas and produce seeds that are viable for up to 60 years, making it difficult to control. Control of Scotch broom requires management over a number of years, using a range of control techniques depending on the requirements of the site. Due to banks of seeds in the soil and soil disturbance during manual removal, resprouting is likely and ongoing management of the site will be required during the first few years.

Although often highly labor intensive, manual methods of control can be effective for smaller infestations. Pull or dig up plants and remove as many of the roots as possible in order to prevent re-sprouting. To be fully effective, it is essential to remove all mature plants to prevent seed production. For larger plants, tools such as an axe, machete, loppers, or a weed wrench are useful for removal. For larger infestations, mechanical methods of control such as brush cutting or mowing can be effective if repeated throughout the season or combined with other control methods. Mechanical mowing or cutting of young, green plants is ineffective as this often results in a dense carpet of short Scotch broom plants. Mature plants should be cut when flowering in order to prevent seed production. However, cutting is

more effective during the dry season (from July-September) because this can lead to the exhaustion of root reserves and decreased resprouting. In this case, it is essential to reduce the spreading of mature seed pods which can lead to additional infestations. For mature plants, cut near ground level where the stem is more yellow than green. For larger or multi-branched plants, cut at chest height or below and cut off side branches during the dry season. If removing dense patches of Scotch broom, the area should be replanted with natives and mulched to help deter future invasive growth. Biological methods of control are also an option, as grazing by goats and consumption of seeds by chickens have been shown to reduce Scotch broom infestations. Chemical methods such as foliar or basal application of selective or non-selective herbicides are also known to be effective in controlling Scotch broom (King County 2004a, King County 2007c). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix C.

Sweet cherry, Norway maple, European mountain ash and one-seed hawthorn

Sweet cherry, Norway maple, European mountain ash and on-seed hawthorn are all deciduous trees that can form dense thickets in the forest understory and exclude native trees and shrubs. Manual means of controlling these tree species include hand pulling small seedlings and removing young trees with a weed wrench where possible. It is easier to implement manual control when the soil is moist. If the tree is too large for manual removal, girdling can be an effective means of control. Girdling can be accomplished by cutting through the bark and growing layer (cambium) in a complete ring around the trunk. This method is most effective in the spring. Larger trees can also be cut down although re-growth should be monitored and removed for several years after the tree is cut down to prevent resprouting (USDA Forest Service 2004, 2006 and 2007). Fact sheets including plant descriptions, distribution information and best management practices for control can be found in Appendix C.

Yellow archangel

Yellow archangel is a low-growing evergreen perennial ground cover that spreads through stolons and can form dense mats in the forest understory, excluding all other plants. Yellow archangel is most successfully controlled throughout several growing seasons because stem and root fragments can resprout. Due to the shallow root system of the plant, manual removal can be effective between fall and early spring. Although labor intensive, when hand pulling plants it is essential to remove all roots and stem fragments to prevent re-rooting. Mechanical control methods such as cutting with a string trimmer are only effective if combined with other methods such as manual removal or chemical control. Chemical methods such as application of selective or non-selective herbicides can be effective if combined with manual control and monitoring for re-growth. It is important to select an herbicide that is appropriate for the particular site, either aquatic or terrestrial (King County 2007d). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix C.

5.5 Planting and maintenance

Planting with native species is recommended following removal of invasive plants in each management zone. Increasing structural diversity within the shrub layer is a key identified goal within the entire park, with a recommendation to plant tall shrubs park-wide. In addition, establishing shade and canopy cover is key to controlling certain invasive species such as Himalayan blackberry and scotch broom, which can colonize disturbed areas. Due to the climate in the Pacific Northwest, the planting season extends from late fall to early spring during the rainy season when sufficient moisture exists to allow plants to establish. Newly installed plants should be monitored and watered during the hot summer months for the first several years to ensure proper establishment.

Maintenance is vital to the success of any restoration project. The removal and control of invasive species is a long-term commitment that requires regular weeding and maintenance for several years. Many of the invasive species present in Shoreview and Boeing Creek (e.g. Himalayan blackberry, Scotch broom, butterfly bush, etc.) have a tendency to re-grow from deep roots and must have regular maintenance at least two or three times a year in order to achieve effective invasive control and protect any installed native plantings. Maintenance can involve removing any regrowing invasive plants (with the roots whenever possible), regular mulching of native plantings, replacing native plants that have died, placing appropriate signs and/or fencing around restored areas and watering newly installed plants throughout at least the first two growing seasons.

5.6 Monitoring

Monitoring is equally important to the success of a restoration project. Regular monitoring is particularly important in urban areas where forested stands are surrounded by development and invasive species are able to encroach from all sides. Monitoring can take many forms including visual inspections, photo documentation and scientific monitoring.

A basic type of monitoring is the visual inspection of restored areas during regular intervals and making note of any maintenance that is required. This type of monitoring can be done by volunteers, staff or contractors in charge of the restoration project. It should be conducted at least twice a year and more often if possible. This type of monitoring can generate information quickly. However, due to the inherent lack of formal documentation associated with this monitoring method, efficient transmission of inspection observations to maintenance staff is essential.

Another type of monitoring that can easily be implemented is establishing photo points throughout specific restoration areas and photographing the same geographic areas each year. Photo monitoring allows for long-term documentation and comparison of site conditions from year to year. This type of monitoring can also be conducted by volunteers, but the photographs must be taken at the same time each year for accurate comparison. Photo monitoring can be effective in documenting site conditions and is not time intensive. However, the photographs must be analyzed and compared to those from previous years to track changes over time. In addition, it is difficult to generate quantifiable data from this monitoring method.

A third type of monitoring, which is more labor intensive and rigorous than the first two types, involves setting up permanent plots and collecting scientific data similar to that gathered during the 2007 forest inventory discussed in this report. The data can include any number of parameters deemed to be useful to the forest stewards but at a minimum should include survival data, tree density data and cover data for native and invasive shrubs and herbaceous species present. This type of monitoring can be conducted by properly trained volunteers, staff or contractors. This type of monitoring can occur on an annual basis for the first three to five years, and then can be conducted on a bi-annual basis or more frequently depending on site conditions. Using permanent plots to monitor restoration sites allows for evaluation of site conditions and regular opportunities to evaluate the effectiveness of management techniques. In addition, it allows for a quantitative comparison of site conditions evaluation of planting and maintenance techniques over time.

5.7 Specific Recommendations for Management Areas

This section discusses specific recommendations for each of eight management zones in Hamlin Park (Map 2). These zones are based on habitat delineations conducted in the parks (Map 1) as well as locations and extents of invasive species, which are shown in Map 2. Specific recommendations for each zone have been separated into short-term, medium-term and long-term priorities and are presented in section 5.1, *Management Priorities*.

Zone 1

This management zone consists of all areas identified as conifer forest that had substantial understory vegetation present. Due to its size and distribution throughout the park, it was further divided into four sub-zones, 1-A through 1-D (Map 2). Generally speaking, the forests in this management zone consist of a structurally diverse conifer canopy with moderate natural regeneration and a substantial low-statured shrub and herbaceous layer. The most significant threat is the establishment and spread of invasive species that have occurred throughout this zone.

The management goals in zone 1 are to:

1) Remove English holly, cherry laurel, Himalayan blackberry, scotch broom, English ivy and yellow archangel
2) Create survival rings for affected trees within areas heavily infested by English ivy
3) Increase cover of tall shrubs
4) Following invasive species removal, replant with native species including conifer trees
5) Preserve large snags and CWD whenever possible

The forests that border the western edge of the park along 15th Avenue Northeast (zone 1-A) and the forests on both sides of the park bordering Northeast 165th Street(zone 1-A and the northern section of 1-B) are particularly invaded with dense stands of English holly and cherry laurel (Map 2). Control and management recommendations for these species can be found in the invasive species section of the report. However, due to the size and density of these infestations, it is recommended that a contractor be hired to control these areas. Many of the invasive trees in this management zone may be too large for hand pulling and might need to be cut down and treated with herbicide. Due to the large seed bank and high stem densities of English holly in these areas, recurring annual removals over a number of years will be necessary to reduce the stem densities to levels low enough to be managed by a community or volunteer group.

Most of the English ivy in Hamlin Park is also located in zone 1-A (Map 2). Smaller infestations are also present in zone 1-D, especially along the eastern edge of the park bordering the Kellogg Middle School property. Management of this species should be a priority to prevent further colonization throughout the park. Control information about English ivy can be found in the invasive species section of the report. It is recommended that smaller discrete patches be eradicated immediately. In larger infestations, survival rings should be established around trees until dedicated efforts can begin clearing and revegetating these areas. In these cases, it is recommended that manageable-sized sections be brought into restoration in a step-wise fashion over the course of several years, assuring that sufficient resources are available for replanting and the necessary maintenance and monitoring of each area.

There are also relatively small patches of Himalayan blackberry (with lesser amounts of evergreen blackberry) found scattered throughout this zone (Map 2). Because most of these infestations are relatively isolated, they should be targeted for immediate removal. Specific best management practices on how to control and manage Himalayan blackberry can be found in the invasive species section of the report. In areas where native trees or other vegetation are present, manual control is recommended. Mulching with cardboard and replanting immediately after clearing and grubbing the blackberry roots is an effective strategy to control this species. Follow-up maintenance will be necessary for several years following blackberry removal (see the maintenance section of the report).

Scotch broom has invaded limited areas to the north of both ball field complexes in zones 1-B and 1-D (Map 2). Eradication of these relatively small infestations should be a priority before they spread to additional areas of the park. Entire plants should be removed with a weed wrench were possible, assuring that the majority of roots are removed with the plant. Cleared areas should be mulched and

replanted immediately. Continued maintenance will be required to remove additional seedlings and re-sprouts. An additional isolated infestation is present in the northeast section of the zone in a clearing adjacent to a gravel parking lot on 167th Avenue Northeast. This infestation should be removed during similar restoration activities in adjacent Zone 5.

Finally, a small patch of yellow archangel was found along the road where Northeast 165th Street dead-ends into the northern addition of the park (Map 2). This species has the propensity to rapidly spread and colonize forested environments in the Pacific Northwest (Community Mapping Network 2005). Eradication of this infestation should be a high priority while it is still in a manageable state. Due to the small size of the patch, it should be possible to manually remove the plant making sure to grub out as much of the roots as possible, followed by mulching with cardboard and replanting. Repeated efforts and careful monitoring will be required to completely eradicate this species. More information regarding the control of this species can be found in the invasive species section of this report.

Removal of invasive tree and shrub species should be followed by addition of CWD when possible and under planting of native conifer and deciduous trees along with tall shrub species to increase native regeneration and improve structural complexity in the forest. The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, cascara, grand fir (*Abies grandis*), Pacific dogwood, Pacific madrone, western hemlock, western red cedar
Suggested Native Shrubs: Baldhip rose (*Rosa gymnocarpa*), beaked hazelnut, evergreen huckleberry (*Vaccinium ovatum*), Indian plum, oceanspray (*Holodiscus discolor*), low Oregon grape, Oregon boxwood (*Paxistima myrsinites*), red elderberry (*Sambucus racemosa*), red flowering currant (*Ribes sanguineum*), red huckleberry, salal, serviceberry *(Amelanchier alnifolia)*, snowberry (*Symphoricarpos albus*), thimbleberry (*Rubus parviflorus*), vine maple (*Acer circinatum*)
Herbaceous species: Deer fern (*Blechnum spicant*), sword fern, goatsbeard (*Aruncus dioicus*)

Zone 2
Management zone 2 is the conifer forest without understory forest type and is made up of four distinct areas of the park, sub-zones 2-A through 2-D (Map 2). As discussed in the results section, the trees in this forest type are predominantly western hemlock with relatively low native regeneration (Table 2). Furthermore, this forest shows little structural heterogeneity, indicating that the trees are more or less even aged (Figure 3).

The management goals in zone 2 are to:

1) Establish an official trail system within this area and block off and revegetate unnecessary social trails
2) Revegetate bare areas with native trees, shrubs and herbaceous species. It is recommended that a scientific study is performed in these areas to test various soil amendments and vegetation species prior to full-scale revegetation efforts
3) Preserve large snags and CWD whenever possible

The greatest management concern in this zone is the evident lack of natural growth and establishment of native shrub and herbaceous vegetation. While some areas do show minimal growth, much of this zone is a barren terrain of unvegetated forest duff. There was also the highest percent cover of bare dirt measured in this forest type, indicating that exposed soils are present (Table 3). Several causes may be attributable to the lack of vegetation in this management zone. One potential cause is trampling by people and animals, which may be causing a problem in some areas. This hypothesis can easily be tested by conducting an exclusion study in which some areas are fenced off from human traffic.

Another possible cause is soil compaction from historic and present uses. Some evidence of compaction can be seen in areas along heavily used trails, however it does not appear to be a problem zone-wide. The lack of damage to the canopy trees also suggests that compaction is not the predominant cause.

The physical properties of the soil could also be a contributing factor. Some areas within zone 2-B were noted where salal appeared to be dead or actively dying, with what looked like little or weak regeneration. However, the typical understory species would take root in the upper layer of soil and would generally colonize even extremely marginal soils. It has also been suggested that water movement is limited in these areas by the presence of a cemented substratum beneath the surface layer of soil (MacLeod Reckord 1986). However, this has not been substantiated. The soil in these areas is quite sandy and might not retain adequate moisture, making plant establishment difficult

While western hemlock forests can form extremely dense canopies limiting light conditions on the forest floor, this does not appear to be the situation in Hamlin Park. This zone does not have an appreciably higher overstory density compared to other forest types in the park. Furthermore, sizeable canopy gaps can be observed throughout much of the zone. Additional studies will be required to better understand the dynamics that are responsible for the current lack of understory species recruitment.

It is recommended that a limited study be performed to test the efficacy of potential restoration techniques in this zone. For example, several areas throughout the zone could be planted with a variety of appropriate native shrub and tree species and maintained under differing controlled conditions. Soil tests could provide further information about existing conditions at each study plot. Depending on the results of preliminary tests, variables such as exclusion from trampling, appropriate plant species, and soil amendments could be tested within multiple study plots. With plots replicated throughout the zone, species survivability could be monitored and compared across treatments. To control against the effects of trampling, treatment areas should be fenced off. Newly established plants should be watered for the first two seasons and the plots should be monitored for several years to determine the most effective treatments. Based on the results of the study, the appropriate restoration techniques could then be expanded to larger areas within the zone.

It is recommended that particularly hardy species be chosen to conduct the study. The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Western hemlock, western red cedar
Suggested Native Shrubs: Beaked hazelnut, evergreen huckleberry, low Oregon grape, oceanspray, salal, snowberry
Herbaceous species: Sword fern

Zone 3
Zone 3 consists of three conifer/deciduous mixed forested areas of the park, 3-A through 3-C (Map 2). The largest and most intact of these is zone 3-A located in a shallow ravine in the western half of the park. These forests have the lowest overstory density of the park and are dominated by red alder (Table 2). Conversely, the highest native conifer tree regeneration was also measured in this forest type. The presence of red alders and salmonberry suggest that these forests are generally wetter than other areas of the park. Like zone 1, the most significant threat to this zone is the establishment and spread of invasive species.

The management goals in zone 3 are to:

1) Remove English holly, cherry laurel, European mountain ash, Portugal laurel, Norway maple, Himalayan blackberry and English ivy

2) Increase cover of tall shrubs
3) Following invasive species removal, replant with native species
4) Preserve large snags and CWD whenever possible

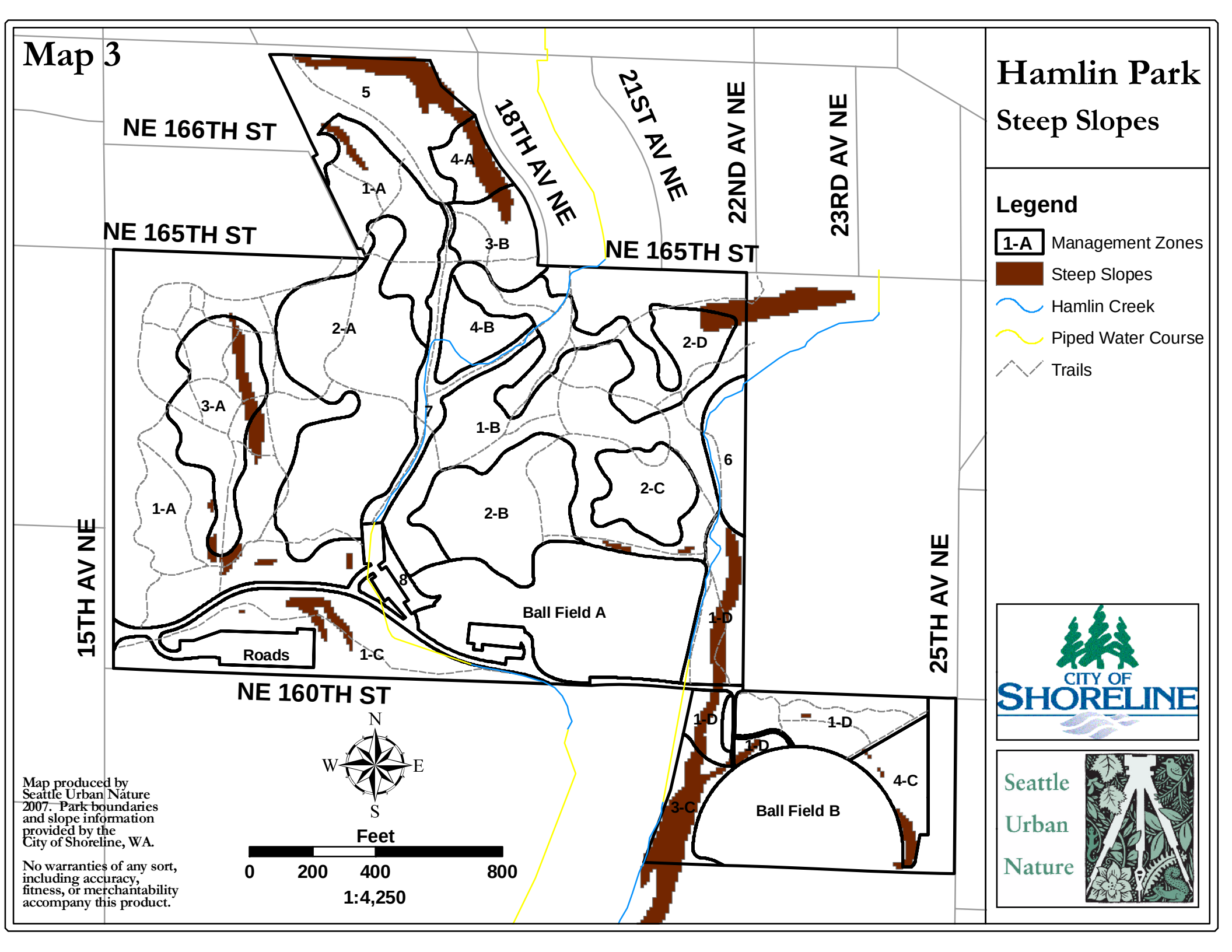
English holly and cherry laurel are ubiquitous species occupying the understory of zone 3-A, along with smaller patches of English ivy (Map 2). There are also high densities of European mountain ash present in this zone. Control and management recommendations for these species can be found in the invasive species section of the report. Because of its proximity, it is recommended that invasive species eradication in zone 3-A be performed in conjunction with the efforts outlined for zone 1-A above.

The west side of zone 3-B, located in the south-east corner of the new park addition north of Northeast 165th Street, has a small area heavily dominated with English holly and cherry laurel (Map 2). Because of its relatively small size, this area should be a priority for eradication. The relatively isolated patch Himalayan blackberry along 18th Avenue Northeast should also be considered for eradication before it continues to spread throughout the adjacent forest. Because the infestation is fairly contiguous and does not contain extensive native vegetation, mechanical control or control with goats may be possible. Also of concern in this zone is a large patch of English ivy extending down the slope from 18th Avenue Northeast. Because of the steep slopes in this area, it is recommended that a contractor be hired to remove the ivy and stabilize the slope to avoid potential erosion (Map 3). Some areas of the slope adjacent to the ivy currently have minimal understory vegetation which can be under planted at the same time.

Zone 3-C along the western side of the lower ball field complex is heavily invaded with English holly, cherry laurel, and Portugal laurel (Map 2). There are also high levels of Himalayan blackberry recorded in this zone. High densities of Norway maple were recorded in this zone and will also need to be addressed. Most of the Norway maples measured were of small diameter and can easily be pulled by hand. Larger trees should be located and either girdled or cut down. Refer to the management recommendations for this species in the invasive species section of the report. This small strip of forest is fragmented by buildings and development on its western edge and by the athletic field on its eastern edge. Also, the overstory canopy appears less developed than the other forests in the park. As a result of these disturbances, this area is in severe decline and will require dedicated efforts to restore. Furthermore, because most of this area is situated on steep slopes, it is recommended that professional contractors be considered for controlling this area (Map 3).

Restoration of zone 3 should follow the general guidelines described in the planting and maintenance section of the report, and for zone 1 above. Removal of invasive tree and shrub species should be followed by addition of CWD when possible and under planting of native conifer and deciduous trees along with tall shrub species to increase native regeneration and improve structural complexity in the forest. The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, cascara, grand fir, Pacific dogwood, Pacific madrone, red alder, western hemlock, western red cedar
Suggested Native Shrubs: Baldhip rose, beaked hazelnut, evergreen huckleberry, Indian plum, oceanspray, low Oregon grape, mock-orange (*Philadelphus lewisii*), Oregon boxwood, Pacific nine-bark (*Physocarpus capitatus*), red elderberry, red flowering currant, red huckleberry, redosier dogwood (*Cornus sericea*), salmonberry, serviceberry, snowberry, thimbleberry, twinberry (*Lonicera involucrata*), vine maple
Herbaceous species: Deer fern, sword fern, goatsbeard


Map 3
Hamlin Park
Steep Slopes
NE 166TH ST
NE 165TH ST
NE 165TH ST
NE 160TH ST
15TH AV NE
18TH AV NE
21ST AV NE
22ND AV NE
23RD AV NE
25TH AV NE
5
4-A
1-A
3-B
2-A
4-B
2-D
3-A
7
1-B
6
2-C
1-A
2-B
8
Ball Field A
1-D
Roads
1-C
1-D
1-D
1-D
4-C
3-C
Ball Field B
Legend
1-A Management Zones
Steep Slopes
Hamlin Creek
Piped Water Course
Trails
CITY OF SHORELINE
Seattle Urban Nature
N
W
E
S
Feet
0 200 400 800
1:4,250
Map produced by Seattle Urban Nature 2007. Park boundaries and slope information provided by the City of Shoreline, WA.
No warranties of any sort, including accuracy, fitness, or merchantability accompany this product.

Zone 4

Zone 4 consists of the madrone/conifer mixed forests found in three separate areas of the park (Map2). The madrone/deciduous forest type in the far south-eastern corner of the park is also included in this management zone as part of zone 4-C (Map 2). This zone has most of the same invasive species issues discussed for zones 1 and 3 above.

The management goals in zone 4 are to:

1) Remove sweet cherry, English holly, cherry laurel, Himalayan blackberry and English ivy
2) Increase cover of tall shrubs
3) Following invasive species removal, replant with native species including conifer trees
4) Preserve large snags and CWD whenever possible

Zone 4-A is located along 18th Avenue Northeast in the northern addition to Hamlin Park (Map 2) This zone has a markedly high density of sweet cherry, especially on the slope in the southeast portion of the zone. Control of this species should be considered before the infestation spreads to other areas of the park. See the control and management recommendations for these species in the invasive species section of the report. While small seedlings can easily be pulled by hand, many larger trees were measured and should be girdled or cut, realizing that ongoing efforts will be required to control resprouts and new plants. Control of sweet cherry should be a priority for this zone, especially considering the low densities of our native bitter cherry found throughout the park. Care should be taken during restoration efforts in this zone due to the presence of steep slopes along 18th Avenue Northeast (Map 3). During the survey, a large pile of yard debris was noted in this zone to the east of transect number 24 (Map 1). Efforts should be taken to reduce these occurrences as they can be vectors for the introduction of invasive species. Signs should be posted along the street discouraging such behavior.

The most interior of the madrone/conifer mixed forests is located on the west-facing slope between the main trail corridors in the north-central portion of the park, designated as zone 4-B (Map 2). This zone has a well developed native canopy and shrub layer. Because of this, eradication of English holly and cherry laurel from this zone should be considered a high priority. A combination of pulling small stems and cutting/herbicide application is recommended, followed by replanting with native conifer trees.

Zone 4-C located in the southeast corner of the park adjacent to the lower ball field complex is heavily invaded with Himalayan blackberry (Map 2). Specific best management practices on how to control and manage Himalayan blackberry can be found in the invasive species section of this report. Like zone 4-A, this zone has high densities of sweet cherry in the regenerating understory. Eradication of this species should be considered, taking care to properly distinguish between the native bitter cherry also present in this zone. Recent evidence suggests that these species can hybridize, making identification particularly difficult (Jacobson and Zika 2007). Because of this, eradication efforts should be enacted only by trained professionals familiar with these species.

Restoration of this zone should follow the general guidelines described in the planting and maintenance section of this report. In areas where there is existing native vegetation, removal of invasive tree and shrub species should be followed by under planting of native conifer and deciduous trees to increase regeneration and structural complexity. Areas where intensive restoration efforts have taken place will require mulching with cardboard and the addition of shrub and herbaceous species. CWD should also be installed whenever possible. The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, cascara, Douglas fir, grand fir, Pacific dogwood, Pacific madrone, red alder, western hemlock, western red cedar, western white pine
Suggested Native Shrubs: Baldhip rose, beaked hazelnut, evergreen huckleberry, Indian plum, oceanspray, low Oregon grape, Oregon boxwood, red elderberry, red flowering currant, red huckleberry, salal, serviceberry, snowberry, thimbleberry
Herbaceous species: Deer fern, sword fern, goatsbeard

Zone 5

The most northern section of Hamlin Park north of Northeast 165th Street was designated as zone 5 (Map 2). This zone includes the strip of mixed forest along the outer edge, the currently unmaintained shrubland area, and the grassland adjacent to the main trail (Maps 1 & 2). No assessment plots were sampled in this zone. The forested areas of this zone are heavily invaded by Himalayan blackberry, while the open canopy areas are dominated by both Himalayan blackberry and Scotch broom (Map 2). The forested western section of this zone has high densities of English holly and cherry laurel. The eradication of Himalayan blackberry and Scotch broom should be considered a high priority, as their persistence will continue to compromise the adjacent forests.

The management goals in zone 5 are to:

1) Remove English holly, cherry laurel, Himalayan blackberry and Scotch broom
2) Following invasive species removal, replant with native species including conifer trees
3) Preserve large snags and CWD whenever possible

Specific best management practices on how to control and manage Himalayan blackberry can be found in the invasive species section of this report. In some contiguous patches which do not contain native vegetation, such as the large clearing in the center of the zone, mechanical control or control with goats might be possible. In areas where native trees or other vegetation are present, manual control is recommended. Mulching with cardboard and replanting immediately after clearing and grubbing the blackberry roots is an effective strategy to control this species. The northeast section of this zone is also situated on steep slopes and will require slope stabilization efforts following blackberry removal (Map 3). Follow-up maintenance will be necessary for several years following blackberry Scotch broom removal (see the maintenance section of this report).

After clearing invasive shrubs from the central area of the zone, the area should be mulched and heavily replanted with native trees, shrubs and herbs. Depending on the environmental factors present on site, it could be possible to manage part of this area as a meadow or scrub-shrub type habitat. The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, cascara, Douglas fir, grand fir, Pacific dogwood, Pacific madrone, red alder, western hemlock, western red cedar, western white pine, big-leaf maple
Suggested Native Shrubs: Baldhip rose, beaked hazelnut, evergreen huckleberry, Indian plum, oceanspray, low Oregon grape, Oregon boxwood, red elderberry, red flowering currant, red huckleberry, salmonberry, serviceberry, snowberry, thimbleberry, mock orange; vine maple., Nutka rose?
Herbaceous species: Deer fern, sword fern, goatsbeard.

Zone 6

The cleared area directly adjacent to the Kellogg Middle School track is designated as zone 6 (Map 2). No assessment plots were sampled in this zone. The area is made up of a lower depressional area with moderately wet moisture conditions and appears to be the main input of water that re-emerges from culverts directly below this zone. The City of Shoreline stream GIS layer shows an open water course flowing through this area, although there is no direct evidence of a defined stream channel or of any

above-ground discharge point. Additional surveys should be performed before restoration efforts are enacted in this zone to better understand the hydrology of the area.

The management goals in zone 6 are to:

1) Remove Himalayan blackberry and English ivy
2) Create survival rings for affected trees within areas heavily infested by English ivy
3) Following invasive species removal, replant with native species including conifer trees
4) Preserve large snags and CWD whenever possible

The northern half of this section has no tree cover and is heavily infested with Himalayan blackberry. Mechanical control may be possible throughout portions of this zone, paying close attention to areas where native species and/or wet soil conditions may be present. The southern half has moderate deciduous canopy cover, mainly of red alder. The understory of this part of zone 6 is dominated by English ivy. See the control and management recommendations for these species in the invasive species section of this report.

After invasive species clearing, the area should be immediately mulched and replanted with native species. Refer to the general guidelines described in the planting and maintenance section of the report. Plantings should aim for the rapid establishment of canopy cover in the northern part of the zone to aide in the control of Himalayan blackberry. Alternatively, parts of this zone may be favorable for the creation of a wet-meadow habitat (see the wet meadow palette below).

Forest palette:
Suggested Native Trees: Bitter cherry, cascara, Douglas fir, grand fir, Pacific dogwood, Pacific madrone, red alder, western hemlock, western red cedar, western white pine.
Suggested Native Shrubs: Baldhip rose, beaked hazelnut, clustered wild rose (*Rosa pisocarpa*), evergreen huckleberry, Indian plum, oceanspray, low Oregon grape, nootka rose, (*Rosa nutkana*), Oregon boxwood, pacific willow (*Salix lucida ssp. lasiandra*), red elderberry, red flowering currant, red huckleberry, redosier dogwood, salmonberry, serviceberry, Sitka willow, (S*alix sitchensis*), snowberry, thimbleberry, twinberry, mock orange; Pacific ninebark, vine maple.
Herbaceous species: Deer fern, lady fern (*Athyrium filix-femina*), sword fern, goatsbeard.

Wet meadow palette:
Suggested Native Shrubs: clustered wildrose, evergreen huckleberry, Nootka rose
Suggested Native Herbaceous Species: arctic lupine (*Lupinus arcticus*), blue wildrye (*Elymus glaucus*), California aster (S*ymphyotrichum chilense*), Canada goldenrod (*Solidago canadensis*), common red paintbrush (*Castilleja miniata*), Douglas aster (*Symphyotrichum subspicatum var. subspicatum*), farewell to spring (*Clarkia amoena*), fireweed (*Chamerion angustifolium ssp. angustifolium*), graceful cinquefoil (*Potentilla gracilis*), Henderson's checker-mallow (*Sidalcea hendersonii*), Idaho blue-eyed grass (*Sisyrinchium idahoense*), Idaho fescue (*Festuca idahoensis ssp. roemeri*), large-leaved lupine (*Lupinus polyphyllus*), meadow barley (*Hordeum brachyantherum*), miner's lettuce (*Claytonia perfoliata*), nodding onion (*Allium cernuum*), Oregon iris (*Iris tenax*), Oregon sunshine (*Eriophyllum lanatum*), Pacific silverweed (*Argentina egedii ssp. egedii*), pearly everlasting, small camas (*Camassia quamash*), slough sedge, tufted hairgrass (*Deschampsia caespitosa*), western buttercup (*Ranunculus occidentalis*), western columbine (*Aquilegia formosa*), yarrow (*Achillea millefolium*), yellow monkey flower (*Mimulus guttatus*).

Zone 7
Zone 7 consists of the main trail corridor that bisects the park from the central parking lot to Northeast 165th Street (Map 2). This zone includes the arterial trail that follows the intermittent stream channel north towards 18th Avenue Northeast (Map 2). The main management concern for this zone is to keep

the trail corridors defined and to limit the expansion of trampled areas where secondary trails intersect. One option would be to create paths with defined borders and to plant native trees and shrubs directly along each side. Rerouting the upper fork of the trail out of the existing stream channel should also be considered, which would allow for the revegetation of this sensitive area.

The management goals in zone 7 are to:

1) Formalize a trail system and block off and revegetate unnecessary social trails
2) Potentially move the main trail corridor out of the stream channel and revegetate stream banks

The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Western hemlock, western red cedar.
Suggested Native Shrubs: beaked hazelnut, evergreen huckleberry, low Oregon grape, oceanspray, salal, salmonberry, snowberry, tall Oregon grape (*Mahonia aquifolium*), western mockorange.
Herbaceous species: Sword fern.

Zone 8

The small area adjacent to the central parking lot is designated as zone 8 (Map 2). This area consists of horticultural shrubs planted directly adjacent to the parking lot in addition to a small area with significant native species cover, including a number of Pacific madrone trees.

The management goals in zone 8 are to:

1) Remove English holly plantings
2) Following invasive species removal, replant with native species including conifer trees

There are several large horticultural plantings of English holly bushes that should be considered for removal, as they are contributing to the invasive species problem throughout the park. Three other large plantings along the opposite side of the parking lot should also be removed at this time (Map 2). Plants should be cut and treated with herbicide and the areas replanted with native or non-invasive species. The native forest remnants should be cleared of invasive tree and shrub species and regularly maintained.

REFERENCES

Bunnell, F.L., I. Houde, B. Johnston and E. Wind. 2002. How dead trees sustain live organisms in Western Forests. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181. http://www.fs.fed.us/psw/publications/documents/gtr-181/025_BunnellHoude.pdf

City of Shoreline. 2001. Topography2001 GIS shapefile.

City of Shoreline website. 2007. http://www.cityofshoreline.com/cityhall/projects/acquistions/southwoods.cfm

City of Shoreline website. 2007a. http://www.cityofshoreline.com/about/history/index.html

Community Mapping Network. 2005. Yellow archangel (*Lamiastrum galeobdolon*). http://shim.bc.ca/invasivespecies/_private/yellowarchangel.htm

Elzinga, C., D.W. Salzer and J.W. Willoughby. 1998. Measuring and monitoring plant populations. BLM Technical Reference 1730-1. BLM National Science and Technology Center. http://www.blm.gov/nstc/library/techref.htm

Guntenspergen and Dunn. 1998. Introduction: Long-term ecological sustainability of wetlands in urbanizing landscapes. Urban Ecosystems 2: 187-188.

Harmon, M.E., J.F. Franklin, F.J. Swanson, P. Sollins, S.V. Gregory, J.D. Lattin, N.H. Anderson, S.P. Cline, N.G. Aumen, J.R. Sedell, G.W. Lienkaemper, K. Cromack Jr. and K.W. Cummins. 1986. Ecology of coarse woody debris in temperate ecosystems. Advances in Ecological Research 15: 133-302.

Jacobson Arthur L. and P.F. Zika. 2007. A new hybrid cherry, *Prunus x Pugetensis* (*P. avium x emarginata*, Rosaceae), from the Pacific Northwest. Madrono 54(1): 74-85.

Jones and Stokes. 2002. Final Vegetation Management Plan: Discovery Park.

King County Noxious Weed Control Program. 2004. English Ivy (*Hedera helix*) Weed Bulletin. http://dnr.metrokc.gov/wlr/lands/weeds/pdf/english-ivy-control.pdf

King County Noxious Weed Control Program. 2004a. Best Management Practices: Spanish Broom (*Spartium junceum*) and Scotch Broom (*Cytisus scoparius*), Fabaceae, Class A & B Noxious Weeds. http://dnr.metrokc.gov/wlr/lands/weeds/pdf/scotch-spanish-broom-control.pdf

King County Noxious Weed Control Program. 2005. Best Management Practices: Evergreen blackberry (*Rubus laciniatus*) and Himalayan blackberry (*Rubus discolor syn. Rubus armeniacus*). http://dnr.metrokc.gov/wlr/lands/weeds/pdf/blackberry-control.pdf

King County Noxious Weed Control Program. 2007. King County Noxious Weed List. Seattle, WA

King County Noxious Weed Control Program. 2007a. English holly (*Ilex aquifolium*). http://dnr.metrokc.gov/wlr/lands/weeds/holly.htm

King County Noxious Weed Control Program. 2007b. Herb Robert Weed Alert Fact sheet. http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Herb_Robert_Factsheet.pdf

King County Noxious Weed Control Program. 2007c. Scotch Broom Weed Alert Fact Sheet. http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Scotch_Broom_factsheet.pdf

King County Noxious Weed Control Program. 2007d. Yellow Archangel Weed Alert Fact Sheet. http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Yellow_Archangel_FactSheet.pdf

MacLeod Reckord (Landscape Architects). 1986. Hamlin Park Master Plan Report. Prepared for the King County Department of Planning and Community Development.

Mannan R.W., E.C. Meslow, and H.M. Wright. 1980. Use of snags by birds, Douglas fir forests, western Oregon. J. Wildl. Manage. 44(4):787-797

Pacific Northwest Center for Geologic Mapping Studies. 2007. http://geomapnw.ess.washington.edu/

Seattle Urban Nature. 2004. A Citywide Survey of Habitats on Public Land in Seattle, a tool for urban restoration planning and ecological monitoring. http://www.seattleurbannature.org/Resources/SERProceedings-Victoria.pdf

Seattle Urban Nature. 2006. Citywide Habitat Assessment: Interim Report – March 2006. http://www.seattleurbannature.org/Projects/CHAInterimReport.pdf

Seattle Urban Nature 2005. Deadhorse Canyon (Lakeridge Park) Vegetation Management Plan. http://www.seattleurbannature.org/Projects/DHC.html

Sheldon & Associates, Inc. 2003. Cheasty Greenspace Vegetation Management Plan.

South Woods Preservation Group. 2007. http://savesouthwoods.org

Spies, T.A. and J.F. Franklin. 1991. The structure of natural young, mature and old-growth Douglas fir forests in Oregon and Washington. pp. 91-109. In: Wildlife and Vegetation of Unmanaged Douglas fir Forests. USDA Forest Service PNW-GTR-285. Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Stevens, V. 1997. The ecological role of coarse woody debris: An overview of the ecological importance of CWD in BC forests. Research Branch, B.C. Ministry of Forests, Victoria, B.C. Working Paper 30/1997.

Stiles, Vicki. 2007. Shoreline Historical Museum, Executive Director. Personal communication.

Thornton Creek Alliance website. 2007. http://www.scn.org/tca/

USDA Forest Service. 2004. Norway maple (*Acer platanoides*). http://www.na.fs.fed.us/fhp/invasive_plants/weeds/norway-maple.pdf

USDA Forest Service. 2005. Horse chestnut (*Aesculus hippocastanum*) http://www.na.fs.fed.us/fhp/invasive_plants/weeds/horse_chestnut.pdf

USDA Forest Service. 2006. European mountain ash (*Sorbus aucuparia*). http://www.na.fs.fed.us/fhp/invasive_plants/weeds/european-mountain-ash.pdf

USDA Forest Service. 2007. Sweet cherry (*Prunus avium*). http://www.na.fs.fed.us/fhp/invasive_plants/weeds/sweet-cherry.pdf

Appendix A. Average percent density of trees (stems/acre) and cover of shrub, herb and grass species where present in Hamlin Park (on surveyed plots) and frequency park-wide.

Scientific Name[1]	Common Name	Native	Average cover or density in sampled plots[2]	Frequency park-wide
Trees				
Acer macrophyllum	big-leaf maple	Yes	20 stems/acre	19
Acer platanoides **	Norway maple	No	148 stems/acre	25
Acer pseudoplatanus **	sycamore maple	No	45 stems/acre	6
Aesculus hippocastanum **	horse chestnut	No	17 stems/acre	22
Alnus rubra	red alder	Yes	42 stems/acre	34
Arbutus menziesii	Pacific madrone	Yes	82 stems/acre	53
Cornus nuttallii	Pacific dogwood	Yes	15 stems/acre	19
Crataegus monogyna **	one-seed hawthorn	No	12 stems/acre	16
Frangula purshiana	cascara	Yes	12 stems/acre	16
Ilex aquifolium*	English holly	No	924 stems/acre	78
Pinus monticola	western white pine	Yes	27 stems/acre	66
Populus balsamifera ssp. trichocarpa	black cottonwood	Yes	10 stems/acre	9
Prunus avium **	sweet cherry	No	304 stems/acre	63
Prunus emarginata	bitter cherry	Yes	50 stems/acre	6
Prunus laurocerasus*	cherry laurel	No	145 stems/acre	47
Prunus lusitanica **	Portugal laurel	No	17 stems/acre	22
Pseudotsuga menziesii	Douglas fir	Yes	70 stems/acre	97
Quercus sp.	oak	No	10 stems/acre	3
Salix scouleriana	Scouler's willow	Yes	10 stems/acre	3
Sorbus aucuparia **	European mountain ash	No	88 stems/acre	69
Thuja plicata	western red cedar	Yes	121 stems/acre	88
Tsuga heterophylla	western hemlock	Yes	107 stems/acre	72
Shrubs				
Corylus cornuta	beaked hazelnut	Yes	4	22
Cotoneaster bullatus **	hollyberry cotoneaster	No	2	3
Cotoneaster salicifolius **	willowleaf cotoneaster	No	2	3
Cotoneaster simonsii **	Simons cotoneaster	No	1	3
Cotoneaster sp. **	cotoneaster	No	1	6
Cytisus scoparius*	scotch broom	No	1	9
Daphne laureola **	spurge laurel	No	T	3
Gaultheria shallon	salal	Yes	24	97
Mahonia nervosa	low Oregon grape	Yes	17	94
Oemleria cerasiformis	Indian plum	Yes	1	3
Ribes sanguineum	red-flowering currant	Yes	1	3
Rosa gymnocarpa	baldhip rose	Yes	3	22
Rosa nutkana	Nootka rose	Yes	1	3
Rubus discolor*	Himalayan blackberry	No	17	44
Rubus laciniatus*	evergreen blackberry	No	T	3
Rubus leucodermis	blackcap	Yes	2	6

Scientific Name[1]	Common Name	Native	Average cover or density in sampled plots[2]	Frequency park-wide
Rubus spectabilis	salmonberry	Yes	1	13
Rubus ursinus	creeping blackberry	Yes	9	81
Sambucus racemosa	red elderberry	Yes	T	9
Vaccinium ovatum	evergreen huckleberry	Yes	T	6
Vaccinium parvifolium	red huckleberry	Yes	2	91
Forbs				
Blechnum spicant	deerfern	Yes	T	3
Cardamine hirsuta	hairy bittercress	No	T	6
Chamerion angustifolium ssp. angustifolium	fireweed	Yes	1	9
Circaea alpina	small enchanter's nightshade	Yes	T	6
Corallorhiza maculata	summer coralroot	Yes	T	13
Dryopteris expansa	wood fern	Yes	2	3
Galium aparine	cleavers	Yes	1	6
Geranium robertianum*	herb Robert	No	2	31
Geum macrophyllum	bigleaved avens	Yes	T	3
Hedera helix*	English ivy	No	10	63
Hieracium albiflorum	White-flowered hawkweed	Yes	T	3
Hypochaeris radicata	hairy cat's-ear	No	T	6
Lapsana communis	nipplewort	No	1	22
Lonicera ciliosa	orange honeysuckle	Yes	T	3
Mycelis muralis	wall-lettuce	No	1	78
Polystichum munitum	sword fern	Yes	5	66
Pteridium aquilinum	bracken fern	Yes	8	100
Ranunculus repens*	creeping buttercup	No	T	3
Rumex obtusifolius	bitter dock	No	T	3
Solanum dulcamara*	deadly nightshade	No	T	9
Taraxacum officinale	dandelion	No	T	9
Trientalis borealis ssp. latifolia	starflower	Yes	4	69
Trillium ovatum	trillium	Yes	T	6
Viola glabella	stream violet	Yes	T	3
Viola sempervirens	evergreen violet	Yes	T	9
Grasses				
Agrostis sp.	bentgrass	X	T	3
Carex deweyana	Dewey sedge	Yes	T	22
Carex sp.	sedge	Yes	1	3
Elymus glaucus	blue wildrye	Yes	T	3
Holcus lanatus	velvetgrass	No	T	19
Luzula parviflora	small-flowered woodrush	Yes	T	6
	unknown grass species	X	T	6

[1] Species in bold are non-native species. Species denoted by * are species which have been given a legal designation by the King County Noxious Weed Program (King County 2007). Species denoted by ** are non-native invasive species which do not have a legal designation at this time.
[2] T=Trace presence of species (less than 1%).

Appendix B. Bryophytes found in Hamlin Park during the 2007 survey.

Scientific Name	Common Name
Atrichum selwynii	Selwyn's atrichum moss
Aulacomnium androgynum	Aulacomnium moss
Brachythecium sp.	Brachythecium moss
Calypogeia sp.	Calypogeia sp.
Cephalozia lunulifolia	
Ceratodon purpureus	ceratodon moss
Dicranoweisia cirrata	dicranoweisia moss
Dicranum fuscescens	dicranum moss
Dicranum tauricum	dicranum moss 2
Eurhynchium oreganum	Oregon eurhynchium moss
Eurhynchium praelongum	eurhynchium moss
Homalothecium fulgescens	tree mat homalothecium moss
Hypnum circinale	hypnum moss
Hylocomium splendens	splendid feather moss
Isothecium myosuroides	Isothecium moss
Lepidozia reptans	
Lophocolea bidentata	
Lophocolea heterophylla	
Neckera douglasii	Douglas' neckera moss
Orthotrichum lyellii	Lyell's orthotrichum moss
Orthotrichum speciosum	lanceolate-leaf rock moss
Plagiothecium laetum	plagiothecium moss
Plagiothecium undulatum	undulate plagiothecium moss
Polytrichum juniperinum	juniper polytrichum moss
Porella navicularis	
Pseudotaxiphyllum elegans	elegant pseudotaxiphyllum moss
Radula bolanderi	
Rhizomnium glabrescens	rhizomnium moss
Rhytidiadelphus loreus	loreus goose-neck moss
Scapania bolanderi	
Tetraphis pellucida	tetraphis moss
Ulota obtusiuscula	ulota moss

Appendix C. Invasive Species BMPs.

Trees
Norway maple (*Acer platanoides*). http://www.na.fs.fed.us/fhp/invasive_plants/weeds/norway-maple.pdf

Horse chestnut (*Aesculus hippocastanum*)
http://www.na.fs.fed.us/fhp/invasive_plants/weeds/horse_chestnut.pdf

English holly (*Ilex aquifolium*). http://dnr.metrokc.gov/wlr/lands/weeds/holly.htm

Sweet cherry (*Prunus avium*). http://www.na.fs.fed.us/fhp/invasive_plants/weeds/sweet-cherry.pdf

European mountain ash (*Sorbus aucuparia*)
http://www.na.fs.fed.us/fhp/invasive_plants/weeds/european-mountain-ash.pdf

Shrubs
Himalayan blackberry (*Rubus discolor*)
http://dnr.metrokc.gov/wlr/lands/weeds/pdf/blackberry-control.pdf

Scotch Broom (*Cytisis scoparius*)
http://dnr.metrokc.gov/wlr/lands/weeds/pdf/scotch-spanish-broom-control.pdf

Herbaceous Species and Vines
Herb Robert (*Geranium robertianum*)
http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Herb_Robert_Factsheet.pdf

English ivy (*Hedera helix*)
http://dnr.metrokc.gov/wlr/lands/weeds/pdf/english-ivy-control.pdf

Yellow archangel (*Lamiastrum galeobdolon*)
http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Yellow_Archangel_FactSheet.pdf

Appendix D Stake locations for 32 plots established in Hamlin Park, 2007.

GCS WGS 1984 - Decimal Degrees				
Park	**Plot**	**Latitude**	**Longitude**	**Bearing**
Hamlin Park	1	47.74357477901	-122.30270389183	0
Hamlin Park	2	47.74438664565	-122.30258332125	225
Hamlin Park	3	47.74447529210	-122.30325649834	280
Hamlin Park	4	47.74467266583	-122.30527703554	180
Hamlin Park	5	47.74354116999	-122.30565160153	20
Hamlin Park	6	47.74520285248	-122.30520334125	0
Hamlin Park	7	47.74592391020	-122.30538429403	0
Hamlin Park	8	47.74675953232	-122.30621633124	180
Hamlin Park	9	47.74679948025	-122.30728415954	180
Hamlin Park	10	47.74591941426	-122.30862825141	0
Hamlin Park	11	47.74522632020	-122.31028376007	135
Hamlin Park	12	47.74525715755	-122.31169016748	90
Hamlin Park	13	47.74571001957	-122.31004741223	270
Hamlin Park	14	47.74569792234	-122.31240785900	0
Hamlin Park	15	47.74685588659	-122.31205001890	90
Hamlin Park	16	47.74702936345	-122.30556393142	250
Hamlin Park	17	47.74652614411	-122.30988568569	270
Hamlin Park	18	47.74752592549	-122.30686838343	180
Hamlin Park	19	47.74692702149	-122.30834286243	0
Hamlin Park	20	47.74764552062	-122.30860495378	45
Hamlin Park	21	47.74710199218	-122.30611100564	340
Hamlin Park	22	47.74750622158	-122.31190137733	90
Hamlin Park	23	47.74854662223	-122.30859194513	45
Hamlin Park	24	47.74905413661	-122.30840275673	0
Hamlin Park	25	47.74758320551	-122.31060555657	90
Hamlin Park	26	47.74805127899	-122.30939450732	180
Hamlin Park	27	47.74685695348	-122.31105520800	180
Hamlin Park	28	47.74706919764	-122.31254328346	180
Hamlin Park	29	47.74807453294	-122.31271704944	180
Hamlin Park	30	47.74814918599	-122.31141090664	270
Hamlin Park	31	47.74937065535	-122.30980765954	135
Hamlin Park	32	47.74822597134	-122.30667866415	90

Appendix E. Map of locations for 32 plots established in Hamlin Park. Points show the origins of plots.