December 2016

Twin Ponds Park Vegetation Management Plan

Shoreline, WA 98133

King Conservation District

LOCAL RESTORATION
EARTH CORPS
GLOBAL LEADERSHIP

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Twin Ponds Park Vegetation Management Plan

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Special thanks to Twin Ponds Park stewards Yoshiko Saheki and Jim Conuel for their support in creating this document and their invaluable dedication and knowledge of the park.

Cover photo: Trail in the western open space (Zone 4). Inset: fireweed, salmonberry, Douglas spirea, and mock orange.

1. Introduction

Twin Ponds Park is a multi-use park located in southcentral Shoreline, WA. The park is centered around two created ponds surrounded by walking trails, natural areas, and a formal manicured park area. In addition, the park includes a synthetic soccer field, a tennis court, an informal arboretum, and a community garden. Thornton Creek and its tributary Meridian Creek flow through the ponds, eventually emptying into Lake Washington. The focus of this report is directed towards the management of the natural areas of the property that are informally designated for passive recreation and habitat conservation values. Specifically, the purpose of this plan is to provide a summary of the existing conditions of the parks designated natural areas and to develop general recommendations for their ongoing restoration and management. Having an overall understanding of existing conditions will help make informed management decisions and provide baseline conditions that can be used to track and monitor changes to the park over time.

In 2016, the City of Shoreline contracted with EarthCorps to provide mapping and vegetation management recommendations for Twin Ponds Park (with funding through a grant from the King Conservation District). During the 2016 field season, EarthCorps ecologists worked with existing site stewards to create Habitat Management Units (MU's) in order to identify and track existing and future management activities. These efforts divided the park into 9 general Park Zones and 17 individual Management Units (including the ponds) based on current habitat types, plant species assemblages, trails, and other topographical features (Map 1). In order to characterize the existing conditions of these natural areas, EarthCorps performed a rapid survey of the vegetative structure and composition of each MU. Information presented in this report describes the general conditions of each MU and provides recommendations for long-term management and stewardship of the park's natural areas.

Developing a long-term vegetation management plan is an important step towards protecting, enhancing, and maintaining the forests and associated natural areas found within the park; increasing the natural, social, and economic services they provide. These services include: storm water mitigation, flood and erosion control, improved air quality, carbon sequestration, enhanced wildlife habitat, public education, passive and active recreation, as well as many other documented benefits to the health and well-being of the community. Forests and wetlands 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. In addition, these natural areas offer a valuable cultural resource to Shoreline's community and provide important recreational and educational opportunities. Through active management and ongoing stewardship, these wetlands and natural areas will continue to be a valuable asset to Shoreline residents and the surrounding communities.

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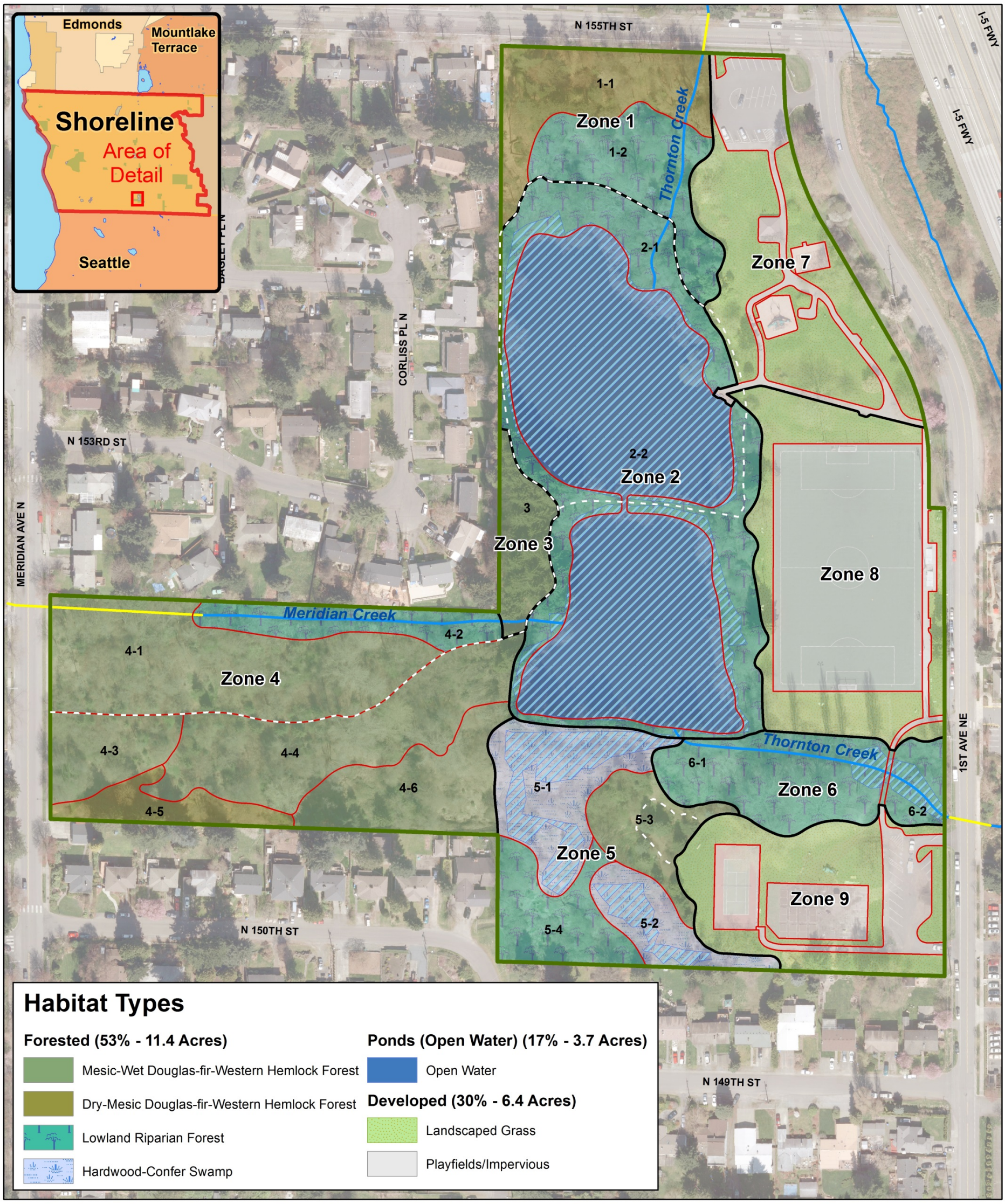
Twin Ponds Park

Park Zones and Habitat Management Units

Map 1



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2. Forest and Natural Area Assessment

EarthCorps performed a rapid survey of each MU during the 2016 field season. During this inventory, the vegetative structure and composition of each MU were characterized. The purpose of the forest assessment and analysis was to:

- Create Management Units to prioritize and track habitat restoration and management efforts
- Develop specific recommendations to restore and increase the health and structure of existing vegetation communities
- Provide baseline data on the existing structure and composition of the vegetation communities

2.1. Management Units

Twin Ponds Park was initially divided into nine different Park Zones (Map 1). These zones were then partitioned into areas of similar habitat types based on dominant plant species associations, topography, or other existing features during GPS (global positioning system) assisted field surveys (Map 1). Overall, a total of 17 discrete natural area Management Units (MUs) were delineated that include four different broad forested habitat types (Table 1). These habitat types were adapted from the ecological classification system developed by NatureServe and utilized by the Washington Dept. of Natural Resources (WADNR) and the Washington Natural Heritage Program (WNHP) (Rocchio and Crawford, 2015). These broad habitat types were then further separated based on unique species associations within these typings, topography, or other pertinent features (Map 1).

The forested and wetland habitat types were adapted from the WADNR classifications while the open water and developed habitat types (which include lawn, developed play areas, soccer fields, tennis courts, the community garden, and sidewalks/parking areas) are not represented by this system. The developed and open water areas represent nearly half (47%) of the total park area. Table 1 and Figure 1 show a summary of these broad habitat types found throughout the park. These Park Zones and Management Unit delineations are used in this report to reference distinct areas within the park and can be used to plan, prioritize, and track management and restoration efforts over time.

2.2. Assessment Procedures

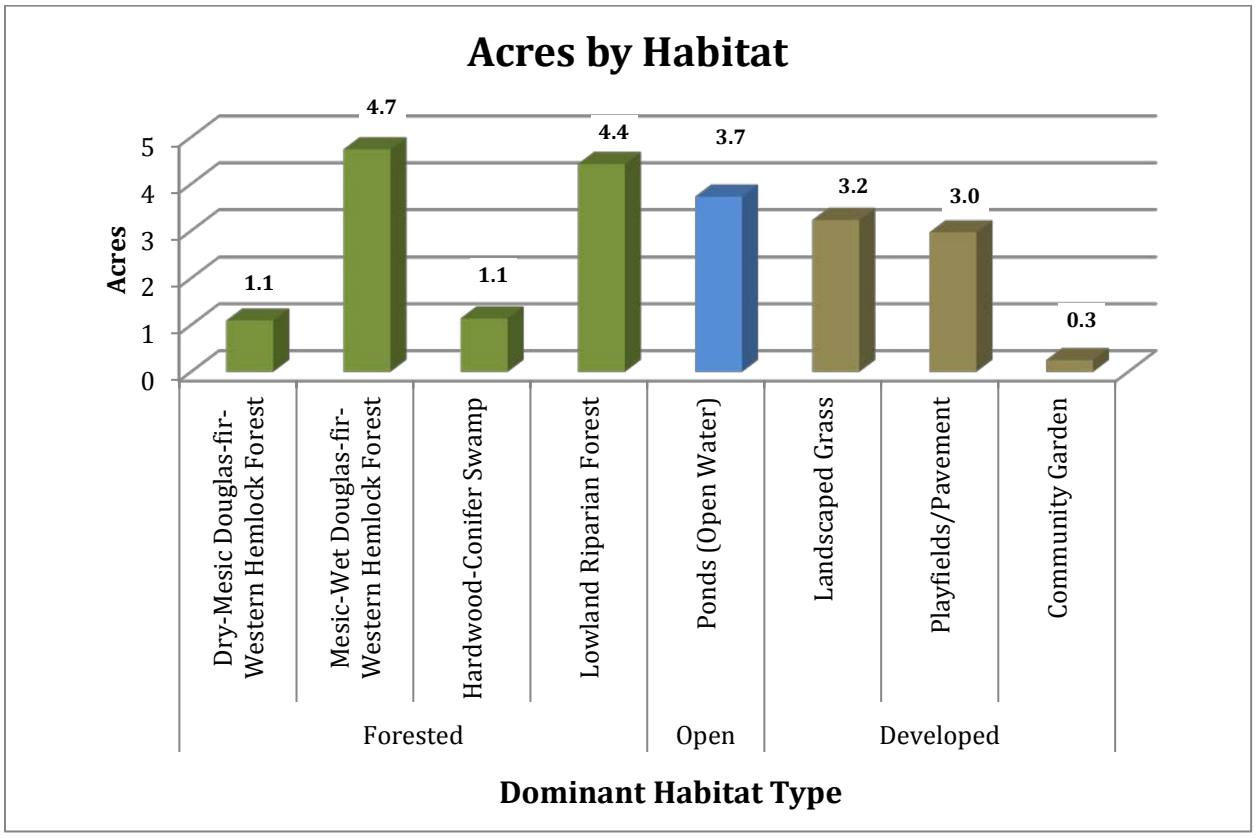
Each natural area Management Unit was inventoried using a rapid visual assessment procedure to provide a general understanding of the composition of the existing vegetation present throughout the Park. Information collected for each area included dominant native plant species (trees, shrubs, groundcovers), presence of dominant non-native invasive plant species, and the presence of other habitat features or general site characteristics. This information was used to develop an overall assessment of the structure, composition, and health of the park. All field surveys were conducted in early June of 2016 by EarthCorps ecologists.

Table 1. NatureServe and developed/disturbed ecological system units and the acres and percent of each type present in Twin Ponds Park.

Habitat Type*	Acres	Percent of Total
Forested (53% - 11.4 Acres)		
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	4.7	22%
North Pacific Lowland Riparian Forest and Shrubland	4.4	20%
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	1.1	5%
North Pacific Hardwood-Conifer Swamp	1.1	5%
Open (17% - 3.7 Acres)		
Ponds (Open Water)*	3.7	17%
Developed (30% - 6.4 Acres)		
Landscaped Grass*	3.2	15%
Playfields/Pavement (includes parking lots, sidewalks, playgrounds, Soccer field and tennis court)*	3.0	14%
Community Garden*	0.3	1%
Grand Total	21.6	

*Indicates a type that does not correspond to a NatureServe System.

Figure 1. Cumulative acres of each habitat type present in Twin Ponds Park by general land cover.



Twin Ponds Park

Open Space Habitat Managment Units

Map 2

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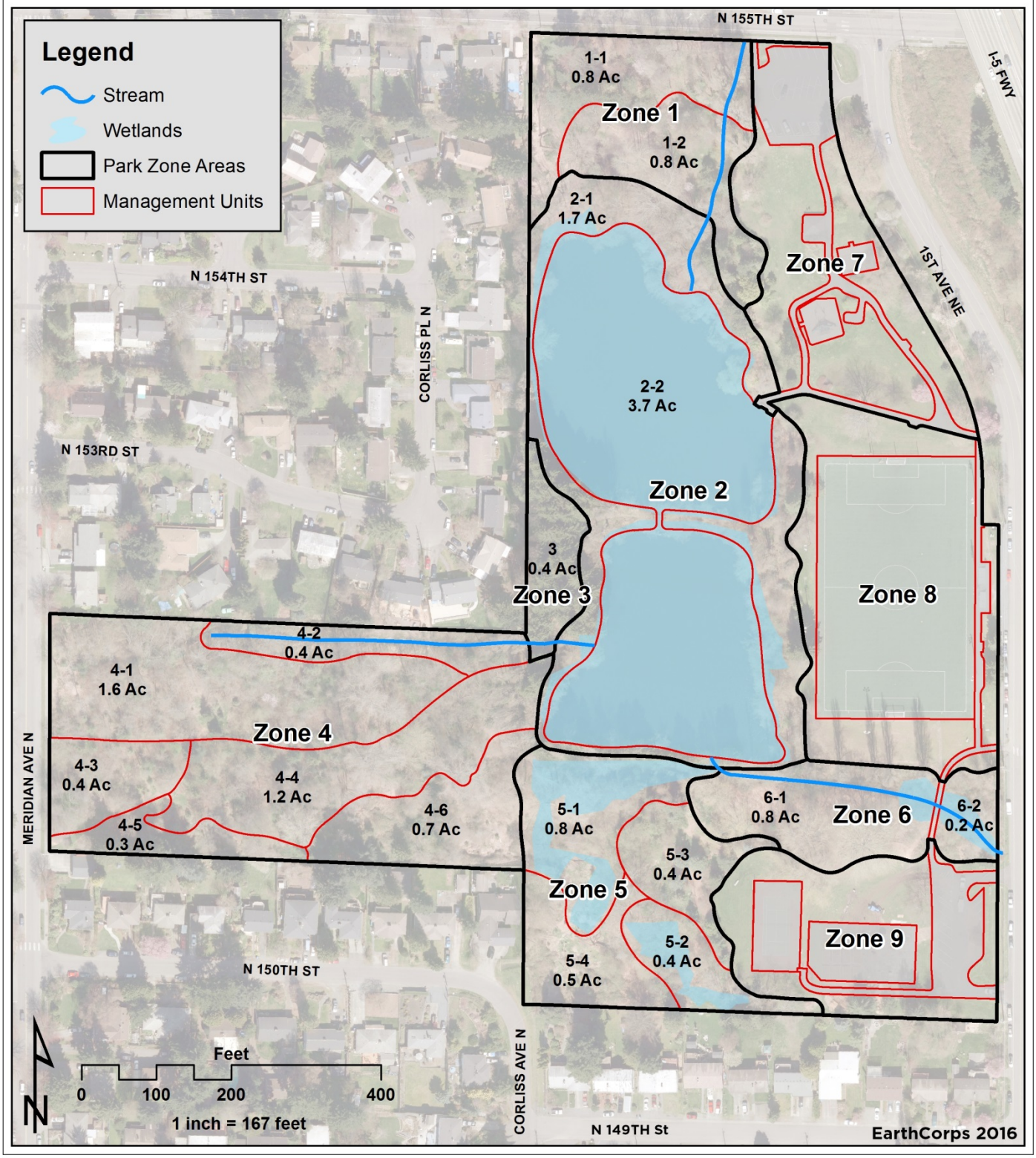


Table 2. Habitat Management Units and habitat types showing acres and square feet.

Management Unit	Habitat Type	Acres	Square Feet
1-1	Dry-Mesic Douglas-fir-Western Hemlock Forest	0.79	34,356
1-2	Lowland Riparian Forest	0.75	32,744
2-1	Lowland Riparian Forest	1.65	71,901
2-2	Open Water	3.73	162,445
3	Mesic-Wet Douglas-fir-Western Hemlock Forest	0.37	16,098
4-1	Mesic-Wet Douglas-fir-Western Hemlock Forest	1.59	69,433
4-2	Lowland Riparian Forest	0.43	18,829
4-3	Mesic-Wet Douglas-fir-Western Hemlock Forest	0.41	18,064
4-4	Mesic-Wet Douglas-fir-Western Hemlock Forest	1.20	52,131
4-5	Dry-Mesic Douglas-fir-Western Hemlock Forest	0.30	13,261
4-6	Mesic-Wet Douglas-fir-Western Hemlock Forest	0.71	31,136
5-1	Hardwood-Conifer Swamp	0.77	33,579
5-2	Hardwood-Conifer Swamp	0.37	16,155
5-3	Mesic-Wet Douglas-fir-Western Hemlock Forest	0.45	19,530
5-4	Lowland Riparian Forest	0.53	22,910
6-1	Lowland Riparian Forest	0.84	36,591
6-2	Lowland Riparian Forest	0.22	9,783

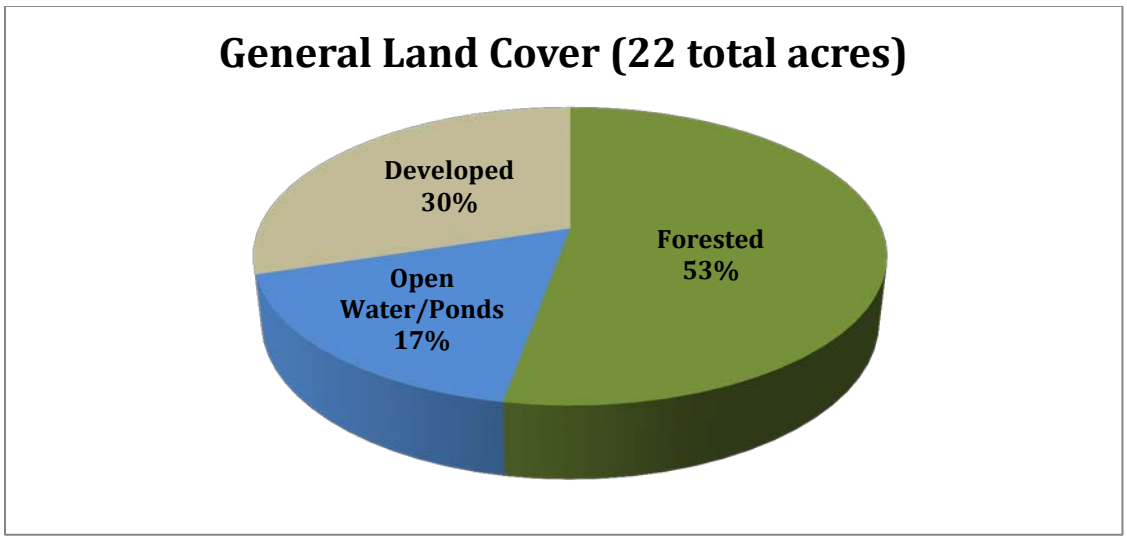
3. Results and Findings

The following sections of the report describe the general conditions of the property (section 4.1) and a more detailed description of each of the dominant habitat types (section 4.2).

3.1. Property-wide Conditions

Overall, a little more than half of the entire park property (53%) is made up of upland and wetland forests (Figure 2). The remaining land area is made up of developed (30%) and open water (17%). The riparian forests and forested wetlands are generally situated around the ponds themselves and in the southern portion of the park, while the upland forests are predominantly found in the northern and western portions of the park (Map 1). The eastern portion of the park is primarily developed and made up of formalized park improvements and playfields (Zones 7, 8 and 9).

Figure 2. Proportion of general land cover types present throughout Twin Ponds Park.



The natural areas found in Twin Ponds Park are generally comprised of young developing native forests such as those found throughout Zone 4 and relatively disturbed forested wetlands and riparian areas. The northern portion of Zone 1 (MU 1-1) and Zone 3 have a more mature non-native dominated conifer canopy with a generally sparse understory. Overall, these natural areas are heavily fragmented and influenced by their surrounding residential and urban land uses. As a result, the forests are generally in a state of decline and heavily impacted by invasive plant species.

The upland forested areas present at Twin Ponds Park generally represent young conifer-deciduous mixed forested woodlands that predominantly make up the western portion of the park in Zone 4. These forests are generally moist, mixed woodlands with a predominantly deciduous canopy made up of red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*). Many young coniferous trees have been planted throughout the central portion of

Zone 4, particularly along the main path that connects Meridian Ave N with the pond loop trail (Map 1). Along with western red cedar (T*huja plicata*) trees, other planted conifer species include Douglas fir (*Pseudotsuga menziesii*), grand fir (*Abies* grandus), and western hemlock (*Tsuga heterophylla*). Other common native tree species present in these areas include bigleaf maple (*Acer macrophyllum*), cascara buckthorn, (*Rhamnus purshiana*), bitter cherry (*Prunus emarginata*), Oregon ash (*Fraxinus latifolia*), and Scouler's willow (*Salix scouleriana*). The other upland areas (MU 1-1, Zone 3, and MU 5-3) have a more mature conifer canopy that is made up of predominantly non-native species that include Norway spruce (*Picea abies*), giant sequoia (*Sequoiadendron giganteum*) and *Pinus* species. Zone 3 is almost exclusively made up of mature Norway spruce canopy. MU 5-3 has considerable variety of both native and ornamental species that have been planted as the "Arboretum" over the past twenty years. For more information on these efforts, see https://twinpondspark.wordpress.com/history/.

A diverse arrangement of shrub species can be found in the upland forests with particular associations varying by available soil moisture. Wetter, low-lying areas have salmonberry (*Rubus spectabilis*), willow (Salix) species, red-twig dogwood (*Cornus sericea*), red elderberry (*Sambucus racemosa*), and Pacific ninebark (*Physocarpus capitatus*). Dryer areas are dominated by beaked hazelnut (*Corylus cornuta*), Indian plum (*Oemleria cerasiformis*), thimbleberry (*Rubus parviflorus*), oceanspray (*Holodiscus discolor*), baldhip rose (*Rosa gymnocarpa*), serviceberry (amelanchier alnifolia), snowberry (*Symphoricarpos albus*), and others.

The herbaceous/groundcover layer is not generally well developed and is dominated by western sword fern (*Polystichum munitum*) and creeping blackberry (*Rubus ursinus*). Other prevalent species include largeleaf avens (*Geum macrophyllum*), piggyback plant (*Tolmiea menziesii*), fringcup (*Tellima grandiflora*), false lily-of-the-valley (*Maianthemum dilatatum*), lady fern (*Athyrium filix-femina*), western bracken fern (*Pteridium* aquilinum), and stinging nettle (*Urtica dioica*).

The riparian forests and forested wetlands are dominated by wet adapted species with the tree canopy predominantly composed of black cottonwood, alder, and willow species with some Oregon ash. The riparian forest in Zone 6 also has a number of non-native trees present in the overstory including linden, London Plane, oak, and birch trees. The shrub layer is generally well developed and made up of willows, salmonberry, Pacific ninebark, vine maple (*Acer circinatum*), twinberry (*Lonicera involucrata*), and Pacific crabapple (*Malus fuscu*). Native herbaceous species in these riparian forests and forested wetlands include water parsley (*Oenanthe sarmentosa*), giant horsetail (*Equisetum telmateia*), skunk cabbage (*Lysichiton americanus*), stinging nettle, lady fern, and Cooley's hedge-nettle (*Stachys cooleyae*).

The biggest threat to the health and function of these forests is the continued spread and introduction of non-native invasive plant species. Many areas of the park have become substantially invaded with several species of invasive plants common in our area. Map 2 shows the approximate locations of selected invasive species concerns. It should be noted that this is

not a complete or thorough inventory of all invasive species in the park and is meant as a general reference only. Dominant invasive species that are present and widespread within the park include Himalayan blackberry (*Rubus bifrons*), English ivy (*Hedera helix*), English holly (*Ilex aquifolium*), and English hawthorn (*Crataegus monogyna*). Other invasive species that are isolated or less dominant include Italian arum (*Arum italicum*), yellow archangel (*Lamiastrum galeobdolon*), bohemian knotweed (*Polygonum* x *bohemicum),* Poison hemlock, (*Conium maculatum*), bittersweet nightshade (*Solanum dulcamara*), hedge-false bindweed (*Calystegia* (*Convolvulus*) *sepium*), creeping buttercup (*Ranunculus repens*), cherry laurel (*Prunus laurocerasus*), Portugal laurel (*Prunus* lusitaInica), reed canarygrass (*Phalaris arundinacea*), common periwinkle (*Vinca minor*), herb Robert (*Geranium robertianum*), black locust (*Robinia pseudoacacia*), and European mountain-ash (*Sorbus aucuparia*). While these species are not required for control in King County, their ability to spread and outcompete native plants makes them a continuing and increasing threat to the structure and function of the natural areas. A long-term invasive species management strategy is recommended in order to control or eradicate these species. More information is provided in the following sections of this report.

The natural areas in Twin Ponds Park represent an important resource to the surrounding community for the recreational and ecosystem services that they provide. Urban forests face increasing human pressures and disturbances and maintaining the health and stability of these natural areas will ensure that they continue to provide these processes and functions for years to come. Continued active management and restoration will help to maintain and increase the ability for these forests to support the valuable ecosystem services that they provide.

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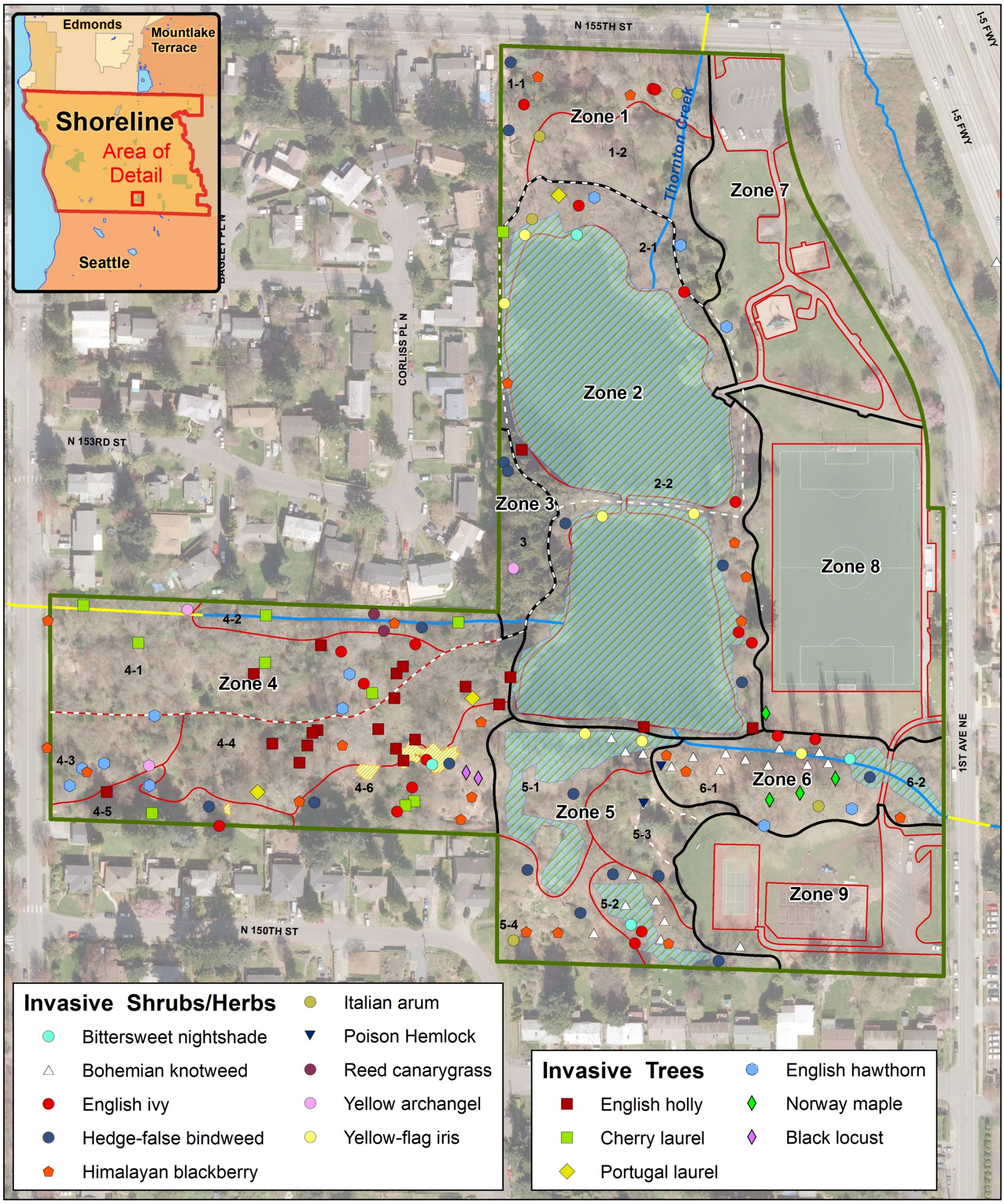
Twin Ponds Park

Dominant Invasive Species Locations

Map 3



Legend

- Park Boundary
- Park Zone Areas
- Management Units
- Trails
- Wetlands
- Open Water Course
- Piped Water Course

N

0 75 150 300

Feet

1:1,600

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3.2. Dominant Habitat Types

Five natural habitat types (including open water) were identified using the WADNR ecological classification system not including disturbed or developed areas of the Park. This section provides a description of each of these habitats and indicates their location and context within the park and associated Management Units (MUs)

3.2.1. North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest

Photo 1: MU 4-1 looking east along the access trail showing salmonberry, young conifer trees, and the deciduous dominated overstory.

The North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest is the most dominant forest type present in the Park and comprises the majority of the western portion of the property in Zone 4. Smaller isolated areas include the spruce forest in Zone 3 and the "arboretum" represented by MU 5-3 (Map 1). These forests are generally defined by moist conditions that support a variety of tree and shrub species. The forests in Zone 4 (MU's 4-1, 4-2, 4-3, 4-4, and 4-6) are relatively homogenous and were separated by trails for management purposes. Generally, the wetter portions of these forests extend from the lower–lying areas near Meridian Creek in the north and transition to generally dryer conditions towards the south. MU 4-1 exhibits some lower depressional areas that exhibit seasonal flooding and may retain moisture throughout the dryer months. A ditch or swale is present in the northern portion of MU 4-4 that also exhibits generally wetter conditions than the surrounding forests and collects standing water during the wet season.

Photo 2: MU 4-4 showing high cover of sword fern indicative of this ecological system.

In general, these areas are currently dominated by a relatively sparse deciduous dominated tree canopy made up of black cottonwood, red alder, and bigleaf maple, with smaller components of bitter cherry, cascara buckthorn, and other species. A few relatively large grand fir and western hemlock trees are present in the overstory, although the current evergreen canopy is mostly sparse.

Large Scouler's and Pacific (*Salix lasiandra*) willows are also scattered throughout. Oregon ash is also present but not prevalent. Some large western red cedars (as well as some non-native conifers including coast redwood (*Sequoia sempervirons*) and giant sequoia (*Sequoiadendron giganteum*) trees) extend into the canopy in MU 5-3. Zone 3 (with the single MU 3) is unique in that it has a nearly closed conifer canopy made up exclusively of non-native Norway spruce trees. The understory in this area is poorly developed and generally invaded with invasive yellow archangel and hedge-false bindweed (Map 2).

Photo 3: MU 4-4 showing a young planted western hemlock tree.

The native shrub layer is varied throughout this forest type, with some areas exhibiting a well-developed shrub layer with high species richness. Salmonberry, red-twig dogwood, and red elderberry are common in the wetter areas with more typical upland associated shrubs (beaked hazelnut, Indian plum, ocean spray, serviceberry, thimbleberry, snowberry etc.) in dryer areas of the forest. The herbaceous layer is also variable with some areas exhibiting high cover and diversity. In general, sword fern, trailing blackberry, and largleaf avens are the most common herbaceous species throughout Zone 4. Moist areas can exhibit high cover of false lily-of-the-valley and star-flowered Solomon's seal (*Maianthemum stellatum*), with other notable species including lady fern, fireweed (*Chamerion angustifolium*), Oregon wood-sorrel (*Oxalis oregana*) and cow parsnip (*Heracleum maximum*).

Conditions in the mesic-wet Douglas-fir western hemlock forest are variable. Overall, invasive species are prevalent throughout and represent a significant threat to the future structure of the forest. Of specific concern is the relatively high density of invasive trees, especially in Zone 4 (Map 2). English holly and English hawthorn are dense in MU's 4-1, 4-3, and 4-4 and cherry laurel is locally predominant in areas of 4-1 and 4-6. Black locust is also prevalent in MU 4-6. Himalayan blackberry is locally prevalent especially along the margins of the park, and English ivy is dense in portions of MU's 4-1 and 4-6. These forests are also the site of active restoration, with multiple areas currently being improved and restored. Many young conifer trees have been planted throughout these forests in Zone 4 which over time will transition the forests to a more evergreen dominated system. More information on the control of invasive trees and the importance of restoration site maintenance can be found in the Management Recommendations section below.

3.2.2. North Pacific Hardwood-Conifer Swamp

The North Pacific Hardwood-Conifer Swamp habitat is found in Zone 5 in the area of the delineated wetlands south of the ponds in MU's 5-1 and 5-2 and in the eastern portion of Zone 6 in MU 6-2 (Map 1). These forested wetlands are typified by saturated mucky soils in low-lying depressions. These wet hydrological conditions create a somewhat open tree canopy with a relatively high cover of shrubs. In the larger wetland area of MU 5-1, the central portion exhibits characteristics of an emergent wetland with high herbaceous cover of skunk cabbage, water parsley, and lady fern. The tree canopy is dominated by tall black cottonwoods and red alder trees, and the shrub layer is dense with willows, vine maple, Pacific crabapple and other species.

Photo 4: MU 5-2 showing high shrub cover of willow and vine maple, with heavy cover of English ivy in the ground layer.

Overall, these habitats are generally disturbed although some portions have relatively intact wetland characteristics, primarily in the central portion of MU 5-1. High cover of invasive species is generally prevalent throughout, with the greatest threats posed by bohemian knotweed, yellow flag iris, and English ivy. Because of the sensitive nature of these areas, disturbance and access should be limited.

3.2.3. North Pacific Lowland Riparian Forest and Shrubland

The North Pacific Lowland Riparian Forest and Shrubland habitat type is generally found adjacent to moving rivers or streams. In Twin Ponds Park, these forests are predominantly found in a relatively narrow corridor surrounding the ponds and along the open channels of Meridian (MU 4-2) and Thornton Creeks (MU's 6-1 and 6-2) (Map 1). Around the pond edges and in areas of slow moving water along the creeks, the riparian forests show some similar characteristics with the hardwood-conifer swamp ecological system. These forests extend north into the lower

Photo 5: MU 2-2 along the SE corner of the pond showing willow shrub cover, water parsley, and invasive yellow flag iris.

portion of Zone 1 into MU 1-2 and southwest from the wetlands in Zone 5 into MU 5-4. These wetlands and moist riparian forests are dominated by black cottonwood, alder, and various willow species. MU 6 is dominated by a variety of non-native deciduous tree species as well, including Norway maple (*Acer platanoides*) which can be quite invasive. The area in MU 5-4 has a relatively open canopy and is also the location of active and ongoing restoration efforts. Zone 4-2 is comprised of a narrow strip adjacent to the property line and also has a relatively open canopy. Because of this exposure, both of these areas exhibit high cover of red canarygrass. Efforts to increase the canopy in these Zones could help eventually shade out this species and lessen its impact in the system. Some areas of these forests have relatively high cover of native shrub species including willow, vine maple, twinberry, Pacific crabapple and other species. The lower depression in MU 1-2 has a limited number of native plants installed that were doing well at the time of this survey. However, much of these areas are heavily invaded with non-native invasive weed species. Blackberry is predominant along much of the pond shorelines and bohemian knotweed is prevalent along Thornton Creek in MU 6-1. Other invasive species of concern include yellow flag iris in the submerged pond margins and English ivy in relatively isolated patches (Map 2). The wet soils generally associated with this habitat make it highly sensitive and susceptible to human disturbances, which should be limited where possible.

3.2.4. North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest

The North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest habitat type was identified in two general areas of the Park in Zones 1 (MU 1-1) and 4 (MU 4-5) (Map 1). These forests are typified by a dominant coniferous canopy with a shrub layer made up of dry-type plant species. This system is closely related to and transitions into the Mesic-Wet Douglas-fir-Western Hemlock system type and the forests in these MUs have structural aspects of both. In general, this forest type has higher conifer overstory compared to the wetter type which is currently dominated by deciduous canopy. In MU 1-1, the canopy is generally comprised of non-native conifer and deciduous trees while the canopy in MU 4-5 is predominantly young Douglas fir.

Photo 6: MU 4-5 showing young Douglas fir trees along the southern boundary of the park.

The native shrub layer is generally sparse in both parts of the park, with evidence of past clearing (potentially for sight lines) in MU 1-1 along North 155th Street. A portion of Thornton Creek flows through the northeast corner of MU 1-1, although the creek quickly transitions to upland habitat in this area. Himalayan blackberry is prevalent and heavy in some locations, and isolated patches of English

ivy were noted in both MU's (Map 2). Other invasive species include cherry laurel, common periwinkle, creeping buttercup (*Ranunculus repens*), hedge-false bindweed, and herb Robert (*Geranium robertianum*). Notable native herbaceous plants include bedstraw (*Galium aparine*) and Pacific bleeding heart (*Dicentra formosa*)

4. Management Recommendations

Priority actions for restoration at Twin Ponds Park should focus on three general areas of concern: the eradication of priority invasive species, the continued maintenance of existing restoration efforts; and increasing the structural diversity of the forest with the installation of appropriate native plants. In addition, increasing public awareness and education around invasive species and habitat restoration could help reduce encroachment from private property and limit additional disturbance to the natural areas.

In general, the majority of the existing natural areas are relatively young, early successional deciduous dominated forests. Consequently, these forests are also substantially fragmented from past disturbances (logging, clearing, development, etc.) and continue to receive considerable urban pressure from adjacent land use and ongoing human impacts. As a result, the existing conditions of the forests are generally degraded and in various states of decline. Invasive species are prevalent and continue to spread and the park generally lacks substantial native tree regeneration.

Despite these considerations, past and continued efforts have substantially improved the conditions of these natural areas and continue to alter the current trajectory of the health and structure of the park as the forests here mature. Because of the pressures noted above, active management will be necessary to sustain and improve the health and function of these natural areas over time.

The following is a summary of general restoration management recommendations that are intended to provide overarching guidance towards improving the current and future health and structure of the forested natural areas. Over time, these improvements will help transition the trajectory of succession towards a more self-sustaining system that will be resilient to ongoing pressures as population and urbanization continue to increase in the region over time.

4.1. Priority Volunteer Restoration Considerations

Overall primary forest restoration efforts (suitable for volunteers) should focus on the following general themes:

1. Existing site maintenance and restoration efforts within previously cleared areas including targeted invasive species management of priority noxious weeds (see below);
2. Increasing the structural diversity of the forest with park-wide native tree and shrub planting focused on increasing overall conifer canopy;

3. Incremental reduction of predominant invasive plant species that are currently widespread or occupy large or dense portions of the park (as time and resources become available).
4. Substantial amounts of trash and other debris were historically removed from the park and inorganic material is still present in many areas. If warranted, this material should be considered for removal in order to facilitate habitat restoration efforts. For example, MU 5-2 has some sizeable piles of broken concrete along the edge of the eastern boundary of the wetland. This material should be considered for removal as part of the planning for any larger-scale restoration efforts in this area.

Primary restoration efforts should focus on maintaining existing areas that have previously been cleared of invasive species. It is important to provide continued resources towards supporting these efforts before instigating new projects in unconnected areas of the park. New projects should only be implemented when enough investment (both labor and capitol) can be expected to sustain maintenance on both existing and planned efforts.

4.1.1. Zone Summaries for Short-Term Stewardship Vegetation Management

The following recommendations are provided as suggested short-term restoration objectives for each zone.

A general approach to stewardship should follow these overarching guidelines:

- Remove isolated or small patches of invasive plants first before initiating removal of large or dense infestations.
- When dealing with larger or dense infestations, consider the following:
    - Work in small, manageable sections and consider the level follow-up maintenance efforts that will be required for long-term success.
    - Sheet-mulch if practical for invasive species suppression and plant hardy trees and shrubs for initial establishment. Sheet mulching with burlap or cardboard and 6-8 inches of woodchip mulch is recommended in areas of recently cleared or bare ground for weed suppression and moisture retention.
        - Be mindful of spreading mulch on rare or sensitive plants. Make sure to only use clean material free of weeds to avoid introducing additional invasive species. Hedge-false bindweed can quickly establish on newly mulched areas.
    - Only initiate new clearing if resources are available to maintain existing active restoration sites.
- Mulch rings should be considered around individual plant installations where appropriate and practical.
- Consider late summer or early fall for initial clearing activities to plan for favorable fall plant installation timing.

- Plan for infill-planting one to two years after initial planting occurs. Generally plan for an additional 20% of initial planting density.
- Consider tracking restoration efforts by MU in order to track progress and coordinate follow-up maintenance activities.
- Consider establishing photo-points in areas where repeat photographs can be taken prior to initial clearing and again once or twice a year for the first 3-5 years during site establishment. This information can be useful in tracking progress and employing adaptive management.
- Target plant species prioritized for removal should include; Himalayan blackberry, English ivy, bittersweet nightshade, hedge-false bindweed, herb Robert and manageable sprouts of all invasive tree species (English holly, cherry laurel, Portugal laurel, English hawthorn, black locust, Norway maple, and European mountain-ash). Small or isolated patches of yellow archangel may also be considered in areas where manual control is feasible.
    - Larger trees (that cannot be removed by manual digging) should be flagged for treatment by a Park's contracted licensed herbicide applicator.
    - Trees can be limbed up to facilitate access but should not be cut which will result in aggressive re-sprouting.

General short-term recommendations for each Zone:

Zone 1: Management Zone 1 includes two MU's: the upland forested unit (MU 1-1) and the lower riparian influenced unit (MU 1-2). The greatest concerns in Zone 1 include the spread of Italian alum (primarily in the western portion of 1-2) and isolated to scattered patches of Himalayan blackberry and English Ivy (Map 2). Long-term management should consider the eventual replacement of the primarily non-native tree canopy with native trees, focusing on establishing a conifer understory. In addition, invasive control and native plant infill is recommended in the wet-meadow area of unit 1-2.

Short-term management goals for Zone 1 include:

- Hand-remove ivy and periwinkle in MU 1-1 and replant.
- Hand-remove isolated occurrences of yellow flag iris in MU 1-2.
- Incrementally remove Himalayan blackberry from upland areas, working towards the larger infestation along North 155th Street in the northwest.
- Native tree plantings are recommended to ultimately replace the current non-native dominated tree canopy
- Consider planting sword fern, salal (*Gaultheria shallon*), dull Oregon grape (*Mahonia nervosa*) and/or other low growing shrubs near North 155th Street to maintain sightlines (coordinate with Parks).

- Remove invasive species from wet meadow in MU 1-2 and plant additional species such as Oregon ash, willow, red-twig dogwood, twinberry, Pacific ninebark and other wet adapted tree and shrub species.
- Control hedge-false bindweed by manual removal from establishing plants and consider options for control.
- Coordinate with Parks regarding the treatment, control and follow-up maintenance of Italian arum. This plant species should not be manually controlled in this area.

Zone 2: This management zone includes the immediate shoreline and associated low-lying areas surrounding both ponds. In general, the wetlands transition quickly to more upland conditions and trails and other access have resulted in varying levels of disturbance. Where feasible, invasive plants (particularly Himalayan blackberry and English Ivy) could be carefully targeted for removal (in areas outside of the designated wetlands) and followed by native planting. Any work occurring directly along the shoreline should be coordinated with Parks.

Short-term management goals for Zone 2 include:

- Create ivy "survival" rings to free existing trees from English ivy and reduce seed source. Cut all vines at shoulder height and grub out roots in a five-foot radius surrounding trunks.
- Consider plans to coordinate more extensive removal of ivy and blackberry and replant with riparian natives along sections of the shoreline.
- Identify areas adjacent to the ponds where stewardship work may be appropriate – such as relatively dry areas where invasive species management could be effective. For example, the relatively isolated patch of English ivy on the eastern edge of the ponds adjacent to the soccer playfield could be targeted for removal and replanting. Any action should be coordinated with the Parks Department, especially if occurring within a designated wetland.

Zone 3: The greatest concerns in Zone 3 include the heavy cover of yellow archangel and hedge-false bindweed. Manual control of Yellow archangel could be incrementally attempted, although a coordinated chemical control with follow-up maintenance would generally be recommended for an infestation of this size. Once these species are under control, native planting of trees and shrubs should be a priority.

Short-term management goals for Zone 3 include:

- Consider efforts to reduce and minimize the spread of hedge-false bindweed which is particularly heavy in the northern portion of the zone in the vicinity of the piles of cut and stacked wood pieces. Hand removal and targeted herbicide treatments (managed by Parks) could be effective if coordinated over several seasons.
- Coordinate with Parks to determine best approach for the treatment, control and follow-up maintenance of yellow archangel. A combination of chemical treatment and follow-up hand removal is recommended.

Zone 4: Zone 4 contains the largest and most diverse natural areas and has been separated into six separate management units. This area is also where most of the current and on-going restoration efforts are focused. It may be useful to create individual management goals for each unit in order to help prioritize restoration efforts.

Short-term management goals for Zone 4 include:

- Provide ongoing maintenance of all active restoration sites.
- Create ivy "survival" rings from all trees and consider removal of isolated patches of English ivy.
- Hand-remove small patch of yellow archangel from MU 4-3 and provide follow-up maintenance in this area over time.
- Control hedge-false bindweed from establishing plants in active restoration areas.
- Maintain and expand invasive species control from the trail corridor.
- Consider targeted riparian planting efforts along Meridian Creek to begin the process of shading out reed canarygrass and enhancing habitat function. Efforts could focus on the south bank, although more intensive efforts may necessitate outreach to adjacent land owners.
- Evaluate potential for control of yellow archangel in MU 4-1 and 4-2 in the vicinity of the culvert that feeds the daylighted section of Meridian Creek.
- Consider efforts to remove blackberry and replant with natives along Meridian Ave N.
- Consider replanting efforts following anticipated parks-led invasive tree management.

Zone 5: Zone 5 was separated into four management units: the two wetland dominated MU's (5-1 and 5-2), the generally upland "arboretum" area adjacent to the tennis courts (5-3), and the relatively open-canopied riparian forest in the southwest corner (5-4). Because of the sensitive nature of the designated wetlands in MU's 5-1 and 5-2, stewardship efforts should be targeted primarily in 5-3 and 5-4. Signage could be considered to limit public access through these areas.

Short-term management goals for Zone 5 include:

- Identify and flag all occurrences of poison hemlock within the Zone and notify Parks for removal or treatment. Follow-up monitoring of treated locations should occur regularly and new plants may be manually dug up to prevent re-establishment.
- Identify extent of Italian arum and determine if hand removal could be effective in this area (only if very limited and isolated in distribution, eradication will require thorough and extensive tracking and follow-up). This should be considered a priority in order to limit the spread of this species throughout this portion of the park. Gloves and protective clothing should be worn to protect the skin from the plant's toxic properties. If manual control is not deemed possible, fruits should be cut and bagged in late summer to avoid seeds being spread.
- Regularly sweep through 5-3 to remove any newly established invasive species.
- Primary efforts in 5-4 should focus on maintenance of existing plantings.

Zone 6: The stream corridor where Thornton Creek exits the ponds and flows out of the park beneath 1st Ave NE was divided into two management units separated by the pedestrian bridge. Invasive species cover and density are particularly high throughout this zone, especially in MU 6-1. However, stewardship efforts are currently limited due to the recommended chemical control of these particular species of invasive plants, namely bohemian knotweed and several species of invasive trees where manual control is not effective.

Short-term management goals for Zone 6 include:

- Sweep through 6-1 and remove any accessible and manually controllable invasive species.
- Identify and flag all occurrences of poison hemlock within the Zone and notify Parks for removal or treatment. Follow-up monitoring of treated locations should occur regularly and new plants may be manually dug up to prevent re-establishment.
- Create ivy "survival" rings from any trees with ivy and consider management of relatively isolated patches in the area on 6-1 north of Thornton Creek along the fence.
- Consider occasional sweeps to remove young invasive tree saplings that continue to establish.
- Consider selective tree planting to establish a native tree component that will ultimately replace the invasive trees as they are treated or continue to senesce.
- Coordinate with Parks to determine best approach for the treatment, control and follow-up maintenance of bohemian knotweed. Several targeted applications of chemical treatment and follow-up monitoring are recommended. Riparian plantings along the creek should follow treatment efforts.

4.1.2. Long-term invasive species management project considerations

It is recommended that new clearing efforts focus on expanding and connecting existing active restoration sites. More intense efforts should only be considered if there are enough resources to actively maintain these areas during the site establishment phase that will generally require follow-up invasive species control, planting, and ongoing invasive species management for many years. A combination of contracted crew work followed by volunteer planting and maintenance can be an effective approach.

- Proposed project examples include:
    - Control of large infestation of English ivy in the eastern portion of MU 4-1.
    - Control of heavy blackberry cover along the sidewalk in MU's 4-1 and 4-3.
    - Control of large blackberry patches in MU's 4-4, 4-5, and 4-6.
    - Control of heavy blackberry in MU's 5-2 and 5-4.
    - Control of heavy blackberry in MU's 6-1 and 6-2.
    - Control of heavy blackberry in MU 1-1.

4.1.3. General planting recommendations

Overall goals should focus on amending and increasing future conifer canopy cover where appropriate. Short term goals should work towards creating a dense native understory that will limit the potential for invasive species re-establishment. Vegetation planting of the forested natural areas on the site should be guided by the following general goals and objectives:

1. Goal: Increase evergreen canopy cover (where applicable).
    - Selected Outcomes: Increased storm water mitigation, reduced erosion and flood potential, shading of invasive species.
2. Goal: Increase the structural diversity of the forests by creating multiple layers of vegetation using a variety of shrub, groundcover, and tree species.
    - Selected Outcomes: Improved wildlife habitat and increased storm water mitigation, reduced erosion, and reduced flood potential.
3. Goal: Increase overall native species richness (number of species) of vegetation.
    - Selected Outcomes: Improved wildlife habitat and increased resiliency of natural areas to adapt to disturbances and change.

- Species selection should focus on hardy native plant species that are suited for the particular conditions at each site location (soil moisture, sun exposure, etc.).
- General spacing guidelines should consider shrubs placed at approximately 4-6 feet on center and trees placed approximately 10-15 feet on center (taking into account existing plants as appropriate). Herbaceous plants (such as annuals or delicate perennial wildflowers) are not generally recommended until site is well established or in limited areas where regular maintenance is no longer necessary.
- Any plant species native to the lower Puget Sound ecoregion may be considered for planting, although hardy species well adapted to existing site conditions should be prioritized.
    - Recommended shrub species for generally upland areas (MU's 4-4, 4-5, 4-6) could include (but should not be limited to): Sword fern, Indian plum, vine maple, beaked hazelnut, red-flowering current, serviceberry, thimbleberry, snowberry, and Pacific ninebark.
    - Wetter site locations could also consider red-twig dogwood, twinberry, willow species, Nootka and cluster rose, red elderberry, salmonberry, Pacific crabapple, black hawthorn, Sitka spruce, or other trees and shrubs adapted to moist conditions.
    - Trees could include: western red cedar and western hemlock (shady or moist areas), Sitka spruce (wetter areas), Douglas fir (sunny and generally dry areas), and grand fir (variable).
    - Additional deciduous trees could include Oregon ash, red alder, black cottonwood, bitter cherry, and cascara.
- When possible, plants should be installed from mid-October through late April (prioritize fall planting where possible) to ensure adequate root development and to minimize the

need for irrigation or supplemental watering. Planting can occur outside this window in wetter areas of the park.

4.1.4. Wetland restoration considerations

Special consideration must be taken when working in and around designated wetlands. In most cases, it is recommended that no stewardship activities take place directly in any of the delineated wetlands found throughout the park. Any work in the vicinity of a designated wetland should be authorized by Parks Department. Restoration work taking place in the vicinity of these areas (Zones 2 and 5) should take extra precautions to ensure that these sensitive areas are not disturbed. These precautions include (but are not limited to) the following:

- Limit access and restoration to the summer months in order to minimize soil disturbance and damage to sensitive vegetation. It is also advisable to conduct most work after August 1st to minimize disturbance to nesting and breeding birds. Non-nesting season in our region is generally considered to occur from August 1st through January 31st.
- Limit the size of volunteer restoration work parties within wetlands and their buffers. Reducing the number of individuals in sensitive areas at a giver time will help limit disturbance.
- Avoid leaving weed fragments or composting invasive plants in or around wetlands as the wet or moist soils may promote re-rooting. Plant material should be removed from the area or placed on cardboard or dry debris piles (avoid letting the plants come in contact with moist soil) and checked throughout the year for growth or re-establishment.
- Planting in wetter areas can often occur in late-spring or summer if the root zone remains moist.

4.2. Priority Parks-Driven Restoration Considerations

Some high priority management considerations involve tasks that are not recommended for volunteer labor. These priorities primarily represent tasks that involve the use of restricted chemical herbicides or include projects occurring in designated wetland areas. Herbicide is only recommended for targeted use on invasive plant species that have been given a legal definition by Washington State and King County Noxious Weed Control Boards or specific weeds that are difficult and costly to control using manual methods. High priority weeds of concern present on the property include the following Class B and C non-regulated noxious weeds and select weeds of concern that pose a substantial threat to the health and function of the natural areas:

Species	King County Designation
• Bohemian knotweed (*Polygon x bohemicum*)	Class B – non-regulated
• Poison hemlock (*Conium maculatum*)	Class B – non-regulated
• Italian arum (*Arum italicum*)	Class C – non-regulated

- Yellow archangel (*Lamiastrum galeobdolon*) Class C – non-regulated
- Yellow flag iris (*Iris pseudacorus*) Class C – non-regulated
- English hawthorn (*Crataegus monogyna*) Class C – non-regulated
- English holly (*Ilex aquifolium*) Weed of Concern
- Cherry Laurel (*Prunus laurocerasus*) Weed of Concern
- Black locust (*Robina pseudoacacia*) Weed of Concern
- European mountain-ash (*Sorbus aucuparia*) Weed of Concern

While these species are not required for control in King County, they have the propensity to outcompete native vegetation, alter the structure of forest understories, reduce riparian function, and/or otherwise impact ongoing efforts to restore the health and structure of the forested natural areas and wetlands within the park. It is therefore recommended that a long-term invasive species control plan be considered for the above listed species.

Particular species that are incredibly difficult to manually control include bohemian knotweed, Italian arum, yellow archangel, cherry laurel, and English holly. It is recommended that a carefully targeted herbicide approach is considered for these species. Italian arum can be especially difficult to control (see WA State Noxious Weed Control Board written findings) and coordination with King County Noxious Weeds is advised for the most current control recommendations. Manual control can be effective for other species listed above although considerable efforts may be required over many years. For more information on the threat that these species pose to natural areas in King County and recommended treatment methods, see the King County Noxious Weed Control webpage.

4.2.1. Recommended parks-driven invasive species management projects:

The following information is provided to offer a basis for prioritizing targeted weed control efforts. Targeted Herbicide applications are recommended for these projects as the most cost effective and efficient treatment option. If use of herbicide is not desired, manual efforts could be employed but will require substantial and sustained efforts over many years.

- Restore and maintain the health of the stream corridor and lake-edge riparian habitat by controlling bohemian knotweed and yellow flag iris.
    - Bohemian knotweed primarily found in MU's 5-2, 5-4, 6-1.
        - Recommend targeted foliar herbicide application in early fall.
    - Yellow flag iris found in MU's 2-1, 2-2, 5-1, 6-1
        - Recommend targeted foliar herbicide application in late spring or early summer.
        - Manual methods may be effective on smaller infestations
- Keep aggressive invasive herbaceous plants from continuing to spread through the upland understory, particularly yellow archangel and Italian arum.
    - Yellow archangel in MU 3, MU 4-1 at Meridian Creek culvert opening, and MU 4-3.

    - Italian arum in MU's 1-1, 1-2 (heavy), 2-1 (NW), 5-4, 6-1.
        - Recommend targeted foliar herbicide application for both species in late spring or early summer.
- Control the currently limited populations of poison hemlock.
    - Primarily noted in the western portion of MU 6-1 and isolated patches in MU 5-3.
        - Recommend foliar herbicide application in late spring and again in late summer.
- Stop the spread of aggressive, thicket-forming invasive tree species throughout the forest interior, specifically English holly, cherry laurel, and Portugal laurel.
    - Primarily MU's 4-1, 4-3, 4-4, 4-5, 4-6
        - Recommend targeted herbicide stem injection on larger stems and cut-dab treatment on stems less than one inch diameter.
- Control of English ivy along the west shoreline of both ponds in MU 2-2.
        - Recommend manual removal followed by riparian planting.
- Control of heavy blackberry in MU 2-2 along western edge of north pond (between trail and pond) and along the eastern edge of the south pond in the riparian area adjacent to the soccer field.
        - Recommend combination of manual removal, foliar spray, and cut-dab with herbicide where existing native plants are present.

The above invasive species control recommendations will require a multiple-year commitment that involves initial treatment, monitoring, follow up treatments for each targeted species, and native plant installation. Some of the above tasks may be undertaken with a combination of herbicide and manual control. However, manual control of Bohemian knotweed, yellow flag iris, yellow archangel, and Italian arum may not be feasible. Volunteer stewards could help with follow-up maintenance, planting, and monitoring efforts. An example strategy could include one or more of the following treatments:

Year 1

- January-February: manual control of English Ivy along pond shoreline.
- May-June: initial foliar spray of yellow flag iris, yellow archangel, Italian arum and poison hemlock.
- August-September: full sweep of all natural areas treating shrubby invasive tree species (primarily targeting English holly, cherry laurel, and Portugal laurel, but could also treat selected areas for European mountain ash, black locust, and English hawthorn) by stem injection and cut-dab.
- September: follow-up spray treatment of poison hemlock and yellow archangel.
- September: cut and treat Himalayan blackberry in MU 2-2 along lake edge
- September-early October: foliar treatment of bohemian knotweed from wetlands and riparian corridor in the southern portion of the park.

Year 2

- May-June: follow-up spot spraying of yellow flag iris, yellow archangel, Italian arum, and poison hemlock.

- August-September: rapid resurvey for invasive trees and control of re-sprouts as necessary. Manual follow-up control of English ivy along pond edges.
- September: monitor for regrowth and follow-up spray treatment of poison hemlock.
- September: monitor for regrowth and follow-up treatment of Himalayan blackberry.
- September-early October: follow-up foliar treatment of re-sprouted bohemian knotweed.
- October-December: initial plant installation in areas where yellow archangel and poison hemlock have been treated. Live-stake and plant installation in areas where bohemian knotweed, dense yellow flag iris, English ivy, and Himalayan blackberry have been treated.

Year 3

- May-June: monitoring of all previously treated areas to determine extent of retreatment efforts needed.
- August-September: Follow up treatment of any areas noted during spring monitoring.
- October-December: infill planting in areas determined to need additional native cover.

Years 4 through 10

- Continued maintenance and monitoring of all treated and planted areas.

5. References

King County Noxious Weed Control: http://www.kingcounty.gov/environment/animals-and-plants/noxious-weeds.aspx.

Rocchio, F.J. and R.C. Crawford. 2015. Ecological Systems of Washington State: A Guide to Identification. Washington State Department of Natural Resources. http://file.dnr.wa.gov/publications/amp_nh_ecosystems_guide.pdf

Washington State Noxious Weed Control Board. 2014. Written findings: http://www.nwcb.wa.gov/images/weeds/Arum_italicum_draft_written_findings-2.pdf

Appendix A: Invasive Species Best Management Practices

English Ivy (*Hedera helix*)

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 and leaving them to decompose 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 (King County 2004).

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 raised debris hummocks, a paved area or tarp to prevent stems from re-rooting. Allow the pile to dry out, flipping periodically to ensure complete decomposition. (King County 2004).

Best Management Practices for this plant can be found at:
http://www.kingcounty.gov/environment/animals-and-plants/noxious-weeds/weed-identification/english-ivy.aspx

English holly (*Ilex aquifolium*) and Cherry laurel (*Prunus laurocerasus*)

Cherry laurel and English holly are evergreen trees that can reach up to 50 feet in height, but are usually shorter and often shrub-like when present in the forest understory. These 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 at or above ground level and applying an herbicide concentration directly to the cut portion of the stem as soon as possible is effective. Other methods of herbicide application include frilling (cutting into the cambium and applying herbicide to the wounds) and stem injection where time-release dosages are placed directly into the stem. These methods kill the trees in place which can be left to fall and naturally decompose or can be cut once the tree has died. A study (EarthCorps 2013) found that triclopyr formulations were more effective than glyphosate for cut stump and frilling applications. Treatment with imazapyr stem injection was found to be very effective and should be the method of choice where plants can be left standing until they are dead. Because these trees tend to root sprout and have many seedlings, monitoring around the infested areas on a regular basis will be necessary for several

years after removal. These species should not be cut without the immediate application of herbicide to prevent extensive re-sprouting from the cut stems and associated roots. Follow all applicable laws and regulations regarding the handling and application of herbicide. Depending on the chemical and formulation, use of herbicide may require a licensed herbicide applicator to be present at the time of application. Contact the King County Noxious Weed Control Program regarding permitting requirements or restrictions: noxious.weeds@kingcounty.gov.

Best Management Practices for these plants can be found at:
Cherry laurel: http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/english-laurel.aspx.
English holly: http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/english-holly.aspx.

Creeping buttercup (*Ranunculus repens*)

Creeping buttercup is a low-growing perennial herbaceous flowering plant in the buttercup family. Although creeping buttercup is not currently listed on the King County Noxious Weed List, it poses considerable problems in many wetland and riparian areas within the Puget Sound region. Creeping buttercup reproduces through seeds and stolons (creeping stems) and can exclude other herbaceous species. It is also toxic when consumed by livestock. Young plants in small patches can be manually removed using a small tool such as a hand tiller. It is important to remove all roots and stem fragments to prevent regrowth. Mechanical methods for control are confined to tilling as mowing is not effective to control this species. Tilling large areas repeatedly during a single season can be effective. However, many areas where this plant grows are too wet to be able to till several times a year. In addition, this type of treatment is not appropriate in natural wetland or riparian areas. Chemical methods may also be effective in controlling creeping buttercup, as studies have indicated that application of selective herbicides such as 2,4-D can deter growth of the plant. It is important to select an herbicide that is appropriate for the particular site, either aquatic or terrestrial (Burrill 1992).

Best Management Practices for this plant can be found at:
http://www.kingcounty.gov/environment/animals-and-plants/noxious-weeds/weed-identification/creeping-buttercup.aspx

Hedge false bindweed (*Calystegia sepium*) **and bittersweet nightshade** (*Solanum dulcamara*)

Hedge false bindweed and bittersweet nightshade are both listed as Noxious Weeds of Concern in King County (King County 2008). Control of hedge false bindweed and bittersweet nightshade requires management over multiple growing seasons. For plant infestations of less than 200 square feet, manual removal is typically effective. Wearing gloves, hand pull stems that are close to the ground and pull or dig up roots. This method is often more effective after rain or in loose soils. Take care to remove all stems and roots to avoid re-sprouting. For larger infestations, dig out roots using tools such as a hand tiller, shovel, spade, or claw mattock. Mechanical methods such as mowing are typically not effective due to the habitat and growth patterns of these plants. However, brush cutting of dense thickets of the plant may facilitate access to roots for manual removal. Application of sheet mulching or a “heavy duty geotextile fabric” over an infestation for at least two years may also stunt the growth of these species.

Take care to cut any emerging plants to avoid re-growth. If removing dense patches, the area should be replanted with natives and mulched to help deter future invasive growth. Currently, there are no known biological methods of controlling bittersweet nightshade or hedge false bindweed. Chemical methods of controlling infestations are known to be effective, especially if combined with other methods such as manual control and monitoring. Use of herbicides containing products such as glyphosate can be useful when applied after berries and fruit have formed or in the early summer after plants have produced leaves. It is important to select an herbicide that is appropriate for the particular site, either aquatic or terrestrial.

Best Management Practices for these plants can be found at:
Hedge false bindweed: http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/Brochures/Bindweed_factsheet.pdf

Bittersweet nightshade: http://www.kingcounty.gov/environment/animals-and-plants/noxious-weeds/weed-identification/bittersweet-nightshade.aspx

Himalayan blackberry (*Rubus bifrons*)

Himalayan blackberry is a vigorous evergreen shrub armed with prickles on the stems. This plant thrives in open, disturbed areas but can also invade forested areas on both wet and dry sites. Invasive blackberries often form large thickets that exclude all other species and can also climb and smother small trees.

Control of invasive blackberries requires management over a number of years. Based on the size of the site, various strategies can be effective. For small infestations of invasive blackberries, manual removal is appropriate. For larger infestations, mechanical methods such as mowing or brush cutting can be effective. Manual control consists of cutting 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 a tarp or an impervious surface 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 invasive blackberries, the area should be replanted with natives and mulched to help deter future invasive growth (King County 2010). Another potential chemical control method being tested on steep slopes and in areas with dense cover of native species is the cut and dab method. This technique involves the application of herbicide directly to freshly cut blackberry canes. The advantages of this method include minimizing soil disturbance and damage to existing vegetation.

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 2010).

Best Management Practices for this plant can be found at:
http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/BMPs/blackberry-control.pdf

Bohemian knotweed (*Polygonum x bohemicum*)

Bohemian knotweed is the most common invasive knotweed in western Washington and is a is a hybrid between giant and Japanese knotweed. This species is a large, clump forming perennial, forming canes up to 12 feet tall. This highly invasive plant spreads by seed and vegetatively by rhizome and root fragments. In the Pacific Northwest it colonizes wetlands and riparian areas as rhizome fragments are dispersed by flowing water.

Small infestations can be controlled by manual means. Digging up the roots including all root fragments can be effective if the plant material is removed off-site. Do not compost the plant as it can root in the compost pile. This method of control will take several years of careful monitoring and removal of any root fragments that are sprouting. Covering the infestation with a heavy geo-textile fabric or black plastic for three to five growing seasons can also be effective. However, with both of these methods it is important to monitor up to 20 feet outside the original infestation for other canes that can spread below ground.

For large infestations, chemical application is the most effective control of this plant. Chemicals such as glyphosate and imazapyr have been shown to be effective for bohemian knotweed. It is important to select an herbicide that is appropriate for the particular site, either aquatic or terrestrial. Herbicides can only be purchased and applied to aquatic systems in Washington State by a licensed pesticide applicator. In addition, federal, state and local restrictions apply to herbicide use in critical areas. Refer to King County Noxious Weed Regulatory Guidelines for a summary of current restrictions and regulatory compliance issues.

Foliar application can be conducted early in the season when the plants are three to six feet tall and the spray can be effectively applied over the leaf surfaces. Although spray is most effectively taken up in June or July, most knotweed plants can be over 15 tall at that point in the season. The canes can be cut down to the ground in early spring and will re-grow to an acceptable height for treatment by mid-summer. Treatments over two or more years will be necessary to adequately control the plant. If the canes are cut down, they should be removed off-site and disposed of properly so they do not re-root.

Another method to apply chemicals is the stem-injection method, which has been proven to be very effective (over 90% control rate in the first year) and greatly reduces drift to non-target plants. A stem injection gun is a specially designed syringe that applies a carefully calibrated amount of herbicide directly into each cane. To successfully use this method, each individual cane greater than ½ inch in diameter must be injected. Follow-up injections over several years are important to catch canes that were two small to inject the first year or ones that were not successfully controlled. When large areas of plants are removed, it is necessary to replant with native vegetation.

No biological control methods are approved at this time for control of bohemian knotweed.

Best Management Practices for this plant can be found at:
http://www.kingcounty.gov/environment/animals-and-plants/noxious-weeds/weed-identification/invasive-knotweeds/bohemian-knotweed.aspx

Yellow-flag iris (*Iris pseudacorus*)

Yellow-flag iris is a perennial, emergent herbaceous plant that grows along freshwater margins. It can grow up to five feet tall and has prominent yellow flowers from May to July. This plant is listed as a Non-designated Noxious Weed in King County.

Control of yellow-flag iris requires management over multiple growing seasons. For small infestations, manual removal methods such as hand pulling and the use of hand mechanical tools may be effective. It is necessary to wear gloves when handling this plant, as resins in the leaves and rhizomes can cause skin irritation. Small areas of seedlings or isolated plants can be easily hand pulled from damp or wet soil. Removal of mature plants may require the use of heavier tools such as a pulaski or saw in order to remove the tough rhizomes. Take care to remove all rhizomes, as any remaining in the ground can re-sprout. Dispose of rhizome fragments away from the site. Do not compost rhizomes in home compost systems as they can continue to grow even after three months without water. All manual control sites should be monitored for several years for signs of re-growth.

Larger infestations of yellow-flag iris may require removal by mechanical means or treatment with herbicides. When clearing large infestations, the area should be replanted with native vegetation to prevent re-colonization. Mechanical methods of removal include hand mechanical tools, riding mowers, and light mechanical cultivating equipment. Several years of intensive mowing or cutting of this plant may keep it contained and can potentially kill it by depleting the energy reserves in the rhizomes. Mechanical control in wetland areas is allowed in unincorporated King County. Check with local jurisdictions for regulations in other areas.

For large infestations, chemical methods such as herbicide application may be necessary to control the plant. Monitoring is essential for several years after initial treatment; in some cases a reapplication may be required. Because yellow-flag iris is a monocot, only non-selective herbicides such as glyphosate or imazapyr are effective. The King County Noxious Weed program recommends a 5% solution of glyphosate (aquatic formulation only, such as AquaMaster or Rodeo) with the surfactant Competitor, sprayed after flower drop in late spring or early summer. It is important to select an herbicide that is appropriate for the particular site, either aquatic or terrestrial. Herbicides can only be purchased and applied to aquatic systems in Washington State by a licensed pesticide applicator. In addition, federal, state and local restrictions apply to herbicide use in critical areas. Refer to King County Noxious Weed Regulatory Guidelines for a summary of current restrictions and regulatory compliance issues.

Best Management Practices for this plant can be found at:
http://www.kingcounty.gov/environment/animals-and-plants/noxious-weeds/weed-identification/yellow-iris.aspx