CARKEEK PARK

FOREST MANAGEMENT PLAN

Update 2007

This Forest Management Plan is dedicated to
Nancie Hernandez
in grateful appreciation for 13 years of Park Maintenance and volunteer guidance.

Front cover photos taken in subunits:

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CARKEEK PARK
FOREST MANAGEMENT PLAN

Created by Peter Noonan, March – December 2002
Updated by Lex Voorhoeve, December 2005 – November 2007
Prepared for:

- Seattle Department of Parks and Recreation
- Carkeek Park Advisory Council

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NOTE
Like any forest management plan, this is a dated document, now describing the situation by the end of 2007. Over the next ten years big changes are expected in the Carkeek forest, particularly due to the over-mature Alder/Maple forest declining. Updating this document in response to those changes will likely need to occur every five years.

RECOMMENDATION
The non-forested units in Carkeek Park include unique wetland and riparian habitat, valuable to salmon and other wildlife. A management plan to address those units would make an excellent companion to this document.

Diagrams by Peter Noonan
Maps by Dale Johnson
Photos and drawings by Lex Voorhoeve
Plant Palettes, Appendix 5, completed by Doug Gresham

Photo 1. Jacobo switchback between subunits 1B and 1C, installed by the Parks Trails Program; volunteer crew led by Jacobo Jimenez.

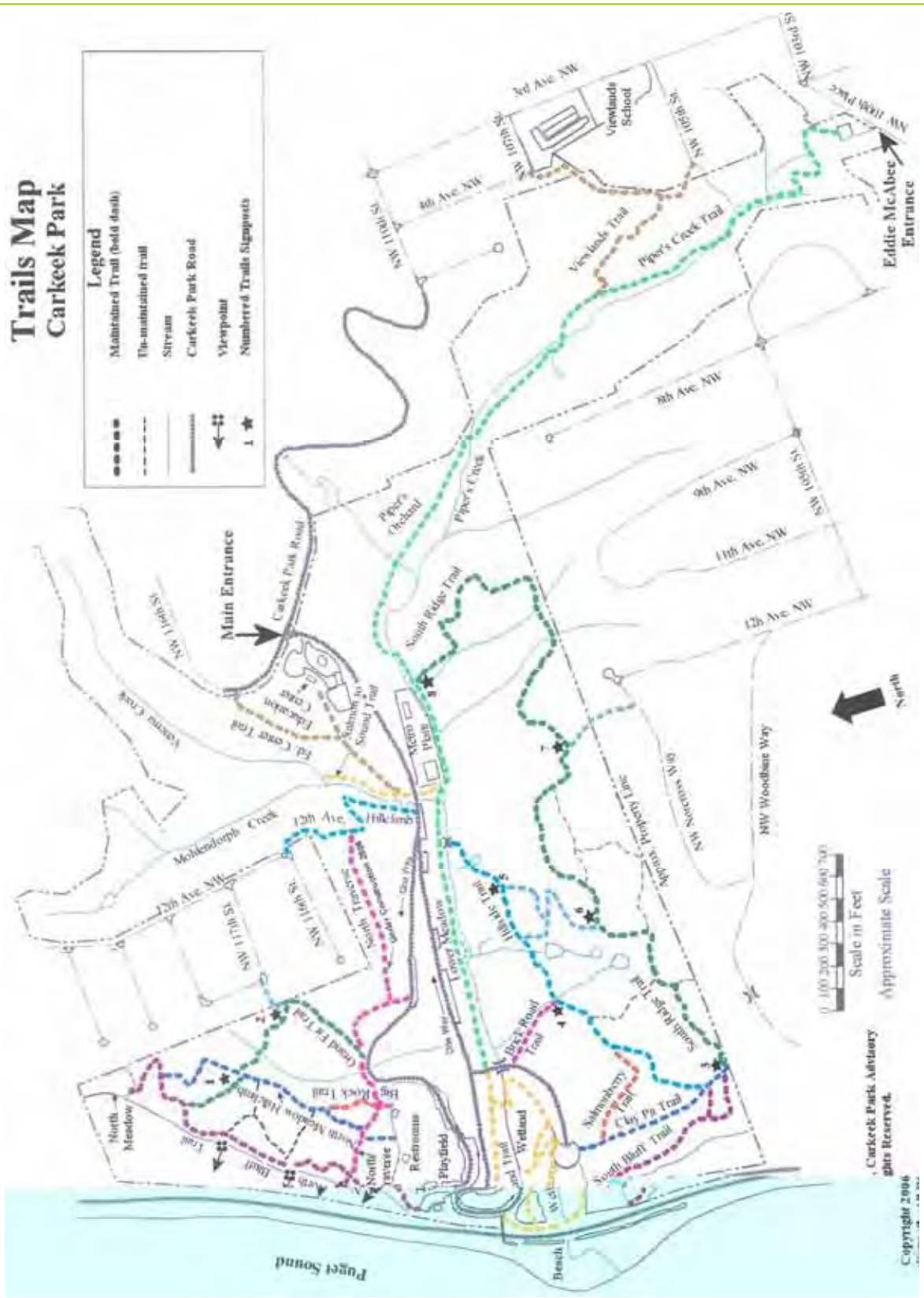

Figure 1. Carkeek Park Trails Map

SUMMARY

This Forest Management Plan states the overall goals of forest management in the urban forest of Carkeek Park. It describes management practices that focus on invasive removal, establishing a new forest generation and enriching existing forests. It describes the forest of Carkeek Park, subdivided in management units, analyzing the present problems and challenges. This plan incorporates the Green Seattle Partnership, initiated in 2005. It also provides recommendations for the non-forested management units of Carkeek Park as they interact with the forest units.

1. INTRODUCTION

This Forest Management Plan (FMP) for Carkeek Park was initiated by the Carkeek Park Advisory Council in 2002. It was made possible by a Seattle Department of Neighborhoods Matching Fund, "Small and Simple" Projects Grant. It came to fruition by the end of that same year, December 2002, when author Peter Noonan presented the draft version to Senior Urban Forester Mark Mead. Since then the FMP has gone through several processes of reviewing and updating, culminating in this updated version. Due to the dramatic changes anticipated for Carkeek Park's forested canopy in coming years this plan will likely need to be updated or amended within the next ten years.

Carkeek Park is a 180-acre property of the Seattle Parks and Recreation Department situated in the Northwest Parks District. It encompasses a series of steep, forested ravines that cascade from close to 500 feet down to sea level. The park includes a number of creeks, the largest being Piper's Creek named after one of the pioneering families at the beginning of the 20th century. An estimated 150 acres is forested, the remaining 30 acres is wetlands, roads, meadows, play areas and beach. This FMP focuses on the forested area. Short suggestions are included for the non-forested areas, because their maintenance affects the forested areas, and vice versa.

After logging in the early 1900's land use at Carkeek was primarily agricultural: grasslands and orchards. Traces of a brick factory are still present; a fishing industry was situated on the beach. After Carkeek Park was created in 1929 agricultural use was reduced and finally terminated. The area started the long process of forest regeneration with pioneer vegetations of red alder and big-leaf maple, interspersed with a few evergreen trees. Evergreen-dominated pockets developed near the North Meadow (Unit 4B), the Environmental Learning Center, and the Norcross entrance (Unit 1D). A generally dense undergrowth developed with native species like salmonberry, thimble- berry, sword fern, salal and others. When the surrounding plateaus were developed before and shortly after WW II, non-native garden species started to intrude into the park, some of which are invasive or noxious weeds. One invasive species, English Ivy, was planted on purpose to reduce erosion of the steep slopes!

At the turn of the 20th century the 60–70 year-old forest is maturing and approaching its demise, literally "falling to pieces", creating small and large gaps in the canopy. In natural Pacific Northwest forest succession fallen trees would soon be replaced by the next, mostly evergreen, forest generation. However, in this urban forest, surrounded by urban neighborhoods and with a poor conifer seed source, this natural process has been disturbed

and without intervention an invasive-dominated shrub canopy will develop instead. In order to guide the forest into the desired direction of a “natural evergreen forest” the Carkeek Park Advisory Council initiated this FMP. During the Public-Involvement-Process (PIP) a significant interest in increasing plant species diversity within the park was identified. This too is reflected in the FMP.

In the year 2005 this initiative was integrated into the City-wide Green Seattle Partnership, GSP (see Appendix 2).

2. BACKGROUND

Note: this chapter was copied without changes from the original 2002 Forest Management Plan.

HISTORY

The original Carkeek Park was located on Sand Point Way at Pontiac Station from 1918 to 1926 (Sherwood, 2002) on land owned by Morgan J. Carkeek. In 1926, the Federal Government acquired the park and the site became the Sand Point Naval Air Station. Mr. Carkeek was given $25,000 in return which he offered to the city to help acquire another parcel for park use.

The present-day site of Carkeek Park was purchased by the City of Seattle in 1929 for $125,000 (Larson, 16) (See General Map). The site had originally been known as Piper's Canyon, named after the original owners.

By the time Carkeek Park was established, most of the area had been logged and was subsequently in one form of agrarian production or another (Kroll Land Parcel Map). The Piper family had built an 80-acre family farm (Sherwood, Larson, 16). Whereas, most of the Southwest corner of the park and upper reaches of the creek were used as pasture land. Vitamilk, a local dairy was located at the present site of Viewlands Elementary School (Butts, 2002). To the West of the canyon, cherry orchards had stretched from the Southern end of the park near the sound to the North Bluff (Butts, 2002). In addition to the Piper farm, the purchase had included a few other homesteads and a fishing operation named the Whiz Company. Today, the Piper Family orchards are maintained for cultural heritage (Larson, 16).

PARK USE

Prior to becoming a park there seem to have been development plans at the end of Mary Avenue; preliminary terracing can still be recognized in the SW corner of subunit 1B.

During the first two years of the park's existence, the land was leased as pasturage. As community interest increased though, the city stopped renewing permits and developed other means of using the park (Sherwood, 2002).

Presently, these uses include beachfront, picnic and play areas, a model airplane runway, trails, an orchard, forested glens and three open meadows. In addition, Carkeek is the site of a Metro King County sewage processing plant and the end point for several storm drainage systems.

PHYSICAL NATURE

Physically, Carkeek Park is an anomaly to the otherwise uniform Northwest Seattle (Shannon, 12). This area, in general, tends to be flat and plateau-like rising gently to a height of

500ft. Over millennia though, the Piper's creek system, fed by water seeping from the extensive bog between present day Greenwood and 8th Avenues, has eroded down into this glacially deposited material, developing a series of steep narrow ravines. The bulk of this ravine system today makes up the Park.

Along the coast, wave action had eroded the base of the high plateau, causing deep seated landslides. This has all but stopped due to the construction of the Burlington-Northern Railroad's seawall. Landslides that occur today tend to be superficial, with deep seated movements happening rarely. The area of highest landslide probability appears to be in the Northwest Section along trail N7, although the level of danger is presently unknown.

SOIL STRATIFICATION

Deep soil coring in the region reveals soil layers of non-glacial clay/silt, underlying glacially deposited layers of clay-silt with sand pockets, gravely-sand, and sandy-gravel/silt with lobes of clay. The top layer is subdivided with the last and uppermost material deposited having not been glacially overridden. Thus, the soil crust tends to be fairly loose and permeable while the lower layers are some of the densest soil types in the world (Waldron, 1962; Young, 1993). Figure 2 presents this in cross-section view.

The Seattle area also contains recently deposited soils. These are Colluvial, Alluvial, Depression-Filling and Fill soils.

The first of these, Colluvial, is described as a gravitationally driven accumulation of fallen material. It covers the sides and accumulates at the toes of slopes through soil creep, surficial sloughing, land sliding and slope wash. By nature Colluvial soil in Carkeek tends to be "soft to medium, dense to soft to stiff" (Shannon, 12).

The next two soil types, Alluvial and Depression-Filling, are water driven. Alluvium is a water deposited material associated with riparian areas. It consists mainly of silt, sand and gravel, but may also contain organic material (Waldron, 1962). Depression Filling soil is a combination of clay, silt and organic materials. Most depression filling soils are found on upper ridges, plateaus, or as part of river alluvium (a good example of this is the soil directly underlying the site of Carkeek's "Constructed Wetlands"(Waldron, 1962)). Depression Filling soils are associated with wetland habitats (Shannon, 12).

The final soil type, Fill has been deposited by human construction and can consist of almost any soil type. In general, Fill is highly slide prone in slope areas. Most Fill soils around Carkeek are limited to the road cut for NW 110th St and certain residential properties that abut park boundaries.

LANDSLIDES

Most slides in the past are of a type known as "colluvial". They tend to consist of shallow, superficial sloughing of loose material (Shannon, 12). Donald Tubbs found, in 1975, that slides were most likely to occur at the contact point between the upper sand layer and underlying Lawton Clay or Pre-Vashon Sediments on greater than 15 percent slopes (Tubbs, 72). Please refer to the soils map in the Map Section for approximate location of "the contact".

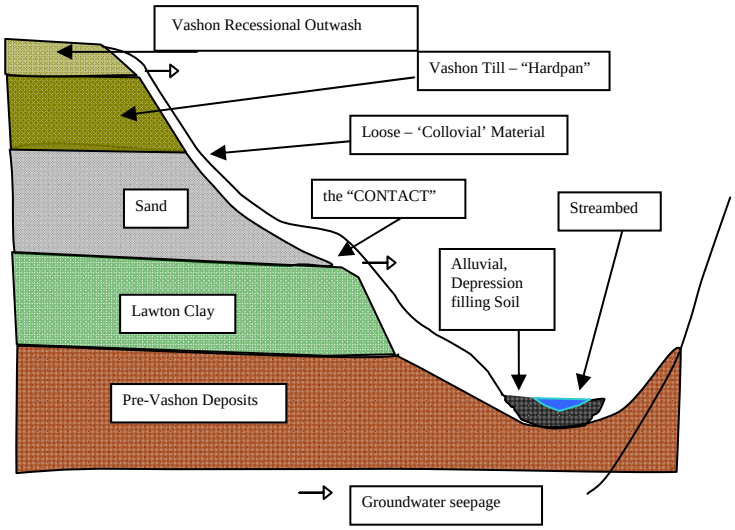

Figure 2. Slope Cross Section Showing Soil Stratification, adapted from Shannon and Wilson, Tubbs and Waldron

SEDIMENTATION

Significant water quality problems such as increased sedimentation, nutrient loading, turbidity, siltation and deposition of heavy metals have resulted from landslides and slope erosion (Gresham, 2002, personal interview). Construction projects in the upper and lower reaches of the watershed have created large areas of bare soil that is easily washed into the active channel by surface run-off. Unimproved trails and poorly designed or maintained erosion control devices may also be contributing.

Herrera Environmental Consultants, Inc. (HEC, Inc.) conducted an erosion and sedimentation evaluation of Carkeek in 1998 for SPU and found a number of issues. The highest priority has been placed on preventing continued and future sediment transport in stream channels.

This management plan does not address these issues as they have already been covered in Gaia Northwest, Inc.'s Pipers Creek Rehabilitation – Erosion and Sedimentation Management Program and Design Manual (1997) and the above-mentioned Herrera report. We have noted problematic areas in our management designs and on our maps and suggest that further consultation with HEC, Inc. occur concurrent with forest management.

FORESTS

Though, the forests that once stood in Carkeek Park are long gone, their grandeur can still be seen in the enormous cedar stumps scattered throughout the area. These stumps and the subsequent forested landscape that arose after farming and grazing practices stopped are hosts to a mélange of wildlife.

A main focus of management is to enhance existing wildlife habitat within the park. Though this plan focuses on increasing native plant abundance and diversity, it should be realized that the creation and maintenance of native habitat for wildlife is one of the underlying goals.

A SHORT HISTORY

One of the earliest descriptions of the historic Carkeek Park forest is found as part of the timber cruises done for the Puget Mill Co. in 1899 (Ames, 12/28). The author notes that timber

in this area, “can be handled cheaply (because of the close proximity of the sound), but is not of the best quality.”

In present times, “not of the best quality”, would most likely imply that the forest contained wood rots, decay or poorly shaped trees. But given the times and the context, it could have meant that the forest had already been logged and thus, the existing trees were young, or that the forest contained high percentages of undesirable species.

PRESENT DAY

To better understand the ecological processes potentially at work in Carkeek Park, one should view the forests in transition. Currently, most of Carkeek is in a plant community development stage commonly known to Ecology as “Secondary Succession”. In this stage, the quick growing, pastureland species that had thrived when the area had been grazed have given way to longer-lived trees and shrubs.

A certain amount of these trees are conifers, but the vast majority are the faster growing, opportunistic deciduous trees – Big Leaf Maple and Red Alder. Because the area was subjected to a variety of agricultural uses prior to creation of the Park, the dominant mature tree canopy tends to consist of differing amounts and quantities of species. For instance along Piper’s Creek from the McAbee Entrance to the Metro Pumping Station, the forests tend to consist of Big Leaf Maple with Red Alder and an occasional coniferous tree. While, to the West at the Norcross Entrance, the dominant trees tend to be Red Cedar and Western Hemlock and Douglas Fir.

In General, Carkeek Park's forests can be described as mixed deciduous stands ranging from near complete broadleaf cover on the park’s Southwestern slope to near 50:50, coniferous : deciduous ratios in the Northwestern corner (Forest Zones Map).

Overall distribution of deciduous to evergreen trees is approximately 60:40 (Figure). The forest's upper canopy consists of approximately 20% open space organized into forest gaps. These are beneficial to lower canopy diversification and, in successional terms, can lead to species shifts in the upper canopies. As older groups of trees die out, younger trees, replace them by growing up and filling the gaps.

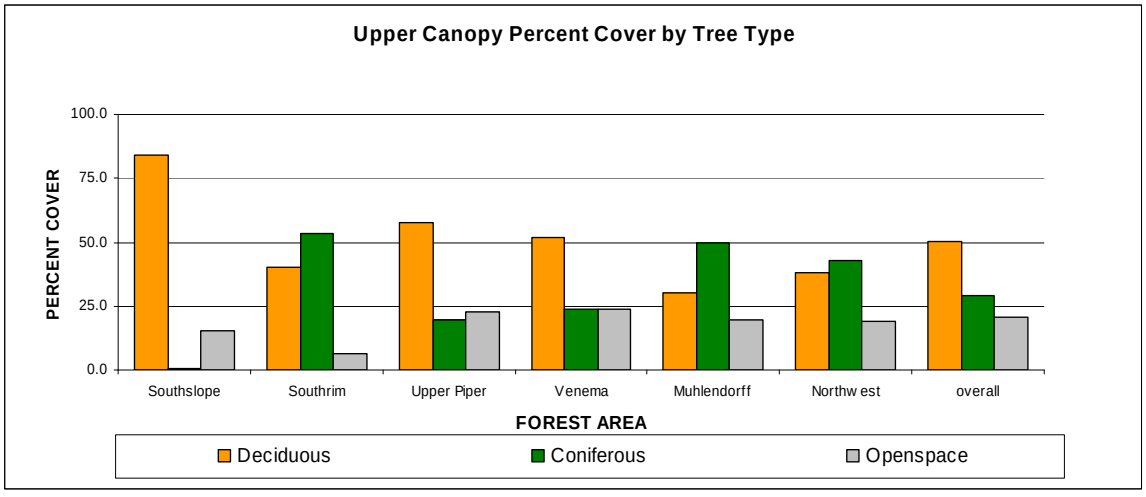

Figure 3. Forest Canopy Percent Cover by Tree Type, Deciduous versus Coniferous

This process is being undermined in natural areas, though, by the establishment and proliferation of exotic plant species. Several species, such as Holly, English Laurel, Horse chestnut, Himalayan Blackberry, and Ivy have been observed growing in forest gaps and lower

forest canopies, displacing natural vegetation and essentially causing natural forest regeneration to come to a halt.

Evergreen and deciduous trees not only differ in occurrence, but individual species occur at different ratios throughout the park. Presented pictorially (Figure 4), this shows that, based on dominant tree species, Carkeek's forest can be divided into several different stands. For instance, on the South slope (Clay Pit Trail) the species composition is drastically different from just above and to the East on the South Rim (Norcross).

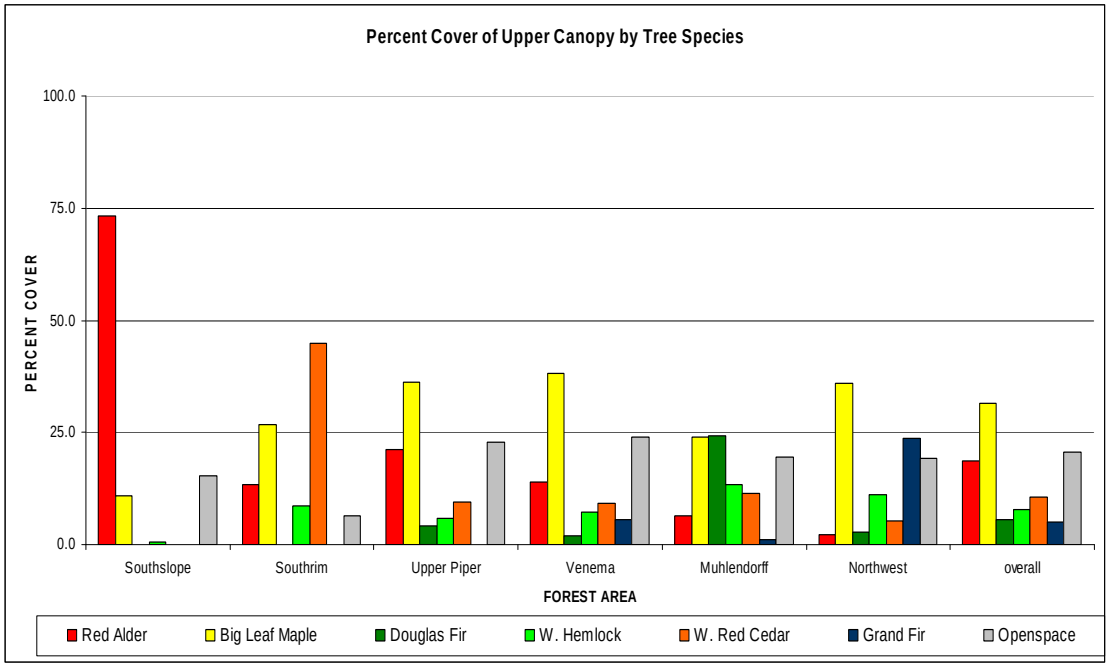

Figure 4. Carkeek Forest Canopy Cover Composition by Species in Several Vegetation Units

Variation in dominant tree cover can indicate fundamental differences in site conditions. Potential differences in nutrient supply, water table level and other growth requirements can have a direct result in vegetative composition. A map of forest stand types has been devised extrapolating that a specific vegetative community can be associated with a particular tree canopy and that this in turn indicates differences in growth requirements.

Carkeek has been divided 6 forest stand types in order to develop management strategies that best fit specific areas. These types are illustrated in Figure 6 below.

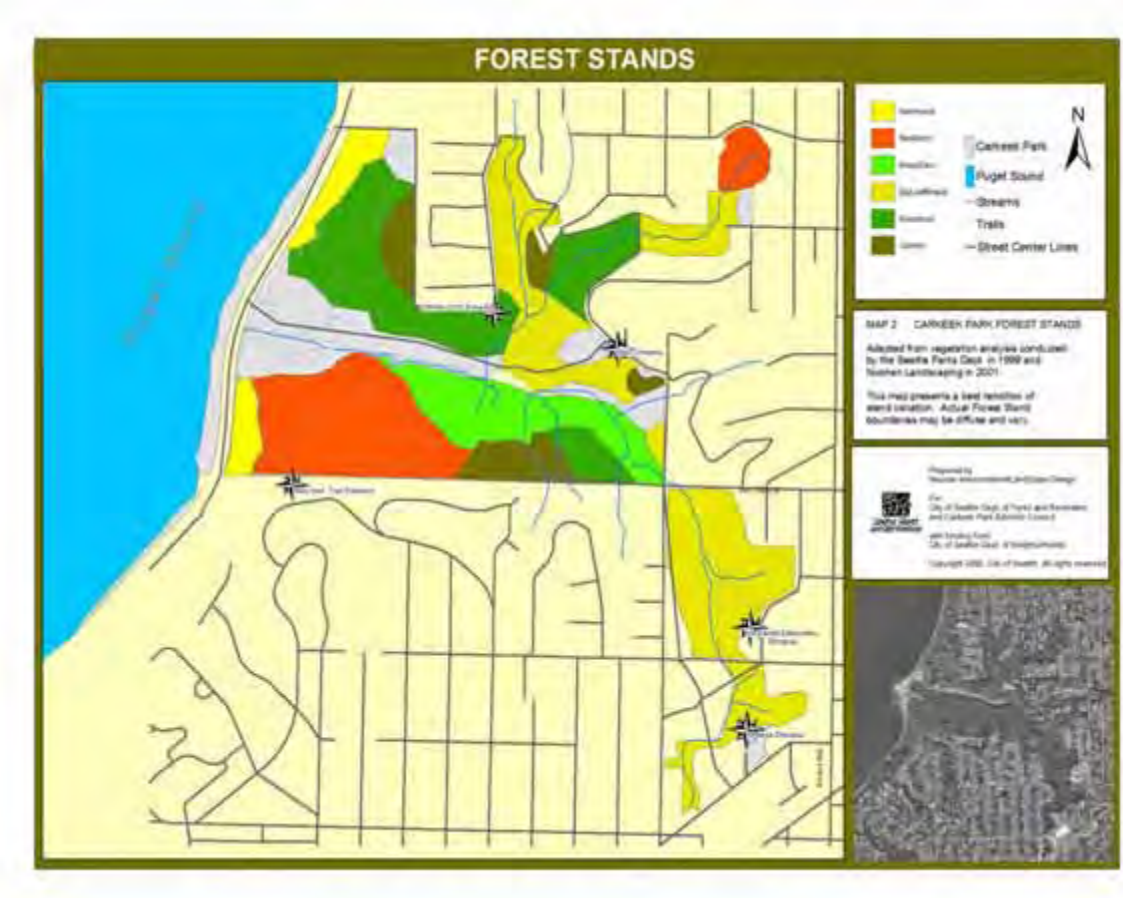

Figure 5. Forest Stand Types Found in Carkeek Park

RED ALDER STANDS

A large portion of Carkeek Park's non-maintained forested area is covered with dense stands of mature Red Alder. These stands occur along waterways, in the upper Venema Creek "headwaters" basin, the slopes in the South West quadrant, along both sides of the lower Piper's Creek trail and depressional land features throughout the park.

In general, trees within these stands tend to be in a state of demise. Blow downs are frequent and snags of various sizes and states of decomposition are common. These stands tend to lack significant mid-stories but have extremely dense deciduous lower canopies with a variety of perennial herb layer and groundcover species.

Salmon Berry thickets with patches of elderberry are common. Sword fern and native blackberry are interspersed beneath. The general groundcover in these communities tends to consist of Pacific Waterleaf (*Hydrophyllum tenuipes*), Bleeding Heart (*Dicentura formosa*), Piggyback Plant (*Tolmiea menziesii*) and Pacific Sword Fern (*Polystichum munitum*). The Upper Middle Canopy contains English holly, Cherry Laurel and Maple.

Areas covered in Red Alder tend to be within riparian zones or on toe slopes where artesian springs are present. Conifer populations in Carkeek Park on the other hand, will generally be found growing in drained and well-drained areas. Such areas would be on mid- and shoulder slopes, knobs and other raised land features. The large amounts of water draining through Red Alder stands could indicate these areas are subject to higher amounts of erosion.

Thus, disturbance levels would be higher in Alder stands through the constant downhill movement of soil and water.

The general composition of the Red Alder stand's upper canopy tends towards large monocultures with interspersed pockets of Big Leaf Maple and randomly occurring coniferous trees – mainly Western Red Cedar with a few Western Hemlock.

There are remnant stumps of ancient Western Red Cedars in Red Alder stands and if hydrology has remained constant, these areas would have had a high rate of decay with most of the available nutrients being allocated to the living canopies. Farming and grazing, which occurred up to the 1930's, would have inadvertently removed significant amounts of nutrients. Red Alder – being able to produce its own nitrogen- would have been an ideal post-harvest colonizer under these pretexts.

Having found that both upper and lower canopies basically consist of monocultures (Red Alder and Salmonberry respectively), we speculate that the affects of selective forces could be more intensive in these stands than in other stands at Carkeek.

In the past, there have been several projects focused on "jump starting" succession within Carkeek's Red Alder stands. These took on the form of tree plantings, in which several thousand conifer seedlings and several small trees were planted into these communities.

Today, the affects of these work parties are hard to quantify. Many of the small conifers are still present, somewhat obvious because they were planted close in to major trails. This study did not find any significant number of seedlings.

BIG LEAF MAPLE / RED ALDER STANDS

Deciduous forests dominated by Big Leaf Maple make up the significant portion of Carkeek Park. These stands almost always tend to be a mixture of Maple and Red Alder with an occasional Conifer – namely Douglas Fir, Western Red Cedar and Western Hemlock. In many ways these stands resemble the mixed stands discussed in the next section. The primary feature that distinguishes a stand as a Big Leaf Maple stand is the predominance of Big Leaf Maples (over 50% by cover) in the upper canopy.

As in the Red Alder stands, members of the Big Leaf Maple upper canopy appear to be at the end of their lifespan with many members in one state of atrophy or another. Blow-downs are fairly common and snags occur regularly. Unlike the Red Alder stands, Big Leaf Maple stands tend to have some middle canopy development. Lower canopies tend to be more stratified and, though sword fern tends to create large monocultures, there tends to be more diversity in the lower and ground cover communities.

The plant communities found in Big Leaf Maple stands are similar if not synonymous with those found under mixed forest and conifer forest stands. These stands are found on the same topographic levels as mixed canopies and tend to have the same hydrologic regiment.

Big Leaf Maple stands appear to occur mainly on drained and well drained middle slopes. They can be found at mid slope, on shoulders, knobs, dry toe slopes and other features convex, flat or concave provided that the soil is drained. As a general rule, these stands seem to occur above the wet areas where Red Alders dominate and below the well-drained upper areas where conifer stands tend to occur.

The occurrence of Big Leaf Maple stands could result from a combination of disturbance in the form of unstable side slopes and water erosion and seed dispersal. Because of their similar lower canopy compositions and relatively identical ecological and hydrological regiments, these areas could be the best place to concentrate any further enrichment and/or re-establishment efforts focused on accelerating succession.

DECIDUOUS / CONIFEROUS MIXED STANDS

Mixed forested stands tend to consist of Maple, Red Alder, Douglas Fir, Western Red Cedar and Western Hemlock, with Grand Fir occurring in the Northwest region of the park. As has been mentioned earlier, these stands resemble Big Leaf Maple Stands in many ways and it would be logical to assume that the one is in succession with the other. The main distinction is that Mixed Stands tend to have Over Stories which consist predominantly (more than 50%) of Conifers.

Typically, Mixed Stands and Big Leaf Maple Stands occur in a mosaic pattern throughout the drained and well-drained mid slopes. Both are found at mid slope, on shoulders, knobs, dry toe slopes and other features convex, flat or concave most often with one stand appearing as variably sized pockets within the other. Unlike the Big Leaf Maple Stands, mixed stands consist of trees in earlier developmental stages of their life span. Blow-downs seem to occur frequently, and there is a significant amount of snagged and downed woody material in many of these stands, but the wood tends to be of hardwood origin.

The Under stories are dominated by Western Hazelnut, Oceanspray, Elderberry, sword fern and nettles, with the same amounts of species diversity occurring as in the Big Leaf Maple Stands. It should be noted that, though these canopies consist mainly of conifers, their mid and lower canopies consist mainly of deciduous and aggressive non-native species.

CONIFEROUS STANDS

The relative abundance of downed woody and organic material present in the forest floor and the occurrence of a number of typical deep woods species, such as Red Huckleberry and Twinflower suggest that these areas have been less disturbed in the past.

Individual conifer trees tend to all be approximately 60 and 80 years in age, with a few species especially Grand Fir in the Northwest corner appearing to be a great deal older. It is a common logging practice to leave a few trees on each logged parcel in order to reseed the area.

Conifer stands tend to have the most developed middle canopy and conifer tree regeneration in the lower vegetative layers. In general, regeneration was observed more often in the Conifer Stands than in any other forested stand, though, it was not found to be significant in most areas, with an exception in the Grand Fir dominated Northwest corner. Hemlock regeneration was found to occur, as expected, on nurse logs. The seedlings of which seemed to prefer Hemlock wood as a growing medium rather than Douglas Fir, Red Cedar and hardwood debris.

WILDLIFE

Carkeek Park is part of an open-space tract in Northwest Seattle that links native habitats in Richmond Beach, to the North, with those of Golden Gardens, to the South. The park is home to a broad diversity of wildlife. It provides many essential shelter and foraging habitats for several migratory birds, Mountain Beaver, giant salamander, and river otter. Larger land mammals have been known to travel this corridor, with bobcat appearing in Discovery Park a few years ago and multiple coyote sightings occurring throughout the general area.

MIGRATORY BIRDS

There are a large number of migratory birds that frequent Carkeek Park. According to a 2001 survey, over 100 bird species have been spotted throughout the year. One reason for this great variety of birds is the broad diversity of habitats available to birds throughout the Park. Another reason is that the developed forests provide shelter from storms. There is abundant food sources throughout the park, including insects, salmonberry, and blackberry.

Birds common to cottonwoods include fox sparrows, woodpeckers, owls and sapsuckers. These birds tend to use cottonwoods during the summer and can be found mainly in the forest understories. Red alders attract a variety of warblers, including the Yellow-rumped, Townsend's, and Black-throated. Sword fern understory in the forest attracts olive-sided flycatchers, palliated woodpeckers, and winter wrens.

As an urban forest, Carkeek offers birds a sanctuary from tall buildings, large windows and objects lit at night. Birds in the forest are still subject to neighborhood cats and other non-native predators though. Management of the forest should address the needs of these birds as an important component to overall forest health.

RESIDENT SPECIES

The park is home to a number of year round species, many of whom would be classified as opportunists. These species include the common crow, starling and grey squirrels. The park is also home to several over-wintering bird species. Many of which utilize the dense shrubby understories as shelter and foraging habitat.

There have also been sightings, though rare, of a local creature called the Giant Salamander. This amphibian inhabits creeks and streams growing to proportions easier to measure in feet than inches. Several sightings occurred along Piper's Creek when the sewer line was laid for the processing plant (Butts, 2002, personal interview).

In the past coyotes have existed in the park on a resident and or transitory basis. There is a current trend in wildlife ecology to re-introduce apex predators back into environments. It has been suggested that the absence of these creatures, at Carkeek in particular, has led to a population explosion in smaller ground inhabiting mammals, such as Mountain Beaver.

In 2007 a coyote pair successfully raised three cubs. Their impact on the Mountain Beaver (over)population is not yet clear.

Mountain Beaver (*Aplondontia rufa*) is found in Coastal Western Hemlock, Mountain Hemlock and Engelmann spruce-subalpine fir biogeoclimatic zones. They are generalist herbivores, feeding on ferns, grasses, forbs, mosses, shrubs, hardwoods and softwoods. Mountain beaver require nearby water, either in the form of succulent plants or aquatic landscape components. They also require well-developed shrub and forest canopies, such as those found in the Park.

Mountain Beavers cause damage to young trees. The damage can be identified as an oblique cut through the stems up to 2.5 cm in diameter at ground level (Dutton, 2002). They climb young saplings to a height of 8 ft, cutting the side branches with the characteristic oblique cut. The animals also cause damage to roots by debarking, cutting the roots, and plant destabilization.

3. GOAL, OBJECTIVES, ISSUES

GOAL

The goal of this Forest Management Plan is to ensure the long-term sustainability of Carkeek Park as part of Seattle's urban forest resource. This is accomplished by protecting, restoring, and enriching native plant communities which mirror the structure, function, and composition of the region's native, natural forests to the extent possible within the matrix of the urban environment.

OBJECTIVES

The following 11 objectives work towards this goal:

- Reduce non-native, invasive plant populations
- Protect remnant areas of high quality, native forest
- Protect and enhance (enrich) critical, sensitive, and/or rare sites
- Sustainably restore native plant communities, focusing on naturally occurring "gaps" in the canopy (possibly extending such gaps to speed up the restoration process)
- Ensure the use of regionally-adapted and genetically diverse plant stock
- Enhance soil conditions
- Reduce and prevent soil erosion
- Maintain and enhance wildlife habitat
- Reduce negative impacts of inappropriate site use
- Maintain site safety
- Ensure the long-term adequacy and effectiveness of site management practices.

ISSUES

Carkeek Park as a whole is facing the following issues, affecting forest management:

- Over-mature Alder/Maple forests - a major part of the forest needs to be restored within the next 15 years
- Abundance of mountain beavers, resulting in damage to plantings and considerable erosion
- Rapidly spreading Ivy and Holly populations
- Increasing recreational pressures

- Encroachment issues with neighbors because of its unusual high boundary/surface ratio
- Lack of animal control enforcement, resulting in the park seemingly to be off-leash friendly
- Squatters
- Trail safety

Photo 2. Invasive Garden Groundcover Overflowing Into the Park, Unit 4B

4. MANAGEMENT

THE URBAN FOREST

Urban forests are relics in an urban environment of a once dominant forested land cover. For these relics to be sustainable requires regular, periodic and attentive maintenance. The current condition of many forest stands in Seattle including Carkeek will require massive capital improvement to the forest infrastructure to reach sustainable maintenance levels. Just how much maintenance is required at a given site will primarily depend on the forest stand's condition and its ability to regenerate. The presence, or absence, of invasive plants can be an indicator of stand condition. At sustainable maintenance levels an urban forest stand in the good condition would consist of an assemblage of individual plants in a community capable of out-competing, with mild human intervention, invasive plant threats. A forest stand in poor condition would consist of individual plants without a robust community structure and incapable of competing. If a plant community is unable to compete, species composition will shift as invasive plants displace desired species.

The ability of a specific plant to compete depends on the site where it is growing. Most plant species have adapted to a specific set of growing conditions. Under optimal growing conditions a species is more capable of competing – or is said to have a 'competitive advantage'. In a natural system competition and plant composition shifts brought on by

competitive advantage eventually lead to distinctive plant communities, which are regulated by competitive pressures. This suggests that a balanced natural system is one in which competitive pressures are maintained between plant communities.

Urbanization disturbs the natural balance of competition that exists between plant communities in the non-urbanized world in two major ways:

- First, urbanization as a process is physically disruptive. Urbanization necessitates site "improvements" like terracing, ditching, leveling, road construction, and underground infrastructure. In the process of urbanization, soil compaction occurs. Buildings, roadways and gardens take up space, replacing a major part of the existing on-site plant communities and puncturing the edge of remaining communities. Urbanization results in four main effects threatening the relic plant communities: a drastic change in light conditions; disturbance of the hydrological regime; disruption of the natural seed-supply; shifts in wildlife species composition and numbers.

- Second, urbanization introduces new plant species through horticultural trade, the process of landscaping and backyard gardening. When horticultural plants reproduce and spread into natural areas without intentional planting and maintenance it is said that they have "escaped" or have "naturalized". These new plant species – each with a different set of competitive advantages – may begin to out-compete native plants for available nutrients and space. There are several horticultural plants in the Seattle area that have done this. This often has dire consequences for the natural plant communities.

The main purpose of forest management is to counter the before mentioned effects of urbanization, restoring the forest relics as close as possible to native plant communities, ensuring sustainability while simultaneously facilitating the recreational and educational functions inherent to an urban forest.

Without such management the existing forest remnants will deteriorate into "urban jungles" of ivy, blackberry, holly, morning glory, clematis, periwinkle, and other invasives - with far-reaching negative effects. In Seattle awareness of this process has led to creation of the "Green Seattle Partnership" or GSP, a major capital improvement campaign aimed at controlling invasive plants on 2500 acres of Seattle's urban forest by the year 2025 (Appendix 2).

This Forest Management Plan is a tool designed to help realize the GSP-objectives in Carkeek Park.

BEST MANAGEMENT PRACTICES

Over the past twenty years restoration science and practice have improved dramatically. Seattle Parks has published general Best Management Practices (BMPs) for work in Natural Areas, "Best Management Practices, 2005-2010", available on the internet at, http://www.seattle.gov/PARKS/projects/bmp.htm.

RESTORATION AS A PROCESS

Through practice, Parks has identified five (5) phases which successful restoration projects tend to go through. These phases are: Pre-Implementation - Planning and Building Community Support, followed by: 1 – Invasive Removal, 2 – Plant Installation, 3 – Plant Establishment, 4 – Maintenance and Monitoring.

Pre-Implementation – Planning and Building Community Support

In Carkeek Park *Planning* culminates in the publication and revision of this document. *Community Support* has grown over the years as the result of the Public Involvement Processes required by Department of Neighborhood Matching Fund Projects, and by organizing regular work parties, initially for the restoration of the trails system, more recently also for planting work parties. A core of faithful volunteers is at the center of a larger and changing group of about 50 volunteers that is notified when STARS work parties are planned, each 3rd Saturday of the month. STARS = Streams, Trails, and Restoration Stewards.

Another form of community support evolved in 2005 and 2007 by the Carkeek Park Environmental Learning Center offering a **Master Foresters Course**, resulting in well-trained Master Forester volunteers some of whom will adopt a section of the forest for monitoring, maintenance, and (planning of) planting activities.

Planning and Community support dovetails with the citywide Green Seattle Partnership, mentioned before. In Carkeek Park community support is still a focus point and priority of the Carkeek Park Advisory Council, initiator of this Forest Management Plan.

1. Invasive Removal

Removing Invasive Species

Non-native invasive plants tend to be highly capable of out-competing all plants and typically survive under a wide range of growth conditions. Heavy invasive plant infestation suggests that forest conditions have degenerated to a point where existing native communities on site are no longer capable of functioning as a self-sustaining unit. When this occurs plant communities lose their ability to compete and the community as a structure begins to dissolve.

Photo 3. Removing of invasive holly trees

Invasive plants are a major problem in natural areas. In spots where invasives have overtaken or are beginning to overtake the native vegetation, restoration should include their complete removal and replacement with suitable natives. Successful management contains the spread of such plant species and reduces the size of existing populations. Invasive control focuses both on individual plants and on infested areas.

Within the context of the Green Seattle Partnership a matrix has been developed for prioritizing invasives removal based on the health care triage system; see Appendix 2 for detail on the TREE-iage system.

Appendix 3 gives a detailed description of the major invasive species in Carkeek Park and describes methods of their removal.

Invasives removal is just one step in the multi-stepped, multi-year process of reforestation/enrichment. Often it is the most important step, but long-term removal success is dependent on the success of the total reforestation project. Effective reduction of plants such as Himalayan blackberry, English ivy, English holly and laurel requires not only a physical elimination of vegetation material but also subsequent replacement of that material with a new herb layer, a shrub layer of native fruit-bearing species, and mid- and upper-canopy tree species. Public pressure is mounting to eliminate sales of ivy and holly in the horticultural trade.

Other site preparation

Apart from invasive removal other steps may be necessary before planting. Restoration efforts preferably focus on existing openings in the forest canopy, so called “gaps”. In some cases a gap is too small, or several smaller gaps are close to each other. In such a case it might be considered to artificially enlarge or connect gaps in order to create a larger restoration area. Techniques such as this are currently in experimental phases at the Cedar River Watershed and may be applicable at Carkeek, see also Appendix 14: “Ecological thinning” and “Restoration thinning”.

If a gap has a dense shrub layer it may be necessary to clear the areas where spot planting is to be effected (see Appendix 7, Spot planting). In an area of roughly 5 x 5 ft shrubs are cut back to about 1’ above ground level and the severed parts are pulled into the surrounding bushes. Usually the cut bushes will resprout, either from buds at the root collar or from dormant buds along the stumps. This regrowth will soon cover the created opening and be in competition with the planted plants. Liberation then becomes a necessary maintenance practice (Appendix 8). Since a gap is often criss-crossed by fallen trunks and branches these clearing spots are chosen where the terrain is fairly open. Distance between spots is about 25 – 35 ft.

If line planting is the method to be used, parallel lines about 30’ apart are cut through the dense under growth, thus providing access both to the area and to the planting sites.

In both cases site preparation causes a certain degree of disturbance in the existing under growth. Therefore this activity should be done *outside the nesting season* that lasts from mid March to mid June.

2. Plant Installation

After invasives management (when necessary) a restoration project focuses on installation of native trees and plants. Depending on the condition of the existing plant community, reforestation will entail either a) a complete or near-complete re-establishment of native trees, shrubs, and herbs or b) enhancement of the existing native plant population, also called **enrichment**.

Establishing a New Plant Community

A new plant community is needed in areas so overwhelmed by invasive plants as to be completely devoid of native vegetation. Such areas will require a deep and energetic commitment from the local neighborhood and the Seattle community at large.

- Plant species are selected, based on their capacity to out-compete other plants – especially non-native invasive species.
- Such native plants will typically be robust growers capable of spreading vegetative as well as from seed.
- When replacing invasive plants which bear prolific amounts of berries or seed it is important to plant natives which do the same.

Carkeek Park does not (yet) include such invasives savannas but they could develop if no attention was given to restoration/enrichment, as outlined in this FMP.

Enhancing Existing Plant Communities

Many forested areas have existing plant communities but are facing inundation by invasive plants. Enhancement reduces the threat of invasive inundation by eliminating spot colonization by non-native plants and replenishing the local flora as needed.

In Carkeek Park restoration/enrichment focuses on recent gaps in the forest canopy (see Appendix 4). In gaps the upper story trees have fallen, but the existing understory of smaller trees, shrubs and herbs is still present, albeit damaged by the fallen trees

A gap needs to have a certain minimum size where improved light conditions enhance growth of planted species. Since it also enhances growth of existing undergrowth and invasives, close monitoring of planted gaps is imperative. A minimum size also reduces the chance of total destruction of new plantings by falling trees from the gaps' perimeter. 700 sq. yards is considered an acceptable minimum area for a viable gap. Smaller gaps are considered "immature"; they are monitored and when they have extended beyond the minimum size they will be included in the planning of restoration/enrichment work. As mentioned before, gaps can also be enlarged or connected in order to create larger restoration areas.

A "gap map" as shown in Appendix 12 should be made annually in May/June. When the trees are bare it is more difficult to estimate gap dimensions

Trying to establish a new forest generation by under planting a dense mature Alder/Maple cover has the risk that falling trees/crowns destroy many of the plants/trees. It is expected that over the next 10 years more and more gaps will form because the existing Alder/Maple forest is over-mature. An increase of gap restoration work is therefore to be expected.

Locally developed best Management Practices

Locally developed best management practices that apply to the installation process are:

- Designing a planting plan (Appendix 6)
- Spot Planting (Appendix 7)
- Bare-root planting (Appendix 1)
- Planting on a (steep) slope (Appendix 1)
- Liberation (Appendix 8)

Planning

Planning of plantings involves a number of steps in chronological order:

1. Identifying the area to be planted (gap), including its size
2. Assessment of soils and hydrology
3. Developing a "Future-image" for that site: what will the mature vegetation look like
4. Developing a plant list: species and quantities (to be produced by June for the 2nd following planting season)
5. Developing a planting plan, indicating which plants go where, and spacing (Appendix 6)
6. Organizing the actual planting activity.

It is clear that steps 1 – 4 need to be done a year ahead of step 6. In order to facilitate this process, **plant palettes** (Appendix 5) were developed which include commonly found plants as well as several rare and infrequently found species which are expected to be able to thrive. Notably four native huckleberries have been included, of which only two are occasionally spotted in the forest presently.

For organizing the actual planting activity useful guidelines are provided by the Green Seattle Partnership (Appendix 9, GSP document). Planning, planting, and subsequent monitoring is to be documented (See Appendix 10: Documentation).

3. Plant Establishment

A planting site will require at least three (3) years of intensive monitoring and maintenance. A common saying regarding woody perennial plants states “first they sleep, then they creep and then they leaf”. This suggests that many woody species require at least three years, once planted, establishing root systems sufficient enough to support growth and survival without regular maintenance. Often the length of the terminal shoot is a good indicator for how well-established the plant is. Such maintenance activities include: mulching, weeding, watering, monitoring, and **liberation**. If plants do not survive, replacement may be necessary. In such cases, 3 additional years of maintenance are required. Preventing this extra investment in time, attention, and resources is one of the motivations to practice Spot planting (Appendix 7).

Mulching is widely used in areas easily accessible by motorized equipment. As mulch mostly chipped woody debris is used. However, in a forest where the planting area (gap) is often very difficult to access, this type of mulching may be impossible. It is not cost-effective. The often existing canopy of shrubs also serves to protect the young plants. It can help to amass dead leaves around the young plants although a thick layer of leaves may prevent rain from wetting the soil around plants. There are also concerns that unwanted weed seeds are imported together with wood chips.

Weeding is a practice used in borders, but hardly applies to forest plantings. However, occasionally weeds are imported together with the plants, although this may diminish when bare-root planting becomes standard practice. Invasives control takes the place of weeding in forest plantings.

Watering is a very labor-intensive task in forest plantings, because often there is no nearby source of water and the terrain is difficult to access. If plantings are put in during the late fall and winter months, watering is usually less necessary. In Carkeek Park plantings on the south slope are less prone to drought, but plantings on the North slope need to be watered regularly. Sources of water are: nearby creeks and friendly neighbors. Approaching neighbors for water often creates a friendly relationship, giving the neighbors a feeling of co-ownership. It is a form of community building.

Monitoring is nothing else than regular inspection of the premises. Often but not always monitoring goes hand in hand with liberation, or with invasives control. Monitoring always includes checking the condition of the planting, success rate, growth, level of invasives, damage by mountain beavers, falling branches etc. Monitoring should be limited to once or twice a year, otherwise recognizable “social trails’ will develop, inviting the public to explore the area. Monitoring data are entered into a monitoring sheet (Appendix 10, Documentation).

Liberation is a form of maintenance where the direct competition for light is removed from around and above the planted specimen(s). See: Appendix 8: Liberation.

4. Maintenance and Monitoring

Long-term care is probably the most important element of restoration because without some amount of human intervention the process of forest degradation will continue to occur. Another word for long term care is sustained monitoring. This is where Master Foresters and Forest Stewards, adopting a section of the park, play an important role. By being observant and looking for problematic situations when walking through the forest they notice such situations as: presence of invasive plants, human caused denuding and erosion, homeless camp sites, newly formed gaps in the canopy, and other changes in the forest character. It is important that they document their observations and communicate these to parks’ staff. They form the eyes, and often the hands, for the park maintenance crew.

Photo 4. A vision for Carkeek Park restoration: a rich mixture of ground cover, shrubs, younger and older trees

5. MANAGEMENT UNITS

Management Units were created as a means of organizing the maintenance needs for a given area in a logical and efficient way to better focus available energy and resources. Typically, areas are grouped under an overarching theme. This theme should be general enough to incorporate all aspects of management within the area, yet specific and concise enough to avoid miss-interpretation. Management units at Carkeek Park have been identified based on the following overarching themes, 1) Natural Forests, 2) Waterways, 3) Education, 4) Historic Preservation, 5) Recreation, 6) Access. These themes were further divided into 17 discreet units based on geographical contiguousness. These units have been graphically represented on map 1 and are listed below. In this chapter short characterizations of all units/sub-units are given. In the next chapter each forest unit and subunit is described in more detail.

MANAGEMENT UNIT	OVERARCHING THEME
1. Forest Unit One	Natural Forests
2. Forest Unit Two	
3. Forest Unit Three	
4. Forest Unit Four	
5. Piper's Wetland	Waterways
6. Creeks (Piper's, Venema, Mohlendorph)	
7. Learning Center Campus	Education
8. Orchard	Historic Preservation
9. Lower Meadow	Recreation
10. Model Airplane Field	
11. Playground	
12. North Meadow	
13. Beach	
14. Trails	Access
15. Roadways	
16. Metro enclave	---
17. Llandover Woods	External Unit, Natural Forest

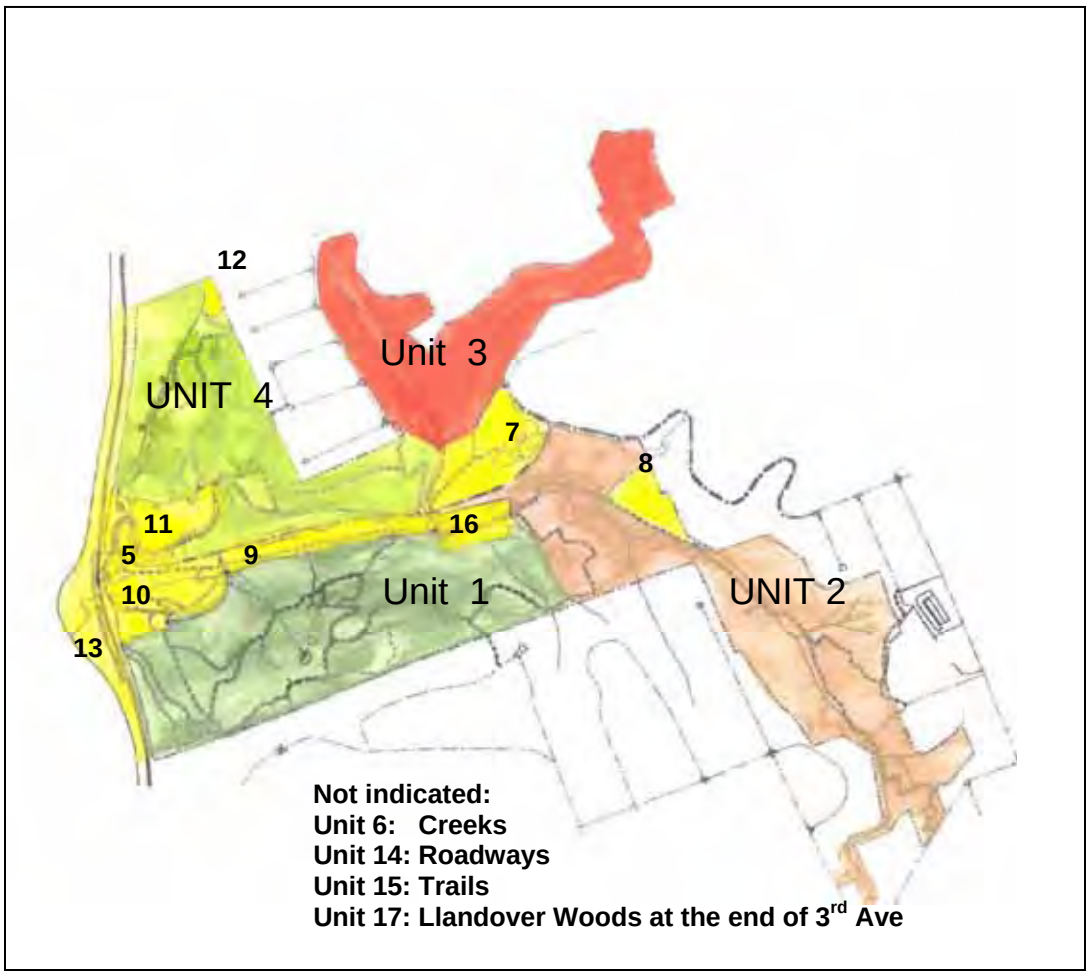

Figure 6: map of the four forest units and other units

UNIT ONE

Unit 1 includes the forested area of Carkeek Park from Piper's Creek to the north, East Metro Creek to the east, the park boundary to the south and the railroad tracks to the west. It is the largest forest area in the park situated on medium sloped terrain on the north facing slope of the park. It is crossed by a number of creeks and at places very wet.

It has been divided into four (4) subunits based on the trail system and, roughly, on environmental factors.

Subunit 1A is the west facing bluff which decreases in elevation northward from the parks' south boundary. The backside of the bluff has been included in the subunit up to the point where the Clay Pit trail separates this subunit from subunits 1B and 1D. The former south meadow is located in the southeast corner of this subunit.

Subunit 1B is the north facing slope due east of the Clay Pit Trail. The area is known to support a higher than average number of bird species and individuals. All efforts will be taken to maintain the current habitat qualities of the western half of this subunit, the boundary being the watershed boundary between creeks 20 A and 20 B. This area is dominated by Alder, Maple, and Salmonberry. Maintaining the character of the existing forest stand is accomplished by planting species commonly found to exist in the area, including: Alder, Salmonberry and Foam Flower. In addition berry producing species like Cascara, Bitter Cherry, and Service Berry can be added (enrichment). Currently conifers exist in low numbers throughout the area. This is acceptable and an occasional conifer can be planted. The relative ration of conifer to deciduous species should remain more or less constant with present conditions however.

Subunit 1C is due east of subunit 1B along the same north facing slope. The area is directly above the metro transfer station and part of the area includes metro-owned property. Parks has been given verbal approval to manage the natural forest areas occurring on metro lands in a fashion akin to other areas of the park. The reason this subunit was split from 1B is based on the stability of the native plant communities. A survey conducted in 1999 found that this area had the highest rate of species diversity in the park, partly due to site diversity: four creeks traverse this sub unit. Management in this area will aim at maintaining plant community stability. This means preventing any additional trails or other human incursions into the area except for the sole purpose of removing invasive plant populations, enriching specific areas with native plants, or restoration activities.

Subunit 1D is the upper plateau south of both sub units 1B and 1C. The area tends to be drier than areas lower on the slope. Conifer trees dominate in many areas of this subunit. Encroachment of invasive plants from backyard landscaping is a major issue in the area, notably Ivy and Periwinkle. Major GSP work parties in 2006 and 2007 have made a big dent in the Ivy cover at the Norcross entrance.

UNIT TWO

Unit 2 is basically the Piper's Creek ravine from where it starts at NW 100th Pl to where it widens just before the Metro Transfer Station. Its boundaries are for the larger part park boundaries. Subunit 2 is traversed by the Piper's Creek Trail, perhaps the most frequently used trail in the park, running from the McAbee entrance at NE 100 NW PL to the beach. Creek Stewards focus on the creeks in this unit, that counts 3 subunits.

Subunit 2A is the lower part of the ravine, abutting subunit 1C, unit 7, Campus, and Unit 8, Orchard. The slopes of the south hillside are very steep and have a cover of Alder/Maple forest that is rapidly declining. Where mature gaps occur management aims at restoring a mixed coniferous forest. The promontory at the north side carries a young coniferous forest. It is the site of the Piper's homestead, and Mrs. Piper's paintings show the views over the Piper's ravine at the beginning of the 20th century (copies to be seen at the ELC).

Subunit 2B is formed by the middle part of the narrowing ravine, with steep slopes; the east side widens into the "Viewlands bowl", watershed of the Viewlands creek (20 J), a marshy area with steep slopes. All slopes are covered with a declining cover of Alder/Maple. A temporary "service trail" needs to be created to provide access to restoration areas.

Subunit 2C is the upper reach of the Piper's Creek ravine, narrower and with even steeper slopes than subunit 2B. The Piper's Creek trail originates at NW 100 PL.. This entrance area needs special attention being the entrance used most frequently by pedestrians. The uppermost section of this subunit is hardly manageable because it is so narrow.

UNIT THREE

Unit three is formed by the upper reach of Venema creek and the whole of Mohlendorph creek. The whole area is designated as a "conservation area" and no trails are maintained. Venema creek and possibly Mohlendorph creek are salmon spawning creeks for Chums, also possibly Coho. Unit boundaries are the park boundaries to the north and two imaginary lines going down from the ELC Campus (Unit 7) to the confluence of Venema and Mohlendorph, and going up from there to the corner of 12th Ave NW.

Unit Three has been subdivided into two subunits: the Mohlendorph creek watershed (***Subunit 3A***), and the upper Venema creek watershed (***Subunit 3B*).**

Management policy for this unit is to preserve its nature reserve character. Nevertheless invasives control and restoration/enrichment planting will have to be practiced.

Creek Stewards focus their attention on these creeks (see also Appendix 11).

UNIT FOUR

Unit Four is the counterpart of Unit 1, forming a fairly extensive forest on the gentle south facing and very dry slope at the west end of the park. No natural creeks traverse this unit; one seasonal creek carries street runoff from the adjoining neighborhood. Management aims at invasives removal and enrichment; relatively few restoration projects are to be expected because there is an established young mature mixed forest community present.

Unit four has been subdivided into the following four subunits.

Subunit 4A is squeezed in between the access road to the playground (Unit 11) and the 12th Ave neighborhood. The east side is stocked with young mature mixed forest; the west part is mature Maple forest. There is a rich understory of Oregon grape but Ivy and Holly are serious threats to this rich forest. A new trail more or less parallel to the motor road was completed in 2007 to provide access when restoration becomes necessary and to provide an alternative for walking along the road (North Traverse).

Subunit 4B is the forest North of the playground (Unit 11). It has recently been stripped of Ivy and Holly (2005). It carries an interesting rich mixed forest at places dominated by Grand Fir, and middle story species like Cascara, Willow, Bitter Cherry and Serviceberry. There is a fair amount of natural regeneration of this species. An edge community was planted along the edge with the North Meadow (Unit 12), January 2005, and replanted in 2007; 5 Memorial Madrones were added in December 2007. This planting needs close monitoring. Some restoration is needed at the south-east corner of the subunit; otherwise this area can be left alone but for occasional monitoring.

Subunit 4C is the enclave in the loop of the playground access road; it consists of steep slopes with, at the west end of the subunit, a slope-enclosed wetland. Management aims at maintaining and enriching the existing dry mixed forest and removal of invasives, most notably Police Helmet..

Subunit 4D is the bluff and steep slope between subunit 4B and the railroad tracks. The area is difficult to access, there are no trails. January 1997 some severe landslides occurred and structures were installed below the North Meadow to prevent further slides. The area is basically left alone except for evicting an occasional squatter. However, occasional monitoring must be done to detect threatening invasives, gaps, and landslides. This subunit is part of a forested North-South corridor along the railroad tracks, used my migrant wildlife like coyotes, beaver (?) and cougar (?)

NON FORESTED UNITS

UNIT FIVE – PIPER'S WETLAND

Unit five contains the wetlands at the end of Piper's Creek. It is a swamp traversed by the creek. Management is aiming at getting rid of the blackberries and enriching the existing swamp forest vegetation. The area has a high educational/recreational value because of the yearly salmon return around Thanksgiving. Since 2001, a volunteer Creek Steward has held monthly work parties concentrating on invasive removal and revegetation with appropriate riparian vegetation.

Photo 5. Piper's Creek streaming through the wetlands (Unit 5)

Photo 6. Piper's Creek floodplain east of the Metro facility (Unit 6)

UNIT SIX - CREEKS

Unit six is formed by the three major creeks in the park: Piper's Creek, Venema Creek, Mohlendorph Creek, and other tributaries (see Appendix 11, Creek numbering). Management is focused on maintaining these creeks as viable salmon spawning creeks. A 200' wide zone in subunits adjoining creeks is identified as "riparian zone" and receives special attention from SPU, the park maintenance crew, including normal restoration activities of Forest Stewards. The overarching goal is to have creeks run through a tunnel of overhanging vegetation, thus keeping the water temperature low and giving salmon protection from predators on their way up. This goal affects the management of the adjoining units.

Unit 6 shows a mix of invasives including knotweed, blackberry, morning glory, English ivy, and policeman's helmet. Volunteer stewards under Seattle Public Utilities Creek Steward program work on removal of invasive species, usually within 25-100 feet of the creek channel. Ongoing revegetation consists of a native riparian palette including (but not limited to) Western red cedar, Sitka spruce, Douglas fir, Western hemlock, Oregon Ash, Cascara, Red osier dogwood, Salmonberry and Thimbleberry, various ferns, Devil's club, Vine maple, Stinking currant, Indian plum, Red elderberry, and Beaked hazel.

In 2006-2007 a major King County and Advisory Council financed knotweed-out project, initiated and executed by Doug Gresham, reduced the impact of this species considerably.

UNIT SEVEN – LEARNING CENTER CAMPUS

Photo7. Carkeek Park Environmental Learning Center

Unit seven is the Environmental Learning Center Campus, the promontory enclosed by the park boundary, the entrance road to the park and the Salmon to Sound trail. Partly open space, partly borders, and partly forest, it serves an educational purpose with a collection of native herbs, shrubs and trees. In addition there are buildings and the service yard. Special

attention is given to the Hazel Wolff Memorial Hazel Grove. Management is focusing on keeping this a spic and span area. Ivy and Periwinkle invasion, however, is serious. During 2007 much progress was made with GSP assistance to clear the unit of invasives and replant.

Photo 8. The Salmon to Sound Trail leads to the imprint pond and amphitheatre (Unit 7)

Photo 9. Historic Piper's Orchard (Unit 8)

UNIT EIGHT - ORCHARD

Unit eight is the historical Piper's Orchard, discovered about 25 years ago under a thick blanket of Blackberries (Photo 9 & 10). This orchard has been restored and afterwards been maintained under the inspiring leadership of Ron Schaevitz. Management aims at maintaining this historical monument. Issues at the Orchard are: unclear boundaries with neighbors on the East side, encroaching Blackberry bushes, and a heavily invasives-infested (including Clematis) zone between the orchard and the North Creek. Japanese knotweed is a tenacious invasive. Desired enrichment plantings along the East and West side would be forest edge communities. Tall trees should not be planted and possibly even be removed. When there is a conflict of interest, orchard interests prevail. Orchard management focuses on "organic farming" and eradication of pests like apple maggots.

Photo 10. Historic Piper's Orchard, in the background the NE facing slope of subunit 2A

UNIT NINE – LOWER MEADOW

Photo 11. Unit 9, the Lower Meadow, a gathering place for community events

Unit nine is the lower meadow, a long narrow grass field between the road and Piper's Creek with a few clusters of trees. Open space is a rare commodity in Carkeek Park and **no trees or shrubs should be planted in this open space, even not to replace trees that have fallen.** The area is frequently used by groups for picnics.

Management of the tree/shrub zone between the Piper's trail and Piper's Creek is aiming at creating a dense shrubbery with a limited number of big trees, whose root systems hold the creek banks together The dense shrubbery serves to protect the creek and the trees need to be limbed, ultimately up to 20', both for allowing enough light to keep a healthy shrub layer and to reduce shade on the meadow. A sound guideline is to have 1/3 of the tree free of branches.

UNIT TEN – MODEL AIRPLANE FIELD

Unit ten is the model airplane field between Unit one and the wetlands. Management is aiming at maintaining this area as a healthy grass field with an open view to the Puget Sound. This will necessitate limbing of trees planted in borders.

Photo 12. Model Airplane Field (Unit 10)

UNIT ELEVEN – PLAYGROUND

Unit eleven is the most heavily used area in Carkeek Park because it contains the playground with the "Salmon Slide" (1997). It is a heavy maintenance area; special attention must be given to detecting hazardous trees. Management is aiming at keeping it a healthy open space with an uninterrupted view on Puget Sound. This will necessitate limbing of planted trees. The sloped and forest-covered area North of the playground is prone to erosion because it is heavily used as an extension of the playground. To keep the forest alive protection of this area and establishing a protective ground cover is a high priority. Efforts to realize this were undertaken in 2007.

Photo 13. Carkeek Park Playground: Home of the famous salmon slide

UNIT TWELVE – UPPER MEADOW

Unit twelve is a man-made open space at the North edge of Unit 4B. It is a much visited recreational area because of its unique view over Puget Sound and the Olympics. Management is aiming at preserving an unblocked view over the Sound from the recently placed bench, keeping at least part of the meadow an open recreational space with drought resistant grass vegetation. The big Red Cedar tree is NOT to be limbed up! At places there is Gorse, an unusual invasive. A forest edge community was planted in 2005 along the meadows south edge. It was replanted January 2007. It needs to be monitored closely.

Photo 14. Puget Sour

Photo 15. Beach - Unit 13

UNIT THIRTEEN - BEACH

Unit thirteen is the ever changing beach of Carkeek Park. It serves both a recreational and educational purpose. Concerns are water quality of Piper's Creek, a preferred play zone for children; safety because of the freely accessible railroad tracks; and several invasives.

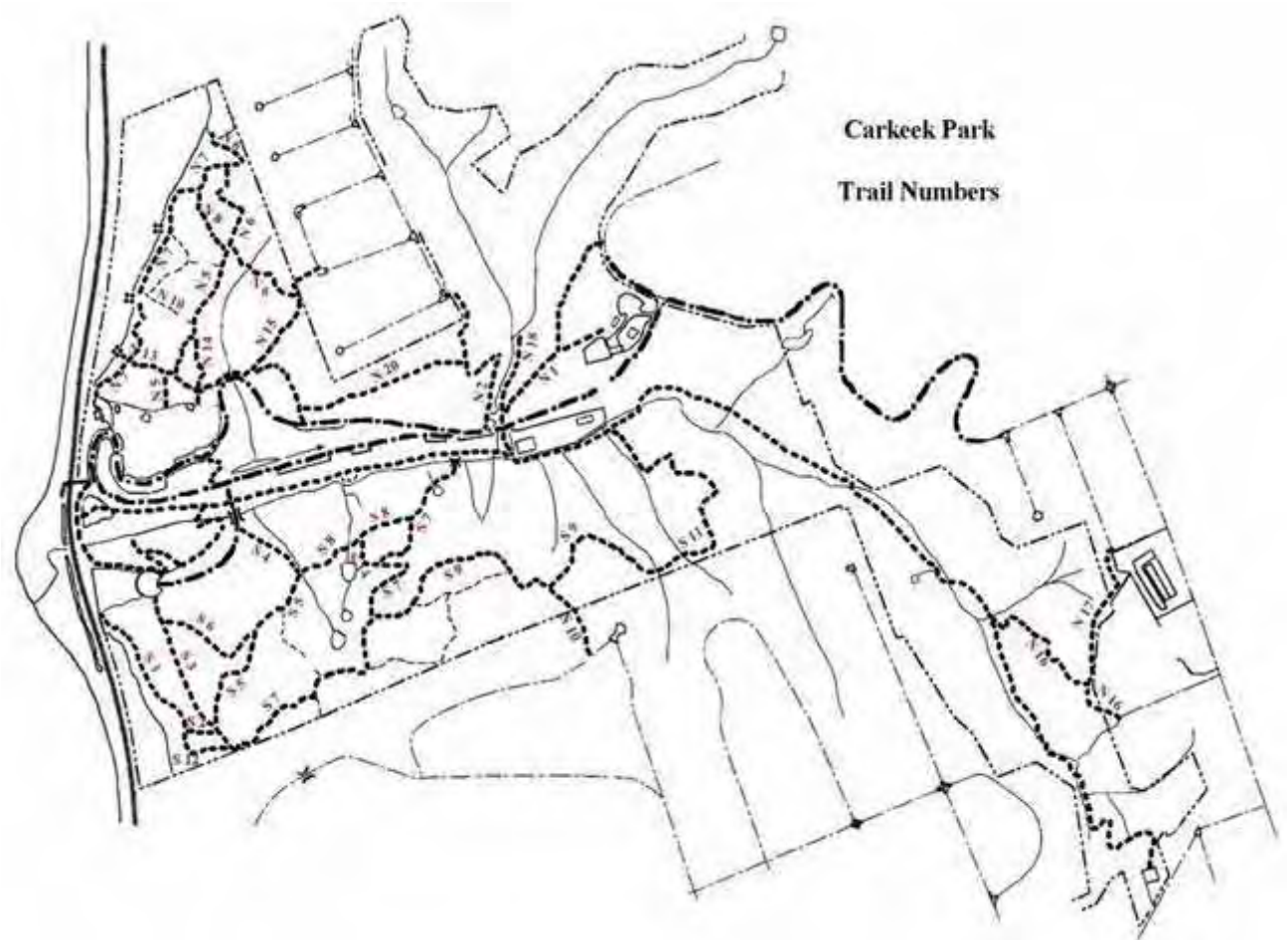

Figure 7. Carkeek Park Trails System

UNIT FOURTEEN - TRAILS

The extensive trails system in Carkeek Park was upgraded between 2001 – 2007 according to the existing codes for trail establishment. Forest restoration projects should not plant tall shrubs and trees closer than 3 ft to the edge of a trail. A swath 8 ft wide, 4 ft on each side of the trails' center line, and 8 ft high should be kept free of overhanging branches.

Subunit boundaries are sometimes defined by trail numbers, see map above. The trails map available to the public has trail names, see page 4. An "Adopt a trail" program is functioning in Carkeek Park. For information call 206 684 0877.

UNIT FIFTEEN - ROADS

Overhanging branches should be limbed, creating a 15' high free corridor; no new trees must be planted closer than 15' from the edge of the road.

UNIT SIXTEEN - METRO

To the east of the lower meadow, Unit16, the Metro Transfer Station is situated, a former treatment station and still a standby. Collected sewer is pumped from here to the water treatment plant at West Point. The area is 250' x 500'; the south half of this domain forms a unity with subunit 1C. The person/office to contact about forest issues is: King County Property Services, Bernard Thompson, 206 296 0887. Issues are overhanging Alder trees and forest restoration.

Photo 16. Unit 16 – Metro property includes the slope to the left

UNIT SEVENTEEN - LLANDOVER WOODS

Llandover Woods is a 10 acre park west of the intersection 3rd Ave NW and 145th Street. Qua management it is the responsibility of Carkeek Park. Restoration projects are carried out by a group of local volunteers, following guidelines established in the Llandover Woods Vegetation Management Plan, prepared by the Seattle Urban Nature Project (see their web-site).

6. FOREST MANAGEMENT UNITS

This chapter describes forested subunits in greater detail and identifies current (2007) management priorities and actions to be taken (projects). In addition regular monitoring will identify *opportunistic projects*, i.e. projects that at this moment cannot be foreseen but will become manifest when the over-mature forest cover opens up, forming more and more gaps (see Appendix 12).

Many planting projects, both restoration and enrichment, have been realized in the period 2002 – 2005, see Appendix 13: Realized projects.

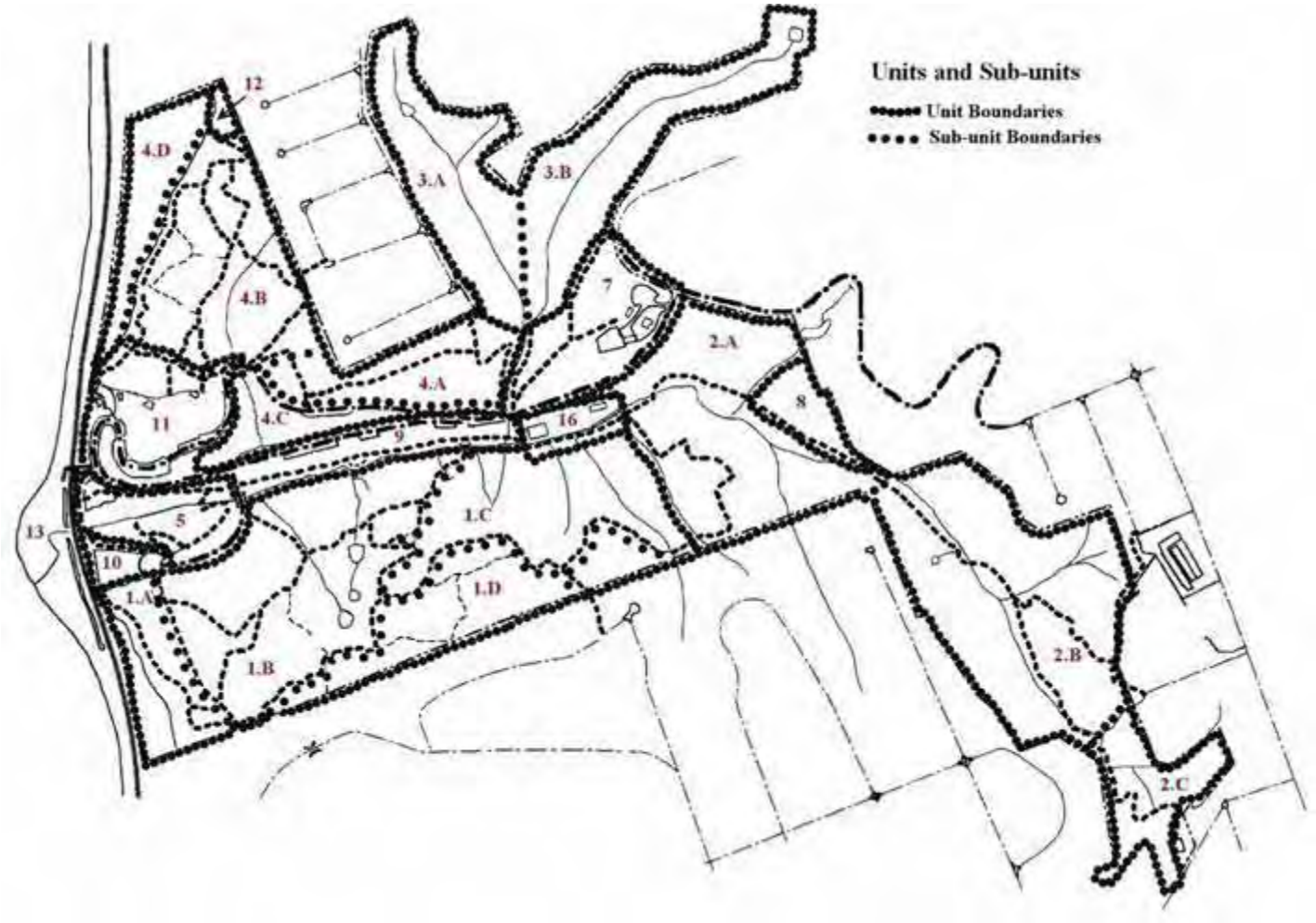

Figure 8. Forest Management Units Map

UNIT ONE

Unit One includes the forested area of Carkeek from Piper's Creek to the north, East Metro Creek to the east, the park boundary to the south and the railroad tracks to the west. It is the larges forest unit, on the wet, north-facing south slope of the Park. It has been further divided into four (4) subunits based on the trail system and, roughly, on environmental factors.

Unit 1 Subunit A

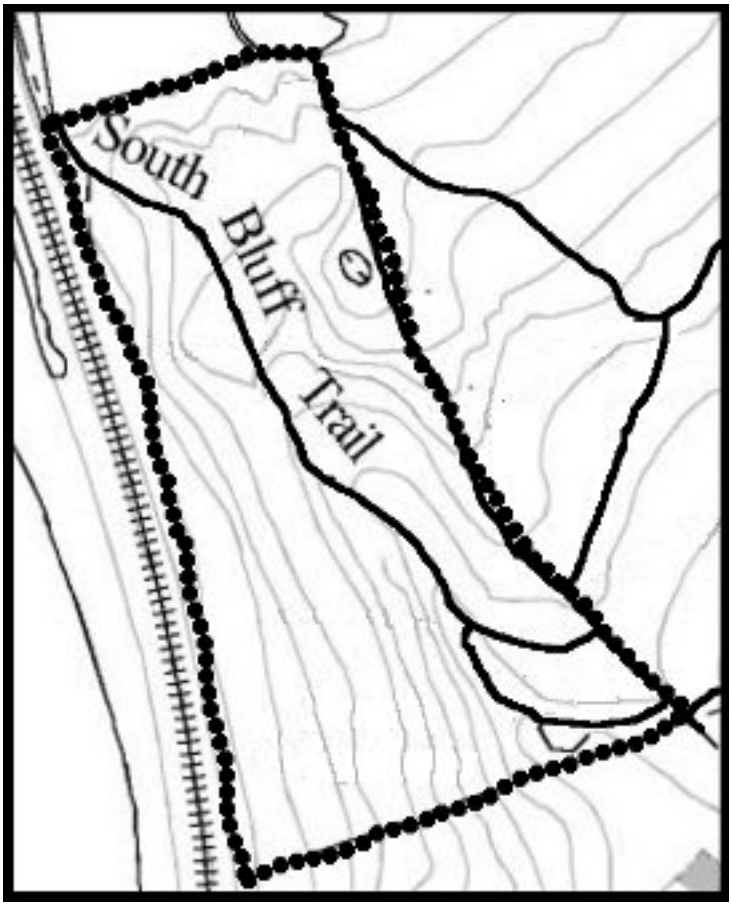

Figure 9. Subunit 1A

Figure 17. West slope of subunit 1A

Figure 18. South Meadow of subunit 1A, recently restored to forest edge.

GOAL

Maintain site character; establish bluff plant community on, and west of ridgeline.

DESCRIPTION

Presently, this area has a mixed deciduous forest with a fairly dense under story of shrubs and only a few evergreen trees. It is suspected that many of these trees result from past enrichment plantings. Key areas include: 1) the dry, steep bluff on the Westside, 2) the plateau area on the south side which includes the former south meadow, 3) the small wetland area adjacent to the Clay Pit Trail on the north side, which is the site of a former clay pit, 4) the plateau located in the northeast corner above the model airplane field.

Plants suitable to the area vary, based on slope position and orientation. Along the bluff head and upper western slope the most suitable plants would tolerate or prefer dry, exposed

conditions. Shorepine, Madrone, Hairy Honeysuckle, Oceanspray and Snowberry are species expected to thrive in this environment, to name a few. Farther down the western slope, the area becomes wetter and is more suitable for Douglas fir, Big Leaf Maple, and willows. On the eastside of the bluff the forest is dominated by Alder and Salmonberry. The forest association has been identified as high quality bird habitat and should keep its predominantly deciduous character, provided that invasive plant species do not begin to dominate. After demise of the Alders a mixed forest community can be established. In 2004 a forest edge community was installed on the eastern ¾ of the former south meadow to discourage tresspassing of park visitors and dogs into private property. This area experienced a grass fire in the summer of 2005. Three Gary Oaks were planted there in January 2006.

BOUNDARIES

North	Model Airplane Field
East	trail "S3" = Clay pit trail
South	Park Boundary
West	Burlington Northern Santa-Fe Railway

CHARACTERISTICS

- High peeling bluff cascading down to Railway bulkhead and beach
- Soil tends to be dense
- Near airplane field there is a small wetland area
- Nice view point over Puget Sound from the former south meadow and other locations along the edge.

ISSUES

- Area has high slide potential, threatening the S1 trail
- Preservation of Sound and Mountain views
- South Meadow Fire hazard

PLANT PALETTES (Appendix 5)

Puget Sound Bluff
Wet Deciduous
Forest Edge
Mesic Mixed

MANAGEMENT PRIORITIES

- Enrich Bluff head with Puget Sound Bluff community
- Monitor forest edge community on former south meadow
- Keep the view from the west side of the former south meadow open (maintenance)
- Monitor/maintain existing restoration work.

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 1 A, project 1

Re-establish native vegetation in wetland area above Unit 10 (Model Airplane field).

Objective

Re-establish native plant community in wetland area to replace source of blackberry infestation

Located on the West side of Clay Pit Trail approximately 100 yards south and up hill of Unit 11 (model Airplane field) is a depressional wetland area, a former clay pit. Currently, the area is filled with Salmonberry, Blackberry and Holly. Restoration requires that existing non-native plants be taken out and native vegetation be planted in the area. Within the aquatic zone (area inudated with water for more than 9 months of the year) an herbaceous wetland plant community should be used, while surrounding the area should be a wet deciduous community. This area is excellent for Oregon Ash, Cottonwood, and willows.

Early 2007 a willow cloning corner was established along the Clay Pit trail.

Subunit 1 A, project 2

Extend shrub edge community planted on former south meadow, extending into the gap just north of the plateau

Objective

Increase foraging and shelter habitat for wildlife while armoring forest edge with fruit producing shrub and small tree species.

Here is an opportunity to establish a mixed fruit producing small tree / shrub forest border along the North / Northeast edge of the former South Meadow. The eastern ¾ of the South Meadow itself has been planted in 2004 with a mixture of species, including one Yew, Service Berry, Nine Bark, and – recently – 3 Gary Oaks. A limited open area is left to maintain a view point over Puget Sound. There is a fairly heavy Blackberry infestation (which should be taken care of prior to planting), and a dense undergrowth of Salmon Berry and Indian Plum.

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Sub unit 1A project 3

Enrich shrub vegetation on plateau above Unit 10 with trees.

Objective

This plateau, from which one has a marvelous view over Puget Sound, could be developed as a view point area by planting e.g. some Oak trees in addition to the already existing deciduous trees like Bitter Cherry. An extension of this area is the new gap that opened up along the railroad track. This area seems suitable for shore pine and madrone. The plateau just above the gap could be a nice viewpoint

Sub unit 1A project 4, 5, and 6

New gaps, to be addressed when appropriate.

Objectives

Maintain the predominantly deciduous character of the area because of its importance for both resident and migratory bird populations. Gap 6 is slated for restoration in 2008.

Unit 1 Subunit B

Photo 19. Gap in SW corner, cleared of blackberry Nov. 2004 and Feb. 2006, partly replanted Feb. 2006, Project 1B 1

Photo 20. East of Project 1B 1, site of an upcoming Project, 1B3

GOAL

Maintain general deciduous character of indicated area (see unit map), enhance avian habitat.

DESCRIPTION

Area is dominated by Red Alder and Salmonberry. There is a dense ground layer of Pacific Waterleaf covering the entire subunit. Birds use this area more than other areas of the park for foraging and shelter. Though, presently, the canopy lacks stratification, the Salmonberry understory acts as shelter and food supply.

BOUNDARIES

North	Piper's Creek Riparian Zone
East	Trail "S7"
South	Trail "S9", the South Edge trail
West	trail "S3"

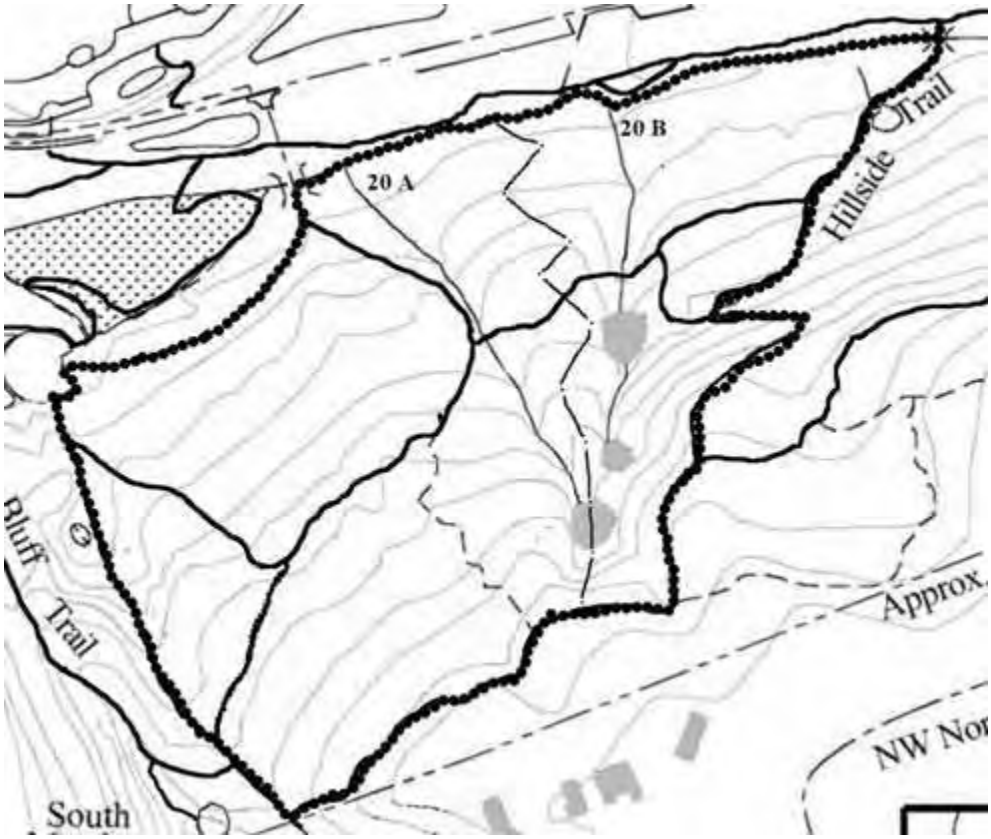

Figure 10. Unit 1B, the boundary between the West section and the East section is indicated by the zig-zag line.

CHARACTERISTICS

- Concavely sloped area with several spring-fed streamlets (20A & 20B)
- Dominated by aging Red Alder, thick Salmonberry understory and diverse ground layer
- One of the heaviest used by birds because of area's extreme deciduous character. Area character should be maintained.

ISSUES

- Aging upper canopy
- Poor middle canopy development
- Low fruit producing species diversity
- Mountain beavers
- Squatters
- Blackberry and Ivy

PLANT PALETTES (Appendix 5)

In the West section of the subunit:

Wet Deciduous Broadleaf
Mesic Deciduous Broadleaf

In the East section of this subunit:

Mesic Evergreen
Wet Evergreen

MANAGEMENT PRIORITIES

- Maintain character as mixed deciduous forest
- Enrich vegetation in depressional wetlands and riparian streamlet areas
- Monitor / Maintain existing restoration work

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 1 B, project 1

Restore existing canopy gaps

Objective

See project 2. This gap was planted with conifers in 2002, some of which survived mountain beavers and falling trees. Ongoing monitoring. This gap ties in with 1B2.

Subunit 1 B, project 2

Restore existing canopy gaps in SW corner of subunit

Objective

Increase tree diversity and canopy layering while preserving the areas deciduous character.

This gap, (the Beverly/Jamie gap) recently cleared of blackberry, has been partially planted in previous years. As described before this subunit needs to be maintained as a primarily deciduous forest stand with occasional evergreens because of its importance for avifauna. Two still immature gaps to the west and east of this gap will most likely mature soon, creating the possibility to extend the intended planting.

Trees planted in 2006 and 2007 include: Birch, Alder, Maple, Ash (!), Black Hawthorn, Gary Oak; shrubs: Oregon grape, Vine maple and others.

As an experiment some Vancouveria was planted but the results are dubious.

Subunit 1 B, project 3

Restore existing canopy gaps in SW corner of subunit

Objective

Increase tree diversity and canopy layering while preserving the areas deciduous character.

This gap is waiting for a few more mature Alders and Maples to come down, then it will be joined with the 1B2 and 1B1 gap,

Subunit 1 B, project 4

Enrich wetland at mouth of creek 20A

Objective

Create an open canopy of Ash above the dense Salmonberry shrub layer.

Slated for 2008

Subunit 1 B, project 5

Restoration of gap along the hillside trail

Subunit 1 B, project 5

Restoration of gap along the hillside trail

Objective

Create a rich mesic/wet coniferous forest.

This gap that opened up between 2005 and 2007 has been partially planted in 2007 and 2008. It reached from Piper's creek up along the slope. Some remnants of earlier plantings (mid-nineties) are still there. Species planted: close to the creek: Sitka and Ash; along the slope: red cedar, hemlock, cascara, Black Hawthorn, Crab Apple. **Ivy is still a big issue!**

Subunit 1 B, project 6

Restoration of gap (ultimo 2007 still immature)

Objective

Maintain deciduous character.

Unit 1 Subunit C

GOAL

Enhance and preserve existing natural character of area

Because of its rich composition this area should remain closed to human activity as much as possible.

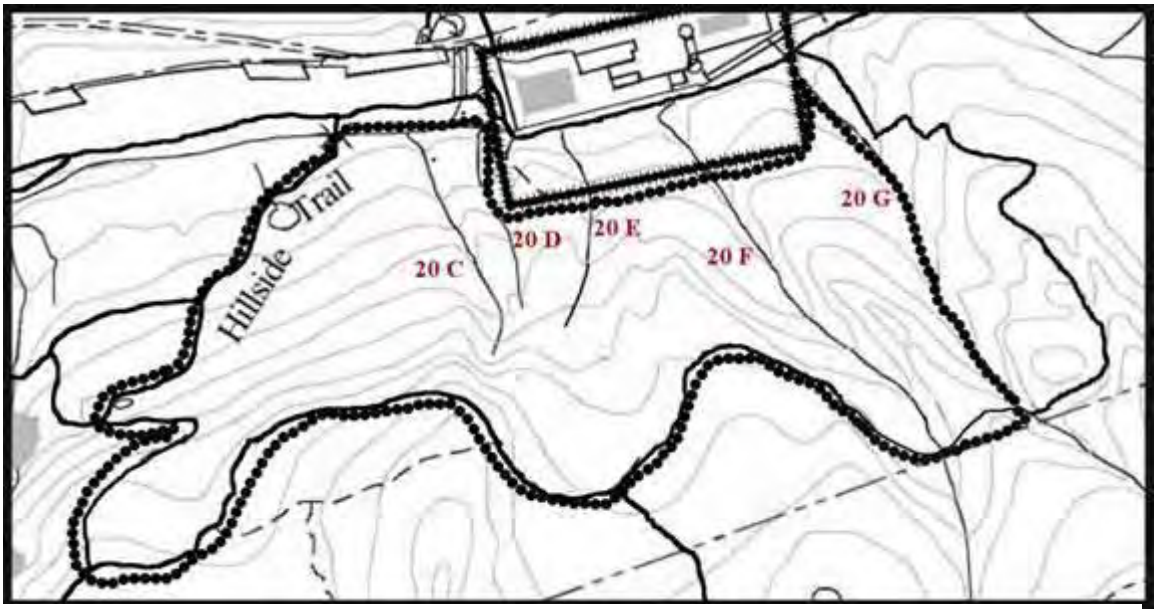

Figure 11. Unit 1 Subunit C

Photo 21. New gap formation

Photo 22. Field of false-lily of the valley

DESCRIPTION

Species diversity tends to be high compared to the rest of the park. There is an extensive field of False Lily of the Valley in the west-center of the area. There are two dense patches of English Ivy which have been removed in 2006 but need monitoring. Holly is also an increasing problem. Recently three larger mature gaps have formed that were planted; immature gaps are present and more gap forming is expected. Below the Norcross entrance there are two wetlands, feeding three creeks, 20 C-D-E (see Appendix 11); on the east side of this subunit the west metro creek (20 F) traverses the subunit from south to north.

A section of 125' x 500', the south half of the Metro Transfer Station, is part of this subunit. No trees potentially taller than 80' should be planted close to the Piper's Creek trail because their crown should not reach Metro premises. Preferred species: Ash and Crab Apple.

Two bridges cross the East Metro (20G) and West Metro (20 F) creeks. The steep slopes of the ridge between these two creeks need special attention; there is heavy mountain beaver-induced erosion.

BOUNDARIES

North	Piper's Creek Riparian Zone
East	East Metro Creek (no.20G)
South	Park boundary and trail "S9"
West	trail "S7"

CHARACTERISTICS

- Area of several small concave slopes.
- Multiple spring-fed depressional wetlands and streams
- Mixed deciduous forests with scattered conifers
- Western Hemlock and Red Cedar are regenerating in small amounts
- Area has highest degree of species diversity in park

ISSUES

- Possible social trail incursions
- Poorly developed middle stories
- Mountain beavers
-

PLANT PALETTES (Appendix 5)

Mesic coniferous
Moist evergreen

MANAGEMENT PRIORITIES

- Invasives removal
- Gap restoration planting
- Monitoring/liberation

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 1C project 1

Re-establish native plants in Ivy-cleared areas

Objective

Improve forest structure that is lacking a middle story.

This (small) section of subunit C was cleared of Ivy summer 2005 (Pro Parks project). There is a an open shrub layer with Elderberry, but the ground is fairly bare. Vaccinium was planted Jan. 22, 2006, but more middle story trees can be added, like Yews (Mesic Coniferous Palette). This section connects with the area of project 1D 1.

Subunit 1C project 2

Re-establish native plants in creek-enclosed gap

Objective

Create a rich mixed forest to reduce erosion forces.

Several attempts have been made to enrich this area, for the first time in 2003 with 1-year old seedlings donated by Weyerhaeuser. Hardly any of these survived the mountain beavers. In 2007 several Ashes and Sitka's were planted and further enrichment is slated for 2008.

Subunit 1C project 3

Gap restoration Mesic evergreen

Objective

This gap just north of the South Edge Trail, enriched in 2004, suffered both from in-falling trees and Mountain Beaver damage. Monitoring should assess the damage and indicate how much additional trees should be replanted. Some planting was done in 2007.

Subunit 1C project 4

Gap restoration Wet evergreen

Objective

Same as 1B5: rich mixed forest.

This area is fairly wet because of the closeness of the clay layer: water seeps out at many places. In 2007 and 2008 a mix of Red Cedar, Hemlock, some Douglas Firs, and various deciduous trees and shrubs were planted (Cascara, Twinberry, Currant, Crab Apple).

Subunit 1C project 5

Gap restoration Wet evergreen: gap still immature

Subunit 1C project 6

Gap restoration Mesic and Dry Evergreen

Objective

Erosion prevention

This area has had a lot of attention because of the bridge building activities. Planting was done in the years 2004 – 2007, with reasonable success. Species variety is great, including e.g. Yews and Cottonwood.

Subunit 1C project 7

Gap restoration: Dry Evergreen and riparian forest.

Objective

Erosion prevention

This relatively new gap consists of the flood plain of creek 20 G and the very steep, sandy slope to the west of it. The slope is a mountain beaver condominium and tons of sand are deposited into the creek.

The gap is slated for restoration in 2009.

There is a big patch of Devils club!

Photo 23. Mountain Beaver activity leads to heavy erosion on this steep west slope of East Metro Creek

Subunit 1C project 8

Gap restoration: Wet Evergreen and riparian forest.

Gap still immature; it forms a bridge between 1C2 and 1C4.

Subunit 1C project 9

Gap restoration: Wet Evergreen and riparian forest.

Objective

Form an attractive varied shrub/low tree cover on the slope just south of the Piper's creek trail.

Having a varied composition offers the public (Piper's Creek trail is the busiest trail in the park) a different experience after coming out of the Piper's canyon. Limited planting has been done, with the experience that Twinberry is a good species to plant on these very wet slopes with heavy clay. Preferred species: Ash and Crab Apple.

Strictly speaking this is Metro land, see also page 36.

Unit 1 Subunit D

GOAL

Add diversity and stratification to the existing forest

DESCRIPTION

Subunit 1D is a gently undulating plateau, separated from subunits 1B and 1C by the South Edge Trail that runs along the edge of the ravine. It has a mostly sandy soil and harbors one of the biggest concentrations of evergreens in Carkeek Park,

BOUNDARIES

North	trails "S7" and "S9"
East	-
South	Park Boundary
West	Clay Pit Trail

CHARACTERISTICS

- Mixed Coniferous/Deciduous forest dominated by Red Cedar and Big Leaf Maple; locally natural regeneration of Hemlock
- Sandy, well-drained, soils; terrain fairly flat

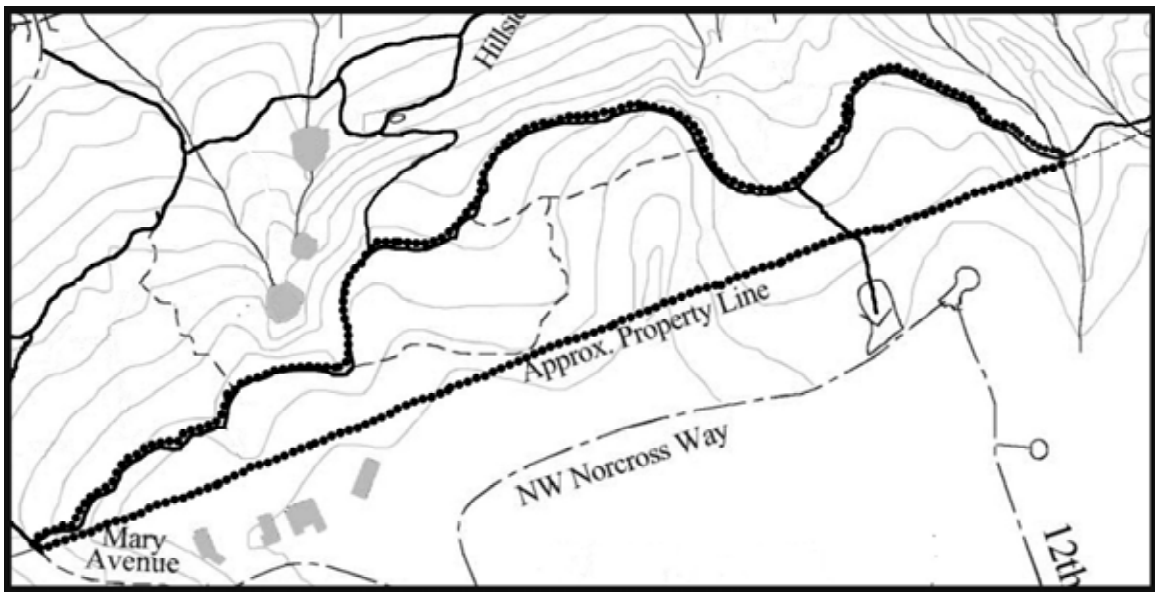

Figure 12. Subunit 1D

ISSUES

- One of the major issues in this subunit is colonization of non-native plants from sources outside park boundaries, Ivy, Holly, and Periwinkle. To establish a dense shrub border on park land to armor the forest from outside forces would require cutting trees down along the park boundary. The removal of trees goes against Parks Department policy and thus it would be easier to entice bordering property owners to remove non-natives and establish a shrub border on their properties, abutting the park.
- Multiple developing social trails from private residences
- Maintaining storm drain outflow pipes at Norcross.

MANAGEMENT PRIORITIES

- Invasives removal
- This area is an excellent candidate for restoration work that will establish tertiary stage vegetation(evergreen trees) in the lower canopies.
- Enrich area with mesic mixed forest community; establish a diverse forest community while increasing canopy layering
- Monitoring/replanting (when necessary)/liberation.

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 1 D Project 1

Re-establish native vegetation in Ivy-cleared areas

Objective

Enrich existing ground cover and forest structure.

The section of subunit 4D enclosed by the Norcross Trail and the South Edge Trail has been chosen for focusing Ivy removal, because part of that area is one of the richest corners of young mature coniferous forest in the park. The east part of this section is “on its way out”. On the south-east side a forest edge community was be established to create a visual barrier between the park and private property (Swanson work party 1/22/06). Additional GSP work parties have nearly eliminated Ivy from this project area and underplanting with ferns, Salal, Cedar, Hemlock, and many other species have enriched this section of the forest. The slope down to the West Metro bridge still needs attention.

Subunit 1 D, Project 2

Ivy removal and underplanting

Objective

Take out one of the major Ivy/Holly concentrations in Carkeek Park, preparing that area for restoration.

Area is contingent with the area of the previous project. Many small school groups and Boy scout projects have addressed part of the Ivy problem in 2006/2007. The area is slated for underplanting in 2008.

Photo 24. Unit 1D has serious problems with ivy, holly and periwinkle - but is also a rich, young-mature dry conifer forest

Photo 25. Mature yew trees - a rare presence in Seattle's parks. Are they native?

Subunit 1 D, Project 3, 4, 5

Ivy removal and restoration

Small gaps in the process of maturing. Gap 4 has been planted in 2007, including an experiment with *Linnaea borealis*. Monitoring is indicated.

UNIT TWO

Unit Two, situated to the east of Unit one and of the Campus area, is basically the steeply sloped Piper's Creek ravine with a few side-ravines. It has been subdivided into three subunits, the lower Piper's Creek ravine, the middle Piper's Creek ravine, and the upper Piper's creek ravine. Management is aiming at prevention/reduction of erosion.

Unit 2 Subunit A

GOAL

Establish climax stage vegetation in occurring gaps with emphasis on a dense ground cover and shrub vegetation to reduce erosion.

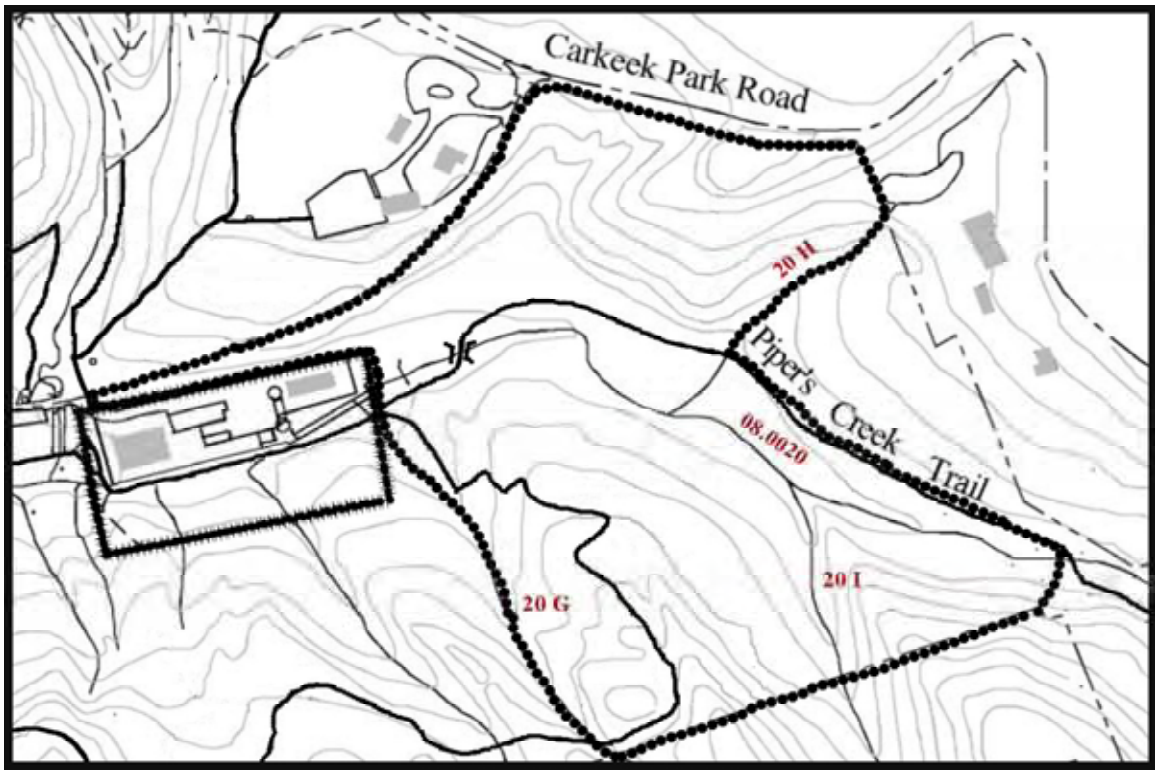

Figure 13. Subunit 2A

DESCRIPTION

The lower Piper's creek ravine is very heterogeneous. A dry ravine abuts the Campus area with a dry knoll with young coniferous forest next to it, the former Piper's homestead. There is a wide, periodically flooded creek bed SW of the Orchard, recently enriched with Oregon Ash.

From the south creek no 20 I enters Piper's Creek. There are steep slopes both on the south and the north side of this subunit. The Alder forest on the South-slope is rapidly reaching implosion stage

Piper's Creek trail runs parallel to Piper's Creek.

BOUNDARIES

North	NW Carkeek Rd/Park boundary
East	Park Boundary
South	Bridge crossing Piper's Creek at 110th NW
West	Metro facility / East Metro Creek (20 G)

Photo 26. Red alder forest is past maturity and starting to lose control of this site. Ivy is present and will take over if site is not restored

CHARACTERISTICS

- Area is dominated by Piper's Creek
- Sensitive slopes – due to instability - can be found to the SW along trail "S11"
- High volumes of people use Piper's Creek Trail to access park from McAbee Entrance
- Slopes tend to be steep
- Soils are dense / wet
- Streamlets are abundant

ISSUES

- Large non-native populations around Piper's Orchard North along Piper's Creek and at Park's main entrance.
- Multiple slides in the past attributed to disturbance and soil stratification .

- Mountain beavers
- Aging upper forest canopy
- Trail safety
- Squatters

PLANT PALETTES (Appendix 5)

- Wet deciduous forest
- Coniferous forest, wet
- Coniferous forest, mesic

MANAGEMENT PRIORITIES

- Improving access to the Environmental learning Center by implementing the planned trail down the ravine east of the ELC
- Enriching the Piper's Creek floodplain
- Japanese Knotweed control
- Monitoring/liberation

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 2 A Project 1

Replant and extend Ash planting along Piper's Creek.

Objective

To diversify Carkeek Parks' forest types by establishing an Ash-dominated forest in the wider creek bed east of the Metro Transfer station.

The wide creek bed SW of the Orchard is a good site for Oregon Ash, as the Senior Urban Forester Mark Mead pointed out. It is on his instigation that Oregon Ash was planted in this section of subunit A. Survival has been good but some replanting may be necessary due to the influence of a dense Japanese Knotweed vegetation. Farther downstream the canopy is opening up and Oregon Ash can be added to the existing plant palette. Coordination with the SPU program is recommended.

An extensive Knotweed control project (2006/2007, Doug Gresham) has greatly reduced the impart f this invasive. Some Oregon Ashes were added in 2007.

Subunit 2 A Project 2

Gap restoration

Objective

Establish Wet/Mesic Evergreen forest with rich under growth.

This gap was addressed in 2007 (the Linda/Loren gap). As an experiment 8ft long willow sticks, flagged at the top, were placed near the planting spots in order to make finding the

spots in the dense Salmonberry jungle easier. This worked like a charm. Most sticks rooted but it still has to be seen if they survive on the long run. If so that would create a temporary willow middle story.

Subunit 2 A Project 3

Gap restoration

This steep slope will soon need attention. It is difficult to access and needs experienced planters. The main objective will be erosion prevention

Unit 2 Subunit B

GOAL

Establish climax stage vegetation in lower canopies while controlling non-native plants.

DESCRIPTION

Subunit B is the middle zone of Piper's Creek Ravine, with one major side creek coming from the Viewlands bowl to the east, the Viewlands Creek (0020 J). All slopes are steep to very steep and landslides occur. The Maple-dominated forest is declining and multiple gaps are expected to occur within the near future.

Piper's Creek trail, joined by the Viewlands trail, is a busily trafficked trail.

For SPU/Earthcorps activities in this area, see Appendix 11

BOUNDARIES

North	Bridge crossing Piper's Creek at 110th NW
East	Park Boundary / Viewlands Entrance
South	Sewage and street run-off pipes at 105th st.
West	Park Boundary

CHARACTERISTICS

- Area has several, small depressional wetlands higher on the slopes, both east and west of Piper's Creek
- A large wet area in the "Vieuwlands bowl"
- Aging Big Leaf Maple trees
- Poor canopy stratification
- Low species diversity
- Unstable wet slopes

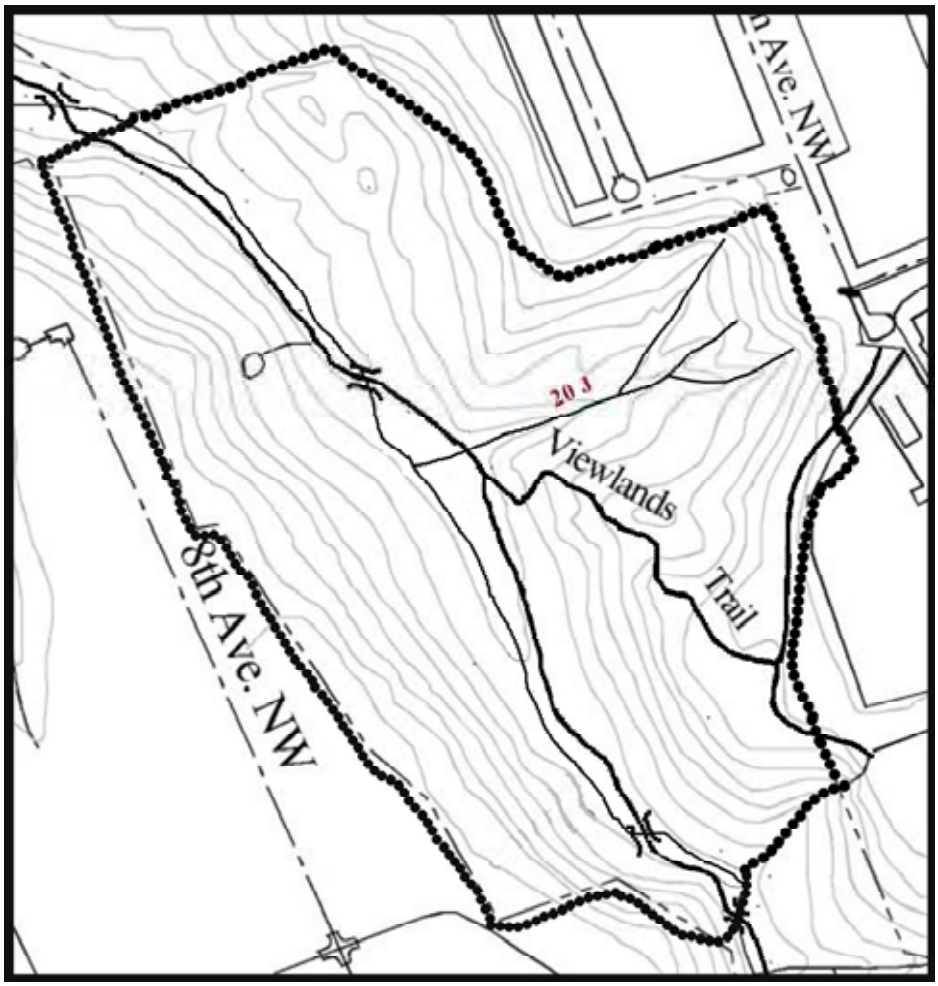

Figure 14. Subunit 2B

ISSUES

- Forested/sensitive slopes exceed Park boundary
- Sensitive slopes
- Widespread invasive inundation
- Trail safety
- Squatters

MANAGEMENT PRIORITIES

- Stabilize soils with appropriate plantings
- Enrich area with Mesic, mixed forest community
- Trail safety
- Monitoring

PLANT PALETTES (Appendix 5)

- Mixed forest, wet
- Coniferous forest, wet
- Coniferous forest, dry

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

This subunit is also a target area for SPU/Earthcorps Creek Steward projects, see Appendix 11

Subunit 2 B, project 1

Restore forest after removing a massive Blackberry seed source

Objective

Reduce Blackberry seed source and active infiltration of the park from the boundaries.

Strictly speaking this area belongs to the Seattle School District and any activities should be discussed with the School District.

Subunit 2 B, project 2

Restore forest after removing Blackberry

Objective

Reduce erosion from the steep slopes of the Viewlands bowl; gap restoration.

The Viewlands bowl is the watershed of the Viewlands Creek (no. 20 J). It is a difficult to access area, very wet, transected by numerous side creeks and infested with Blackberry and Ivy. It would be a suitable area to establish a forest dominated by Sitka spruce, adding to the diversity of Carkeek Park. Coordination with SPU projects is desirable. Invasives removal is imperative prior to planting. Help from the Natural Areas Crew has was given in 2006 and the area was planted in 2007: Ashes, Sitka's, some willows and Cottonwoods.

Under the dense blanket of Blackberry numerous small Cedars were found, probably planted in the context of SPU activities about 3 years earlier. They now have been liberated.

Subunit 2 B, projects 3 - 11

Restoration

The projects 3 – 11 are developing gaps, some of them mature enough to be given attention (see Appendix 12).

Unit 2 Subunit C

GOAL

Control and limit erosion of steep slopes.

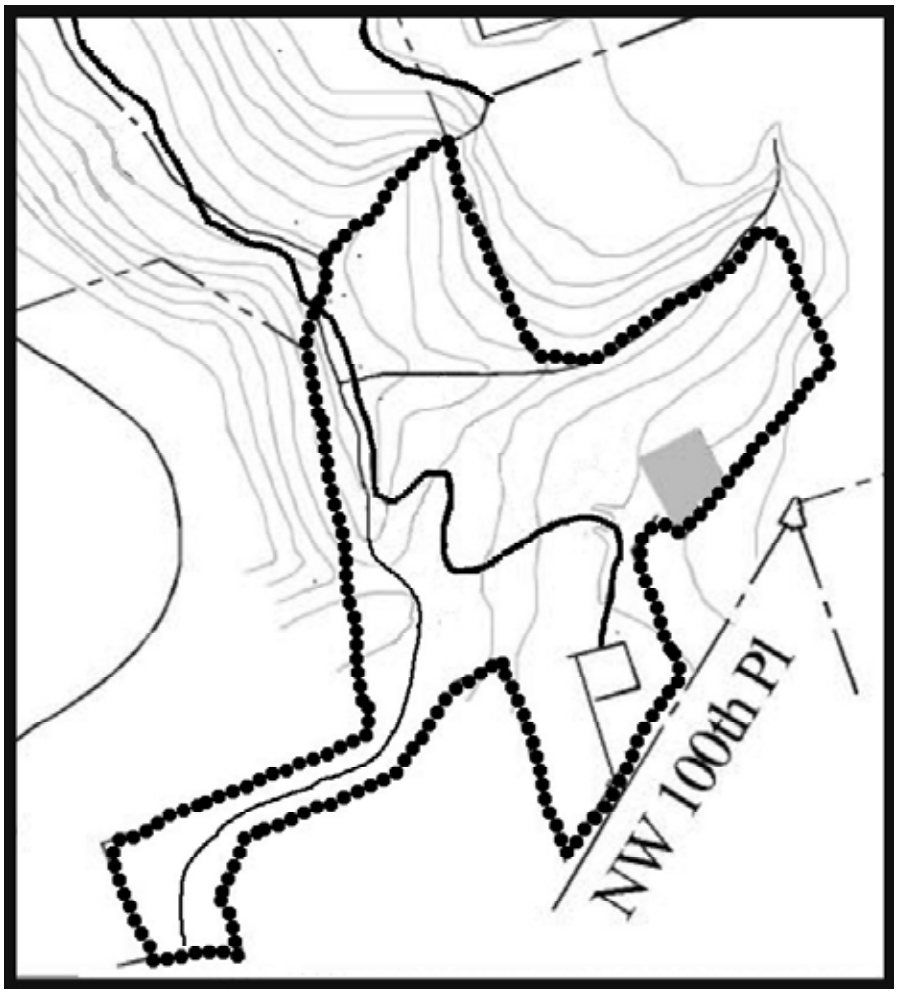

Figure 15. Subunit 2C

DESCRIPTION

This is the upper zone of Piper's Creek ravine, narrower and with even steeper slopes than subunit 2B. Here the Piper's Creek Trail starts at NW 100 PL, the McAbee entrance. The entrance area is a recreational zone with parking and needs regular special maintenance

BOUNDARIES

North	105th st. creek + park boundary
East	Park Boundary
South	Park Boundary at McAbee Entrance
West	Park Boundary

CHARACTERISTICS

- High numbers of planted coniferous trees along the underground sewer line more or less parallel to Piper's Creek
- Coniferous regeneration occurring off trail
- Wetland areas in Piper's creek source and tributary.

ISSUES

- Heavily inundated with non-native invasive plants
- Poor canopy development
- Large invasive populations at forest/park boundary
- The Park basically being the ravine-bottom only; slope management is nigh impossible
- Heavy erosion of the Piper's Creek Trail at the steep entrance
- Squatters
- Garbage dumping where the park touches 8th Ave.NW
- Poorly accessible narrow upper ravine

MANAGEMENT PRIORITIES

- Invasives removal
- Trail safety
- Monitoring

PLANT PALETTES (Appendix 5)

- Coniferous forest, wet
- Coniferous forest, mesic

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 2 C, projects 1 - 4

Restoration

The gap areas 1 – 4 have received some attention in the past (no. 1) and removal of Blackberry has been tried, but not consistently enough to be successful. Being a much used entrance to the park more attention for forest restoration seems to be justified.

UNIT THREE

Unit Three has the status of "Conservation area", implying that hardly any interference with the vegetation is allowed. However, restoration and enrichment are desirable, especially where the old forest cover is on the way out. Invasives control is an ever-present issue.

Both Venema Creek and Mohlendorph Creek are potentially salmon spawning creeks and additi

onal stream control activities may be necessary.

Unit three is subdivided into two subunits A and B

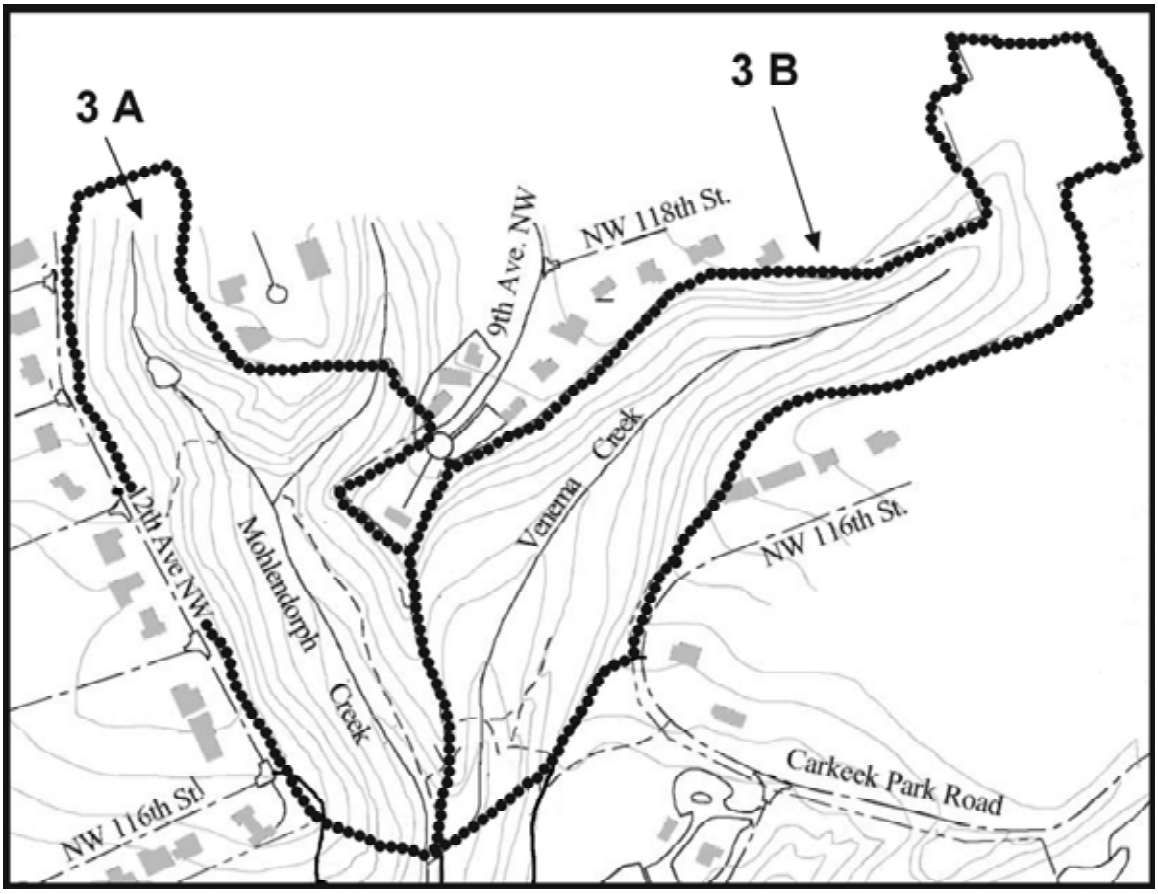

Figure 16. Unit 3

Unit 3 Subunit A

GOAL

Maintain as a undisturbed conservation area

DESCRIPTION

This subunit is a fairly wide ravine with steep slopes and with one side-ravine coming in from the east. This side ravine has beautiful old-growth characteristics but is threatened by ivy.

In its upper reach there is a wetland. The east slope is fairly stable with mature forest; the west slope is unstable and in urgent need of reforestation. There are interesting thickets of hazelnut.

BOUNDARIES

North	Park Boundary at Mohlendorph Creek
East	Park Boundary / Ridgeline dividing Venema and Mohlendorph Creeks
South	A virtual line from the Mohlendorph-Venema Creek confluence uphill to the end of 12th Ave NW
West	Park Boundary = 12th Ave. NW

CHARACTERISTICS

- Area has several, small depressional wetlands
- Aging Big Leaf Maple trees
- Poor canopy stratification
- Low species diversity

ISSUES

- Forested/sensitive slopes exceed Park boundary
- Sensitive slopes
- Widespread invasive inundation
- Garbage dumping along 12the Ave. NW

MANAGEMENT PRIORITIES

- To maintain the area as a conservation area
- To enhance and preserve forest structure and vitality with the control and removal of invasive plant populations and the re-establishement of native plant communities.
- Monitoring

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 3 A, project 1

Restoration

Objective

Erosion control and reestablishing an open forest cover.

This ravine has complicated structure with its stable east slope, the bottom lands and the very dry and sandy west slope, inhabited by mountain beavers. Restoration is urgent but problematic because of the steep slopes.

It seems appropriate to plant some high ground water tolerant species like willows and Cottonwood in the bottom lands, and to plant Douglas Fir and Cedar on the steep slopes, accompanied by the appropriate deciduous middle/understory species.

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Photo 27. View into the Mohlendorph Ravine. The East slope is a rich conifer forest, the West slope is in urgent need of restoration

Unit 3 Subunit B

GOAL

Maintain as a undisturbed conservation area

BOUNDARIES

North	Park Boundary at Venema Creek source
East	Park Boundary / trail “N1”
South	A virtual line from the Campus down to the confluence of Venema and Mohlendorph creeks

West	Ridgeline dividing Venema and Mohlendorph Creeks/ Park Boundary

CHARACTERISTICS

- Mixed Coniferous / Deciduous forests with aging Big Leaf Maple trees
- Poor canopy stratification
- Some amount of natural softwood regeneration
- Low species diversity
- Area includes only creek in Park with an active Salmon run.
- 2 sewer lines run through area
- Area, including stream has been the focus of several restoration projects

ISSUES

- Forested/sensitive slopes exceed Park boundary
- Widespread invasive inundation
- Flooding
- Slope erosion
- Water quality
- Choices to be made: blackberry control or maintaining valuable bird habitat at upper reach of Venema Creek.

MANAGEMENT PRIORITIES

- Water quality control, i.e. erosion control
- Invasives removal
- Enrichment with understory species (erosion control!)
- Monitoring

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 3 B, project 1

Restoration of the gap at the lower end of Venema Creek

Objective

Protection of Venema creek, a salmon spawning creek.

This area has been planted – reasonably successfully – in 2006; replacement planting may be necessary.

UNIT FOUR

Unit four is the counterpart of Unit One: a broad forested area at the mouth of the Piper's Creek ravine. It differs from Unit One in being very dry as a result of its south-facing slopes and the absence of spring-fed creeks.

This unit is subdivided into four subunits.

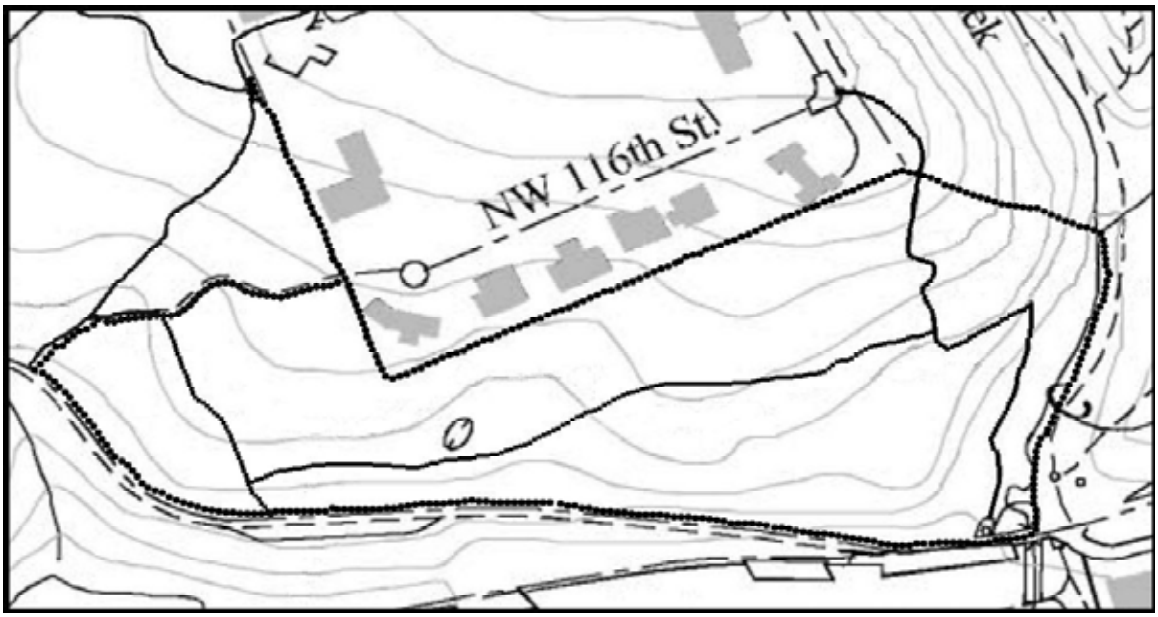


Figure 17. Subunit 4A

Unit 4 Subunit A

GOAL

Maintain and enhance area as trail-free coniferous/mixed forest wildlife area

DESCRIPTION

Subunit 4a consists of a gently sloped, narrow plateau between the urban neighborhood north of the park and the access road to the playground. The east and south slopes are steep; in the western half there is a depression that sometimes holds water. The east side carries an open, mature, mixed forest; the western half is dominated by aging Maple. There is a rich undergrowth of Salal and Oregon grape, but Ivy and Holly are abundantly present. The North Traverse trail, completed in 2007, creates an alternative traffic-free ELC – Beach connection.

BOUNDARIES

North	Park Boundary
East	A virtual line from the end of 12th Ave to the confluence of Venema and Mohlendorph Creek, and from there: Venema Creek
South	NW Carkeek Park Rd and Parking Lot
West	Social trail from "N15" to 116th Str.

CHARACTERISTICS

- Dry mixed forest
- Poor canopy stratification
- Low species diversity
- Locally a dense layer of Oregon grape

PLANT PALLETTES (Appendix 5)

- Dry mixed forest

ISSUES

- Sensitive slopes
- Widespread invasive inundation
- Widespread presence of Holly and scattered Ivy

MANAGEMENT PRIORITIES

- Re-Establish native communities along trail system (N2)
- Invasives removal, notably Holly
- Monitoring

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 4 A, project 1

Gap restoration

Objective

Restore dry mixed forest with a Madrone component.

This gap is still maturing.

Subunit 4 A, project 2 and 3
Gap restoration

Objective

Same as 4 A 1

Some evergreen Huckleberry was planted in 2004; few survived. There is a fair amount of potential upper story trees; restoration can focus on enrichment.

Photo 28. East section of Subunit 4A, looking at gap 4A3

Unit 4 Subunit B

GOAL

Maintain and enhance as diverse, stratified coniferous/mixed forest

DESCRIPTION

Subunit 4B is a large, fairly homogeneous, concave area with a dry creek in the center; the creek is not spring-fed but carries street run-off down to Piper's Creek wetland. Being a south facing slope the area is dry and carries a dry vegetation. The west edge of the subunit is formed by a steep bluff drop off. The south section of this forest area, south of trail "N13", is considered to be an extension of the playground (Unit 11) and is therefore included into that area.

Figure 18. Subunit 4B

BOUNDARIES

North	Park Boundary and North Meadow
East	Park Boundary
South	Social trail from 116th Str. to "N15" trail "N13"
West	Edge of the bluff

CHARACTERISTICS

- Area has one of the largest populations of mature coniferous trees, mostly Grand Fir
- Natural softwood regeneration is occurring here, as well as Grand Fir regeneration
- Massive Ivy and Holly removal realized in 2004/2005

PLANT PALLETTES (Appendix 5)

- Dry mixed forest

ISSUES

- Area receives large amounts of foot traffic
- Multiple social trails lead to soil compaction and a poorly developed duff layer
- How does the area react to the massive Ivy removal?
- Overflow of Galeobdolon luteum from gardens into the park
- Encroachments of private property into the park

MANAGEMENT PRIORITIES

Research has shown that this area tends of be one of the most stratified areas of the park. Management is aiming at maintaining/enhancing the existing rich forest composition. Monitoring of the Ivy removal. Monitoring the forest edge, replanted January 2007, along edge of North Meadow.

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

Subunit 4 B, project 1

Gap restoration (Gudrun's gap)

Objective

Create dense forest edge community and, at 50 ft distance from the boundary, a new generation of Grand and Douglas fir.

There is an existing dense thicket of Hazelnut. A few firs have been planted in 2006/2007.

Subunit 4 B, project 2

Forest edge

Objective

Protect microclimate of the forest by creating a dense shrub zone along the edge.

Planted in 2005 the plantation was neglected and dies. Replanted in 2007 with a thick layer of wood chips added, success is better. December 2007 5 Madrones were added.

Subunit 4 B, project 3
Forest edge/canopy repair

Objective

Create a dense forest edge along the adjacent property.

The gap was partially planted in 2006 but is slated to be replanted in 2009.

Subunit 4 B, projects 4 and 5
Gap restoration

These gaps are still immature.

Photo 29. Well-stratified forest with an abundance of Grand Firs, including natural regeneration

UNIT 4 Subunit C

GOAL

Maintain and enhance area as a Coniferous / Mixed forest wildlife preserve.

DESCRIPTION

Subunit 4C is a narrow strip of land at the east end squeezed between the in-coming and out-going access road; at its west end there is a wetland bordered by very steep slopes to the north. The wetland harbors a nice willow population. It receives its water from the street run-off creek traversing subunit 4B and drains through an underground pipe to the Piper's Creek Wetland (Unit 5)

BOUNDARIES

North	NW Carkeek Park Rd. (Going West)
East	
South	NW Carkeek Park Rd. (Going East)
West	Trail connecting lower and upper meadow

Figure 19. Subunit 4C

CHARACTERISTICS

Subunit 4C is only a small subunit with a dominant influence of the road and – but for the little wetland – few exciting characteristics.

ISSUES

- Hazardous trees (aging Big Leaf Maples) falling over the access road
- Poor canopy stratification
- Low species diversity
- Invasives, most notably Police Helmet

PLANT PALETTES **(**Appendix 5)

- Dry coniferous forest (not in the wetland area)

MANAGEMENT PRIORITIES

Monitor for hazardous trees
Enrich area with Dry Coniferous forest community when necessary; prevent spreading of Police helmet

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

No projects have yet been identified

UNIT 4 Subunit D

GOAL

Maintain and enhance area as a trail-free natural wildlife preserve, serving as a wildlife corridor along the railroad tracks.

DESCRIPTION

Mostly very steep, slide-sensitive area (major landslide in January 1997) with nearly vertical wall at its east boundary (Geologically interesting!); numerous young Alder stands on slides. Some major slide prevention constructions. However, up on the bluff indications for coming slides are already visible.

BOUNDARIES

North	Park Boundary
East	Bluff edge, more or less coinciding with trail “N7”
South	Subunit is more or less a triangle and has no real south boundary
West	BNSF Railway

CHARACTERISTICS

- Young forests mainly consisting of Red Alder on landslide-disturbed soils
- Low species diversity

ISSUES

- Forested/sensitive slopes exceed Park boundary to the north
- Sensitive, slide-prone bluffs/slopes
- Squatters
- Invasives

PLANT PALETTES

Puget Sound Bluff

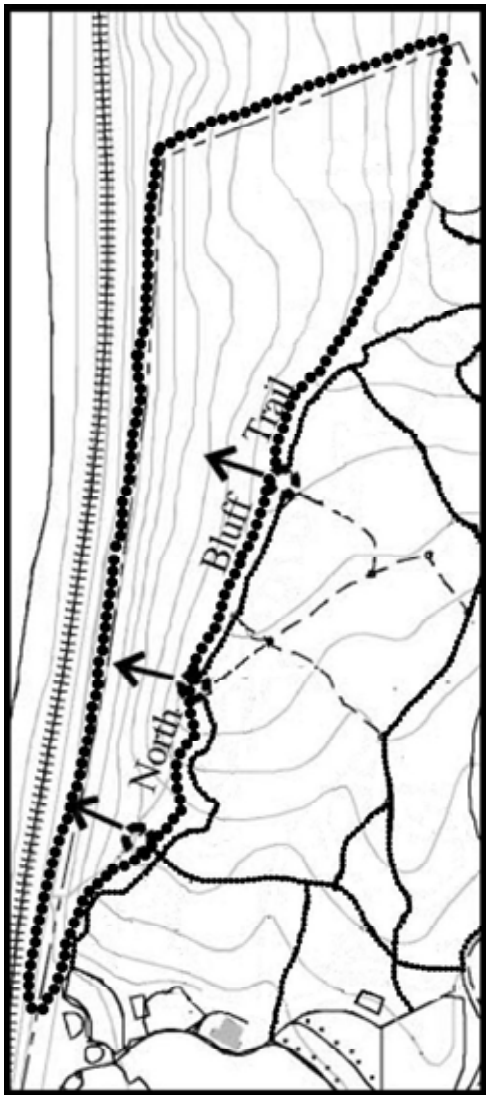


Figure 20. Subunit 4D

MANAGEMENT PRIORITIES

Pretty much a “hands off” policy but for occasional monitoring and invasives control. However, thinnings may be necessary to preserve the Puget Sound view from the North Meadow.

PROJECTS

(see also chapter 7, Projects summary, and Appendix 12)

No projects have yet been identified.

7. PROJECTS

A number of restoration/enrichment projects have been identified in the forested areas of the park (previous chapter). Many of the projects identified in 2002 have been realized (See Appendix 13), some are still waiting for execution, and many new projects have emerged recently. All these projects have been described in the previous chapter. In this chapter these projects are listed and a short project narrative is also included.

In Carkeek Park forest work falls within the framework of the Green Seattle Partnership project, managed by Carkeek Park staff and the Advisory Council Forest Committee, or within the framework of the Seattle Public Utilities project to enhance the riparian zones in Carkeek Park. In the listing below only GSP projects are entered.

In the column "Project type" IR stands for Invasives removal

In the column "PLANNED FOR" the planting season prior to the first growth season is given, i.e. "2007" is the planting season from Fall 2006 – Spring 2007.

It's expected that as this 2007 revision matures additional projects will be identified, given the over- mature character of the forest. These are "opportunistic projects" , not included in this listing because they are still virtual projects.

The SPU/Earthcorps projects in the park are not included here because they follow their own protocol, see Appendix 11.

It is important that the Projects List below is **updated each year before June** in order to prepare the plant list that is needed for the planting season 1.5 year later, and also to evaluate what has been done, what has not been done, and why not.

The project numbers correspond with the gap numbers, see gap map 2007, p. 77.

PROJECTS

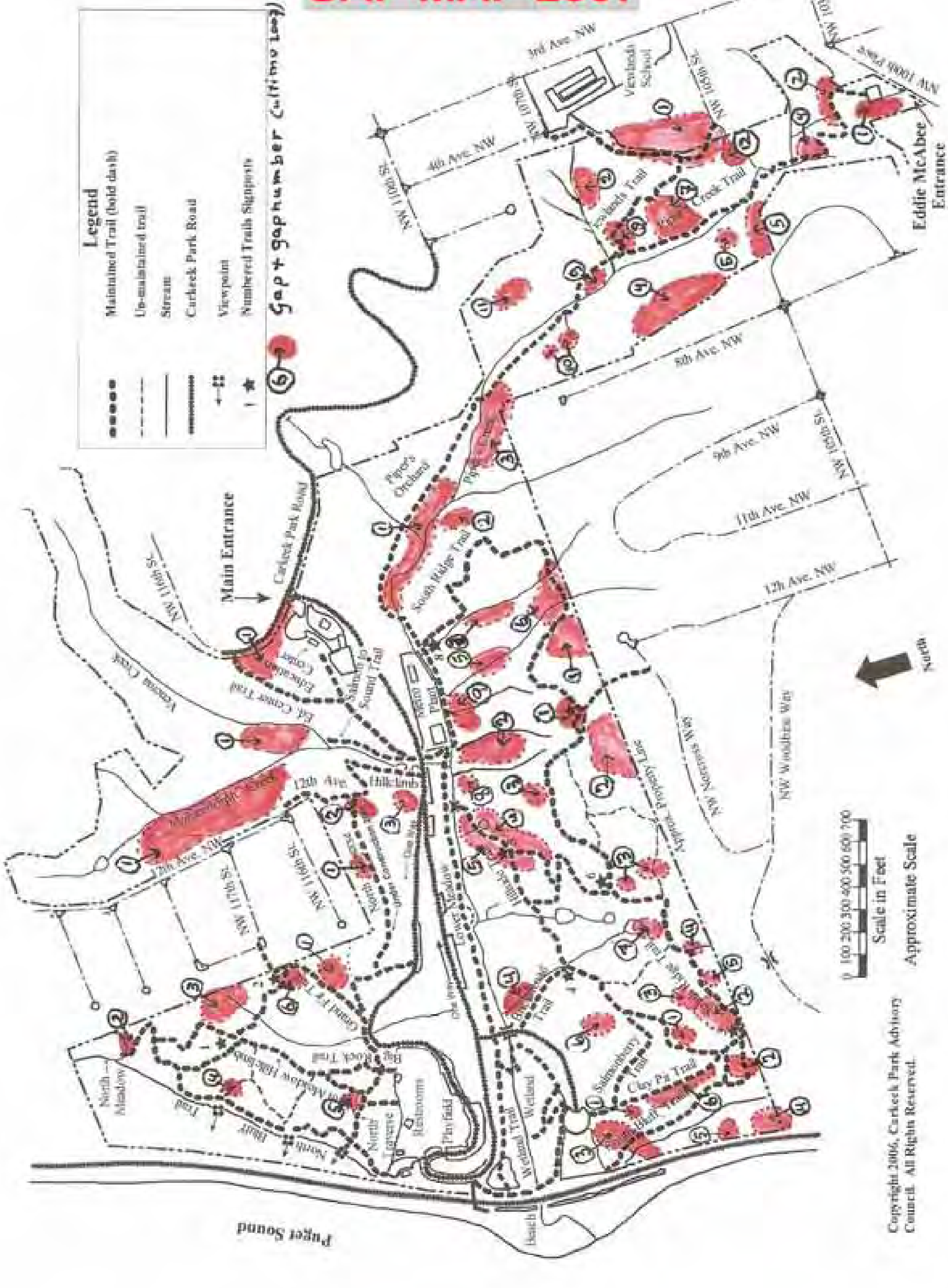
PROJECT NUMBER	SUGGESTED PROJECT MANAGER	PROJECT TYPE	PLANNED FOR	COMMENTS
1A1	GSP	IR/Restoration	2007	Partly realized
1A2	GSP	IR/Enrichment	2007	Partly realized
1A3	GSP	Enrichment	2008	
1A4	GSP	Restoration	?	
1A5	GSP	Restoration	?	
1A6	GSP	Restoration	2009	Predominantly deciduous forest
1B1	GSP	Restoration	2002	To be monitored
1B2	GSP	IR/Restoration	2007	To be monitored
1B3	GSP	IR/Enrichment	?	Blackberry removal first

PROJECT NUMBER	SUGGESTED PROJECT MANAGER	PROJECT TYPE	PLANNED FOR	COMMENTS
1B4	GSP	Enrichment	2003	To be replanted 2008
1B5	GSP	Restoration	2008	In progress
1B6	GSP	Restoration	?	Immature gap
1B7	GSP	Enrichment	2008?	
1B8	GSP	Restoration/Enrichment	Ongoing	Riparian vegetation
1C1	GSP	Enrichment	2006	Partly successful
1C2	GSP	Restoration	2003 2007	Additional planting in 2008
1C3	GSP	IR/Enrichment	2004	To be monitored and extended
1C4	GSP	Restoration	2007 2008	In progress
1C5	GSP	Restoration	?	Maturing
1C6	GSP	Restoration	2005 2007	Monitoring and extension
1C7	GSP	Restoration	2009	Plants ordered 2007
1C8	GSP	Restoration	?	Maturing
1C9	GSP	Restoration	2008	Ongoing; Metro land!
1D1	GSP	Enrichment	2006 2007	Big Earthcorps project
1D2	GSP	Invasives removal; planting	2006-2007 2008	Boy scouts/schools /Swanson project
1D3	GSP	Enrichment	2008`	Gaps developing
1D4	GSP	IR + Enrichment	2007	Trial with Linnaea
1D5	GSP	Restoration	?	Gap developing
2A1	GSP	IR/Establishment	2003-2007 2008	Extension of successful 2003 Ash plantings
2A2	GSP	IR/Restoration	2007 2008	Additional planting in 2008
2A3	GSP	IR/Enrichment	2009?	Kind of urgent but difficult

PROJECT NUMBER	SUGGESTED PROJECT MANAGER	PROJECT TYPE	PLANNED FOR	COMMENTS
2B1	GSP	IR/Restoration	?	Seattle School District terrain
2B2	GSP	IR/Restoration	2007	Successful. Needs monitoring
2B3	GSP			Lost
2B4	GSP	IR/Restoration	?	Former SPU project; no records
2B5	GSP	Enrichment with shrubs only	?	Problematic: twin pipes area; shrubs
2B6	GSP	Gap Restoration	?	Gap developing
2B7	GSP	Gap restoration	2009	Problematic with slide zones
2B8	GSP	Gap restoration	?	Problematic with slide zones
2B9	GSP	Gap restoration	2008?	Flood zone
2B10	GSP	Gap restoration	?	Gaps developing
2B11	GSP	Gap restoration	?	Gap developing
2B12	GSP	Gap restoration	?	Gap developing
2C1	GSP	IR/Enrichment	?	Blackberry control; needs shrubs
2C2	GSP	IR/Enrichment	?	Blackberry control; edge community
2C3	GSP	Restoration	?	Needs a few trees; marked “4” on map
3A1	GSP	IR/Restoration	2008-2009	Mark and Kyle project
3B1	GSP	IR/Enrichment	2006	Some replanting needed
4B1	GSP	Enrichment	2006/2007	May need some more trees
4B2	GSP	Replanting	2007	Fairly successful
4B3	GSP	IR/Restoration	2008	Contact neighbors first
4B4	GSP	Restoration	?	

PROJECT NUMBER	SUGGESTED PROJECT MANAGER	PROJECT TYPE	PLANNED FOR	COMMENTS
4B5	GSP	Restoration	?	
4C	GSP			No Projects identified yet
4D	GSP			No Projects identified yet
7.1	GSP	IR/Enrichment	2008 +	Periphery of the ELC

GAP MAP 2007


Legend
Maintained Trail (bold dash)
Un-maintained trail
Stream
Carkeek Park Road
Viewpoint
Numbered Trails Signposts
Gap + gapnumber
Main Entrance
Carkeek Park Road
Eddie McAbee Entrance
Puget Sound
North
Scale in Feet
Approximate Scale
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APPENDICES

Appendix 1 Bare root planting

Recently Parks has changed from planting potted plants to bare root planting, although for the time being plants will still be delivered as potted plants. This is a major change in the practice of planting, because it will be much less of an effort to bring plants to the planting site and the plant technique also is simpler. There are even special planting spades designed for bare root planting. Below is the sequence of actions that may occur:

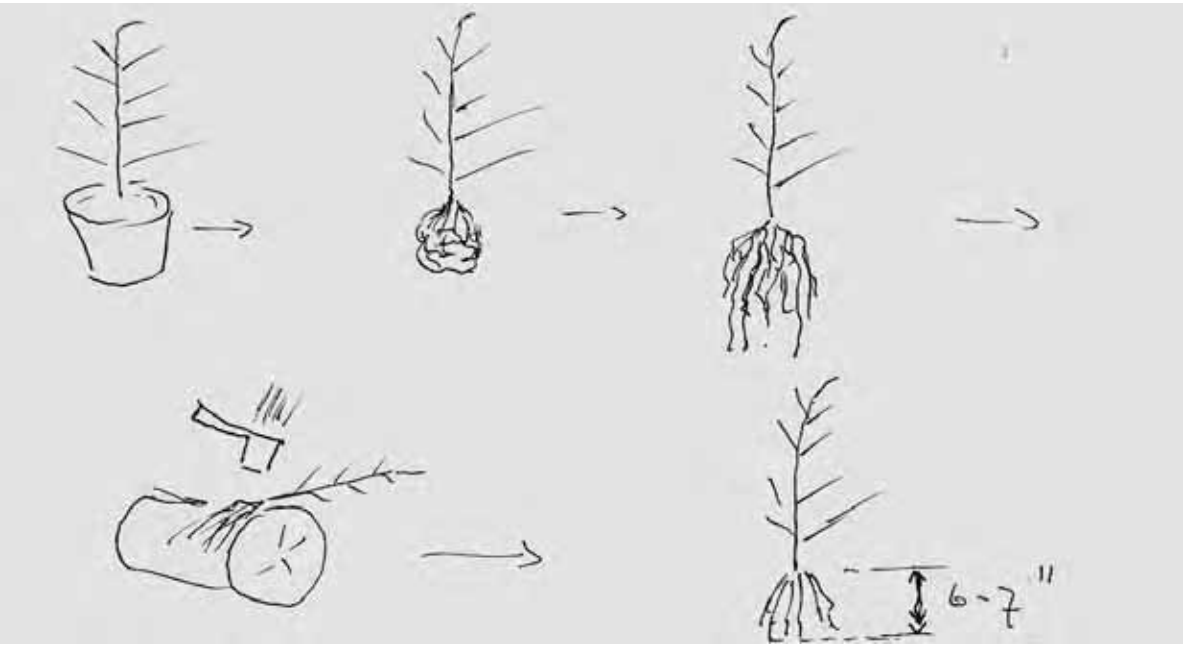
a. *Preparing plants for planting*
b. *Transporting bare root plants*
c. *Temporary storage at planting site*
d. *Planting at a normal site*
e. *Planting on a steep slope*
f. *Planting with a tree spade*

Preparing plants for planting

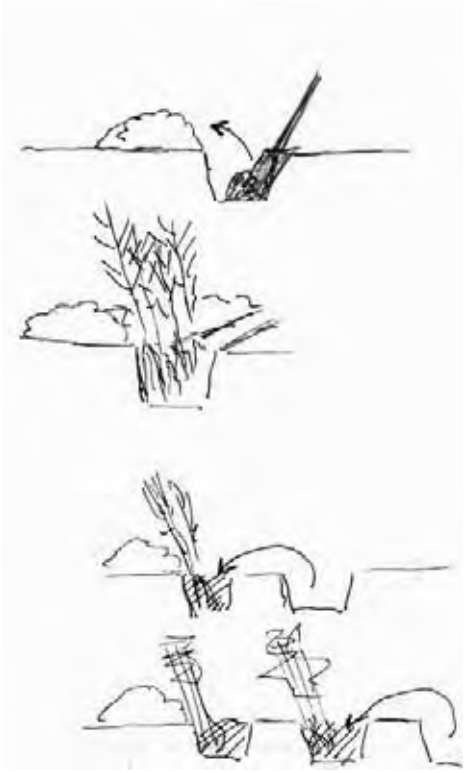
Assuming plants are delivered from the supplier in pots these plants need to be taken out of the pots and temporarily stored. For storage a weed free, well-drained piece of land is needed with a loose soil layer of at least 1ft deep. This area serves for the practice called "heeling in".

After carefully pulling plant + root ball out of its pot, the potting soil is gently shaken from the root system. Potting soil can be set apart or spread over the heeling-in bed. The plant now has a dense bare root system, often with long curved roots due to being confined in the pot. Gently disentangle the roots and then (less gently) cut off the longest roots, leaving the plants with a fairly dense root system of about 6 - 7 inches long. Cutting of the roots can be done with scissors, hand pruners but – more efficiently – with an ax or Javanese or Japanese garden knife.

Keep the uprooted plants in a shady and moist environment, e.g. under wet burlap.



When all plants are un-potted and root systems have been shortened it is time to heel them in. Heeling in is done to temporarily store plants that are to be planted within a few weeks.



Step one: dig a one-spade wide trench of about 7" deep, piling the soil behind the ditch

Step two: neatly arrange the bare root plants side by side in the trench, about 2 – 4" apart, depending on the size of the plants

Step three: dig a second ditch about 1 spade-width away from the first trench, using the excavated soil to fill up the first trench. Gently compress the soil against the roots with your heels (hence: "heeling in"). Root collars of the plants should be more or less flush with the ground, but not exposed!

Step four: neatly arrange the second row of plants, etc. etc.

Purpose is to store a large number of plants on a small area. Creating space between the rows of plants serves the ventilation needed to prevent molding. The larger plants are, the more spacing they need both in the trench and between trenches to ensure sufficient ventilation.

b. Transporting bare root plants

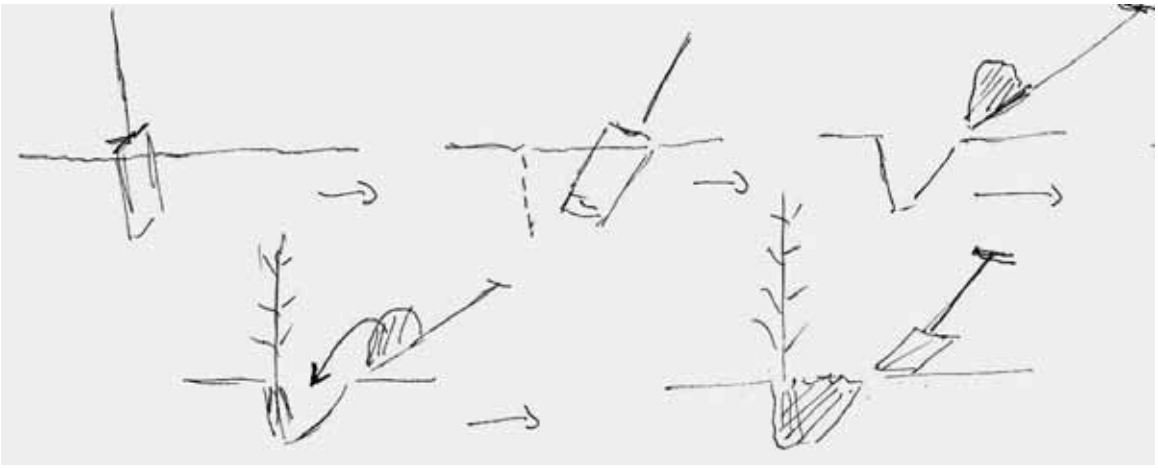
During transport to the planting site, especially when transported in a truck, roots can dry out. Plants can be transported in open plastic bags or wrapped in wet burlap.

c. Temporary storage at planting site

At the planting site plants can be kept in their wrapping until planted. Put the bundles/wraps/bags in a cool shady place. However, if planting will spread over several days the plants have to be taken out of their wrappings and be heeled in. Heeling in can be less meticulous than described above, but the root systems **must** be covered with moist soil to prevent drying out.

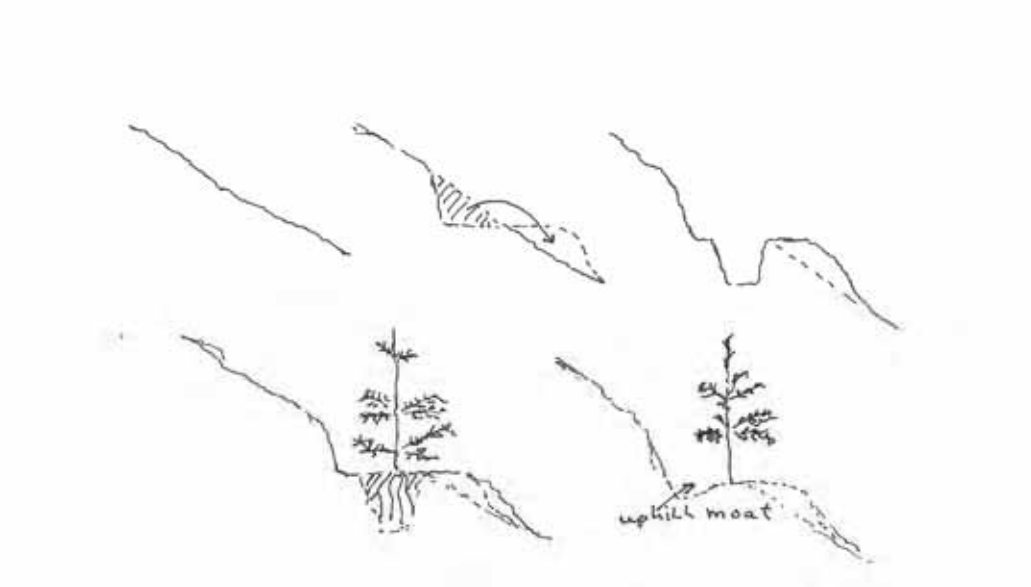
d. Planting at a normal site

Dig a hole of approximately 8" deep; try not spreading the soil all over the place but lifting out a clump of soil that you leave on the blade of the spade. If that does not work, make a neat pie of soil next to the hole. Try not to spill humus or dead leaves into the hole: bare roots need to have firm contact with mineral soil. Place the bare root plant against the back of the hole and fill up the hole, preferably by shoving the clump of soil on the spade back into the hole. The roots get kind of squeezed between the wall of the hole and the added soil. See to it that the root collar is level with or slightly below ground level. Compress the loosened soil with your heel, from the side, not top down because that causes roots to break off. Fill up a depression with loose soil and rake some humus over the planting spot. This will help reduce drying out of the soil.



e. Planting on a steep slope

The principle is the same, but on a steep slope a vertical wall is created on the high side of the planting spot. The excavated soil is carefully piled up at the low side of the planting hole. Planting is normal. However, after filling up the planting hole it is important to leave a moat on the uphill side of the plant. This will facilitate watering, because if the soil is level or slanting outwards, water will run off before ever reaching the roots. A little moat also helps catching rainwater before it runs off.



f. Planting tools

From left to right:

1. little spade for volunteering kids
2. rounded tree spade, specialized tool for bare-root planting
3. short-handled spade for shorter volunteers
4. normal spade for taller volunteers
5. long-handled shovel, NOT to be used for planting but for loading wheelbarrows with gravel

*g. Planting bare-root plants with a special planting spade, the **Tree spade***

The tree spade is designed for bare-root planting of trees 2 – 4 years old.
The rounded shape of the blade makes it possible to lift a coherent clump of soil out of the plant hole and keep it on the spade instead of spreading the soil all over the place.

The process of planting with a tree spade is shown on the next page.

The planter holds the tree spade in front of him, the hollow side facing him

He lifts a clump of soil out of the plant hole, carefully keeping it on the spade

He wiggles the spade a bit back and forth, pushing it down

He lifts a clump of soil out of the plant hole, carefully keeping it on the spade

He places the tree against the straight side of the plant hole, the root collar flush with

He then puts back the clump of soil in Theplant hole while holding the plant in place.

He firmly plants his heel on the loose soil, making sure there is good root-soil contact

------ and a satisfied planter starts looking for the next planting spot.

Appendix 2 – Green Seattle Partnership

During the last decennium it became more and more clear that Seattle's roughly 2500 acres of forested parklands represent not only "nature-values" but also considerable technical and financially quantifiable values. It also became clear that the majority of these parklands are in a dire condition. An overwhelming presence of non-native, invasive species is threatening the forested areas, both by mechanically damaging and killing the trees and by preventing the natural succession from secondary deciduous forest into a new generation of mature evergreen forest. A study revealed that it would actually be less costly to try turning the tide than to let "nature take care of itself". Citizens and City government began to understand that and started exploring possibilities to turn the tide.

In the year 2004 the **Green Seattle Partnership** was created, partnering the City of Seattle and the Cascade Land Conservancy, a public-private venture. The GSP aims at restoring the 2500 acres of forested parklands within a period of 25 years. Its main objectives are:

- Evaluate city-wide forest stand conditions using the Tree-iage model
- Prioritize parks and restoration sites within the parks
- Implement restoration, using Best Management Practices and a 4-phase approach to control growth of invasive plants and encourage native plants
- Build and maintain trail systems in the parks
- Monitor and maintain sites over the long-term.

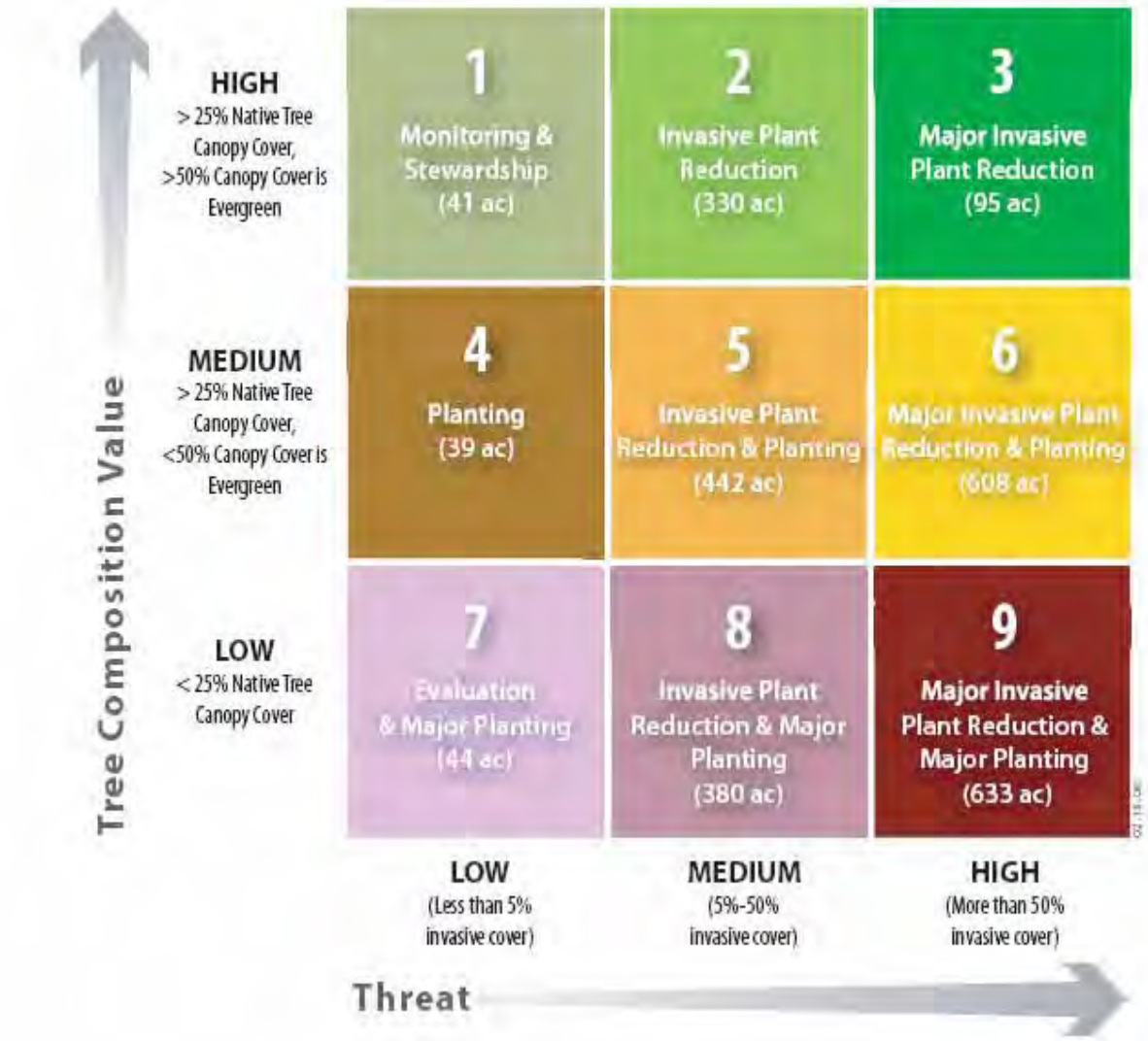
In order to realize these objectives resources must be generated; community involvement is imperative. By 2009 the number of volunteer hours may reach 100,000 per year. This can be achieved by:

- Creating a broad understanding of and support for the GSP
- Promote volunteering and demonstrate appreciation for volunteers, seeking their input in the program
- Training Forest Stewards in volunteer management and practical forest work
- Providing sufficient staff to support volunteer work parties, management, and programs.

In Carkeek Park the invasives situation is not as bad as in many other parks, although there are areas with severe Ivy and Blackberry problems. Some of the GSP objectives have already been pursued during several years: the trails system has been upgraded between 2001 and 2006; a Forest Management Plan has been effective since 2003; a "Master Forester" training has been offered in 2005 and in 2007. And most important: regular forest work parties have been organized since 2002, relying on a small core of forest volunteers. These work parties focus on invasives removal and planting. Monitoring and liberation become regular tasks of the Master Foresters, who adopt a section of the park and lead small work parties.

More detailed information about the GSP is to be found in the Green Seattle Partnership 20-Year Strategic Plan at www.greenseattle.org, or you can also contact the Cascade Land Conservancy at (206) 292-5907.

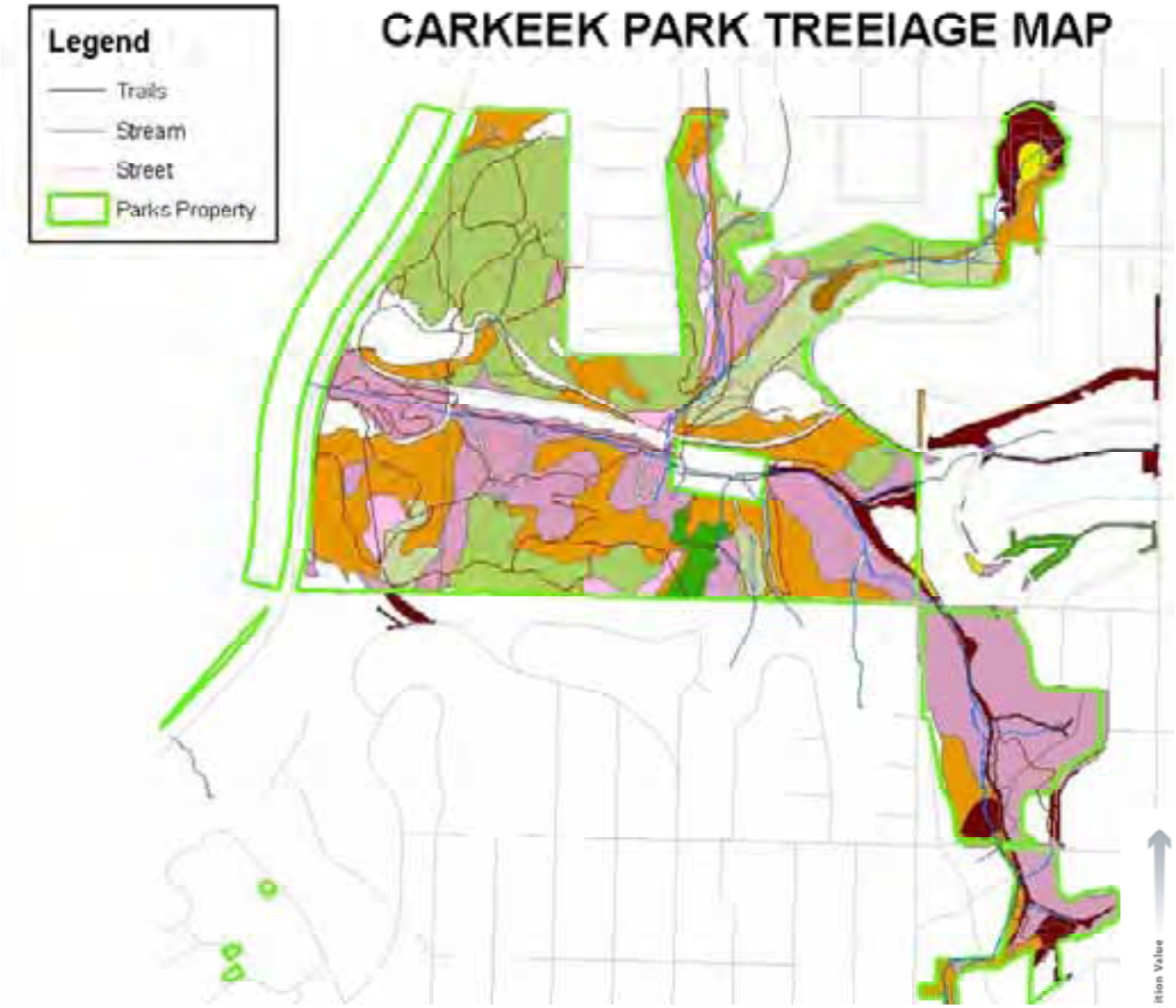
The Green Seattle Partnership TREE-iage Model for forest restoration prioritization.



In this diagram acreage represents all 2500 acres of Seattle's forested parklands. It is clear that categories 5, 6, 8, and 9 form the bulk of the acreage (numbers in brackets give the total acreage of that category). As can be seen from the map on the next page, the situation in Carkeek Park is less desperate than the City-wide condition.

Carkeek Park TREE-iage Map.

As can be seen from the map the categories 2, 5, and 8 are most common in Carkeek Park. However, the extensive category 2 area in the NW-section of the Park, subunit 4 B, has been cleared of Ivy and now would fall within category 1, sage green.



Appendix 3 – Invasive Plant Characteristics and Removal Techniques

A short summary of invasive plant removal information is given below by species.

English Ivy

Habit

A creeping herbaceous evergreen vine that, given the chance, will climb into trees where it will develop into a liana with thick woody stems, sometimes completely enclosing the host tree. As a groundcover Ivy forms dense mats, out-competing nearly all other vegetation. Vines originate from a "mother-root" but branch out and make new roots at the nodes so that it is often difficult or impossible to determine where the vine came from. Ivy rarely flowers on the ground but once in the trees it starts flowering in the fall and producing fruits/seeds early the next year. The fruits are eaten by birds, thus ensuring prolific seed distribution.

There are several types of Ivy (see below); most common is the more or less heart-shaped, leathery form with very strong stems; less common is the deeply incised Ivy with smaller leaves, thinner stems that are less strong and break easily – which makes removal more difficult. There are many in-between forms.

Ivy rarely kills trees directly, although there have been cases of pure strangulation. It is not a parasite, however. The most negative effects of Ivy are:

- Competition with plants and shrubs for light, moisture and nutrients
- Competition with trees for moisture and nutrients
- Once growing into the crown of trees: competition for light and adding considerable weight to the crown, causing failure of branches.
- Contrary to what it was supposed to do Ivy is NOT very effective for erosion control.
- There being such a rich seeds-source in the soil, causing a new generation to emerge after Ivy removal.

Method of removal

When Ivy is present in small concentrations, forming long spreading vines (often over 20 ft long), it is best to try disentangling the individual vines from the vegetation, following the vine to the "mother-root". Pull out the vine, roll it into a bundle, twist it (thus damaging the cambium and preventing regrowth), and toss the bundles in a central pile.

If Ivy is present as a dense mat the best method is to first divide the mat into 4ft wide strips, applying the rule of "Divide and rule" (Divide et impera). This is done by pulling up the blanket with your hand or a tool like an adz or pick-ax and have a second person cut roots and vines with a hedge trimmer (loppers are not effective here). Even better works using a sharp pruning saw: lift up the mat with one hand and cut the vines and roots with your other hand. When you have made cuts about 10 ft long, you now make cross cuts so that the "pancake" of Ivy is subdivided into slices of about 10 x 4 ft. The 4 ft wide strips can now be rolled up as if rolling up a carpet, pulling out the roots while rolling. Be careful to not pull out any native plants scattered in the Ivy, like Salal, Oregon Grape, and others.

More efficient is to make the strips 6ft wide (less cutting to do) and have two volunteers pull up the mat with 2- or 3-pronged long-handled cultivators. (Muscle power also works well).

Once a thick roll is created, that roll is cut loose from any remaining roots and stored in a central staging area, possibly on sheets of cardboard or heavy duty weed cloth to prevent it from rooting. Another storage method is to create a platform from dead logs and branches, raised 1 – 2 ft above the ground, preventing the stack of Ivy vines to touch the ground; the vines will dry out and die. Stacks of Ivy, whether on cardboard or on a platform, should not exceed 4ft in height, otherwise the stacks don't dry out.

Once the mat is pulled up and moved out, the area needs to be fine-combed for left behind roots and vines. The best time of the year to pull Ivy is after the nesting season; the dry weather will discourage the vines from rooting again and little left behind pieces dry out and shrivel. Cleared areas should be monitored for left behind pieces and regrowth.

Photo 1. Ivy pile composting on cardboard prevents re-rooting

Photo 3. Ivy bundle on top of log cradle also limits contact with soil

If Ivy is invading the trees it is usually enough to cut Ivy stems at a height of 2ft and 4ft and removing all stems between these two cuts from the tree, thus creating an Ivy free zone, called "life saver". The upper part will dry out and die unless the Ivy started rooting in accumulated humus or rotten places higher up the tree; in that case one has to return and apply herbicide (see below). The lower section of the stems must be pulled out of the ground – if possible; however, if the stems are too thick (more than ¾"), it might be advisable to apply herbicide. If one tries to pull out heavy stems you may both break your back and the Ivy; the Ivy will regrow, your back will not.

Photo 3. Deep-lobed ivy

Photo 4. Shallow-lobed ivy

Photo. Dense ivy cover

Photo 6. Making cuts in a dense ivy mat with a hedge trimmer, a lopper or pruning saw makes "rolling up the carpet" much easier

Photo 7. Ivy is pulled in "rolls" using a potato fork or "trident". Lightweight models like one from Fiskars are effective

Photo 8. Ivy growing up Western red cedar

Photo 9. Same red cedar with "life saver" tree ring established. Natives including Oregon grape, salal and trailing blackberry were found

Use of a chemical herbicide to fight Ivy:

Spraying the leaves is not effective due to the waxy surface: the herbicide just rolls off the leaf.

"Painting" the stump of a cut vine with a 5% solution of Roundup works well. This practice is called "painting" because some commercial brands are colored red. This will sometimes be the only way to get rid of really heavy Ivy stems. It can only be applied by certified personnel.

Himalayan Blackberry

Photo 10. Blackberry plant with previous years dead cane and new sprouts

Photo. Same blackberry dug up showing mother root

Habit

Himalayan blackberry is a struggling prickly woody vine with long scandent branches spreading from a central mother root, but often rooting at the end of the long branches, where a new mother root is started; branches can grow quite high into trees and grow into 1" thick, 30ft long vines. Branches often die during winter and new branches sprout from the mother root, but some of the heavier branches may not die and branch out next season. Blackberry forms dense, impenetrable thickets, a haven for nesting birds like robins and quails.

Blackberries flower in May/June and bear fruit in August/September; the fruits are eagerly eaten both by humans, rodents, foxes, and birds, thus spreading the seeds.

Negative effects of Blackberry are mainly that it out-competes all other vegetation and is difficult to remove – a most unpleasant job. It is also very invasive both because of its vegetative spreading habit and its rich seed supply. Its main method of spreading, however, seems to be by rooting at the tips of the long vines when they touch ground and from forming new shoots from underground stolons.

Method of removal

Getting rid of Blackberry is mostly a 4-step action (use heavy duty leather gloves and wear heavy duty pants!)

1. Cut all the branches in sections of about 6' long and pile them in a big stack (they will usually not resprout); leave a section of about 2' where the branch sprouts from the mother root.
2. Dig out the mother root, either by pulling it out (hence the 2' long "handles") or by digging up the larger root-systems (spade, adz, pick-ax). Leave as little as possible of the root system in the ground. Root systems can be piled with the branches; they usually dry out and regrowth has not (yet) been observed.
3. Control the area for regrowth of left-behind root sections or unnoticed root systems.
4. Keep controlling the area for several years to take care of new plants emerging from the seed source.

There is another, less used, method, using a brush cutter: cut off all the branches while Blackberry is in full bloom; most of the energy of the plant is now invested in flowering and the roots will find it difficult to sprout abundantly after cutting. Then repeat this at the end of the season and again the following year, when the plants are in full bloom etc. Gradually the plants get exhausted and die off. Labor intensive but a possibility where no volunteer labor is available and mechanized equipment can be used. Mountain Beavers sometimes cut the roots from the "mother root", or even thin stems.

Laurel

Habit

Laurels are tall shrubs or low trees, evergreen with dark green, leathery leaves. This species, although growing in full light, is extremely shade tolerant and survives in dense forests. Hanging branches touching the ground tend to develop roots (off-layering) at the place of soil contact, but less so than Holly.

Although less vigorous than Holly, Laurel is undesirable because it out-competes surrounding shrubs and ground cover, thus gradually expanding the area it occupies.

Photo 12. Large English laurel bush

Young specimens of Laurel can be pulled out but trees over 1" thick must be cut close to the root collar and "painted", which is a nice word for applying an arboricide (5% Roundup). Frilling/painting is also an option (see under Holly). Branches should be stacked on a platform, see under *Holly*.

Holly

Habit

Holly is a strange species. It's most common form is that of a tree with evergreen, prickly, dark green leaves. However, Holly shows a very strong tendency for off-layering, rooting where branches touch the ground, giving rise to a new tree. An even stranger behavior is that when branches bend down and touch ground they may go "underground", forming up to 30' long vine-like rhizomes or underground branches that root and send up new shoots from the nodes. Thus gradually dense thickets of Holly develop with the mother tree in the center. There seems to be a correlation between dense thickets and Mountain Beavers. Mountain Beavers cut the succulent roots, which causes the left-over pieces to form new roots. The resulting plants have no connection with a mother plant and are often fairly easy to pull out – when not too old.

Holly is unisexual; the female specimens are easily recognized in November/December when they carry red berries. Birds love these berries, thus ensuring seed distribution.

The negative aspects that make Holly so undesirable are: its extreme shade tolerance and vigorous propagation, both through seeds and through rooting branches. If not stopped Holly will, over time, totally dominate the middle story of the forest, out-competing all other shrub and middle story trees.

Methods of removal

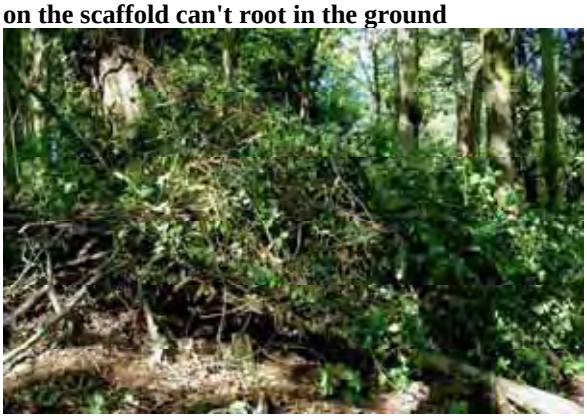
Young specimens, up to ½" thick can be easily pulled out. With two persons pulling, thicker specimens can be pulled out. Pull gently and try to get as much of the root system out. Off-layerings and underground rhizomes, and the shoots they produce can often also be pulled up, but well established specimens may need to be dug up with a spade or a pick ax. Holly trees do have a strong pen root. If a young tree or heavy sprout is resisting its demise, it helps to pull with two persons.

The best way to remove big Holly trees is to cut the tree just above the root collar and "paint" the stump (i.e. apply arboricide, a 5% solution of Roundup). Cutting the tree at a level of say 2' and painting the cut gives poor results; frilling the bark and painting the frill likewise gives poor results when the frilling is done poorly. When frilling is a preferred method the bark should be removed in a full ring and the frilling tool should really cut into the wood: the downward sap stream tends to divert through the outer layers of wood when passage through the bark is interrupted.

Only cutting the trees is counterproductive: there is so much vigor in the root system that the stump will resprout and form a multi-stemmed new tree within years (see photo next page).

Photo 13. Scaffold to hold cut invasive tree stems built of stems and branches

Photo 14. Holly branches and root systems piled on the scaffold can't root in the ground



Best time to do Holly removal is in summer, preferably during the dry season of August/September. Cut branches and felled trees tend to root where touching the ground especially when the soil is damp or moist. Hence one must build scaffolds or platforms from stems and dead branches to keep the Holly branches off the ground: preventing soil contact is vital to prevent sprouting. In summer the leaves and branches dry out quickly, reducing the chances for rooting. If no arboricides can be applied after cutting, it is best to cut the trees at a height of about 2ft and flag the stump. A licensed person can come later to cut the remaining stump close to the root collar and apply arboricides. This goes fast because removing and stacking all the branches is the most time-consuming part of the job.

Photo 15. Dense holly thickets formed by cut holly tree left on the ground to root.

An over-enthusiastic volunteer accidentally did more harm than good here. It took a while to get rid of that mess!

Photo 16 . Cut-stump treatment on holly.

Note the new stem and twigs sprouting from the stump

Photo 17. Frilling method on holly: the frill must go around the entire trunk and into wood

Other Invasive Species

Periwinkle: escapee from gardens, where it is used as ground cover. Forms dense mats and is difficult to remove because of its numerous rooted nodes and by being fairly brittle. Short stem sections will root when left behind.

Yellow nettle: also an escapee from gardens, where it is used as ground cover. Forms dense mats and is even more fragile then Periwinkle, making its removal a tedious job.

Morning Glory: a herbaceous vine that can form dense mats covering shrubs and even trees. Fairly easy to pull out, but the danger is in the succulent roots left in the soil: they just will regrow a new vine. Digging out these succulent (white) roots is time consuming and very much disturbs the soil. It is the only way, though, to get rid of this invasive, other than applying herbicide.

Clematis: a woody vine that can grow high into the trees, forming dense "curtains" of scandent branches. It is fairly easy to pull out the woody root system, provided the stem is not too thick; if so the stem should be cut close to the ground and "painted". The difficulty with Clematis is that it spreads by wind-borne seeds and the source of invasion may be miles away.

Japanese Knot weed: a herbaceous, hollow-stemmed weed with stems up to 6ft tall and 1.5" thick, forming dense, expanding clusters, usually on wet sites but also found on very dry sites. The roots go very deep and just cutting the stems only results in rapid regrowth. Removal focuses on digging out the root system. An alternative could be cutting the stems at regular intervals of about 4 weeks, thus exhausting the roots. Using herbicides is difficult: injection of the root-collar. This needs to be done by specialists. Cut stems dry rapidly and rarely resprout; however, small pieces of the stem that fall into water will sprout new roots When a piece falls into a creek this may cause the establishment of a new colony somewhere downstream.

Other species: see King County list of Noxious Weeds.

Appendix 4 - Gap restoration

Let's follow the development of a forest unit over a period of about 30 years.
Four years ago, in 2000, the forest consisted of a mature Alder/Maple mixture with very few middle story trees but a healthy under story of Salmon Berry and Thimble Berry, an occasional Hazel bush and Elderberry. A gap of roughly 120 x 90 ' was found at the south edge of the unit and planted with 60 evergreens (Douglas Fir, Red Cedar, and Hemlock). 20 groups were established in a spacing of roughly 20 – 25', with three individual trees in each group (open circles), the trees about 3 – 4' apart.

Figure 1

Figure 1 depicts the situation in 2004. 2 new, immature gaps (B and C) are forming. The planted trees in gap A (little circles) are, thanks to consistent liberation, gradually recognizable in the dense under story. Gap B and C are still considered too small to be planted. Under planting of the forest as a whole is not planned because of the damage to be expected from falling trees.

A straight line crossing the unit boundary trails at point 1 and point 2 forms the basis for the given forest profile

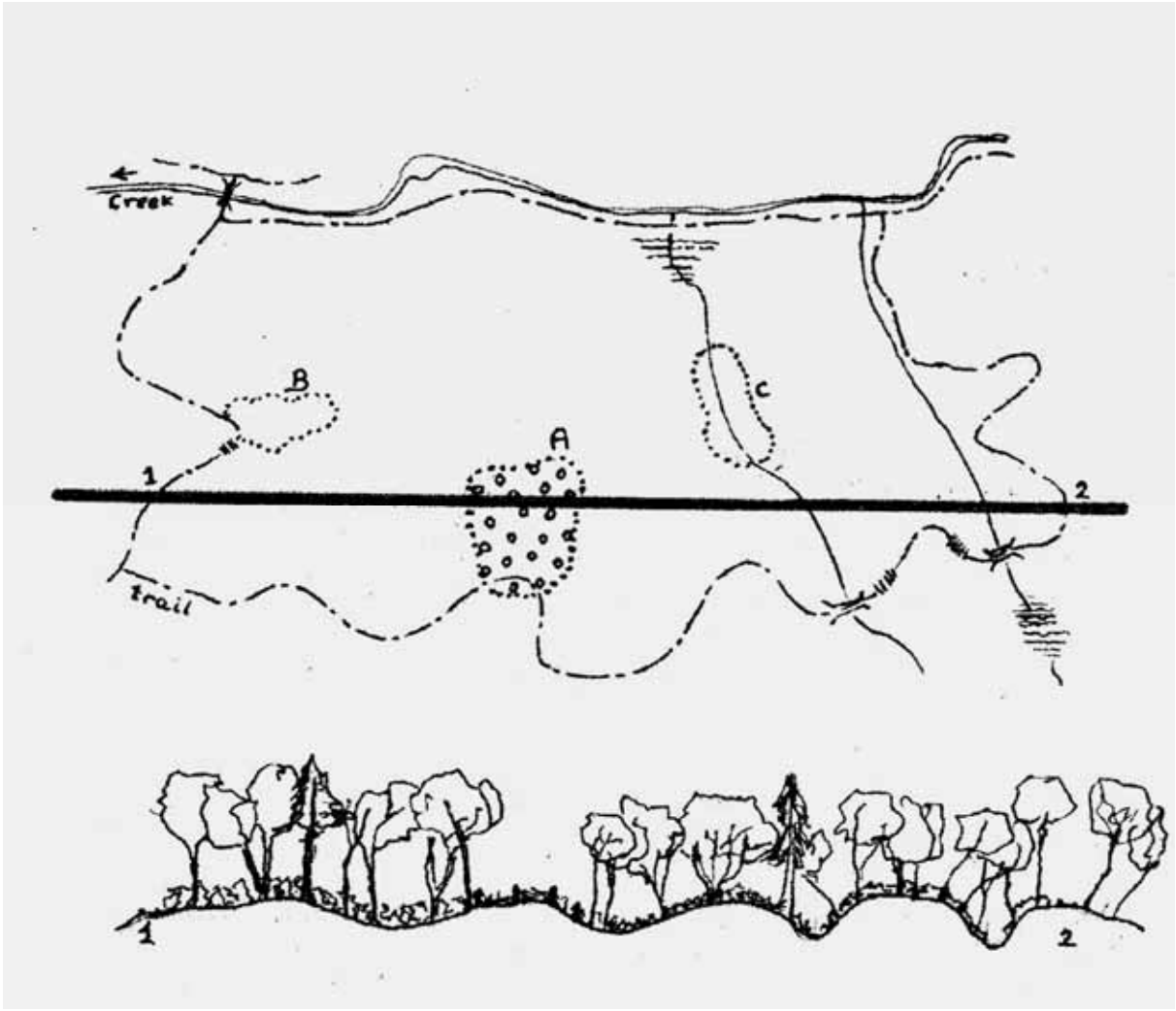


Figure 2

Four years later, in 2008, gaps B and C have grown bigger and were planted (black dots). A new gap, D, is forming lower on the slope. Between gap A and C the forest is deteriorating rapidly. In gap A the planted trees are about as high as the surrounding understory, notwithstanding serious efforts of mountain beavers to prevent that.

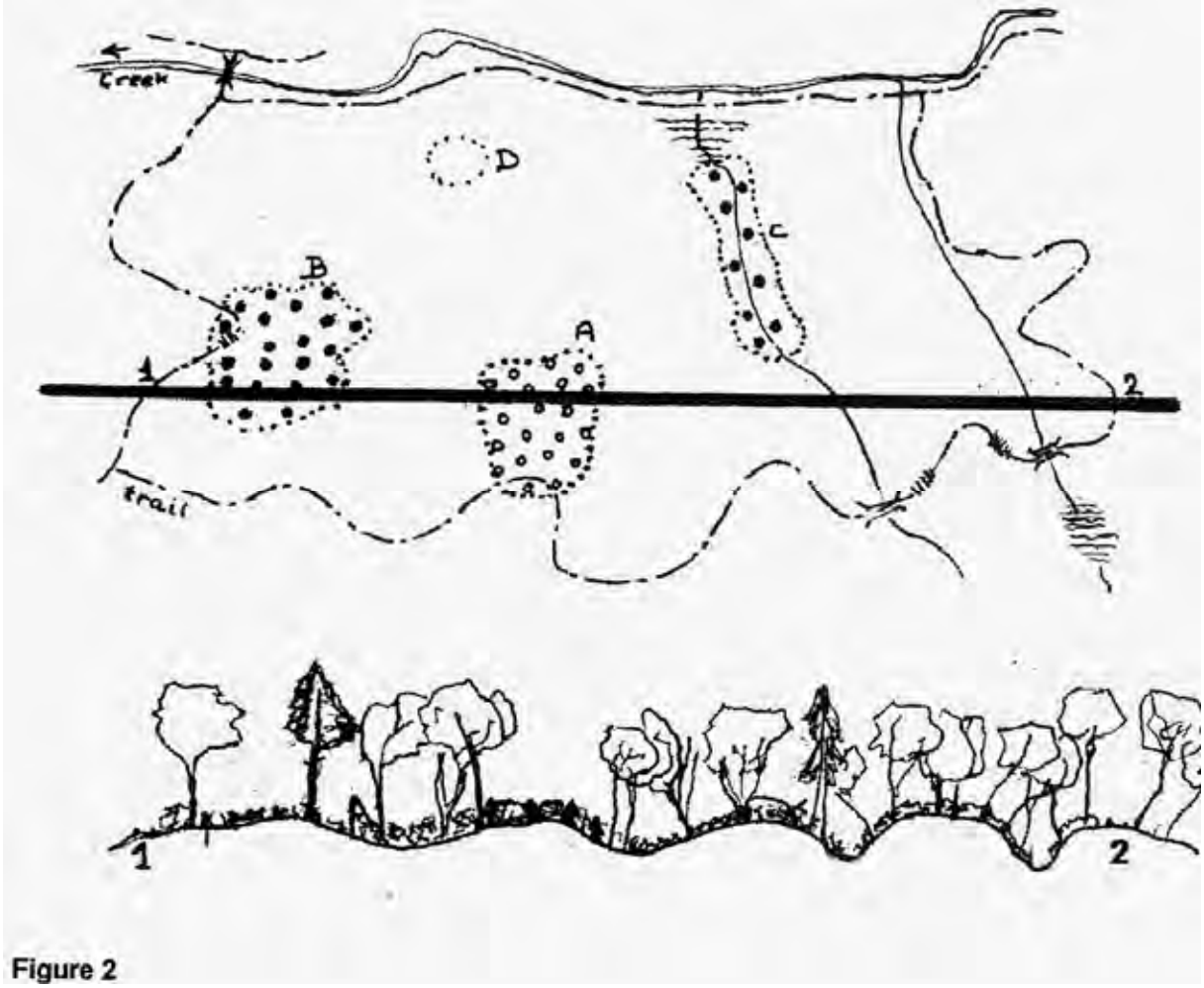


Figure 2

Figure 3

In 2012 the **F** area between gap A and gap C has indeed collapsed and was planted (crosses), conifers on the flat terrain, a few Ashes along the creek. Gap D did not grow bigger but a new still immature gap was forming East of C. In gap A planted conifers start emerging above the under growth.

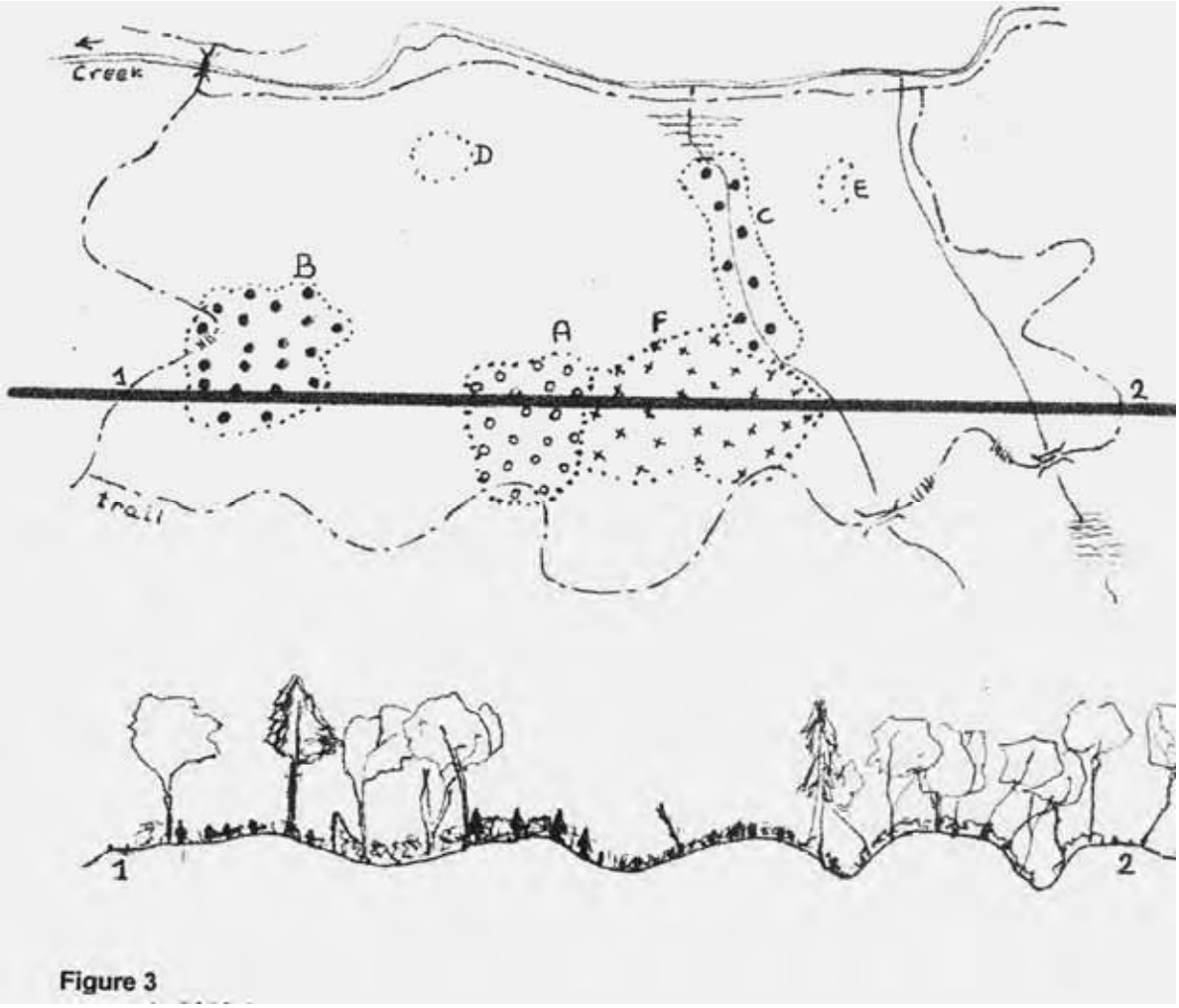


Figure 3

Figure 4

Dramatic changes over a period of four years: gaps D and E matured and were planted in 2014 (black triangles). A major windstorm flattened the forest between B and A, creating gap G that was planted in 2016 (white triangles). The mosaic pattern becomes ever more visible. The oldest plantings (of 2000) are clearly emerging from the under growth.

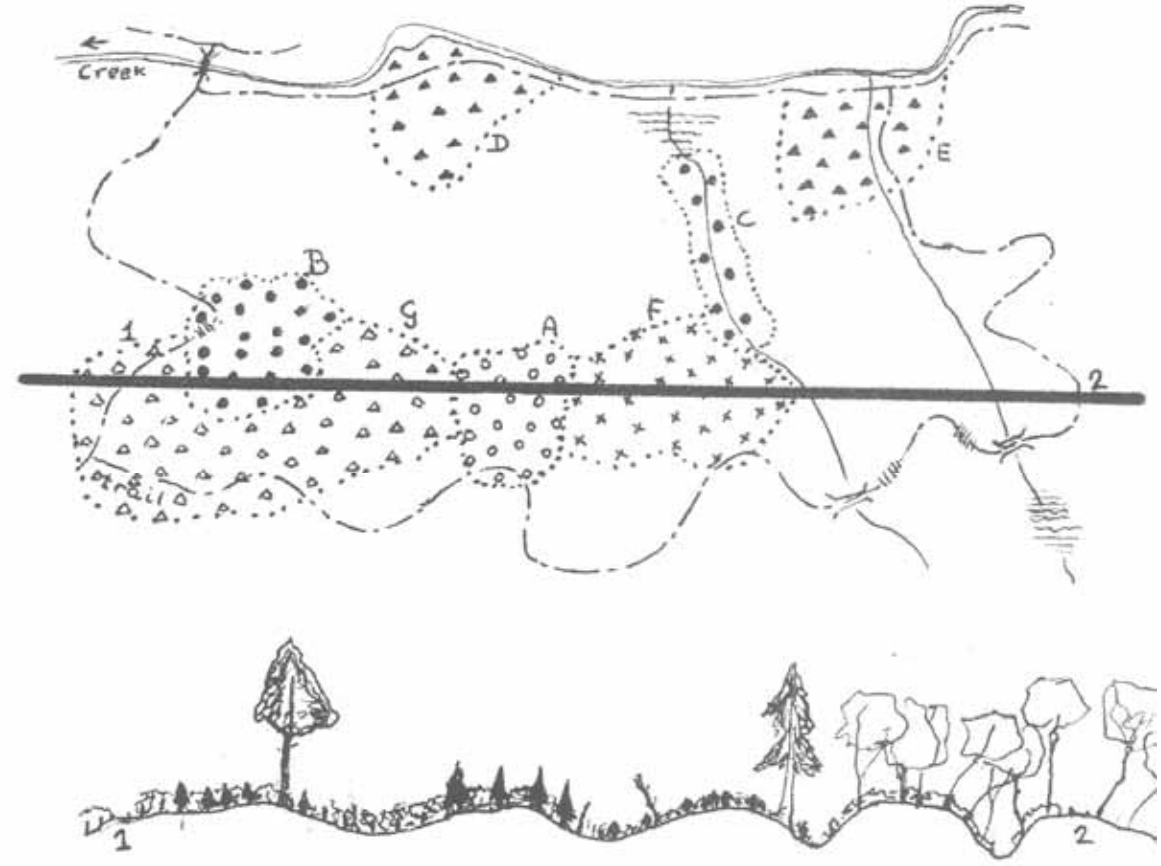
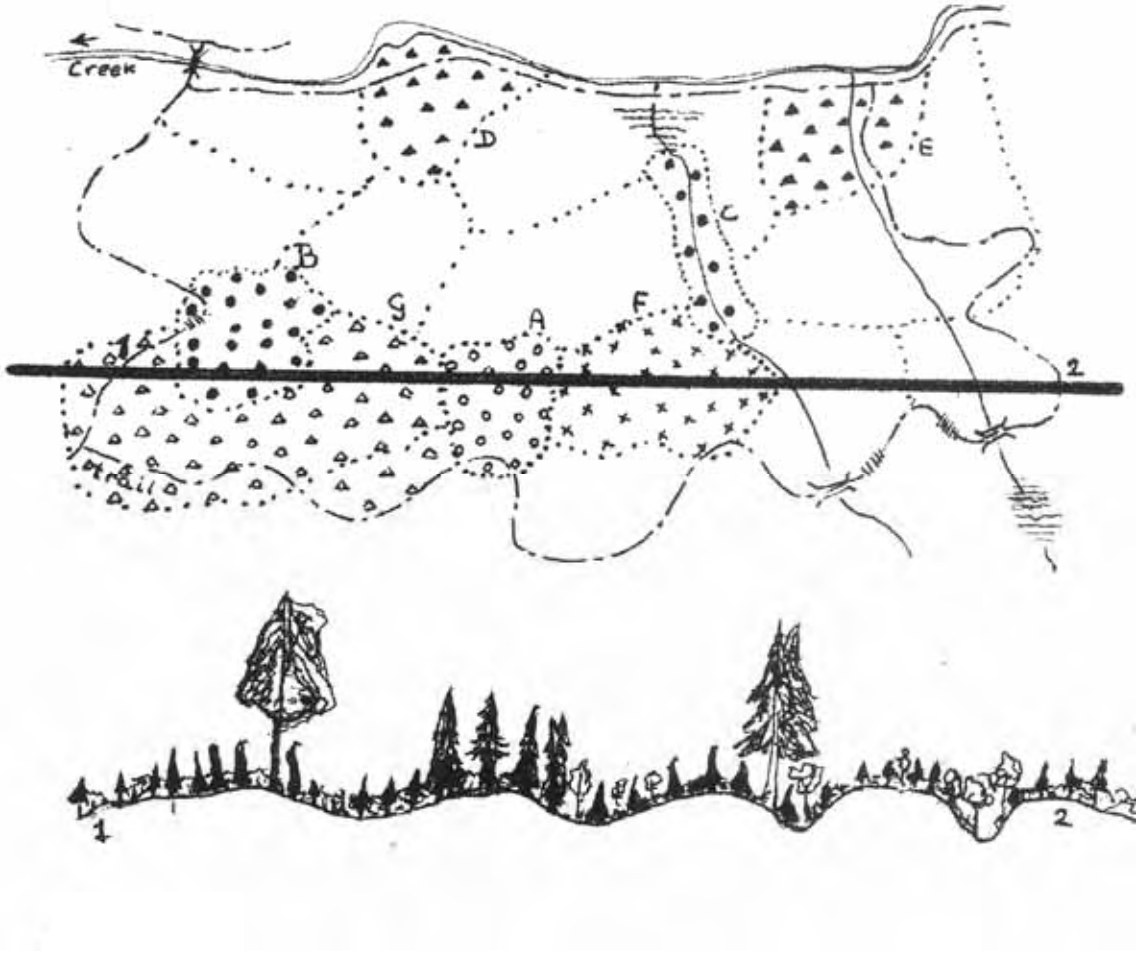


Figure 4

Figure 5

2030. Creation of gaps and their subsequent planting continued and all Alder/Maple forest is gone. The unit is a mosaic of differently aged plantings as demonstrated by the forest profile along the line 1 – 2. Not all "groups of 3" survived totally. In some groups 1 or 2 of the planted trees died, but the overall success of planting is good. In some places 2 or 3 trees are in fierce competition for space and a thinning may be considered. However, in most cases one tree will ultimately dominate the other(s) and in natural old growth forests two mature trees growing 4' apart is not an exception.



Appendix 5 – Plant Palettes

2006 Updated by Doug Gresham

THE FOLLOWING PALETTES ARE INTENDED TO INCREASE SPECIES DIVERSITY

Use these lists as a guide when planning Restoration Projects. If a species does not appear in a list, this does not mean it cannot be added at a later date or incorporated in a project, provided that species fits the habitat. Most species commonly found in the park have been left out, not because they do not belong, but because increased native diversity is a main objective of this Forest Management Plan. Commonly occurring natives can be planted when and where appropriate.

PALETTES:

WET CONIFER FOREST
MESIC CONIFER FOREST
DRY CONIFER FOREST

MESIC MIXED FOREST
DRY MIXED FOREST

WET DECIDUOUS FOREST
MESIC DECIDUOUS FOREST

RIPARIAN WETLAND FOREST
PUGET SOUND BLUFF
FOREST EDGE COMMUNITY

List corrected and completed by Doug Gresham, 5/10/06

5.2

WET CONIFER FOREST

UPPER STORY SPECIES

Sitka Spruce	*Picea sitchensis*
Western Hemlock	*Tsuga heterophylla*
Western Red Cedar	*Thuja plicata*

MIDDLE STORY SPECIES

Devil's Club	*Oplopanax horridus*
False Azalea	*Menziesia ferruginea*
Native Blueberry	*Vaccinium alaskaense, ovalifolium, ovatum*
Pacific Yew	*Taxus brevifolia*
Prickly Current	*Ribes lacustre*
Red Huckleberry	*Vaccinium parvifolium*
Red Twig Dogwood	*Cornus stolonifera*
Salmonberry	*Rubus spectabilis*
Stink Current	*Ribes bracteosum*
Twin Berry	*Lonicera involucrate*
Vine Maple	*Acer circinatum*
Willows	*Salix spp.*

UNDER STORY SPECIES

Bleeding Heart	*Dicentra Formosa*
Clasping Twisted Stalk	*Streptopus amplexifolius*
Evergreen violet	*Viola sempervirens*
False Lily of the Valley	*Maianthemum dilatatum*
False Solomon Seal	*Smilacina racemosa*
Fireweed	*Epilobium angustifolium*
Foam Flower	*Tiarella trifoliate*
Great Northern Aster	*Aster modestus*
Lady Fern	*Athyrium filix-femina*
Large Leaf Avens	*Geum macrophyllum*
Miner's Lettuce	*Montia sibirica*
Queen's Cup	*Clintonia uniflora*
Rattlesnake-Plantain	*Goodyera oblongifolia*
Skunk Cabbage	*Lysichiton americanum*
Slough Sedge	*Carex obnupta*
Star-Flowered False Solomon Seal	*Smilacina stellata*
Twinflower	*Linnaea borealis*
Western Trillium	*Trillium ovatum*
Wood Sorrel	*Oxalis oregano*
Youth-On-Age	*Tolmiea menziesii*

5.3

MESIC CONIFER FOREST

UPPER STORY SPECIES

Douglas Fir	Pseudotsuga menziesii
Grand Fir	*Abies grandis*
Western Hemlock	*Tsuga heterophylla*
Western Red Cedar	*Thuja plicata*

MIDDLE STORY SPECIES

False Azalea = Fool's Huckleberry	*Menziesia ferruginea*
Indian Plum	*Oemleria cerasiformis*
Native Blueberry	*Vaccinium alaskaense, ovalifolium, ovatum*
Oregon Grape	*Mahonia nervosa*
Pacific Yew	*Taxus brevifolia*
Red Huckleberry	*Vaccinium parvifolium*
Red Twig Dogwood	*Cornus stolonifera*
Salal	*Gautheria shallon*
Salmonberry	*Rubus spectabilis*
Twin Berry	*Lonicera involucrata*
Vine Maple	*Acer circinatum*
Western Hazelnut	*Corylus cornuta*

UNDER STORY SPECIES

Deer Fern	*Blechnum spicant*
Sword Fern	*Polystichum munitum*
False-Lily of the Valley	*Maianthemum dilatatum*
Wood Sorrel	*Oxalis oregana*
Trailing Blackberry	*Rubus ursinus*
Inside out Flower	*Vancouveria hexandra*
Bunchberry	*Cornus canadensis*
Fringecup	*Tellima grandiflora*
Twinflower	*Linnaea borealis*

5.4

DRY CONIFER FOREST

UPPER STORY SPECIES

Douglas Fir	Pseudotsuga menziesii
Grand Fir	*Abies grandis*
Western Hemlock	*Tsuga heterophylla*
Western Red Cedar	*Thuja plicata*

MIDDLE STORY SPECIES

Evergreen Huckleberry	*Vaccinium ovatum*
Indian Plum	*Oemleria cerasiformis*
Ocean Spray	*Holodiscus discolor*
Oregon Grape	*Mahonia nervosa*
Pacific Yew	*Taxus brevifolia*
Red Elderberry	*Sambucus racemosa spp. pubens*
Red Huckleberry	*Vaccinium parvifolium*
Salal	*Gautheria shallon*
Salmonberry	*Rubus spectabilis*
Service Berry	*Amelanchier alnifolia*
Snowberry	*Symphoricarpus albus*
Western Hazelnut	*Corylus cornuta*

UNDER STORY SPECIES

Bleeding Heart	*Dicentra formosa*
Bracken Fern	*Pteridium aquilinum*
Deer Fern	*Blechnum spicant*
	?
False Lily of the Valley	*Maianthemum dilatatum*
Fireweed	*Epilobium angustifolium*
Fringe Cup	*Tellima grandiflora*
Great Northern Aster	*Aster modestus*
Hooker's Fairybells	*Disporum hookeri*
Large Leaved Avens	*Geum macrophyllum*
Queen's Cup	*Clintonia uniflora*
Star Flower	*Trientalis latifolia*
Sword Fern	*Polystichum munitum*
Trailing Blackberry	*Rubus ursinus*
Western Trillium	*Trillium ovatum*
Wood Sorrel	*Oxalis oregana*
Youth on Age	*Tolmiea menziesii*

5.5

MESIC MIXED FOREST

UPPER STORY SPECIES

Douglas Fir	Pseudotsuga menziesii
Grand Fir	*Abies grandis*
Western Hemlock	*Tsuga heterophylla*
Western Red Cedar	*Thuja plicata*
Bitter Cherry	*Prunus emarginata*
Cascara	*Rhamnus purshiana*
Crab Apple	*Malus fusca*
Oregon Ash	*Fraxinus latifolia*
Paper Birch	*Betula papyrifera*
Western Dogwood	*Cornus nuttallii*
Willow	*Salix spp.*

MIDDLE STORY SPECIES

Evergreen Huckleberry	*Vaccinium ovatum*
False Azalea	*Menziesia ferruginea*
Indian Plum	*Oemleria cerasiformis*
Ocean Spray	*Holodiscus discolor*
Oregon Grape	*Mahonia nervosa*
Pacific Yew	*Taxus brevifolia*
Red Current	*Ribes sanguineum*
Red Elderberry	*Sambucus racemosa spp. Pubens*
Red Huckleberry	*Vaccinium parviflorum*
Rhododendron, indigenous	*Rhododendron macrophyllum*
Salal	*Gautheria shallon*
Serviceberry (Saskatoon)	*Amelanchier alnifolia*
Snowberry	*Symphoricarpus albus*
Thimbleberry	*Rubus parviflorus*
Vine Maple	*Acer circinatum*
Western Hazelnut	*Corylus cornuta*

UNDER STORY SPECIES

Bleeding Heart	*Dicentra formosa*
Bracken Fern	*Pteridium aquilinum*
Cooley's Hedge Nettle	*Stachys cooleyae*
Deer Fern	*Blechnum spicant*
False Lily of the Valley	*Maianthemum dilatatum*
Fireweed	*Epilobium angustifolium*
Fringe Cup	*Tellima grandiflora*
Great Northern Aster	*Aster modestus*
Hooker's Fairbells	*Disporum hookeri*
Large Leaved Avens	*Geum macrophyllum*
Queen's Cup	*Clintonia uniflora*
Rattlesnake-Plantain	*Goodyera oblongifolia*
Self-Heal	*Prunella vulgarus*
Starflower	*Trientalis latifolia*
Sword Fern	*Polystichum munitum*
Western Trillium	*Trillium ovatum*
Wood Sorrel	*Oxalis oregana*
Youth on Age (Piggy Back Plant)	*Tolmiea menziesii*

5.6

DRY MIXED FOREST

UPPER STORY SPECIES

Aspen, Trembling	*Populus tremuloides*
Big Leaf Maple	*Acer macrophyllum*
Bitter Cherry	*Prunus emarginata*
Cascara	*Rhamnus purshiana*
Douglas Fir	*Pseudotsuga menziesii*
Grand Fir	*Abies grandis*
Paper Birch	*Betula papyrifera*
Western Hemlock	*Tsuga heterophylla*
Western Red Cedar	*Thuja plicata*
Willow	*Salix spp.*

MIDDLE STORY SPECIES

Evergreen Huckleberry	*Vaccinium ovatum*
False Azalea	*Menziesia ferruginea*
Indian Plum	*Oemleria cerasiformis*
Ocean Spray	*Holodiscus discolor*
Oregon Grape	*Mahonia nervosa*
Pacific Yew	*Taxus brevifolia*
Red Current	*Ribes sanguineum*
Red Elderberry	*Sambucus racemosa spp. Pubens*
Red Huckleberry	*Vaccinium parvifolium*
Rhododendron, indigenous	*Rhododendron macrophyllum*
Salal	*Gaultheria shallon*
Servicveberry (Saskatoon)	*Amelanchier alnifolia*
Snowberry	*Symphoricarpus albus*
Thimbleberry	*Rubus parviflorus*
Vine Maple	*Acer circinatum*
Western Hazelnut	*Corylus cornuta*

UNDER STORY SPECIES

Bleeding Heart	*Dicentra Formosa*
Bracken Fern	*Pteridium aquilinum*
Cooley's Hedge Nettle	*Stachys cooleyae*
Deer Fern	*Blechnum spicant*
False Lily of the Valley	*Maianthemum dilatatum*
Fireweed	*Epilobium angustifolium*
Fringe Cup	*Tellima grandiflora*
Great Northern Aster	*Aster modestus*
Hooker's Fairbells	*Disporum hookeri*
Large Leaved Avens	*Geum macrophyllum*
Queen's Cup	*Clintonia uniflora*
Rattlesnake-Plantain	*Goodyera oblongifolia*
Self-Heal	*Prunella vulgarus*
Starflower	*Trientalis latifolia*
Sword Fern	*Polystichum munitum*
Western Trillium	*Trillium ovatum*
Wood Sorrel	*Oxalis oregana*
Youth on Age (Piggy Back Plant)	*Tolmiea menziesii*

5.7

WET DECIDUOUS FOREST

UPPER STORY SPECIES

Alder, Red	*Alnus rubra*
Cottonwood (but away from trails)	*Populus balsamifera, trichocarpa*
Oregon Ash	*Fraxinus latifolia*
Paper Birch	*Betulus papyrifera*
Willow	*Salix spp.*

MIDDLE STORY SPECIES

Black Hawthorn	*Crataegus douglasii*
Devils Club	*Oplopanax horridus*
Indian Plum	*Oemleria cerasiformis*
Nine Bark	*Physocarpus capitatus*
Red Current	*Ribes sanguineum*
Red Elderberry	*Sambucus racemosa spp. Pubens*
Service Berry (Saskatoon)	*Amelanchier alnifolia*
Snowberry	*Symphoricarpos albus*
Stink Current	*Ribes bracteosum*
Twinberry	*Lonicera involucrate*
Western Crabapple	*Pyrus fusca*

UNDER STORY SPECIES

Coltsfoot	*Petasites frigidus var. palmatus.*
Cow Parsnip (away from trails)	*Heracleum lanatum*
False Salomon's Seal	*Smilacina racemosa; S. stellata*
Fireweed	*Epilobium angustifolium*
Great Northern Aster	*Aster modestus*
Inside-out Flower	*Vancouveria hexandra*
Lady Fern	*Athyrium filix-femina*
Large Leaf Aspen	*Geum macrophyllum*
Queen's Cup	*Clintonia uniflora*
Strawberry	*Fragaria chiloensis*
Twinflower	*Linnaea borealis*
Twisted Stalk	*Streptopus amplexifolius*
Vanilla Leaf (Deerfoot)	*Achlys triphylla*
Western Trillium	*Trillium ovatum*
Wood Sorrel	*Oxalis oregana*

5.8

MESIC DECIDUOUS FOREST

UPPER STORY SPECIES

Alder, Red	*Alnus red*
Big Leaf Maple	*Acer macrophyllum*
Trembling Aspen	*Populus tremuloides*
Paper Birch	*Betulus papyrifera*
Willow	*Salix spp.*

MIDDLE STORY SPECIES

Vine Maple	*Acer circinatum*
Indian Plum	*Oemleria cerasiformis*
Thimbleberry	*Rubus parviflorus*
Salmonberry	*Rubus spectabilis*
Red Elderberry	*Sambucus racemosa*
Snowberry	*Symphoricarpus albus*
Hazelnut	*Corylus cornuta*
Cascara	*Rhamnus purshiana*
Bitter Cherry	*Prunus emarginata*
Western Crabapple	*Malus fusca*

UNDER STORY SPECIES

Bleeding Heart	*Dicentra formosa*
Sword Fern	*Polystichum munitum*
False Solomon Seal	*Smilacina racemosa*
Fringecup	*Tellima grandiflora*
Youth-on Age	*Tolmiea mensiezii*
Western Trillium	*Trillium ovatum*

5.9

RIPARIAN WETLAND FOREST

UPPER STORY SPECIES

Cottonwood (but away from trails)	*Populus balsamifera*
Oregon Ash	*Fraxinus latifolia*
Sitka spruce	*Picea sitchensis*
Western Red Cedar	*Thuja plicata*
Willow	*Salix spp.*

MIDDLE STORY SPECIES

Blueberries	*Vaccinium alaskaense, ovalifolium, ovatum*
Devils Club	*Oplopanax horridus*
False Azalea's	*Menziesia ferruginea*
Pacific Ninebark	*Physocarpus capitatus*
Red Huckleberry	*Vaccinium parviflorum*
Red Twig Dogwood	*Cornus stolonifera*
Salmonberry	*Rubus spectabilis*
Stink Current	*Ribes bracteosum*
Twin Berry	*Lonicera involucrata*
Vine Maple	*Acer circinatum*

UNDER STORY SPECIES

Cow Parsnip	*Heracleum lanatum*
Fireweed	*Epilobium angustifolium*
Great Northern Aster	*Aster modestus*
Inside-out Flower	*Vancouveria hexandra*
Lady Fern	*Athyrium filix-femina*
Large Leaf Avens	*Geum macrophyllum*
Queen's Cup	*Clintonia uniflora*
Rattlesnake-Plantain	*Goodyera oblongifolia*
Northern Starflower	*Trientalis arctica*
Skunk Cabbage	*Lysichiton americanum*
Slough Sedge	*Carex obnupta*
Small Fruited Bullrush	*Scirpus microcarpus*
Stream Violet	*Viola glabella*
Vanilla Leaf (Deerfoot)	*Achlys triphylla*
Western Trillium	*Trillium ovatum*
Wood Sorrel	*Oxalis oregana*

5.10

PUGET SOUND BLUFF

UPPER STORY SPECIES

Big Leaf Maple	*Acer macrophyllum*
Douglas Fir	*Pseudotsuga mensiezii*
Madrone (upper slopes and dry spots)	*Arbutus mensiezii*
Shore Pine	*Pinus contorta var. contorta*
Sitka Spruce	*Picea sitchensis*
Willow (lower slope and wet spots)	*Salix spp.*

MIDDLE STORY SPECIES

Cranberry, Highbush	*Viburnum edule*
Evergreen Huckleberry	*Vaccinium ovatum*
Fool's Huckleberry	*Menziesia ferruginea*
Nootka Rose	*Rosa nootkana*
Serviceberry (Saskatoon)	*Amelanchier alnifolia*

UNDER STORY SPECIES

Cow Parsnip	*Heracleum lanatum*
Fireweed	*Epilobium angustifolium*
Great Northern Aster	*Aster modestus*
Large Leaf Avens	*Geum macrophyllum*
Queen's Cup	*Clintonia uniflora*
Twisted Stalk	*Streptopus amplexifolius*
Western Trillium	*Trillium ovatum*
Wild Ginger	*Asarum caudatum*
Wood Sorrel	*Oxalis oregana*

5.11

FOREST EDGE

UPPER STORY SPECIES

Western Dogwood	*Cornus nuttallii*
Willow	*Salix spp. (hookeriana, lucida spp. Lasiandra, mertensiana, scouleriana, sitchensis)*

MIDDLE STORY SPECIES

Black Hawthorn	*Crataegus douglasii*
Indian Plum	*Oemleria cerasiformis*
Mock Orange	*Philadelphus lewisii*
Ocean Spray	*Holodiscus discolor*
Oregon Grape	*Mahonia nervosa*
Red Elderberry	*Sambucus racemosa var. pubens*
Salal	*Gaultheria shallon*
Serviceberry (Saskatoon)	*Amelanchier alnifolia*
Snowberry	*Symphoricarpos albus*
Thimbleberry	*Rubus parviflorus*
Vine Maple	*Acer circinatum*
Western Crabapple	*Malus fusca*
Western Hazelnut	*Corylus cornuta*

UNDER STORY SPECIES

Bleeding Heart	*Dicentra Formosa*
Bracken Fern	*Pteridium aquilinum*
Camas	*Camassia quamash*
Cooley's Hedge Nettle	*Stachys cooleyae*
False Hellebore	*Veratrum viride*
Fawn Lily	*Erythronium oregonum*
Fireweed	*Epilobium angustifolium*
	?
Goats Beard	*Aruncus dioicus*
Great Northern Aster	*Aster modestus*
Hooker's Fairbells	*Disporum hookeri*
Large Leaved Avens	*Geum macrophyllum*
Queen's Cup	*Clintonia uniflora*
Self-Heal	*Prunella vulgarus*
Starflower	*Trientalis latifolia*
Sword Fern	*Polystichum munitum*
Trailing Blackberry	*Rubus ursinus*
Western Trillium	*Trillium ovatum*
Wood Sorrel	*Oxalis oregana*

5.12

Comprehensive list of species and their use in various forest types

Column:
1. WET CONIFER FOREST
2. MESIC CONIFER FOREST
3. DRY CONIFER FOREST
4. MESIC MIXED FOREST
5. DRY MIXED FOREST
6. WET DECIDUOUS FOREST
7 MESIC DECIDUOUS FOREST
8. RIPARIAN WETLAND FOREST
9. PUGET SOUND BLUFF
10. FOREST EDGE COMMUNITY

		Upper story species									
Common name	**Botanical name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Aspen, Trembling	*Populus tremuloides*					X					
Big Leaf Maple	*Acer macrophyllum*					X		X		X	
Bitter Cherry	*Prunus emarginata*				X	X					
Cascara	*Rhamnus purshiana*				X	X					
Cottonwood	*Populus balsamifera*						X	X	X		
Crab Apple	*Malus fusca*				X						
Garry Oak	*Quercus garryana*										
Dogwood, Western	*Cornus nuttallii*				X						X
Douglas Fir	*Pseudotsuga mensiesii*		X	X	X	X				X	
Grand Fir	*Abies grandis*		X	X	X	X					
Hemlock, Western	*Tsuga heterophylla*	X	X	X	X	X					
Madrone	*Arbutus menziesii*									X	
Oregon Ash	*Fraxinus latifolia*				X		X		X		
Paper Birch	*Betula papyrifera*				X	X	X	X			
Red Alder	*Alnus rubra*						X	X			
Redcedar, Western	*Thuja plicata*	X	X	X	X	X			X		
Shore Pine	*Pinus contorta var. contorta*									X	
Sitka Spruce	*Picea sitchensis*	X							X	X	
White Pine, Western	*Pinus monticola*										
Willow	*Salix spp.*				X	X	X	X	X	X	X

		Middle story species									
Common name	**Botanical name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Black Hawthorn	*Crataegus douglasii*						X				
Cascara	*Rhamnus purshiana*										
Crabapple, Western	*Malus fusca*						X			X	X
Cranberry, Highbush	*Viburnum edule*									X	
Devil's Club	*Oplopanax horridus*	X					X		X		
Evergreen Huckleberry	*Vaccinium ovatum*			X	X	X				X	
False Azalea	*Menziesia ferruginea*	X	X			X			X		
Fool's Huckleberry	*Menziesia ferruginea*				X					X	
Hazelnut , Western	*Corylus cornuta*		X	X	X	X					X
Indian Plum	*Oemleria cerasiformis*		X	X	X	X	X				X
Mock Orange	*Philadelphus lewisii*										X
Native Blueberry	*Vaccinium alaskaense, ovalifolium, ovatum*	X	X						X		
Nine Bark, Pacific	*Physocarpus capitatus*						X		X		
Nootka Rose	*Rosa nootkana*									X	
Ocean Spray	*Holodiscus discolor*			X	X	X	X				X
Oregon Grape	*Mahonia nervosa*		X	X	X	X					X
Pacific Yew	*Taxus brevifolia*	X	X	X	X	X					
Prickly Current	*Ribes lacustre*	X			X						
Red current	*Ribes sanguineum*					X	X				
Red Elderberry	*Sambucus racemosa var. pubens*			X	X	X	X				X
Red Huckleberry	*Vaccinium parvifolium*	X	X	X	X	X			X		
Red Twig Dogwood	*Cornus stolonifera*	X	X						X		
Rhododendron, indigenous	*Rhododendron macrophyllum*				X	X					
Salal	*Gaultheria shallon*		X	X	X	X					X
Salmonberry	*Rubus spectabilis*	X	X	X					X		
Serviceberry (Saskatoon)	*Amelanchier alnifolia*			X	X	X	X			X	X
Snowberry	*Symphoricarpos albus*			X	X	X	X				X
Stink Current	*Ribes bracteosum*	X					X		X		
Thimbleberry	*Rubus parviflorus*				X	X					X
Twin Berry	*Lonicera involucrate*	X	X				X		X		
Vine Maple	*Acer circinatum*	X	X		X	X			X		X
Western Dogwood	*Cornus nuttallii*										
Willows	*Salix spp.*	X									

Column:
1. WET CONIFER FOREST
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7 MESIC DECIDUOUS FOREST
8. RIPARIAN WETLAND FOREST
9. PUGET SOUND BLUFF
10. FOREST EDGE COMMUNITY

		Under story species									
Common name	**Botanical name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Bracken Fern	*Pteridium aquilinum*			X	X	X					X
Bunchberry	*Cornus canadensis*										
Camas	*Camassia quamash*										X
Clasping Twisted Stalk	*Streptopus amplexifolius*	X									
Coltsfoot	*Petasites frigidus*						X				X
Cooley's Hedge Nettle	*Stachys cooleyae*				X	X					
Cow Parsnip	*Heracleum lanatum*						X		X	X	
Deer Fern	*Blechnum spicant*			X	X	X					
Evergreen violet	*Viola sempervirens*	X									
False Hellebore	*Veratrum viride*										X
False Lily of the Valley	*Maianthemum dilatatum*	X		X	X	X					
False Solomon Seal	*Smilacina racemosa*	X					X				
Fawn Lily	*Erythronium oregonum*										X
Fireweed	*Epilobium angustifolium*	X		X	X	X	X		X	X	X
Foam Flower	*Tiarella trifoliate*	X									
Fringecup	*Tellima grandiflora*			X	X	X					
Goats Beard	*Aruncus dioicus*										X
Great Northern Aster	*Aster modestus*	X		X	X	X	X		X	X	X
Hooker's Fairbells	*Disporum hookeri*			X	X	X					X
Inside-out Flower	*Vancouveria hexandra*						X		X		
Lady Fern	*Athyrium filix-femina*	X					X		X		
Large Leaf Avens	*Geum macrophyllum*	X		X	X	X	X		X	X	X
Miner's Lettuce	*Montia sibirica*	X									
Piggy Back Plant	*Tolmiea mensiezii*										
Queen's Cup	*Clintonia uniflora*	X		X	X	X	X		X	X	X
Rattlesnake-Plantain	*Goodyera oblongifolia*	X			X	X			X		
Self-Heal	*Prunella vulgarus*				X	X					X
Skunk Cabbage	*Lysichiton americanum*	X							X		
Slough Sedge	*Carex obnupta*	X							X		
Small Fruited Bullrush	*Scirpus microcarpus*								X		
Spiny Wood Fern	*Dryopteris expansa*										
Starflower, Northern	*Trientalis latifolia*			X	X	X			X		X
Star-Flowered False Solomon Seal	*Smilacina stellata*	X									
Strawberry	*Fragaria chiloensis*						X				
Stream Violet	*Viola glabella*								X		
Sword Fern	*Polystichum munitum*			X	X	X					X
Trailing Blackberry	*Rubus ursinus*			X							X
Twinflower	*Linnaea borealis*	X					X				
Twisted Stalk	*Streptopus amplexifolius*					X	X			X	
Vanilla Leaf (Deerfoot)	*Achlys triphylla*						X		X		
Western Trillium	*Trillium ovatum*	X		X	X	X	X		X	X	X
Wild Ginger	*Asarum caudatum*									X	
Wood Sorrel	*Oxalis oregana*	X		X	X	X	X		X	X	X
Youth-on Age	*Tolmiea mensiezii*	x		X	X	X					

Appendix 6 - Designing a Planting Plan

Ideally a Planting Plan (PP) is more than just a list of species + quantities to be planted. A PP is very much about "looking ahead", long term planning.

In a forest situation, e.g. gap planting, the PP may be fairly simple, but even in that situation it is worthwhile to be a bit more specific.

A PP has a few chapters:

1. Terrain description: topography, soil type, and hydrology; external aspects like presence of a road, a creek, private property.
2. Existing vegetation: presence of invasive species and their abundance, composition of the herb layer, shrub layer, middle and upper storey
3. Site preparation: what needs to be done to make the site plant-ready
4. Choice of Plant Palette(s) suitable for this site
5. "Look into the future": what do you expect this newly planted community to look like when it has matured?
6. Based on the previous information and considerations the actual Planting Plan:
   - specifics about site preparation: when, by whom?
   - a (sketched) map of the site with indications which species have to be planted where
   - plant list + quantities
   - specific directions e.g. about planting date, who is responsible, who is planting, spacing, mountain beaver protection, how to plant and where to start planting

As an example a Planting Plan is given for a recently planted edge community in subunit 1 D1, just east of the Norcross entrance.

1. Terrain

   The planting site is a gap occurring at the south boundary of the park where a few over - mature hazardous Alder trees were felled to prevent them from falling on a house. The terrain is flat but sloping in north direction, dry, with a sandy-loamy soil.

2. Existing vegetation

   There was a dense ground cover of Ivy and an occasional Holly; several garden shrubs had escaped into the park: Kerria, Forsythia, Roses. Native shrubs were: Hazelnut, Ocean Spray, Indian Plum, Oregon grape; some Alder trees and Big Leaf Maple are still present.

3. Site preparation

   Clearly Ivy had to be removed prior to planting; this was done by several groups of volunteers, including the home owner of the adjacent property. The Ivy was piled on a platform built on and with dead stems (the first such platform in Carkeek Park!, 2005)

4. Plant Palette

   Under the given circumstances the suitable Plant Palette is "Edge Community": mostly shrubs able to form a dense edge of the park, discouraging park users to stray into private gardens and neighbors to walk straight into the park.

5. "Look into the future"

   The gap was created by felling trees that threatened a house; that is a situation that should not be recreated: **NO potentially tall trees within 50 ft of the park boundary**! That means that the zone of 50 ft wide between the boundary and the first upper story trees is filled with low, light demanding shrubs at the very edge, then a zone of taller shrubs, then a

zone of small trees + shade tolerant shrubs. When maturing this edge community may look like the profile on the next page.

6. The actual Planting Plan

a. site sketch: see previous page. The area is roughly 5000 sq. ft; with an average planting distance of 5 ft about 5000/25 = 200 plants are needed.

b. Plant list

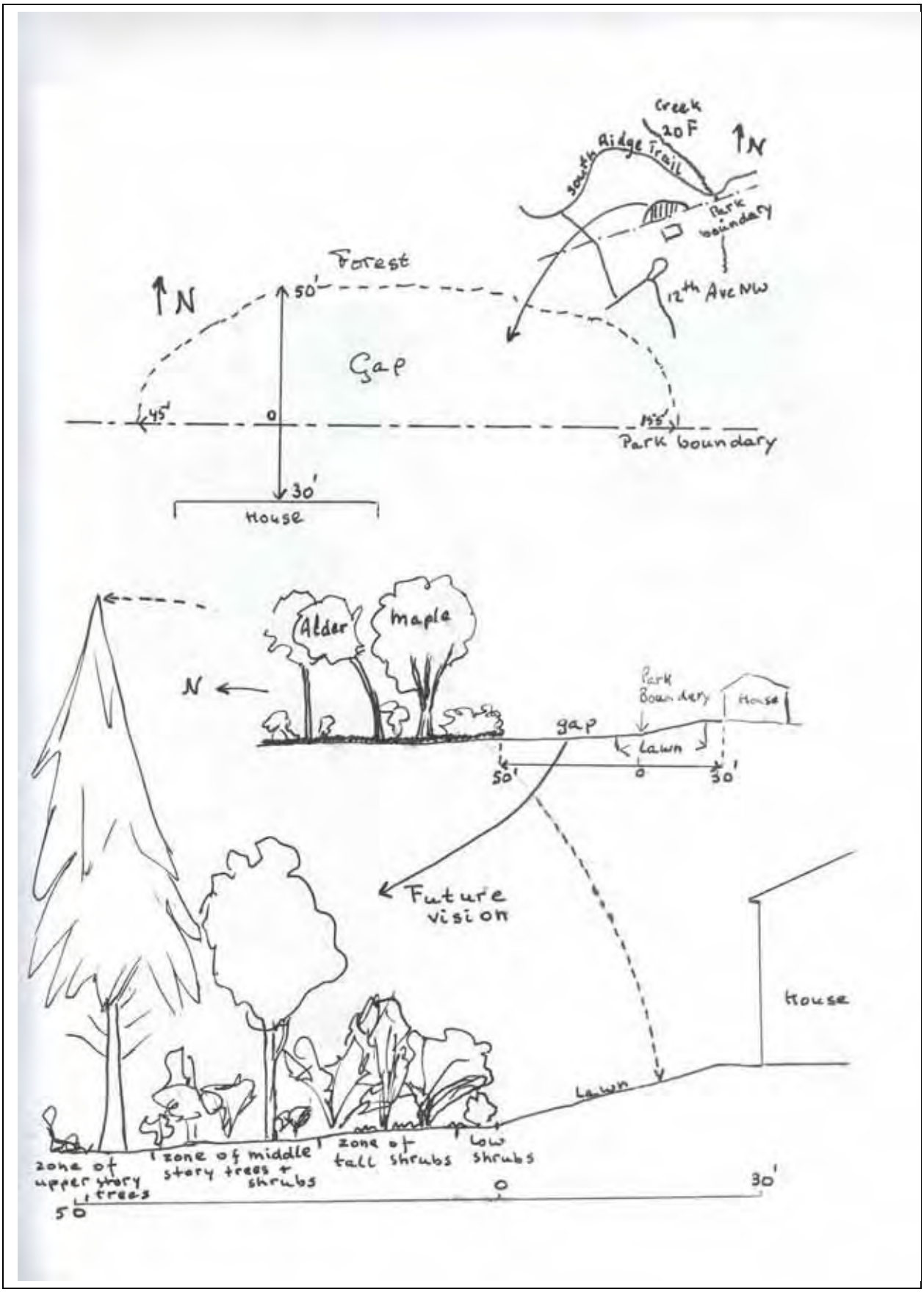
Upper story trees:	Douglas firs	5
	Red Cedar	5
Middle story trees:	Bitter Cherry	5 (not available, added later)
	Cascara	5 (not available, added later)
Understory shrubs	Vine Maple	20
	Service Berry	20
	Ocean Spray	20
	Black Hawthorn	3
	Hazelnut	20
	Nootka Rose	25
	Snowberry	25
Ground cover	Inside-out flower	2 (*Vancouveria*)

Note: the plant list does not totally comply with the Plant Palette because of availability issues.

c. Specifics

- Plant roses and Snowberries along the edge, about 2 ft apart
- Plant shrubs at an average spacing of 5ft, more or less in a triangle-pattern
- Keep the Ocean Spray closer to the boundary, the Service Berry and Vine Maple farther away from the boundary
- Plant Red Cedar and Douglas Fir at the forested edge of the gap
- Put netted sleeves around the evergreens
- Plant ground cover at the edge of the gap.

A Planting Plan for a forest gap can be simpler because there are less complicating factors. However, it is to be recommended that directions are included as to where to plant specific species, especially when the terrain includes drier and wetter areas.


Creek
20F
South Ridge Trail
N
Park boundary
12th Ave NW
Forest
N
50'
Gap
45'
0
135'
Park boundary
30'
House
Alder
Maple
N
Park Boundary
House
gap
Lawn
50'
0
30'
Future vision
House
Lawn
zone of upper story trees
zone of middle story trees + shrubs
zone of tall shrubs
low shrubs
50
0
30'

Ordering plants

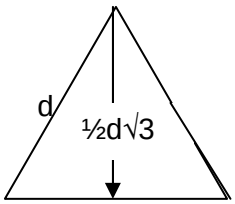
How many trees, shrubs, and herbaceous plants should be ordered 1.5 years prior to the actual planting? Here are some guidelines:

Canopy trees

In a mature forest there are approximately 60 – 80 upper story trees per acre, on average 70. One acre = 43,560 square feet. This means that each mature upper story tree has an area of 43,500**:** 70 = 622 square feet of forest floor as its "territory". By lack of a better word we can call this number **"footprint"**: it is the area of forest floor a mature canopy tree has as its territory, its footprint. Canopy trees have on average a footprint of 622 square feet.

When we plan a planting activity there are basically two main choices: dense planting in order to quickly create a dense young forest that shades out all unwanted invasive species, or planting only as many trees as we aim for in the mature forest. Dense planting is practiced in commercial forestry, and can be considered in very open situations where there is no natural undergrowth of shrubs but a serious chance of invasive species moving in. In Carkeek Park there is usually a dense under growth of shrubs and the system of "spot planting" is preferred, see Appendix 7.

Assuming that canopy trees grow on average more or less in a triangular spacing, the average distance between two trees is the length of one side of a triangle in a grit of triangles.



One triangle has the same surface as the footprint of the tree.
The surface of the triangle is $\frac{1}{2}d^2\sqrt{3} = d^2 \times 0.866 = 622$
From this we calculate **d** to be 26.8 ≈ 27 ft.
With 70 trees per acre their average footprint is 622 sq.ft and their average distance is 27 ft.

Based on the formula $\frac{1}{2}d^2\sqrt{3}$ a table can be constructed with different values for **d** and the corresponding footprint **f**, and the number of plants per acre:**n/a**.

d (in ft)	f (in sq.ft.)	n/a
3	8	5585
6	31	1405
10	87	501
20	346	126
25	541	81
27	622	70
30	779	56

If an area to be planted is e.g. 300 feet long and 75 feet wide, its surface is 22,500 sq.ft. When we divide that by the footprint of canopy trees we know how many canopy trees we are aiming for in the mature forest: 22,500/622 = 36. In the area to be planted we establish 36 planting spots about 27 feet apart, more or less in a triangle spacing (Appendix 7). We plant 3 trees per spot, hoping that one of the three will survive mountain beavers, competition, drought, damage etc. That means that for this area of 22,500 sq.ft we need to order 3 x 36 = 108 trees.

Surface

The formula for ordering canopy trees therefore is:
surface of the area divided by the footprint value x 3

A problem may be to estimate the surface of the area. It helps to have a map of which the scale is known. You can draw in the boundaries of the area, divide it into simple geometric shapes, calculate the surface of each separate shape and add it all up. Another method is that of calculated guessing. Just look around and say: “this area is 300 feet long and 75 feet wide, its surface is 22,500 square feet”. If done with great aplomb nobody will contest it. If it turns out that you ordered too many plants you have a nice reserve for eventualities; if you ordered short you just plant more next year. After all, it must remain fun to be a Forest Steward.

The question of WHAT to order is a different question. Guidelines are found in Appendix 5: Plant Palettes.

Middle story trees

As a rule of thumb the same number of middle story trees is ordered as the calculated number of canopy trees. This can be adjusted for pre-existing species. When planting, finding places to plant can be more random or opportunistic, the guideline of about 27 ft between spots is less strict. As for species to be ordered: see Appendix 5.

Shrubs

In Carkeek Park shrubs are usually present. However, the composition of the existing shrub layer may be a bit one-sided, e.g. 80% Salmonberry. The choice can be made to enrich the existing shrub layer, again: see Appendix 5. The number of plants to be ordered often depends on personal choices.

When an area is very open under an existing canopy, the previous table can be helpful to determine the number of plants needed.

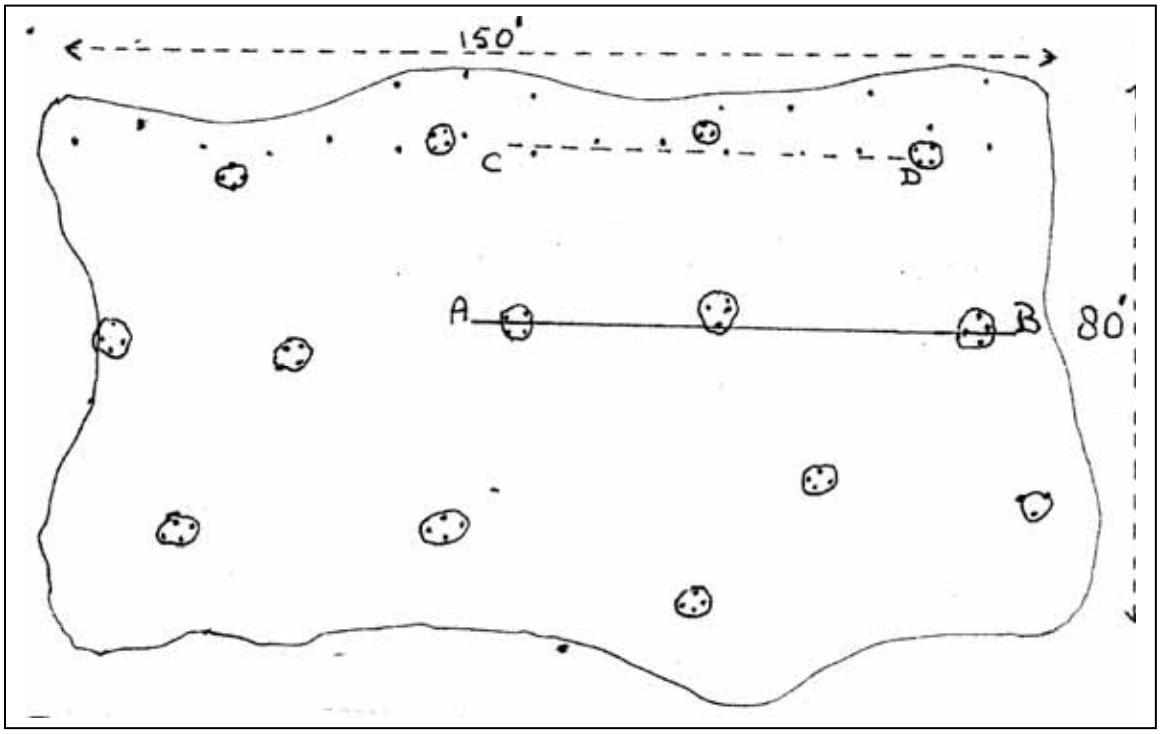
Groundcover

Ground covers are an underserved area in our operations. Some attempts have been made to introduce species that are absent from the existing palettes, like *Linnaea, Trillium,* or *Vancouveria*. The policy is to establish “seed-plantings” and then let nature take its course.

Appendix 7 - Spot planting

Imagine the following situation: a dense mature Alder/Maple forest with hardly a middle story but a fairly dense shrub under story. Within this forest a gap occurs of roughly 80' x 150', or about 12,000 sq. ft. This gap is to be planted, predominantly with conifers, to establish a new forest generation.

If planted in a square spacing of 10' x 10' (100 sq. ft of 'territory' per plant) about 120 plants would be needed. Instead **planting spots** are staked out in a spacing of 25' – 30' (about 622 sq. ft. of territory for each spot) resulting in 19 spots. At each spot 3 or 4 conifers are planted about 4' apart; for the whole area 4 x 19 = 76 trees are needed.
(see also Appendix 6)

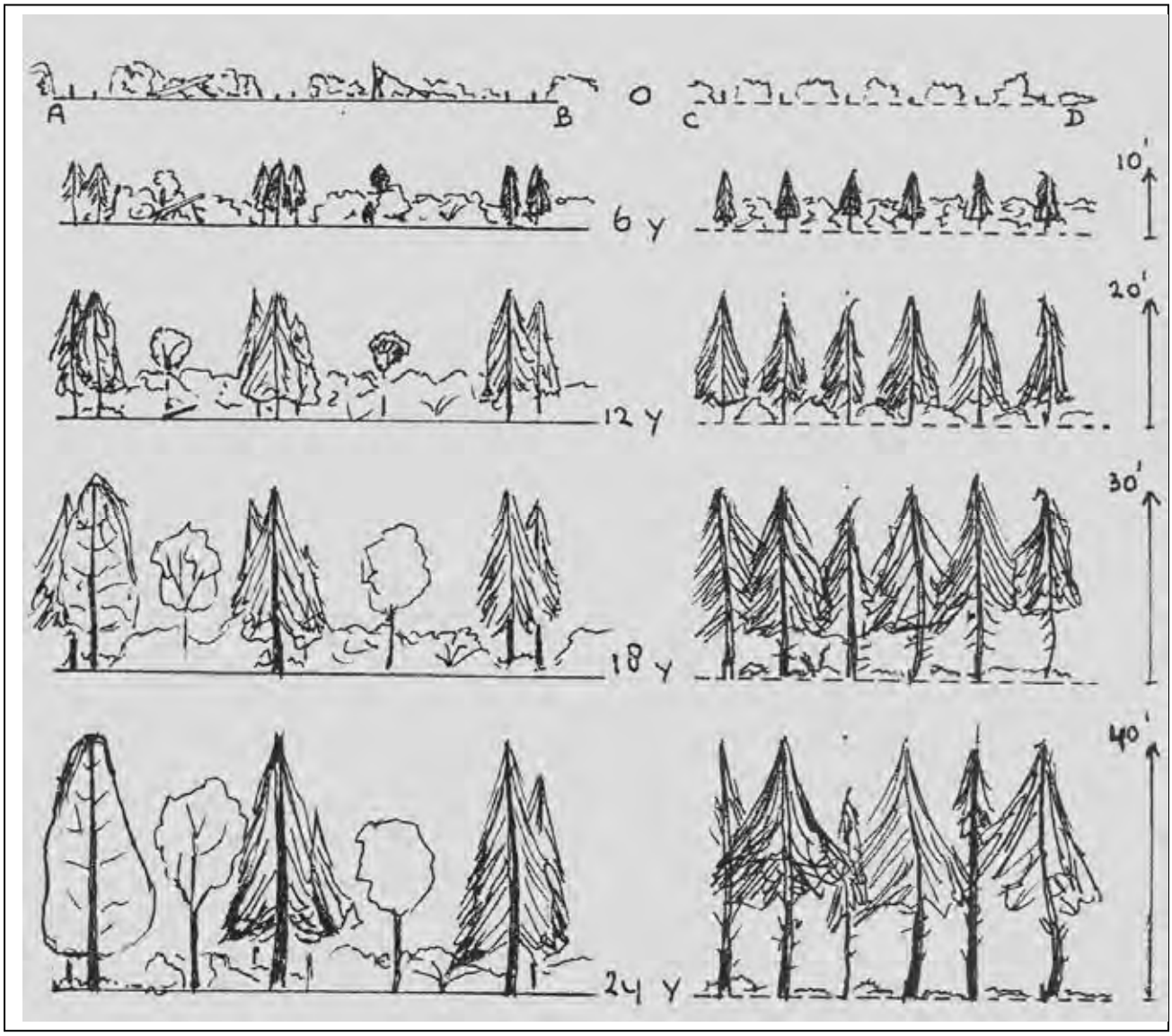


The rationale behind spot planting is that in a mature older forest there are about 60 - 80 dominant upper canopy trees per acre – an average territory of 622 sq. ft. per tree (one acres is 43.560 sq. ft.) or a spacing of about 27'. By establishing planting spots in a spacing of 25' – 30', stocking each spot with 3 - 4 trees, what one actually does is determining the location of the future dominant trees, leaving it to competition between the planted trees at each location which trees will ultimately form the dominant upper canopy tree.

Compared with full area planting in a spacing of about 10’ x 10’ the advantages of spot planting are:

1. about 30% less plants are needed
2. Site preparation is focused on 19 spots only, reducing disturbance of the existing plant communities; it also is less labor intensive.
3. If the existing vegetation is very open the openings can be used for enrichment plantings with shrubs, under story and middle story species.
4. Watering is less labor intensive; only 14 spots are to be visited.
5. Monitoring/liberation are less labor intensive, leaving the rest of the area undisturbed, causing fewer disturbances for wildlife.
6. When the planted conifers outgrow the shrub layer and start expanding their crowns it takes a long time before the existing understory has to yield to the changing light conditions. This is especially important for the avifauna.

Development of spot planting as compared to full area planting can be illustrated as shown below. For the planted trees a height increment of 20”/year is assumed.



Comparing both developments we see that in spot planting the shrub layer remains well developed over a much longer period of time; middle story trees and deciduous trees have an opportunity to develop. Crowns of deciduous and future canopy trees are deep. In the fully planted area competition between conifers starts early, resulting in a declining under growth and dying of lower branches of conifers. The forest starts to look like a plantation with little bio-diversity; a poor wildlife habitat.

Monitoring of spot planting can be a problem because of the dense understory ob e.g. Salmonberry. It helps to have all planted plants flagged with colored tape, but even then they are difficult to spot. A solution has been tried to mark the planting spots with 8ft long willow stakes, flagged at the top. These stakes stand out from a distance and guide the monitoring Forest Steward to where she/he needs to go. Chances are that some of the stakes root, creating an open lattice of willow trees. This creates an additional dimension to the forest where a middle story is often missing. In the long run the planted canopy trees will out compete the willows, which are fairly short-lived and light demanding. The first trial showed encouraging results (project 2A2)

Appendix 8 - Liberation

As discussed in Appendix 7, there are basically two different approaches to planting: dense planting, leaving it to nature who "wins", and spot planting, planting trees at a distance of 25 – 30 ft from each other. Planting trees in a spacing of 10 x 10 ft, an average of about 450 trees/acre, and assuming that about 10% will make it into the final stand about 50 years later, the result is a dense forest with about 450 trees/acre. Planting this many trees, however, often creates a very dense and dark forest in which a diverse undergrowth is suppressed. The advantage is that e.g. Blackberries are shaded out, but Ivy most likely is not. In other words, dense planting can lead to impoverishment of the vegetation without guaranteeing an absence of invasives.

When spot planting a planted tree is intended to grow into a mature tree. Knowing that there are many hazards threatening the tree (mountain beavers, falling branches/trees, competition from other plants) often more trees are planted than necessary. A mature and well-stocked forest counts about 60 - 80 full-grown trees/acre, on average about 27' apart. In order to maintain – or, if absent, to establish a rich diverse undergrowth, a different planting practice can be applied: spot planting (see Appendix 7). In spot planting 3 - 4 trees are grouped together, about 3 – 4 ft apart in a triangle/rectangle; spots are spaced 25 – 30 ft apart, on average 27 ft, or about 70 spots/acre. If these spots are established in a gap in the existing forest canopy, chances are that this gap has or will develop a dense cover of shrubs, or become infested with Ivy and Blackberries. Trees planted in this gap are intended to survive competition from shrubs and/or invasives and, fully developed, to form the new upper canopy of the forest. If no shrubs are present, the space in between spots can be planted with a variety of shrubs and ground cover species, befitting the site. In order to help planted trees in the fierce competition for light **LIBERATION** needs to be practiced: see figure 1 – 6.

The practice of liberation is only possible when plantings are closely monitored, once or twice a year (not more, otherwise unwanted trails will form). Often monitoring and liberation can be done simultaneously. The perfect tool to combine both is the "Liberator".

Liberation is not necessarily limited to planted trees only. When the understory is enriched with different species for more diversity, the planted shrubs may need to be liberated as well. They too have to overcome competition from existing shrubs and/or invasives.

If workers in the forest hesitate to trim or cut back existing shrubs to liberate the desired plants fearing their demise, let it be known that trimmed or cut back shrubs as a rule will make new shoots, often quite vigorously so because of their existing well-established root system. However, liberation should not be done during the nesting season (March through June) or in the weeks following the longest day. At that time the shrub has invested all its energy in growing, flowering, and (the beginning of) fruiting. Consequently its roots are depleted of reserves and a cut back shrub will just not have the energy to make new shoots. Ironically, if one wants to get rid of shrubs (e.g. along trails), the weeks after the longest day are the best period of the year to do the trimming.

1. A planting spot about 4’ across is cleared of invasives and present bushes are cut back to about 1ft. In this spot 3 trees are planted.

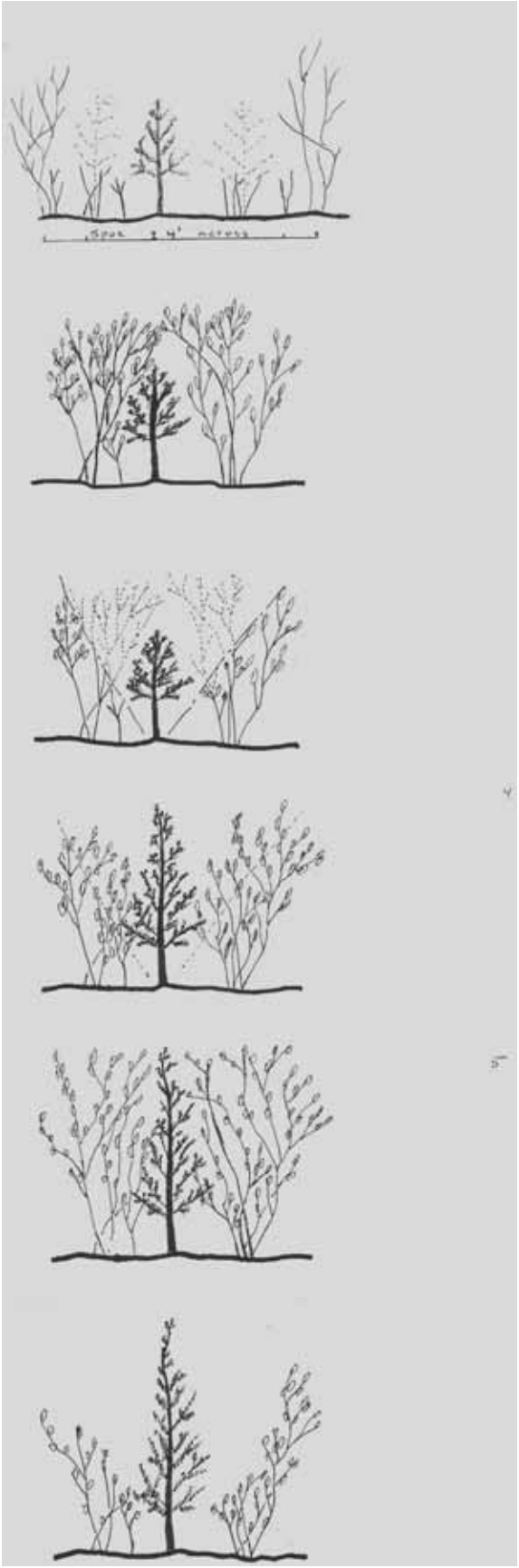
2. During the next growing season planted trees will establish themselves but hardly grow; trimmed bushes, however, will sprout vigorously because they have an established root system. Competition for light sets in.

3. At the end of the first growing season after planting or during the following winter, competing bushes are cut back again: a funnel-shaped opening is created around each tree or planting spot. Light competition is reduced or taken away.

4. During the next growing season all plants grow, both planted trees and shrubs, and after a while competition sets in again.

5. When competition becomes serious, a second liberation is due. Monitoring is necessary to determine that moment.

6. The liberated tree now has established itself well and will be able to compete more vigorously, although a third and possibly fourth liberation may have to follow, depending on the existing shrub vegetation: keep monitoring.



A dense jungle of undergrowth is hiding……two little Hemlock trees, now liberated.

Appendix 9 - Organizing a Work Party

When a work party is to be organized the first requirement is that there is a person who takes responsibility. In the case of Carkeek Park that can be the Park Maintenance person, a Forest Steward, a member of the Advisory Council, the local GSP contact. It can also be a Creek Steward, a GSP official, an Earthcorps member. Whoever is in charge needs to submit a work plan several weeks prior to the event with the with the Carkeek Park Program Supervisor (PS). The PS may sign off the plan for OK but may also convene a meeting with those involved (maintenance crew, GSP, Earthcorps, Advisory Council) to discuss issues like recruiting volunteers, concordance with the Forest Management Plan, parking, plant supply, use of the Park truck and tools trailer, food and drinks, etc.

Once the plan is agreed upon the person in charge needs to work with this checklist:

1. Check out the work site to make sure there are no unexpected surprises like fallen trees blocking the access route
2. Check if pre-work party activities are needed/ready, like bringing in cardboard or mulch
3. Instruct possible co-leaders about their role, who does what?
4. Check the plant supply (if the party is about planting)
5. Check the availability of tools and garbage bags
6. Check the availability of an Emergency Response Plan, a First Aid Kit, a Cell Phone, and possibly a Walkie-Talkie, especially when the group of volunteers is spread over several areas
7. On the day itself arrange for a sign-in table or at least sign-in sheets; have clipboard and ball-point pens available; have name tags available. Put up road signs that point to the sign in table.
8. Taste food and drinks to make sure it is palatable
9. Welcome the group, explain the context of the work party (keep it short!!!), make sure everybody has signed in, and indicate where bathroom facilities are
10. Give a short overview of safety issues like how to carry tools, what to do in case of emergency, who has a cell phone, where is the First Aid Kit, etc.
11. COUNT THE NUMBER OF TOOLS THAT IS TAKEN INTO THE FOREST!
12. At the work site: take some time to talk about: tool safety, site hazards like glass, bees, yellow jackets, hornets, needles, nettles, overhanging branches, steep slopes etc. **Ask if there is anybody with allergy for bee stings!**
    NB: THERE ARE NO POISONOUS SNAKES OR POISON IVY IN CARKEEK PARK.
13. At the work site: demonstrate proper work techniques, both for lifting and carrying, and for planting, Ivy pulling etc..
14. During the work party: do not do too much yourself but keep an eye on everything that is going on, especially planting techniques.
15. When the work party is over: collect the tools and count – it should be the same number as counted before (but often is not). If tools are lost <u>the whole group</u> is helping to recover them.
16. Return to sign-in place and say good-bye, thanking the volunteers and asking for feedback. Mention next work parties (if known).
17. Bring back equipment to storage, if possible with the help of a few volunteering volunteers to clean the tools.
18. Fill out a work party report. Report and sign-in sheet go to the PS, who will forward it to the GSP administration. A copy goes into the Forest Management Plan file (don't forget this!)
19. Go home, satisfied, perhaps thinking that you did good for others; however, it might be that whatever we do, we do for ourselves – and that is OK.

Appendix 10 - Documentation

There are several good reasons for documenting what is going on in the forest:

- The forest is a permanent factor, the people who work in the forest come and go – and every time somebody leaves who has been active in the forest a treasure of information is lost, unless good records are kept of what has been going on.
  Example: a well thought-through enrichment planting was done somewhere on the slopes of the bluff in subunit 1 A – but there is no record of it and nobody knows exactly when it was done, what was planted where.
- Documenting is the basis for monitoring: one can check what was done and then go back to monitor how the forest developed. This monitoring is then added to the previous documentation.
- If you are suddenly confronted with unexpected trees having been planted at a certain place you can go back to the archives and find out when that happened, and why.
  Example: an attentive visitor suddenly sees Oregon Ashes growing along Pipers Creek. When were they planted, and why? The archive gives the answers.
- Documentation creates information about what works and what not
  Example: during monitoring it is observed that Mountain Beavers climb into the netted sleeves installed around newly planted trees to protect them from ----- Mountain Beavers. That is a useful piece of information, provided it is recorded.
- Documentation, especially hours of volunteer input, serves to justify funding proposals, grant requests etc.

In Carkeek Park there are basically 2 documentation stations:

1. The Forest Management Plan documentation forms are filled out and filed in the relevant subunit files in the FMP filing cabinet. Planting Plan, Planting Report, and Monitoring forms.
2. The Green Seattle Partnership forms are filled out and sent to the GSP office: Event request, Event report, and sign in sheets.

Plans for an upcoming STARS work party is part of each project; it is submitted to the responsible authority. Twice yearly an overall plan for projects and work parties is drafted and a time table is designed.

Copies of sign in sheets are kept at the ELC office, sent to the Volunteer Coordinator, and added to the FMP-archive in the relevant subunit file.

Carkeek Park Forest Management Plan

PLANTING PLAN FOR SUB UNIT:

Prepared by:	Date:

Description of area:

Purpose of planting:

Plants to be planted:

Preparations:

Carkeek Park Forest Management Plan

PLANTING REPORT FOR SUB UNIT:

Prepared by:	Date:

Description of the planting event:

Carkeek Park Forest Management Plan, **MONITORING SHEET**

SUB UNIT: **Sheet no.: .....**

Date:	Monitor:	Area:
Observations:		
Date:	Monitor:	Area:
Observations:		
Date:	Monitor:	Area:
Observations:		

2006 VOLUNTEER PROJECT REQUEST

_____DATE_____DIST./CC/UNIT_____

FACILITY/PARK_____

PHONE _____CELL_____E-MAIL _____

VOLUNTEER PROJECT, PROGRAM, OR SPECIAL EVENT *(Please check all that apply)*

❑Special Event (Seattle Works, Earth Month, Day of Caring, Salmon Bake, Bunny…which?

_____

❑ Recreation Program ❑ Park Maintenance

❑ Ongoing Restoration ❑ Planned Improvement

❑Ongoing Volunteer Effort- "Friends Of" /Stewards ❑ OTHER

Prioritize Volunteer Activity (circle) A Work Plan **B** Will help facility/park/unit

ONSITE SUPERVISOR (from your staff or Volunteer supervisor)_____

PROJECT/EVENT DESCRIPTION *(Use back of form for additional project description)*

_____

_____

_____

_____

VOLUNTEER INFORMATION (if applicable-)

# of Volunteers min _____ max_____
Age Group (check any) Adults_____ Children_____ All Ages OK_____

TOOLS/SUPPLIES ❑Will be provided ❑Needed

FOR ADVERTISING: (Please be descriptive… Park at….Look for….,include address….
Meet at:

Contact Name: Contact Phone:
Contact email:
Time (s):
(Some events also want volunteers to help before the event. Please list these days and times.)
Project/Needs:

Route to your Volunteer Coordinator: Volunteer Programs, Box 14 **B- 39** (2/05)

GREEN SEATTLE PARTNERSHIP

Fill out in Pencil Only!

Event Work Log – Date(s) __/__/__ to __/__/__

Park/Site ID	
Forest Steward	
Agency/Agency Contact	
Crew/Crew Lead	

	# Present	Names (if necessary)	# Hours	#Indiv. x #Hours= Total Hours
GSP Staff				
Crew				
Adult Volunteers				
Youth Volunteers				

__INVASIVE REMOVAL Total Area Removed (ft.^{2})_____
Invasive Cover Before Removal: 0-5% 6-50% 51-100%
Invasive Cover After Removal: 0-5% 6-50% 51-100%
Survival Rings Installed: _____

Blackberry	Ivy
Cherry Laurel	Holly
Clematis	Scot's Broom
Field Bindweed	Nightshade
Knotweed	Garlic Mustard
Herb Robert	Other:

___PLANTING *(attach nursery packing list or other species documentation)*

	Bare Root	Potted	B & B	Plugs	Stakes
Trees					
Shrubs					
Groundcovers					
Emergents					
TOTAL PLANTS					

___MAINTENANCE/SITE CONSTRUCTION

Water Plants (#)		Fencing	ft.
Weeding	ft.^{2}	Animal exclusion	ft.^{2}
Mulching	ft.^{2}	Weed control fabric	ft.^{2}
Plant layout/staging	ft.^{2}	Soil preparation	ft.^{2}
Sheet mulching (Cardboard)	ft.^{2}	Hummocks	
Plant salvage (#)		Other:	

___EROSION CONTROL AND STREAMWORK

Erosion control fabric	ft.^{2}	Length of Stretch Restored	ft.
Silt fencing	ft.	In-stream structures: Rocks (#s)	
Live staking	ft.^{2}	In-stream structures: Logs (#s)	
Matting/layering/etc.	ft.^{2}	Pools (#s)	

___TRAIL WORK Total trail completed (ft.) _____

Tasks:		**Structures:**			
Clearing	ft.	Puncheon	ft.	Outslope Struct	ft.
Grubbing	ft.	Turnpike	ft.	Bridge	ft.
Surfacing	ft.	Water bars		Parallel Ditch	ft.
Maintenance	ft.	Check steps		Culvert	
Trail Closure	ft.	Box steps		Other:	

Routing: Forest Steward _____ _____ (Initials) (Date) Project Manager _____ _____ CLC (Initials) (Date) Data Entry _____ _____ CLC (Initials) (Date) Rec'd Parks_____ _____ (Initials) (Date)

SITE DRAWING
Use this space to create a map of your site. Essential elements to include:

North arrow
Reference to site access
General reference to scale (e.g. 1”~50’)
Key to project features (e.g. ☼ - Conifer)

GREEN SEATTLE PARTNERSHIP

Group Volunteer Sign-Up Sheet

THE FOLLOWING RELEASE INFORMATION IS REQUIRED FOR VOLUNTEER INSURANCE AND RECOGNITION PURPOSES. PLEASE PRINT LEGIBLY. For and in consideration of my participation in the Green Seattle Partnership (City of Seattle, Cascade Land Conservancy, and EarthCorps) volunteer program, a voluntary, public/private cooperative program, I release, acquit, and forever discharge the City of Seattle, a municipal corporation, its officers, agents, employees, and volunteers ("the released parties"), and Cascade Land Conservancy and EarthCorps, non-profit organizations, their officers, agents, employees, and volunteers ("the released parties"), from any and all claims, demands, damages, costs, action, or liability, on account of, or in any way growing out of, any and all known and unknown, foreseen and unforeseen bodily injuries or death, or damage to property resulting from or by reason of my participation in, or transportation to or from, any activity, work, or work site in any way related to the program. I understand that the City of Seattle provides volunteer insurance for bodily injury to self and personal and property damage while I volunteer. The undersigned give their permission to be photographed and/or filmed and have their image used by Green Seattle Partnership.

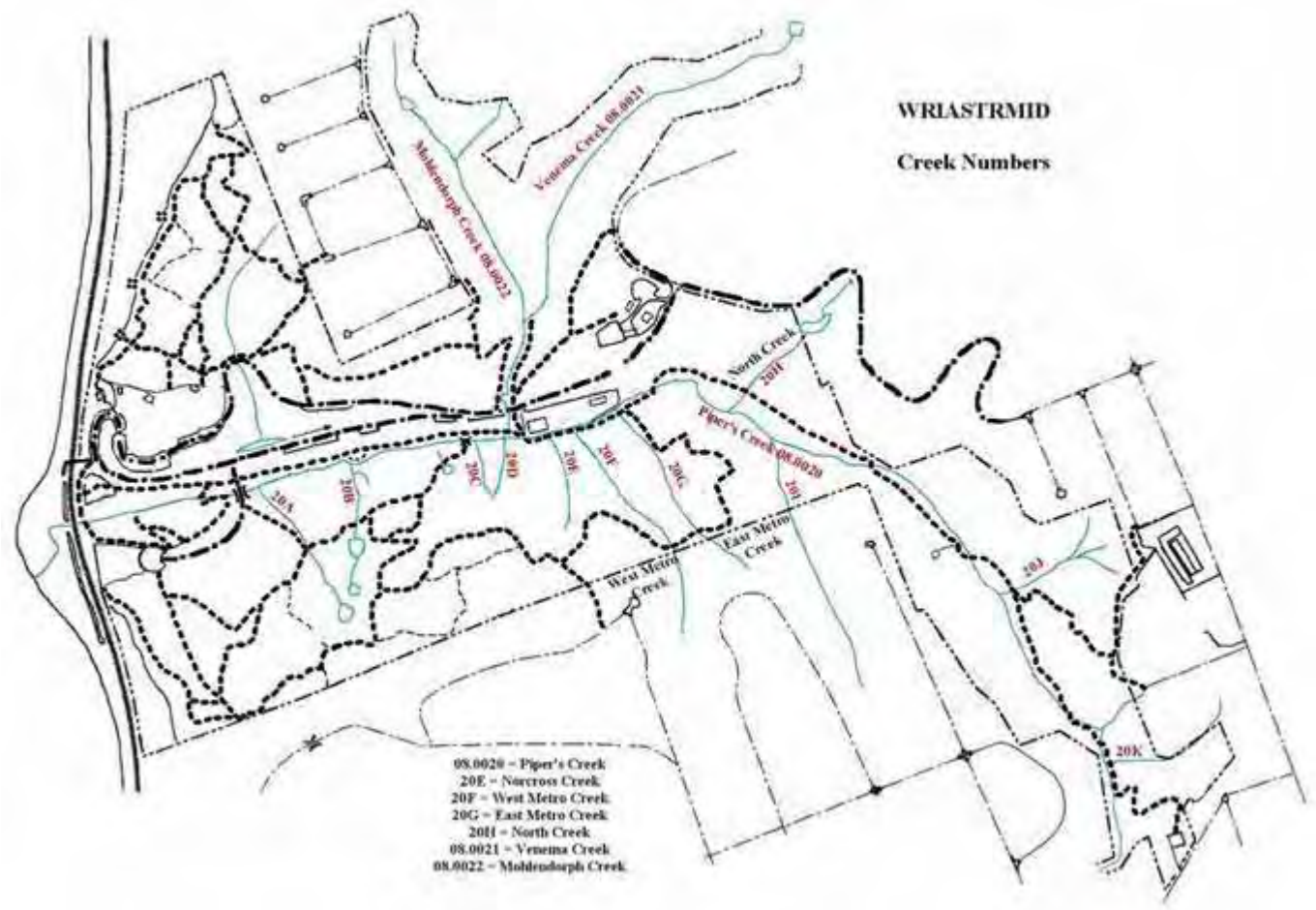
Volunteer Group:			**Volunteer Event Lead Person:**						**Date:**
Location:		**Project:**			**Staff Person:**				
Name	**Address**	**Zip**	**Phone**	**E-Mail** Contact me about GSP or CLC opportunities (Y/N)	***List One*: Birth Date or Driver's License#**	**Check if under 18 yrs old**	**Start Time**	**End Time**	**Total Hours**
				Y/N					
				Y/N					
				Y/N					
				Y/N					
				Y/N					
				Y/N					
				Y/N					
				Y/N					
				Y/N					
				Y/N					
				Y/N					
				Y/N					

DPRV1043.DOC

EVENT TOTALS: Total # Volunteers_____ Total Volunteer Hours_____

Appendix 11 - Creeks

Most of the creeks in Carkeek Park have an official number, see map below. Only a few periodically dry streambeds that are basically open street run-off channels have not been included in the numbering. Some of the names are official names (Piper's, Venema, Mohlendorph); other names are unofficial locally used names (see map). Some creeks are as yet unnamed.

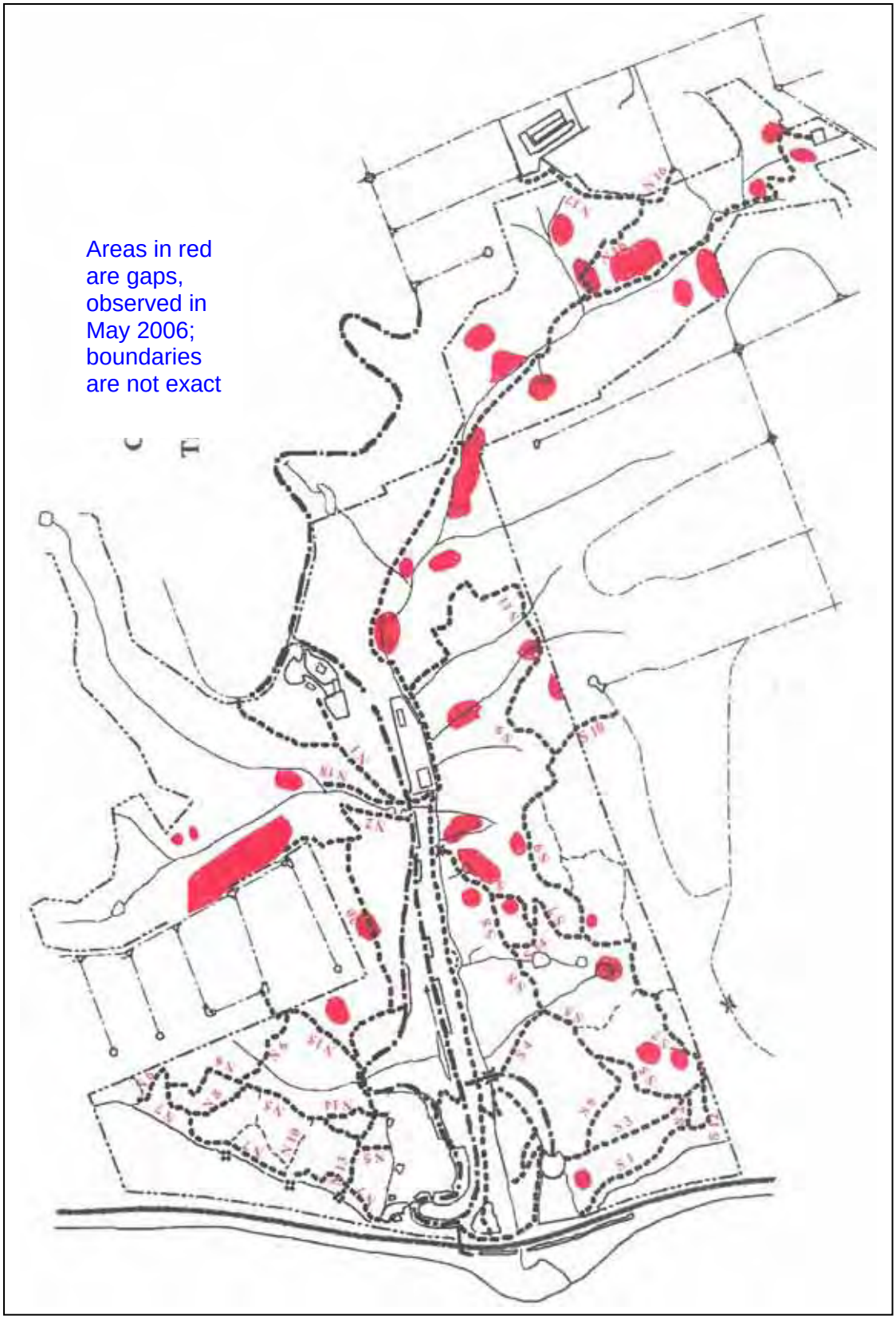


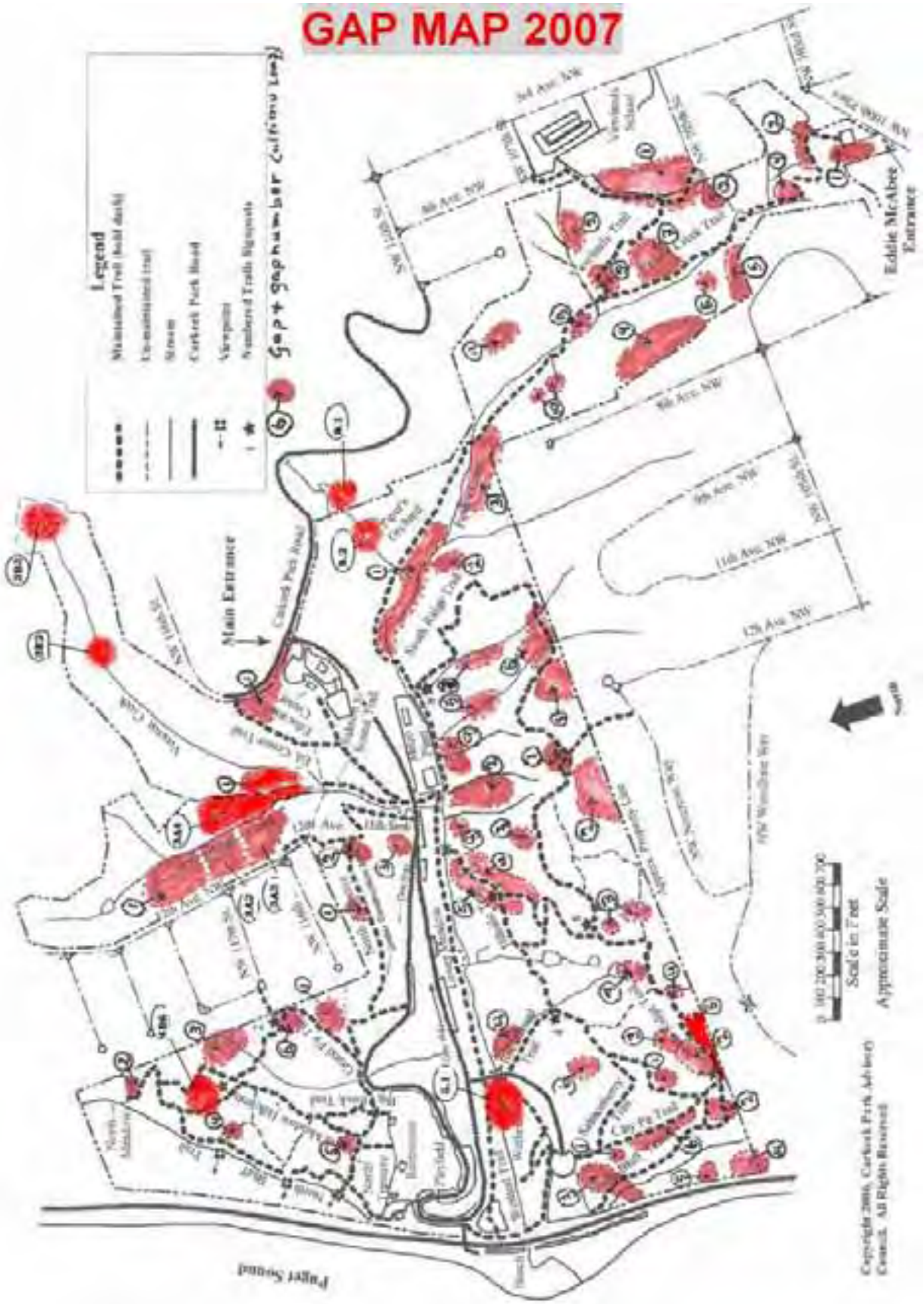
Since 2001 Volunteer Creek Stewards under Seattle Public Utilities Creek Steward program work on ongoing removal of invasive species, usually within 25-100 feet but up to 200' of the creek channel. Ongoing revegetation where appropriate consists of a native riparian palette including (but not limited to) western red cedar, Sitka spruce, Douglas fir, western hemlock, Oregon ash, cascara, red osier dogwood, salmon and thimble berry, various ferns, devil's club, vine maple, stinking currant, Indian plum, red elderberry, and beaked hazel.

Work parties are held monthly concentrating on invasive removal and revegetation with appropriate riparian vegetation. For more information contact:

Seattle Public Utilities
Watershed Stewardship Coordinator
Creek Steward Program
http://www.seattle.gov/util/Services/Drainage_&_Sewer/Get_Involved/Be_a_Creek_Steward

Appendix 12 - Carkeek Park Gap Map June 2006 + September 2007




GAP MAP 2007
Legend
Gap # gap number colors (red)
Maintained Trail (bold dash)
Un-maintained trail
Steps
Carkeek Park Road
Viewpoint
Numbered Trails Signposts
Main Entrance
Carkeek Park Road
Eddie McAbee Entrance
Piper Street
Approximate Scale
Scale in Feet
Copyright 2006, Carkeek Park Advisory Council. All Rights Reserved

Appendix 13 - Planting areas in Carkeek Park 2001 – 2006

Appendix 14 - Restoration and Ecological Thinning

Restoration thinning.

Restoration thinning is performed in stands generally less than 30 years old. The primary goal is to move severely overstocked stands from the competitive exclusion successional stage to later successional stages. In accomplishing this objective, thinning will reduce stem densities such that trees can grow well for longer periods of time, and attain larger diameters more quickly. Additionally tree crown structures and forest stand structures may be more complex**.**

A situation where this principle might apply in Carkeek Park is in subunit 4 D, where there are very dense Alder stands on the slopes below the bluff, established after the major land slides of January 1997.

Ecological thinning.

In a case where there is a larger area of dense older secondary forest, between 30 and 60 years old, without any noticeable gaps, creating an opening in the canopy by felling trees might be considered in order to initiate the restoration process. This will spread out restoration over a number of years instead of having to deal with the whole surface when the stand collapses over a short period of time.

A similar situation can occur where there are several smaller gaps close together in a large homogenous section of secondary forest. Connecting these gaps by felling the trees in between will then create a larger area to restore.

Over mature Alder forest, candidate for ecological Thinning, sub unit 2 A, south slope

This practice of removing (part of) the forest canopy is called Ecological thinning. The practice of ecological thinning is done using a variety of silvicultural methods including thinning from below, variable density thinning, thinning across diameters, “future tree” thinning, creating gaps, girdling trees and possibly topping trees. Planting will often accompany ecological thinning. Primary goals are to maintain and/or accelerate residual growth, stimulate understory development, release intermediate tree growth, encourage plant species diversity, and provide spatial heterogeneity and structural complexity.

Whether creating a new gap or connecting several existing gaps, the option of harvesting sound Alder logs is to be considered. Removing them will improve accessibility of the area considerably, both during the planting process and for the subsequent monitoring/liberation. If the area is really poorly accessible it will be difficult to motivate volunteers to do any invasives control.

However, whether logs are to be harvested or not, there are three important issues:

- no felling during nesting season March – June), or – when close to a major creek – during the Salmon season (mid October – July).
- the area where trees are to be felled must be cleared of invasives prior to felling; once Ivy gets buried under big trees it is virtually impossible to pull.
- precision felling should be practiced, trying to concentrate crowns of felled trees; this will leave more open space and render the area better accessible.

In Carkeek Park much of the South slope of the Park, Unit 1 and subunit 2 A, and the slopes of sub units 2 B and 2 C are areas that are candidates for ecological thinning.

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