Restoration Plan for Interlaken Ravine Site

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Planning Crew:
Sarah Baker, Nancy Goodin, Anna Heckman, Andrea Holmer, Amy Lambert, Maureen Melville, Kevin Ramey, and Sara Stewart

Abstract

Our group in the sustainable landscape class of 2002 selected a 1.5 acre site in Interlaken Park to formulate a restoration plan in cooperation with the City of Seattle Parks and Recreation.

This site was chosen because of its existing ecological values including the presence of native trees and shrubs that support wildlife. Restoration of the Interlaken Ravine Site (IRS) is also important because of the habitat corridor it provides between natural areas in Interlaken Park that are currently being restored.

The site is extensively used by the public, thereby creating a potential for restoration education programs. The site is located near Interlaken Boulevard, creating easy access to IRS.

Planning areas were divided into zones according to the analysis of current site conditions. In preparation for a restoration plan, the following site assessments and analyses were conducted a) soil density and soil chemistry b) existing vegetation and canopy cover c) slope stability d) hydrology e) recreation and f) wildlife. The overall objective of the IRS restoration plan is to increase biodiversity by creating a native mixed conifer forest, thereby recreating patterns of late succession. Objectives also include managing inflow of water into the IRS, thereby increasing the health of the creek, increasing slope stability and increasing passive recreational value by providing opportunities for education.

Restoration steps include removal of invasive species, revegetation of native species, addition of mulch to increase soil health and decrease weed competition, the reduction of erosion and sediment load, stabilization of shallow of surface slopes, opening constructed creek channels, and creating wildlife habitat.

Planting plans incorporate vistas, ornamental species in areas of high public use, wildlife value, slope stabilization, and sediment retention in areas of potential flooding. Due to the extensive size of the project, the site was divided into two phases; plant numbers and budgets were calculated separately for each phase. Planting plans are expressed in drawings, as well as in tables according to each phase and planting zone. Total budget takes into account high use of volunteers and need for low maintenance cost.

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1.0 INTRODUCTION

This report presents a restoration plan for a portion of Interlaken Park, referred to in this document as the Interlaken Park Ravine Site. Interlaken Park is owned by the City of Seattle, and managed by the Seattle Department of Parks and Recreation. The park is a major greenbelt in the Montlake district of Seattle. It consists of a 51.7-acre area located on the north-facing slope of Capitol Hill. The Interlaken Park Ravine Site, a sub-area within Interlaken Park, was selected as a restoration site for the purpose of this project. It is located on the east side of Interlaken Park, directly north of Interlaken Boulevard.

This Interlaken Ravine Site (IRS) is a 1.5-acre ravine sloping steeply and then moderately downhill from Interlaken Boulevard. Restoring this area is critical for several reasons. First, it is an area that is easily accessible to the public: the proposed project area contains numerous high-use foot and bicycle trails, and Interlaken Boulevard borders a portion of it. Second, restoring an area of such high visibility will help meet the public education goals of the Seattle Department of Parks and Recreation by creating new opportunities for restoration education. Third, re-vegetation through restoration efforts is likely to reduce sediment runoff from flood events. The area contains a small section of a spring-fed perennial creek that drains into lake Washington. Fourth, the IRS area is large enough to provide wildlife habitat for native small mammals, birds, amphibians, and reptiles. Finally, restoration of the project area will increase the total amount of contiguous plant and wildlife habitat within Interlaken Park, through creation of habitat corridors. The IRS restoration area is located between areas containing habitat with high ecological value, which increases the importance of restoring this site.

The IRS was also selected for restoration because of the easy road access that would be provided during project implementation phases.

2.0 RESTORATION SITE DESCRIPTION

The IRS selected for restoration is approximately 1.5-acres fanning out in a northward direction from Interlaken Boulevard. For the purpose of this project, the IRS has been divided into two large areas (Phase 1 and Phase 2) based on differences in topography, hydrology and vegetation (Figure 1). The IRS Phase 1 consists of a steep ravine and a small creek that flows in from the south, entering the site from a

culvert at the bottom of a steep slope. The creek is surrounded by native and nonnative vegetation. IRS phase 1 includes an area at the bottom of the ravine where the gradient levels off.

Phase 2 of IRS borders the north side of phase 1. The Phase 2 boundary is at the point where the creek flows out from Phase 1 and enters a channelized area (FIGURE 1). Phase II also includes the surrounding ravine slopes that fan out into a moderately sloping creek floodplain, currently maintained as a residential lawn. Phase 2 ends at the southern boundary of Interlaken Park, at a 2' berm constructed to contain storm water surges and creek overflow. This is also where the creek enters into another culvert, and subsequently flows into a storm drain between residential areas.

Phase 1 and phase 2 areas have been further organized into 8 different zones based on soil type, canopy cover, existing vegetation, and visitor interaction (FIGURE 1). Phase 1 includes zones A-E and phase 2 includes zones X, Y and Z. A short description of each zone is described below:

Zone A: long thin strip averaging 4 feet in width bordering the side of the road. It consists of approximately 4 thousand square feet, or 6% of the total plan area.

Zone B: north-facing slope of exposed soil, approximately 1900 square feet.

Zone C: includes the creek floodplain, approximately 9900 sq ft running the length of Phase 1.

Zone D and E: vegetated slopes located on the west and east sides of the ravine, encompassing 66% of the total IRS area. Zones D and E are relatively steep and range from 23-32 degrees.

Zone Y: includes the creek floodplain extending north of area C. This zone is maintained as an open lawn (receiving a large amount of sunlight). The creek is channeled into a 12-18 inch deep ditch running approximately 60 feet into a storm drain. The total zone area is approximately 7200 sq ft.

Zones X and Z: extensions of slope zones D and E on the east and west sides of the ravine. Moderate slopes (ranging from 5-20 degrees) compared to slopes in zones D and E.

3.0 PROJECT BACKGROUND

During the year 2002, Seattle Department of Parks and Recreation developed a proposal for the restoration design and analysis of several possible sites within Interlaken Park. The proposal was accepted for student review by the University of Washington Sustainable Community Landscapes (SCL) program, which serves local community organizations while providing students with "real life" experiences in the field of environmental horticulture and urban forestry. Therefore the goal of this project was to help Parks and Recreation to design and implement natural resource projects on site.

The creation of this report is the culmination of a group effort of 8 students. Students worked as a team to select an appropriate site in the larger Interlaken Park vicinity, collect and analyze site data, propose a project design, and create a budget and five-year management plan. Throughout the development of this report students also worked in close association with UW faculty, SCL staff, community clients and site managers from the Department of Parks and Recreation, to ensure that their analysis, plans, and designs met the needs of all participants involved. This report is based on material presented in the Department of Environmental Horticulture and Urban Forestry class Selection and Management of Landscape Plants (EHUF 480).

4.0 COMPLIANCE WITH EXISTING PLANS

The restoration plan for the IRS area was developed in compliance with existing park goals, regulations, and mission statements. In addition, Parks and Recreation staff provided guidance in the development of the restoration plan. Specific existing regulations that were used as guidelines in developing our approaches to the restoration plan include the following:

1. Minimize invasive plant species within the park and its surrounding boundaries
2. Promote native plant species
3. Increase biodiversity and forest integrity
4. Foster good relations with park users and neighbors within the community
5. Reduce long-term maintenance requirements

6. Recover wildlife habitat and value
7. Stabilize soil gradients to decrease erosion

All of the above park guidelines are addressed throughout this document.

The first of these guidelines, minimizing invasive plant species, was addressed in the plan in several ways. This includes the removal of current invasive species, mulching bare ground to prevent new invasive establishment, and creating ivy retention lines. The second goal, to promote native plant species, is addressed in the vegetation installation section of the plan that includes recommended native plant communities and expected plant successional stages.

The restoration plan was designed to foster good relations with park users and neighbors by balancing aesthetics with native plant restoration goals. For example, the design preserves good views from scenic vistas located along Interlaken Boulevard. Interpretive signing is also proposed to educate the public about the project and about ways to get involved. Our restoration design also uses unobtrusive fencing along road edges to remind park users about the sensitive nature of the restoration site, while allowing for an open feel to the area.

The restoration design also takes into account the need for minimal maintenance and follow-up efforts, to create an economically viable plan. Plants selected were those that would require little or no follow-up irrigation once established, thereby minimizing maintenance costs. Mulch was also proposed for weedy areas, in order to inhibit weed growth and therefore minimize the need for follow-up weed removal. Mulch is anticipated to reduce weed competition with newly installed plants as well as retain soil moisture. Another plan to reduce maintenance is to plant trees that require less hazard maintenance along the roadside to successionally replace big leaf maple (*Acer macrophyllum)*.

To help recover wildlife habitat, and to address soil and slope stabilization, this restoration plan calls for brush piles and down woody debris to remain on site. Shrubs were also selected for specific areas within the IRS site, to meet certain wildlife needs.

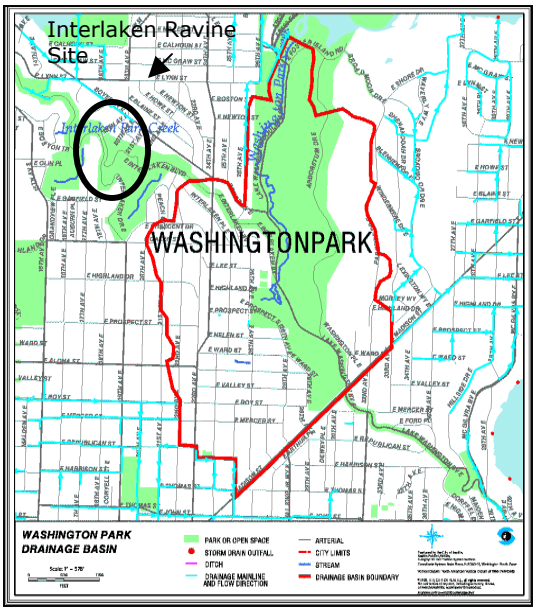
5.0 LAND USE HISTORY

The unique history and characteristics of Interlaken park make it worthy of preservation and restoration.

5.1 Geology and Hydrology

Interlaken Park has the typical geological foundation of the surrounding Puget Sound Trough with permeable Esperance Sand on top of dense Lawton Clay. Advance deposits of fine to medium sands were laid down and over-ridden by thousands of feet of ice during glaciations 14,000 years ago. Retreating glaciers left rock debris, carved low hills and scoured the earth leaving behind large lowland lakes (i.e. Lake Washington) and channels that are today's creeks and ravines.

Interlaken ravine site and the small spring fed creek flowing from Capitol Hill to Lake Washington is evidence of the once natural drainage pattern left over from retreating Vashon glacier. Where perched water tables were compressed between underlining impermeable clay and permeable sandy soils, water rose to the surface creating natural springs. Overtime, water flowing to lower gradients began to erode sandy soils creating creek beds and steep slope ravines such as Interlaken ravine site (USGS, 1962). The IRS creek is one of several unnamed small creeks in the Montlake area flowing into Portage Bay (i.e. Lake Washington).



Many of the creeks and streams in the Montlake area, like IRS creek, have been channeled into culverts and exist only partially above ground. Washington Park creek (WPC) located in the Washington Park Arboretum however, has not been diverted from its natural course and exists at the surface. The WPC may be used as a reference site for better understanding natural drainage patterns and hydrologic regimes due to its close proximity to IRS.

5.2 Forests

As described in the Interlaken Boulevard Programming Study(1996), the park is a forest remnant that was logged in the mid 1800's. Prior to the logging it was a mature low elevation Northwest Hemlock Forest (Franklin & Dryness, 1973). The natural successional pattern was interrupted due to the loss of conifer seed sources and other disturbances. The forest remnant is characterized as being in stalled succession, with early seral species such as big leaf maples dominating the IRS site.

In 1994, the Seattle Parks and Recreation Urban Forestry program began to manage natural areas in Seattle Parks, including Interlaken Park. Shortly after, the Interlaken community organized to form "Friends of Interlaken Park", in an effort to enhance and restore forested park lands. They are currently in partnership with Earthworks to conduct restoration efforts within the park.

5.3 Early Park Planning

Between 1903 and 1906, the Olmsted Brothers Landscape Architects made recommendations for the planning and improvement of paths. During this period, the City of Seattle acquired the land and the Parks Department planned on connecting Volunteer Park to Washington Park through the area now known as Interlaken Park. Their concept of maintaining views and vistas throughout the boulevard is one that is reiterated in the Portico Group's 1986 programming study and in this report.

One notable mistake made by an Olmsted associate was in recommending English ivy (*Hedera helix*) as being a suitable species for planting at Interlaken Park. Today, English ivy poses one of the worst threats to the existing native plant community by means of competing for water and light; thus, altering natural community patterns.

5.4 Vehicular Use

In 1906, a timber bridge was constructed to span the ravine at the south end of the site. Complaints about speeding motorists occurred soon thereafter. Roadway damage due to landslide first occurred in 1910. The timber bridge was removed in 1934 and replaced with a culvert and capped with fill. The interruption in hydrological patterns has caused damage in the past. Large flooding events have been

recorded on the upper side of the ravine causing erosion and landslide damage. Resurfacing of the roadway took place in 1946 along with thinning of the overgrown vegetation.

In 1982, the park was designated an historic landmark due to its bicycle path heritage. Advances in bicycle technology led to a "Bicycle Boom" in Seattle at the turn of the century. In 1897, George Cotterill, the Assistant City Engineer and a bicyclist himself, laid out a series of bicycle paths. The most popular of these, the Lake Washington path, went right through Interlaken Park.

5.5 Recent Park Planning

In 1984, funding from a voter-approved initiative brought major funding to Interlaken Park, among others. One year later, the Portico Group was chosen to do a programming study to look at how Interlaken could fit into the "jewel in the emerald necklace" analogy taken up around the Olmsted era. Although the decisions were not implemented at the time, the resulting comprehensive document holds weight with today's planners (Portico Group, 1986).

6.0 EXISTING CONDITIONS AND SITE INVESTIGATION

This section will describe studies of existing conditions and analyses conducted to assess soils, slope stability, hydrology, existing vegetation, light and canopy cover, recreational use, and wildlife value.

6.1 Soils

Soil Analyses

Site soils were analyzed to gain information on soil structure and chemistry. This information was used to inform plant selection and site design. Soil samples were taken at 5 points throughout phase 1 (Figure 2). Taking soil cores to look at the soil horizons proved to be more difficult than expected due to soil densities. Soil sample locations were placed based on differences in elevation, aspect, light penetration and vegetation cover. Soil analyses were limited to core tests and qualitative analyses of the minimal organic layer present at the points 1-5.

Point 1: located midway down the center of zone B, approximately 10ft above the creek bed. The soil was barren, devoid of vegetation and highly compacted.

Point 2: located in zone C on the west side of the creek. This site is located where the slope meets the flat flood plain of the creek.

Point 3: located mid way up zone E, on 28 degrees slope. Ground cover observed here is predominantly sword fern (*Polystichum munitum*)

Point 4: located at the northern end of zone C, in the level flood plain. Vegetative cover was observed as predominantly skunk cabbage (*Lysichiton americanum*) and salmonberry (*Rubus spectabilis*)

Point 5: located on upper zone D, less than 5 degrees slope. Himalayan blackberry (*Rubus discolor*) and clematis (*Clematis vitalba*) were observed in the area.

At each point, soil horizons were analyzed. Due to the fragile nature of the soil, as well as the small area size, points were not disturbed by digging a full soil pit. Instead, we took at least two soil cores and analyzed the horizons from them.

Although organic layers were present at some sites, they were not abundant, therefore a qualitative analysis was conducted. Notes were taken on organic layer depth and content. Soils densities were determined by collecting a known volume of soil from the A horizon at each point in the site. The rings of soil collected with the bulk density corer were each 47 cm^3. Due to different soil densities between 2 and 4 rings were collected per site. Soils were immediately placed into zip lock bags and stored in cool area until weighed. Samples were weighed wet on a manual mg balance then oven dried for 5 days between 103-109^o Celsius. Soils were removed and weights taken once during the 5 day period to monitor moisture loss. At the end of 5 days, dry weights were taken. Large particles were removed from dry soils and weighed separately to get a percentage of soil >2mm. Total dry weight was divided by volume for each sample to get bulk density. Moisture content was also calculated from these measurements. The difference between the wet and dry weights (i.e. the weight of the water in the sample) was divided by the total wet weight to give the relative percent moisture for each soil sample.

An extra zip-lock bag of A horizon soil was collected from each point for soil texture and chemical analysis. Soil texture was analyzed with the ribbon test. Three of the five soil samples were sent in for chemical analysis. Points 1, 4 and 5 were selected as representative soils of IRS. Point 4 was selected as representative of wetland soils. Soil collected at point 1 represented compacted backfilled soils, similar to soils identified along Interlaken Boulevard. Point 5 was selected as representative of native soil hillsides. Soil samples were sent to the University of Massachusetts soil and plant tissue-testing laboratory (Appendix 1). Lab reports included % N, P, K, micronutrient, pH and toxic chemical levels, as well as recommendations for site preparation.

Soil Results

Soils collected at points 2 and 4 had very similar horizons. Both soils were very soft and wet throughout. Points 2 and 4 also revealed the classic gleying layer at the bottom end of a deep A horizon (approximately 12in). This gray layer indicates poor oxygen penetration and year round wet soils. Point 4 had more gleying than point 2. Point 4 soils were closer to the surface than point 2 soils indicating little aeration in the soil. An Oa layer existed at point 2 in the form of duft created by pine needles. Point 2 soils measured less than ¼ inch thick on average. Point 4 had no such organic layer, even though it was covered in big leaf maple leaves after the autumn leaf drop.

Unlike the soil cores taken at points 2 and 4 in the lower flood plain, the other three points were very hard to get good cores from. Point 1 was dense and had rock and garbage particles buried under the surface layer, preventing less than a 2" core. There was no organic layer associated with the cores taken from point 1. Points 3 and 5 were also very compacted and did not indicate a measurable organic layer at the time of measurement. However, all measurements were taken before the autumn leaf drop. A summary of measurements taken from points 1-5 are summarized in Table 1.

These reports base the nutrient status on agriculture standards which are very different than the native soils in Interlaken Park. The expected nitrogen content in agricultural soils is notably higher than in native soils of Washington.

The data indicates slight variations between samples. For example, in an area above point 2 there was an observed 2" of sand in the upper layer of soil. The sandy soil in this area represents one of many

microenvironments in IRS. The chemical analysis of points 1, 4 and 5 were meant to represent general soil conditions on IRS. In retrospect, point 3 may have been a better candidate for chemical analysis than point 5 due to the high concentrations of backfill soils in the point 5 sample.

According to soil reports, all ravine soils are low in organic content and nitrogen. The low organic content is verified by the observations of small to no hummus layer in most of the ravine. The low reported concentrations of nitrogen were expected given that samples were collected from native soils at the end of the growing season. However, given that plant nutrients are essential to the health and structure of young plants, moderately increasing levels of nitrogen and organics by applying mulch is recommended.

Soils increased in water content as elevation in the ravine decreased. Soil compaction in the wetland area was relatively moderate in the native "undisturbed" areas than on the bare, disturbed hillsides leading up to the slopes. Phosphorous levels were medium to high on IRS slopes and low in the wetland. Lead and Aluminum levels were both low. All macronutrients were at acceptable levels according to the agriculture growth standards. The pH levels are also at an acceptable range. Wetland areas are likely more basic due to storm water runoff and may add difficulty to plant establishment.

6.2 Slope Stability

This section describes slope stability in the Interlaken Ravine study site, and specifically addresses slope stability concerns in Area B (Figure 1). According to the City of Seattle records, unstable slopes in Interlaken Park have been of concern since at least 1910, when documentation of landslides and associated damages began (Program Study, 1986). Slope instability occurs as a result of both natural and human factors described below.

Natural Factors Causing Slope Instability

Interlaken Park area geology and landforms are characteristic of the Puget Sound Region, which experienced several major glaciations during the Pleistocene Epoch. Like the surrounding Seattle area, Interlaken Park lay buried under glacial ice originating in the Coastal Mountains and the Vancouver Range of British Columbia. Park soils contain deposits of fine to medium sands that were laid down and overridden, and laid down again during the course of several glaciation events. As a result, the geologic depositions underlying Interlaken Park contain unconsolidated or partially consolidated sediments, which have been "overridden and compacted by several thousand feet of glacial ice, [but] they are not 'solid rock.'" (Tubbs 1974). As a result of its geologic history, soil erosion from landslides is a major natural hazard in the Seattle area (Tubbs, 1974).

Other Sources of Slope Instability and Soil Erosion

Other sources of soil erosion in the Interlaken Park watershed include altered stream banks, gullies, and surface runoff; many of these sources result from construction activities up-gradient from or within the study site. Human disturbances such as buildings and pavement increase the load that the land must bear, and therefore they increase soil instability. Examples include the vicinity of park throughways, stream crossings, as well as homes and other buildings located upslope of Interlaken Park. Also, diversion of excess water onto the slope is a common human influence on the landscape; this causes soil instability and significant impacts to natural drainage patterns. Loose soils and steep slopes increase soil susceptibility to excessive stormwater runoff. Runoff is directed from rooftops, streets and driveways in the residential neighborhoods above the park; once the water volume exceeds the capacity of storm drains, it overflows into the park, resulting in severe erosion and slope failure. One specific example relating to historic construction is further discussed.

Area B contains a road that spans a steep ravine. Uncompacted fills were used to build the road, which replaced the bridge that once spanned this area of the ravine. Because the roadway was not keyed into firm and well-compacted material, the roadway has subsided along its downslope shoulders. Without intervention, the natural and fill slopes at the Interlaken ravine site steeper than 30 degrees will continue to be unstable during prolonged periods of heavy rainfall. Possible solutions are discussed in the slope stabilization section.

Slope Stability Assessment

Area B was assessed for slope stability by measuring slope gradient using a clinometer. Slope steepness ranged from 32 degrees to 15 degrees (Figure 2). The steepest slope is located in the southwest corner of the site and is covered with several mature sword ferns. There is severe erosion on this part of the slope in the ravine and evidence of damage caused by slope failure exists above the ravine.

Slope failure in areas above IRS.

Several areas in the Interlaken ravine site exhibit possible slope instability. The slope of highest concern is a 32-degree north-facing slope located at the southern end of the site (Area B, Figure 2).

This slope is characterized by unconsolidated surface soils (classified as Quaternary Older Sand by the United States Geological Survey) and is considered unstable due to the slope gradient of greater than 30 degrees.

6.3 Hydrology

IRS contains an open creek channel approximately 30’ long, flowing from a 24” culvert at the southern end into a storm drain at the northern most end of the site. The IRS creek is a perennial system fed by a natural spring in the upper reaches of Interlaken Park. The IRS creek also receives a large amount of inflow from residential stormwater runoff and other small creeks and seeps within the drainage area. The creek is divided into three distinct sections corresponding to zones B, C and Y (Figure 1).

Section 1 is the southern or upper portions of the creek and is surrounded by steep slopes on all sides. Zone B, a steep denuded slope lies above the culvert that enters into the IRS. There is concern for sediment building up at the outfall of the culvert. Zone B is also

currently unstable and suffers from high levels of erosion contributing to the sediment load in the creek.

Section 2, zone C, is considered the most natural section of the IRS creek. The creek meanders and pools in several areas under a canopy of native trees and shrubs and down woody debris. The creek flood zone is high and wide in this area; making soils saturated during the majority of the year.

Section 3, zone Y, is the northern most section of the creek and is currently channeled for approximately 60 feet and then enters into a storm drain. The creek then flows under the adjacent residential neighborhood, merging with other drainage systems and eventually flows out into Lake Washington. The 12-inch wide channel is bordered by turf on both sides. The creek was observed undercutting the channel bank, likely increasing erosion and sediment. An observed 2' high berm constructed out of backfill soil is located between residential property and the creek storm drain suggesting periodic flooding has taken place.

6.4 Analysis of Existing Vegetation

Phase 1

On October 14, 2002 a survey of plant species in phase 1 was performed. The species and location of plants were recorded. Diameter at breast height (DBH) was measured for the trees. Information on locations of plant communities was also recorded (Figure 3).

Big Leaf Maple and other trees
The most prominent feature of vegetation in phase 1 is the big leaf maples that are mature and in decline. There are more than 20 big leaf maples, which dominate the canopy cover around the perimeter of the ravine and over the road (zones D and E). The largest big leaf maple on phase 1 has a 47" DBH. The average big-leaf maple DBH is 24"; the DBH range is from 6-47 inches.

This past year a gap was opened in the canopy on the east side of the ravine (zone E). Uphill from the ravine, a very large big leaf maple fell across the road and into the ravine area, knocking down several other trees as it fell. When the fallen tree debris was examined it was determined that verticillium wilt fungi had infected the tree. The fungi

block the trees vascular system, resulting in decayed tissue. As the fungi spreads in the soil, it is probable that other trees are infected. In older trees this makes them more susceptible to secondary diseases. This suggests that many of the mature big leaf maples may soon decline in health and/or die from disease.

Other significant trees include a horse chestnut (*Aesculus hippocastanum*) with a DBH of 27" on the southwest side of the ravine and a red alder (*Alnus rubra*) with a DBH of 40" on the west slope of the ravine near the riparian area. On the northeast corner of phase one there is a grove of Japanese Cedar (*Cryptomeria japonica*) that were planted as an ornamental species. On the west slope of the ravine there is another group of Japanese cedar that are sapling size, and appear to have been naturally seeded.

Western Hemlock

Most of the western hemlock (*Tsuga heterophylla*) trees are located on the western slope (zone D). The hemlocks are in very poor condition. There is dwarf mistletoe (*Arceuthobium campylopodum*) on the trees, as evidenced by the abnormal "witches broom" branching pattern. These parasitic plants grow slowly and can cause death of the tree, or weaken it so that it is susceptible to other diseases. The hemlocks also had white cotton like tufts on the bark and needles. These are infestations of hemlock wooly adelgids (*Adelges tsugae*). Hemlocks are tolerant of these insects in general but in combination with the dwarf mistletoe the trees are severely stressed. The dying hemlock on the west side of the ravine (zone D) is leaning against the branches of the largest big leaf maple on the IRS. The hemlock is also covered with ivy. The hemlock will likely damage the maple tree if it fails.

Western Red Cedar

In the (zone D) center of the ravine near the stream there are several western redcedar (*Thuja plicata*) trees. They appear to be healthy and are in a good location for their cultural requirements (shade and moisture). There are a few sapling size western redcedars that appear to have been recently planted on the south side of the ravine right next to the road. The mature size of these trees is 200 feet, so they are too large to grow so close to the street. They retain their lower branches as they get older and would block views into the ravine. These saplings should be removed and if possible transplanted.

Mid-Canopy
One of the characteristics of the vegetation on IRS is lack of a substantial middle canopy. There are some vine maples (*Acer circinatum*) growing throughout the site (zones C and D). Some of them were knocked over by the group of maples that fell on the east side of the ravine. They are still living and their branches are touching the ground near the stream. It is possible that they will root and form new plants from these branches. The second most common shrub on the site is beaked hazelnut (*Corylus cornuta* var. *california*). Most of them are on the northwest section of the ravine. Other shrubs include red elderberry (*Sambucus racemosa*), Indian Plum (*Oemlaria cerasiformus*) in the upland areas and salmonberry (*Rubus parviflorus*) in the north riparian area.

Shrubs and Herbaceous Plants
Sword fern and Oregon grape (*Berberis (Mahonia) nervosa*) are the most common herbaceous plants in the upland section (zone E) with a small amount of salal (*Gaultheria shallon*) in some areas. The riparian area has the most herbaceous plants, which include skunk cabbage (*Lysichitum americanum*), buttercup (*Ranunculus*), horsetail (*Equisetum*) and bracken fern (*Pteridium aquilinum*). In the riparian area, most of the herbaceous native plants (and shrubs) are on the north portion; the south portion has English ivy growing in the flood zone and up to the edge of the creek.

The south slope of the ravine, zone B, has significant amounts of exposed bare soil. Very little vegetation was observed on the slope other than two mature sword ferns. Sections on erosion control and slope stability address concerns in this area.

Phase 2

On November 21, 2002 a survey of plant species in phase 2 was performed. The species and locations of plants were recorded. Phase 2 contains 3 zones, X, Y, and Z (Figure 1). The sections were delineated based on their vegetation cover and environmental factors.

Zone X is in the northwest area of the ravine. There is a knoll along the road with several mature big leaf maples. They are in decline as described in phase 1. This zone borders the road at a coastal redwood (*Sequoia sempervirens*) grove. From that point zone X also borders the maintained lawn near the stream. Zone X is the only zone in phases 1 and 2 that has Douglas-fir (*Pseudotsuga menziesii*) trees.

This zone also includes a grove of mature conifers, which includes Douglas-fir, western redcedar and western hemlock. The western cedars and western hemlock in zone x are much larger and healthier than those identified in phase 1. Native orange honeysuckle (*Lonicera ciliosa*) and stinging nettle (*Urtica dioica*) were also observed for the first time in IRS. The middle canopy layer is lacking in zone X, as described in phase 1, although the southwest corner of the zone has 50% cover of hazelnut and Indian plum. There is approximately 25% native groundcover in zone X, which consists of sword fern, salal and Oregon grape. The remaining groundcover is composed of a thick mass of non-native plants such as English ivy, Laurel cherry (Prunus laurocerasus) and English holly (Ilex aquifolium).

Zone Y includes a channeled creek surrounded by turf. On the north side of zone Y there are three California bay (*Umbellularia californica*) trees and some ornamental shrubs. Groundcover in areas adjacent to zone C includes horsetail (*Equisetum*) and buttercup (*Ranunculus*).

Zone Z is in the northeast ravine area. It has an even mix of western redcedar and hemlocks, 12 trees total. There are several big leaf maples and some snags from suppressed deciduous trees. On the border of zone Z next to the road there is a row of mock orange (*Philadelphis lewisii*) shrubs. There are a few hazelnut trees but the mid-canopy is sparse as described above. The south part of zone Z has 50% sword fern cover. The northern part has 90% cover of invasive non-native plants as described in zone X.

6.5 Light and Canopy Cover

Light measurements and canopy cover readings were taken from the same points that soils samples were taken (Figure 2). Readings were taken on a sunny October afternoon before the autumn leaf fall. All five points had some big leaf maple leaf canopy cover. Point 2 had a small amount of deciduous canopy cover, and points 4 and 5 had varying amounts of open canopy as well. Canopy cover was measured

with a hand-held densiometer. Percent cover measurements were taken in the four cardinal directions by two different people and then averaged. Light measurements were taken with a light meter similar to that used in photography. Relative exposure values (EV) were also recorded (Table 2).

Light levels at points 4 and 5 were the highest. Due to the deciduous structure of the canopy, light levels likely increase at points 1, 2 and 3 after leaves drop. They are also likely to increase as the summer sun rises higher in the sky. Point 1 and 3 will see a slight increase in light levels when the deciduous leaves fall, though with their proximity to the steep hill sides, they may not increase as much as points 4 and 5. Point 2 is the only tested area under conifer canopy. This point likely has limited variability in light through the season due to evergreen cover.

It should be noted that light levels are only accurate at the current date and time they were sampled. With an increase in proposed conifer plantings, light levels are expected to decrease.

6.6 Recreational Observations

Current Use

Park users observed within the IRS include bikers, joggers, dog-walkers and the occasional motorcycle. One person reported observing a number of children played in the area; building bridges across the creek and creating forts on sandy knolls behind trees and shrubs.

In recent years, a part of Interlaken Boulevard has been closed to motorized vehicles to increase the ambience of peace and quiet in the park and to create better hiking opportunities for park users. The roadway defining the southernmost border of the site is included as a part of the section closed to vehicles. While this is a step in the right

direction, the bollards apparently do not keep motorcyclists from using the roadway.

Human Impacts to Natural Resources

The portion of Interlaken Boulevard which borders the site is heavily used by pedestrians, bicyclists and dog walkers. Evidence of people walking off-trail was observed and likely contributes to issues of slope instability in IRS. Neighborhood children, dogs and possibly homeless people utilize the ravine. The vista soils overlooking the top of the ravine (zone B) are compacted from constant use.

Dogs were observed running off-leash in the ravine area. Several dog owners encouraged their pets to run to the creek to drink water thereby compacting soil and eroding hillsides. Dogs were also observed chasing wildlife. Dogs were observed harassing birds nesting in shrubs and low-growing vegetation.

Minor dams and bridges constructed in the creek in all probability do not impede the flow of water. However, compaction of saturated soils in sensitive riparian zones should be avoided. Additionally, in order to access the creek and associated riparian areas one has to traverse steep unstable slopes. Compaction of soil and trampling of vegetation increases the risk of erosion.

User Groups

Interlaken Park is used by a number of different organizations. The park is listed on the "Dog Explorer" website and provides a place for people in the dog-walking community to walk their dogs. Interlaken Park is also listed in King County's "best places to work out". For example, the Seattle marathon is routed through Interlaken Park along Interlaken Boulevard. A group of community stewards, "Friends of Interlaken", help to improve the natural areas in the park by conducting monthly restoration work parties.

6.7 Wildlife

Common mammalian carnivores and omnivores such as striped skunks (*Memphitis memphitis*), raccoons (*Procyon lotor*), Virginia opossums

(*Diddelphis virginiana*), ground squirrels (*Spermophilus sp.*), Townsend's voles (*Microtus townsendii*) and western harvest mouse (*Reithrodontomys megalotis*) have been documented as mammals that are likely to inhabitat and/or utilize food resources in the upper and lower margins of the ravine and in forested areas at IRS (Larrison, 1970). Several bat species such as little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*) and Yuma myotis (*Myotis yumanensis*) are also likely to inhabitat forested areas (Pedersen, 1997).

Common reptiles such as western fence lizard (Sceloporus occidentalis), garter snakes (Thamnophis sirtalis), red back salamanders (Plethodon cinereus) and Ensatina salamanders *(Ensatina eschscholtzii)* are also expected to occur.

Several birds that have been documented in Interlaken Park and likely inhabit riparian areas at IRS include golden-crowned kinglets (*Regulus satrapa*), olive-sided flycatcher (*Contopus borealis*), song sparrow (*Melospiza melodia*), Swainson's thrush (*Catharus ustulatus*) and Townsend's warbler (*Dendroica townsendi*).

Zone C, where the creek meanders and pools under a canopy of native trees, shrubs and woody debris, is considered the most natural section of the IRS creek. This section likely has the highest wildlife value in the IRS.

Cavity-nesting birds such as cedar waxwings (*Bombycilla cedrorum*), Bewick's wren (*Thryomanes bewickii*), brown creeper (*Certhia americana*), downy woodpecker (*Picoides pubescens*) and pileated woodpecker (*Dryocopus pileatus*) likely use dead wood and snags on site.

Common raptors including of bald eagles (*Haliaeetus leucocephalus*), Cooper's hawks (*Accipiter cooperii*), red-tailed hawks (*Buteo jamaicensis*), sharp-shinned hawks (*Accipiter striatus*), great horned owls (*Bubo virginianus*), and barred owls (*Strix varia*) are likely to forage at the site, and conifers may be used as roosting sites.

Common urban birds such as European starling (*Sturnus vulgaris)*, Steller's jay (*Cyanocitta stelleri*), American crow (*Corvus brachyrhynchos*) and American robin (*Turdus migratorius*) have also been observed at IRS.

7.0 MANAGEMENT CONSIDERATIONS

7.1 Phase 1

Several goals were identified for the development of a phase 1. One of the most important goals identified was to develop a planting plan that incorporated natural succession patterns and regimes. For example, selecting trees such as Douglas-fir to replace open gaps in the canopy caused by big leaf maple failure will mimic stages of late forest succession. In anticipation of the continuing decline of mature big leaf maples, conifers tolerant of shade are also suggested for planting in phase 1. Proposing shrubs and small trees to fill in the loss of a mid-canopy species is also a goal of phase 1. Creating a mid-canopy structure will also improve wildlife habitat. Plant species were also selected with habitat for birds and other wildlife in mind.

Non-native invasive species will be removed so that native plants can establish on the site. The most pervasive invasive species include English Ivy, cherry laurel, and English holly. English ivy containment lines will be constructed to inhibit adjacent populations of ivy from spreading into newly restored areas.

Although the plan calls for the addition of conifers and mid canopy shrubs, vistas into the ravine will be maintained. Phase 1 planting design includes a staggered pattern of mature plant heights that are low in the foreground and increase upward in height toward areas with existing tall trees.

Invasive species removal

Removal of invasive species is critical to restoring IRS. It is imperative to manage invasive species on site before installing native plants. Removal of non-native species is the first priority in implementing phase 1. This will allow more time to remove weed re-growth before planting, hopefully maximizing weed eradication at the site. Sloped areas present a challenge, however, since removal of the vegetation

will encourage erosion. In these areas, weed removal should be closely followed by placement of erosion control structures and planting (see Slope Stabilization).

English Ivy Removal

English ivy is the most widespread invasive weed on the site. Herbicide is often not effective on ivy due to its thick, waxy leaves. Thus, manual removal is the only viable option. The plants should be hand-pulled or dug out of the ground with as much root material removed as possible. Vines on trees should be cut up to a height of 3'. Do not pull the ivy off the tree, as this can damage leaves, branches or animal nests. English ivy leaves, stems and roots should be removed from the site and disposed of properly, as vines can re-root.

Mowing has also been an effective control method for ivy in some cases. It may be possible to mow the ivy on the sloped areas and then cover it in 4" of mulch or weed control cloth. This process would leave the roots in the soil and limit erosion until the plantings establish. Ideally, mowing should be done in the spring, which is the time of maximum leaf growth. Fewer sugars are stored in the roots at this time and re-sprouting rates should be lower than in other seasons.

As a warning to weed removers, ivy contains compounds known as glycosides, which can cause rashes on sensitive people. Ingestion should be completely avoided as it can cause pain and vomiting. Ivy cover is also a popular habitat for rats. Thus, workers should take care during removal.

Construction of English Ivy Containment Lines

Finally, English ivy containment lines may be constructed to better contain the spread of adjacent ivy population into newly restored areas. Containment lines have been documented to be effective in the

control of Cape ivy (*Delairea odorata*) in the Golden Gate National Recreation Area. Containment lines installed in 1995 successfully stopped Cape-ivy spread. Reducing spread is critical to the systematic reduction of English ivy populations.

Containment lines are 1-2 meters wide and consist primarily of herbaceous plants, topped shrubs and limbed trees. Ideally, containment lines should be constructed within the perimeter of the English ivy infestation which also reduces the size. It is important to reduce and remove as much vegetation and debris as possible in initial containment stages. The stature of most woody shrubs in the containment zone is reduced by cutting them to within 0.5 meters of the ground level with hand tools. Trees should also be limbed to facilitate English ivy root removal and reduce English ivy's upward spread. Once the area is initially cleared of vegetation and debris, then a second more thorough weeding is conducted. The soil surface is raked over to a depth of several inches or until most of English ivy's stems and root fragments are no longer seen.

There have been two areas in IRS suggested for containment lines (Figure 2). The placement of containment lines was based on phase 1 and phase 2 site boundaries. Containment lines make use of edges such as Interlaken Boulevard located at the top of IRS and the berm at the bottom creek boundary. Containment lines were evaluated for erosion, access, impacts to existing native plants. To mitigate social trail impacts, containment lines leading from the roadway will be hidden by dense plantings of shrubs and low-growing trees. Containment lines will also be constructed using nonlinear lines to avoid creation of new social trails and to prevent erosion. Areas steeper than 25 degrees should be mitigated to prevent erosion by placing downed logs and/or cross bars across open areas.

Ideally, containment follow-up should be scheduled on 12-week intervals to remove any English ivy that has entered or resprouted in the containment zone. The follow-up schedule will depend on the quality of initial work, habitat sensitivity and season. It is important to document follow-up needs and observed growth rates in order to refine future containment/removal efforts.

Removal of other weeds within IRS:

- Traveler's Joy clematis– This weed can be removed manually. If use of herbicides is permissible, applying Roundup to a cut stem is also effective in inhibiting further resprouting.

- Morning glory/bindweed (*Convolvulus arvensis*) - This is a perennial vine that is difficult to eradicate due to its deep rhizomes and low growth. Each plant should be removed by hand, removing as much of the rhizome as possible.

- Laurel cherry – The cherry bushes should be cut at the base and the root ball removed, as the stump will re-sprout. If stump removal is not possible, an herbicide like glyphosphate can be applied to the stump to limit re-growth.

- English holly – Removal of holly is similar to that of laurel cherry. Hand removal as much of the plant as possible, including the root ball, should be conducted.

Wildlife Habitat

Wildlife habitat planned for the IRS restoration area includes tree canopy habitat, woody debris, creek riparian corridors, and low-lying shrubs. The following recommendations for wildlife habitat creation include all of the above habitat elements.

Dead wood provides habitat for many vertebrates. In the Pacific northwest 69 bird species commonly use cavities as a place to forage, nest, and shelter (Boyland, 2002). The Bewick's wren uses natural crevices and cavities to build nests made of materials such as moss and leaves.

Salamanders also use down wood for habitat. Ensatina salamanders lay their eggs in moist woodland areas in or under logs. Because of

their habitat value, dead wood and logs should be left to decompose on site.

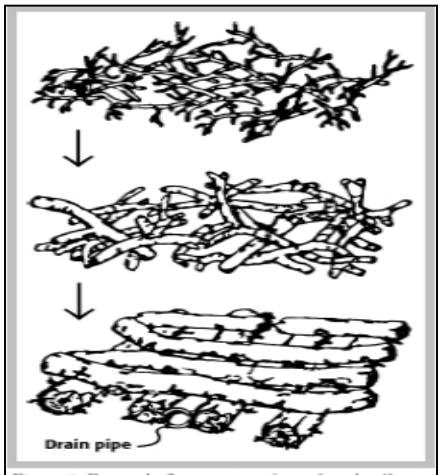


Figure 2. Example for constructing a brush pile. (From: *Landscaping for Wildlife in the Pacific Northwest*, University of Washington Press and Washington Department of Wildlife.)

The placement of woody debris and brush piles also help to provide shelter and cover for birds, amphibians and small mammals. Snags that provide valuable habitat for woodpeckers can be created from hazard trees that pose a threat to safety. These hazardous trees may be cut at a height that creates nesting and foraging opportunities for the threatened pileated woodpecker (Boyland, 2002).

For example, removal of two thirds of the mistletoe-infested hemlock located on the western side of the ravine (which has a high blow-down potential), is recommended for creation of habitat for cavity nesters.

Native plants have been selected in order to increase beneficial insects and invertebrates, and to provide habitat for native fauna. For example, cedar waxwings have been observed building nests made of mosses, leaves and twigs in native trees such as Douglas-fir *(Pseudotsuga spp).* They forage on berries from native shrubs such as salmonberry and eat insects such as cicadas and caterpillars. For example, the planting of Douglas-fir, and salmonberry has been selected to attract insectivorous birds like the cedar waxwing.

Slope Stabilization

This section will address slope stabilization at both the surface level and underlying geologic level. Water runoff and human impacts will also be discussed. Slope stabilization is best achieved when there is structural stability that provides support for vegetation to establish. Without structural stability at the surface level, erosion patterns are likely to continue and decrease opportunities for newly installed vegetation to take hold.

Vegetation is a critical component in maintaining surface level and shallow soil level stability. The installation of plant species with roots

that aid in stabilizing soils are critical to maintaining slope strength. Several of these species (Table 3, Area B) have been recommended for the IRS south slope, which is steep (30-32 degrees on average), denuded, and has a high rate of erosion. Over time, a dense interwoven network of lateral roots (reinforcing the soil to the depth of 1.5 meters) can create a membrane that protects the soil and holds it firmly together. Furthermore, vegetation increases the volume of leaves and limbs that can reduce the volume and velocity of water movement into the soil and the roughness and texture slows and traps water and sediment, decreasing its erosive potential.

On the east and west slopes of IRS it is important to maximize the benefits of existing vegetation and minimize disturbance that could potentially create deep geologic slope failure. These slopes vary in steepness (15-31 degrees) and stability, and are a concern due to an observed slope slump (mass movement of soil) bordering the bottom of the ravine close to the IRS creek. Although mature trees and shrubs are well established on both east and west slopes and have likely contributed to overall slope stability, it is important to recognize that vegetation alone cannot withhold large masses of earth breaking from an unstable foundation (see Geology section). It is therefore recommended that restoration activities on east and west slopes be staggered so that there is minimal impact to soil structure. Combinations of plant species that have lateral and vertical roots have been suggested for east and west IRS slopes (Table 4 and 5, Zones E and D). Deep roots (especially well-rooted, mature trees) can bond unstable soils to stable subsoil by penetrating fissures in underlying rock. Roots with lateral spread tend to be more effective in reducing surface soil erosion (Coppin and Richards, 1990). Finally, in areas where tree removal is necessary, the trunk of the tree should be left intact so that the roots continue to contribute to slope stabilization while the new plantings establish.

Restoration in areas such as steep slopes and areas close to incoming sources of water and runoff from neighboring developments, needs to consider site-specific restoration designs that can increase slope stability. In general, simple measures to reduce inflow at the surface level can be easily achieved. For example, creating curbs or berms on the downslope edge of Interlaken Boulevard could potentially deflect surface water from flowing over the tops of IRS slopes and prevent erosion. The establishment of a dense, wide buffer strip of vegetation along the top of slopes (Table 3, Zone A) will also aid in the capture of excess water and sediment. Finally, fencing the perimeter of IRS will

also help to reduce erosion caused by bicycles, dogs and people attempting to cut across the ravine or access the creek.

Planting Treatments

Treatment 1: Slope Stabilization (Zones B, D and E)

Terracing is suggested for slopes that are 28 degrees or more. Terraces should be constructed with down wood found on site. Dig trench lines 6" deep horizontally on the slope, staggering the placement of trench lines in the steepest areas. Place logs 4 feet or more in length and 12-20" in diameter in trench lines. Support logs with wood stakes. This construction creates small areas of stable soils where vegetation can take hold and in time reinforce slope structure. Coir netting should be securely anchored and come into direct contact with the soil. Covering slopes with coir netting helps stabilize soils and aids in the establishment of plants due to the capture of nutrients, organic matter and water. Application of 4-8 inches of wood chips (preferably after autumn leaf fall to capture the nutrients of the leaf mulch) creates a layer of organic matter at the surface that increases penetration of water into the soil and creates air spaces for organisms that help set rooting patterns.

Treatment 2: Soil Compaction (Zone A)

The soil on the outside perimeter of IRS is heavily compacted. This narrow 6' strip of soil between IRS and Interlaken Boulevard has been compacted by many years of car, bicycle and foot traffic. The soil has likely been compounded by backfill from the construction of the road. Due to the sensitivity of the site (unstable slopes and existing trees) preparing an adequate planting hole and applying mulch is the most appropriate plant care. The planting hole should be two to three times the size of the root ball. The hole should then be backfilled with loose soil taken when the hole was dug. Scarifying the sides of the hole to intermingle the backfill and field soil provides easier access for developing roots (Smith, 1977, as cited in Harris, 1997). Mulch (wood chips) should be applied liberally (6-12 inches thick) around existing trees and newly planted shrubs and ground cover. Mulch has been documented to improve soil aeration and drainage (Smiley, 1994). It also holds moisture and adds nitrogen as well as carbon to the soil. Reapply mulch as necessary.

Treatment 3: Wetland Soils (Zone C and Y)
No soil treatments are recommended for IRS wetlands. Although soil data indicates low levels of carbon and nitrogen, mulch is not recommended due to the high saturation of soils and/or potential flooding.

Planting Design

Zone A (TABLE 3)

When picking the plants to include into zone A there were many factors in which to keep in mind. There is very little light entering the site, the soil is compacted, are relatively low nutrients, and keeping open vistas is important. Selecting plants species to prevent people from accessing the IRS was also a consideration. Many of the plant species selected for zone A include shrubs and groundcover that are shade tolerate, have high transplanting success and low nutrient requirements. These plants include evergreen huckleberry, snowberry (*Symphoricarpos albus*), Oregon grape, salal, woodland strawberry (*Fragaria vesca*), service berry (*Amelanchier alnifolia*), and Nootka rose (*Rosa nutkana.*).

Zone B (TABLE 3)

The plants chosen for Zone B are intended to reduce erosion of the south slope and to prevent view obstruction through the ravine. Plant were selected based on the following characteristics: to be native plants to the region, to act as agents in erosion control, to provide habitat for wildlife and remain small when mature. Plant species selected for Zone B include a native groundcover, fern, small tree and shrubs.

We grouped the selected plant species into planting pairs to enhance symbiotic relationships between species and to match the planting plan to the overall goals of reducing erosion and maintaining a view though the ravine. For example, sword fern, Oregon grape and salal have been grouped together in the planting plan in the upper portion of the slope because they are all low growing and are found together in the native landscape of the region.

Some of the species we chose for this zone can be relatively difficult to establish and slow growing. To compensate, we included a larger

number of these plants in the plan expecting that some will not survive. For example, salal, evergreen huckleberry and thimbleberry are known to be difficult to establish so there is a larger number of these species included in the planting plan.

Zone C (TABLE 3)

This area was separated into two sections based on light and existing vegetation. Zone C1, located on the southern end of the site, is shaded through the whole year by landscape and conifer cover. Due to the moisture in the soil, wetland sedges and low ground cover were picked to dominate this site. Several plants were picked to enhance flower and fruit displays.

Zone C2 consists of a mixture of partial shade and full sun. Here the current vegetation dictated the majority of what was chosen for the planting design. Given the distance from Interlaken Boulevard, taller sedges were used in the area. Devil's club and skunk cabbage were important resources for local indigenous people and will remain on site for its historical value. It will be planted sparsely to discourage a monoculture. Willow (*Salix spp*.), dogwood (*Cornus spp*.) and Pacific ninebark (*Physocarpus spp.*) will be planted used near the creek along with tall mannna grass (*Glyceria elata) to* hold sediment in the creek bed during flash floods. These will also compete with the existing salmonberry thickets.

Zones D and E (TABLES 4 and 5)

The plant design for zones D and E was divided into smaller zones based on similar environmental conditions of available sunlight, moisture level of the soil and the elevation along the slope gradient (Figure 2). Throughout zones D and E, salal, Oregon grape and sword fern are either existing or will be planted. A variety of other groundcovers are selected according to growing conditions in different areas, but the mixture of salal, Oregon grape and sword fern will provide a unifying feature to the whole design.

The design for the south portion of D and E maintains the view into the ravine and increases the ornamental value of the area. Plant species were selected based on ornamental value and arranged to maintain views of the ravine and stream. Zones D3 and E3 near the creek have the same groundcover plants. They were selected for moist shady conditions and have flowers for ornamental value and fruits for wildlife food sources. These plants include false Solomon's seal (*Smilacina racemosa*), inside-out flower (*Vancouveria hexandra*) and false lily of

the valley (*Maianthemum dilatatum*). Pacific dogwoods will also be planted in E3 and will provide ornamental value and increase the mid-canopy that is lacking in this area. In section E4, grand fir (*Abies grandis*) will be planted along the upper slope in the shade below the chestnut and big leaf maples that are present along the rim of the ravine. The grand fir will provide a backdrop to the blooming dogwood trees. The grand fir will also help slope stabilization because of their deep roots, ability to grow in sandy soil and their fast growth rate. Grand fir is a potential climax species capable of growing in sunnier areas too which will be important as more gaps develop in the deciduous tree canopy when the mature maples die. To maintain views, zone D4 will not have any trees planted so that views will be maintained but will have a selection of ornamental shrubs including Pacific rhododendron (*Rhododendron macrophyllum*) and high-bush cranberry (*Viburnum edule*).

The design for the north zones of D & E include tree species that are less tolerant and will grow in the existing canopy gaps. Douglas-fir will be planted in E1, E2 and D2 in a swath across the ravine, but above the riparian area. The Douglas-fir will provide slope stability, increase the number of conifers, and contribute to the goal of promoting succession. Bitter cherry (*Prunus emarginata*) will be planted with the Douglas-fir in section D2. They have a shorter life span (50 years) and should eventually be over-topped and out-competed by the firs, which will contribute to our goal of supporting natural succession. Until then they will provide ornamental value from the flowers, attractive bark and cherries for birds to eat. The shade provided by the trees as they grow may help to suppress the growth of invasive non-native plants such as the blackberry and invasive vines that are currently flourishing under canopy gaps. The shadier zones D1 and E2 have shrubs that include red huckleberry (*Vaccinium parvifolia*) and evergreen huckleberry (*Vaccinium ovatum*) that provide food for wildlife. Groundcover includes ferns such as deer fern (*Blechnum spicant*) and lady fern (*Athyrium filix-femina*). The smaller trees cascara (*Rhamnus purshiana*) and Pacific yew (*Taxus brevifolia*) will be planted in these shady areas. The Pacific yew is a common understory tree in Douglas-fir and hemlock forests. Both trees will add to the mid-canopy and provide nesting sites and food for wildlife. Continuing the pattern of other zones, the upper slopes of E1 and D1 will have ornamental shrubs. These include red flowering currant (*Ribes sanquineum*) in E1 and Indian plum in D1.

Finally on the west slope of the ravine, in zone D, there is a group of the Japenese cedars that are sapling size, and appear to have been

naturally seeded. If the seeding becomes widespread the trees may need to be removed to prevent them from crowding out native species. These trees should remain in the design plan because the trees have very prickly needles and provide a deterrent for foot traffic down the fragile slopes.

Trail Maintenance

Use of Interlaken Boulevard should be encouraged with the provision that park users remain on the designated roadway or on approved secondary trails to keep from impacting vegetation.

Before the installation process in the ravine begins, barriers need to be built and down trees need to be removed along Interlaken Boulevard. Seattle Parks Department has planned to install a temporary fence around the outer edge of IRS. The fence is exactly the same as the fence used in the upper ravine area. This fence will prevent most people from entering the site while native plants are establishing.

Appropriate park signage that describes ongoing restoration activities in the sensitive areas should be placed on the fencing. Additionally, it has been suggested that the large down telephone poles bordering IRS at Interlaken Boulevard be removed. Removal of the telephone poles will create space for the fence and perimeter plantings.

Large woody debris obstructing the trail should also be removed and/or used in site prep and installation.

Finally, in order to keep motorized vehicles from using Interlaken Boulevard it would be beneficial to find some way to prevent motorcycles from using the road while still allowing relatively easy access for Parks' vehicles when necessary.

Increasing Recreational Value

The recreational value of the IRS area can be increased in several ways. Increasing views, for example, is a key element of site design that is intended to achieve this goal. When designing the plan, consideration was taken to preserve the view that currently exists, especially at the southern end. For example, the plan calls for smaller shrubs and herbs at the top of the slope, gradually moving down to trees and taller shrubs by the creek. This will allow park users to enjoy views of both the restored ravine and the Seattle neighborhoods beyond.

The installation of permanent interpretive signs along the trail edge will also provide information for park users. The signs could include, for example, information on the ecology of the area and photos of plant species to help visitors identify species used in the restoration. Interpretive signs should state the purpose of the restoration and credit Seattle Parks and Recreation and the University of Washington for their efforts in the project.

7.2 Phase 2

Plant Design

Zone Y (TABLE 7) is adjacent to a residential property and has been managed by the owner. It has been planted with turf, mowed and generally cared for as a yard. The turf is the only landscaping present.

As part of Phase 2, this area will be planted with various native trees, shrubs and emergents. The goals for the design are in keeping with the overall site goals and are as follows:

- To create wildlife habitat by establishing seed and fruit producing plants.
- To enhance community relations, especially with adjacent neighbors, by establishing somewhat ornamental native plants.
- To increase biodiversity in the area.

The plants for this area were chosen with these goals in mind the area lacks a canopy and is essentially a floodplain. Thus, plants were chosen that appreciate the available conditions, namely high light levels and wet soils. The species that require less water, including

serviceberry and sword fern are to be planted near the edges of the site. Riparian species, including various willows and sedges, are to be planted near the stream bank. The rest of the plants will be planted in clusters evenly over the remaining area.

The hydrology of the area is an aspect of concern. Turf grasses require a great deal of water, and as such may have a large influence on the current hydrology of area Y. It is likely that elimination of the turf, which is an integral part of site preparation for zone Y (see the Phase 2, Invasive Species Removal), may increase soil moisture levels. As such, it is important that Phase 2 is implemented with the understanding that water levels in zone Y may increase.

Invasive species removal

Zones X and Z are heavily impacted by cherry laurel, English holly, and especially English ivy. Overall, these species currently comprise about 75 percent of the shrubs and groundcover within the areas. Removal of these species is a key element for phase 2 site preparation. They should be removed using the techniques outlined in the Invasive Species Removal section for phase 1.

Planting Treatments

Treatment 1: Zone Z
See phase 1, treatment 1

Treatment 4: Mulch, Zones X and Z
Before and after plants are installed spread 4-8 inches of coarse organic material (i.e. wood chips) over the planting area. Mulch can reduce moisture loss, moderate surface soil temperatures, provide added organics to the soil and suppress weeds.

Treatment 5: Turf, Zone Y
Removal of the turf is a key element of site preparation for phase 2 restoration. Ideally, the turf should be dug up and removed. If this is not possible, a viable alternative is to cover the grass in 4” of mulch. This should kill the turf, which will eventually decompose.

Hydrological considerations

Vegetation stabilizes the slopes of the channel, controls erosion of the channel surface and removes pollutants. The channel storage, low velocities, water quality benefits and wildlife benefits create significant advantages over other constructed channels. The presence of vegetation results in loss of energy and increased flow retardance therefore, sediment deposition and scour as well as flow capacity should be considered.

8.0 AFTERCARE AND MAINTENANCE

8.1 Plant Management

Year 1

Post-planting irrigation is perhaps the most critical aftercare during the first year. The Seattle area receives approximately 39" of rain a year, but only about 13" falls during the growing season. As a result, water is usually a limiting resource for restoration plantings in our region. The plantings should be watered at least once a week during the growing season following planting, specifically May through October. Water is best applied in the morning. The plants should be watered around the base, with the amount of water that touches the foliage minimized.

The exceptions to this watering regime are any plants in the floodplain of the stream. It is unlikely that plants near the stream will suffer any drought stress, although they should be monitored. Monitoring of the plants should also include the observation of general plant health. If possible, dead plants should be replaced and notes taken as to which species and plant placements were most successful. This knowledge will facilitate future rehabilitation efforts at the park.

The monitoring and removal of invasive species is another vital component of aftercare in the first year. This should take place at least twice a year, or as often as possible. In general, removal will only involve the hand pulling of sprouts or plants that were overlooked in the pre-planting removal.

Year 2 and 3

Aftercare in the second and third years should mirror that of the first year. Supplemental watering should continue if needed, although it is not as critical as during the first year. Mulch should be added where needed. Plant monitoring and weed removal should also continue as intensively as possible.

Subsequent Years

Invasive weed monitoring should continue indefinitely. The continued application of mulch would also be beneficial to weed and erosion control. Ideally, the successful establishment of plantings, the initial elimination of weeds from the site, and the limitation of further weed encroachment should limit these problems. However, it is almost certain that weed control and mulch application will need to continue into the future.

8.2 Monitoring

Monitoring the success of restoration activities at IRS will be critical in addressing future adaptive management strategies. Organized monitoring and record keeping is valuable for both Seattle Parks and Recreation staff and the community groups that are active in stewardship of park lands. The information collected provides insight into which species establish successfully and should be used for future restoration, or conversely, which species should be avoided. Monitoring also provides information on whether the amount of aftercare provided was adequate. For similar reasons, observations on the effectiveness of invasive species removal techniques and the ivy containment lines should also be documented. The creation of a monitoring plan should be tailored to IRS site conditions and restoration goals. For example, Seattle Parks and Recreation staff created a specific plan for vegetation monitoring in Lincoln Park.

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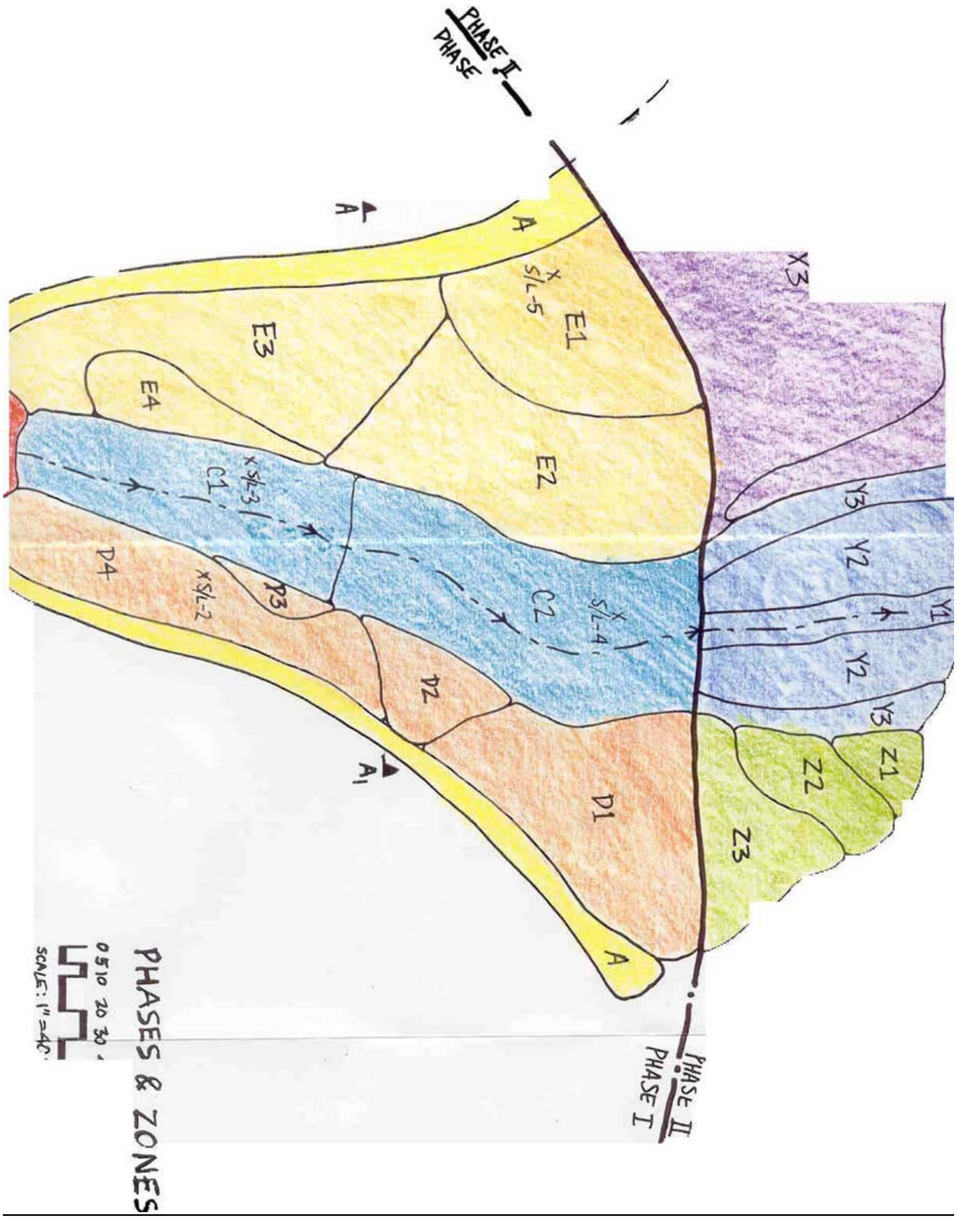
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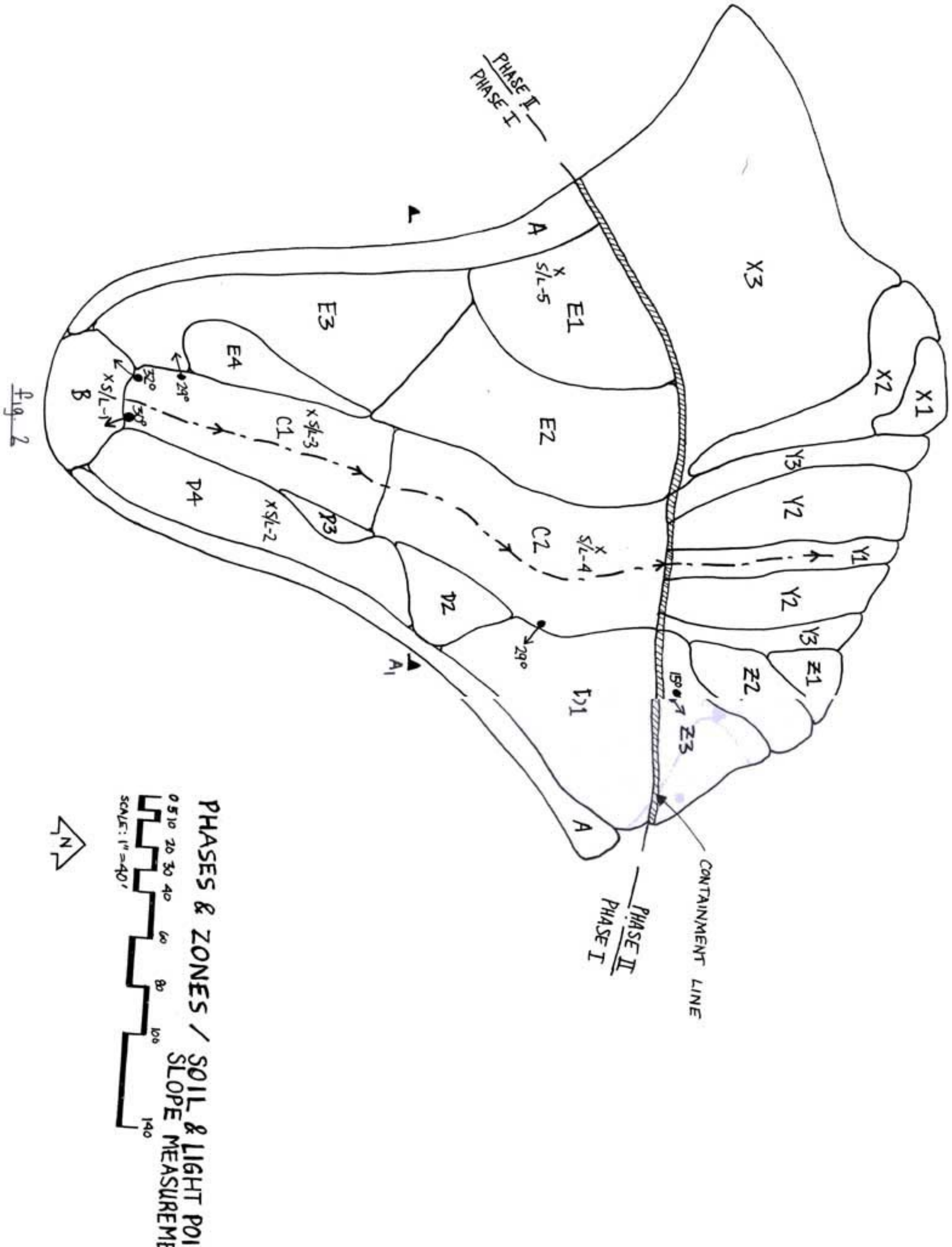
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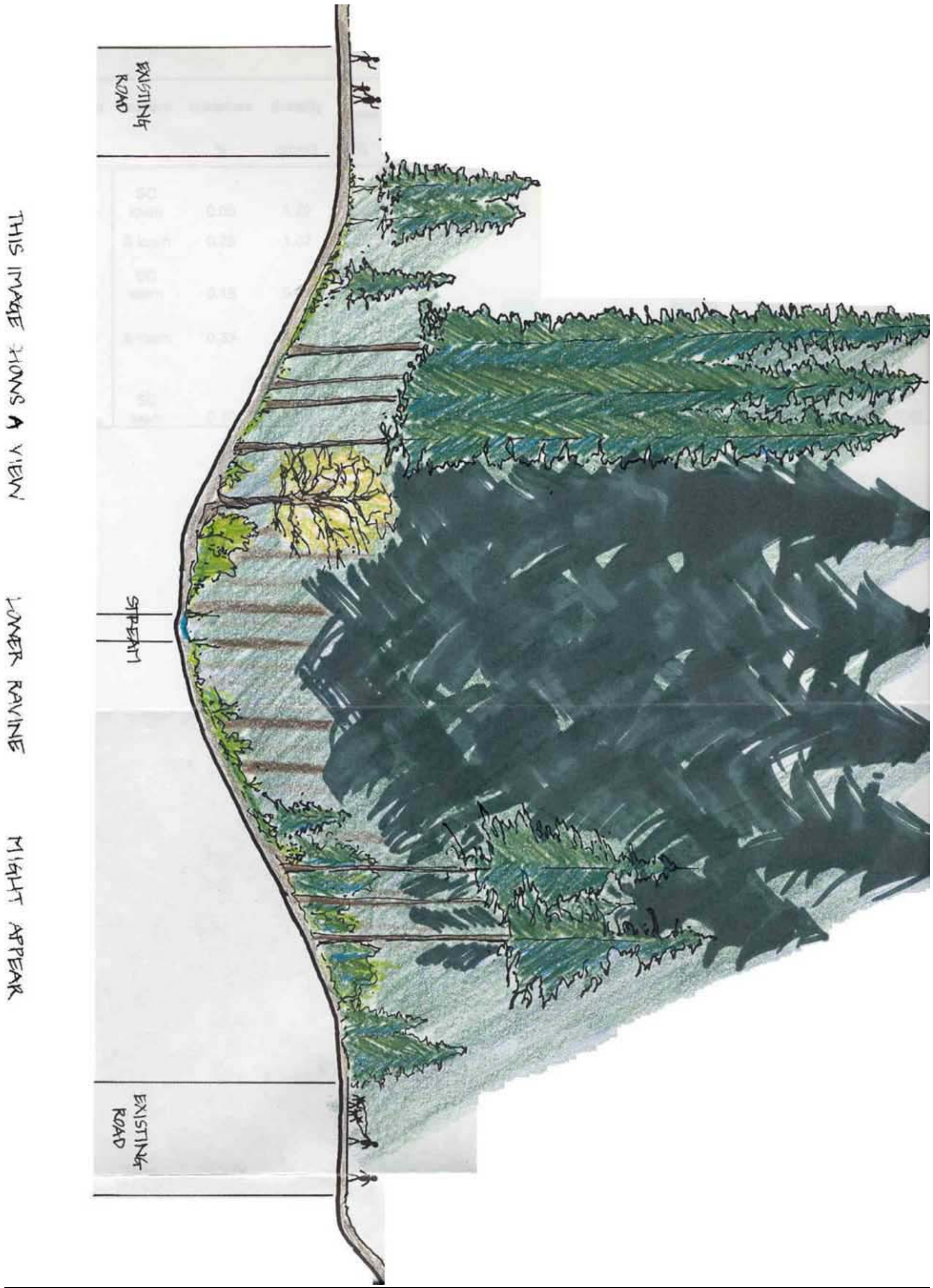
THIS IMAGE SHOWS A VIEW
LOWER RAVINE
MIGHT APPEAR
EXISTING ROAD
STREAM
EXISTING ROAD

Table 1: Physical and Chemical Properties of Soil Plots

Yellow = High, Blue = Low

site	texture	moisture %	density g/cm3	> 2mm %	pH	Organic %	P	K	Ca	Mg	NH_4	NO_3	Pb	Al	micronutrients
							ppm								
1	SC loam	0.09	1.22	60	5.8	6.7	13	154	1805	270	4	26	100	39	normal
2	S loam	0.28	1.07	0											
3	SC loam	0.18	0.87	0											
4	S loam	0.33	1.09	0	6.3	4.5	8	178	1298	310	2	18	55	15	normal
5	SC loam	0.1	1.22	8	5.8	3.6	12	121	1267	196	3	11	88	39	normal

Table 2: Light and Canopy Cover Measurements

Points	Densiometer (% cover)	Light Meter (EV)
1	90.50	14.5
2	95.75	14.5
3	91.50	14.0
4	71.60	15.5
5	72.75	16.5

Planting plan for zone 'A'

Key	Species	Size	Qty	Spacing	Location/Comments	Reasons for use
Trees						
PC	Pinus contorta Shore Pine	1 gal	4	6 ft o.c.	In area "A" Outlined in map	Planted for more diverse conifers and does well in all conditions
TP	Thuja Plicata Western Red Cedar	1 gal	12	6 ft o.c.	Throughout area "A" Outlined on the map	Planted to establish a coniferious forest after the maples have fell, do well in shade
RP	*Rhamnus purshiana* Cascara	1 gal	5	4 ft o.c.	In area "A" on the sandy hill, Outlined in map	Planted on the hill to keep people from seeing the trail, does well in the shade
Shrubs						
Vo	Vaccinium ovatum Evergreen huckleberry	4 in	65	3 ft o.c.	Bare area between and under the trees in area "A"	Installed for a diverse native environment, does well in the conditions of site "A"
Sa	Symphoricarpos albus Snowberry	1 gal	54	2 ft o.c.		
Mn	Mahonia nervosa Oregon grape	1 gal	54	3 ft o.c.		
Gs	Gaultheria shallon Salal	1 gal	54	4 ft o.c.		
Aa	Amelanchier alnifolia Serviceberry	1 gal	35	3 ft o.c.		
Fv	Fragaria vesca Woodland strawberry	4 in	426	1ft o.c.	Right by the trail, about a foot away, and under the fence (A)	A herb which will atteract wildlife
Rn	Rosa nutkana Nootka rose	1 gal	85	3 ft o.c.	Should be planted right behind the fence in area a along the trail	Planted to keep unwanted people from jumping the fence and wreaking the site

Planting plan for zone 'B'

Key	Species	Size	Qty	Spacing	Location/Comments	Reasons for use
	Shrubs					
Aa	Serviceberry *Amelanchier alnifolia*	1 gal.	10	dense: 3ft o.c.	Plant each species in groups of 3 on east side of slope; place mid to high on slope; species favor	slope stability, habitat value, low-growing to keep view open
Sa	Snowberry *Symphoricarpos albus*	1 gal.	10			
Hd	Oceanspray *Holodiscus discolor*	1 gal.	10	dense: 3ft o.c.	favor dry soil, partial sun	native, showy flowers
Rn	Nootka rose *Rosa nutkana*	1 gal.	8	average: 4ft o.c.	see planting specs for area along the road	natural barrier to prevent creation of new social trails, aesthetic value
Pm	Sword fern *Polystichum munitum*	1 gal.	20	dense: 3ft o.c.	Plant each species in groups of 3 on west side of slope; place high on slope; species favor dry soil, shady conditions; plant swordfern in areas of existing ferns	slope stability, habitat value, low-growing to keep view open
Mn	Oregon grape *Mahonia nervosa*	1 gal.	25			
Gs	Salal *Gaultheria shallon*	1 gal. or 4"	25			
Vo	Evergreen huckleberry *Vaccinium ovatum*	1 gal.	20			
Rp	Thimbleberry *Rubus parviflorus*	1 gal.	20	average: 4ft o.c.	low on slope; species favor dry/damp soils and shade	
Sr	Red elderberry *Sambucus racemosa*	1 gal.	12	average: 4ft o.c.	damp shade, plant in groups of 3 or more at bottom of slope	slope stability, habitat value, mid-story structure
Oc	Indian plum *Oemleria cerasiformis*	1 gal.	4			
Rs	Salmonberry *Rubus spectabilis*	1 gal.	5	dense: 3ft o.c.	wet to damp shade, place at very bottom of slope near culvert	slope stability, habitat value
	Herbs					
Fv	Woodland strawberry *Fragaria vesca*	4"	30	dense: 3ft o.c.	Plant dense at edge of road	low-growing ground cover, soil stability, aesthetic value, good in sandy soil

Planting plan for zone 'C'

Key	Species	Size	Qty	Spacing	Location/Comments	Reasons for use
Shrubs						
Ss Shrubs Cs	*Salix sitchensis* Sitka willow	stakes	80	2 ft o.c.	Plant a variety of at least 2 stakes within 5 ft of creek in C2. Plant for only 5% cover in in salmonberry area.	Plants grow well in wet sun. Naturally found along water edges, vegetatively propagate well. Larger shrub to use further down canyon. Most are exelent preformers in restoration. Pretty bark for winter color. Can help retain soil in flood plain.
	Salix hookeriana Hookers willow	stakes				
	Cornus sericea (stolonfera) red osier dogwood	stakes				
Pc	*Physocarpus capitatus* Pacific ninebark	1 gal	40	4 ft o.c.		
Mf	*Menziesia ferruginea* false azalea	1 gal	100	4 ft o.c.	plant 2 of the three species scattered along up slope edges of flood zone. 60% in C2, 40% in C1	Plants grow well in moist soil not wet, sun or shade conditions. Visual flowers and fruit.smaler shrubs for diversity in canopy.
Rn	*Rosa nutkana* Nootka rose	1 gal				
Li	*Lonicera involucrata* black twinberry	1 gal				
Vp	*Vaccinum parvifolium* red huckleberry	1 gal	60	4 ft o.c.	Plant in conifer shaded areas in C1. Plant at least one type of vaccinum.	Plants will add some dimention to the ground cover, they have pleasing fruit and flowers.
Vo	*Vaccinum ovatum* evergreen huckleberry	1 gal				
Oc	*Oemleria cerasiformis* indian Plum	1 gal				
Rp	*Rosa pisocarpa* swamp rose	1 gal	20	4 ft o.c.	Plant on edge of stream. 50% in C1, 50% in C2 in clumps of 2	Rose and Devils club will hopefully ditract users to play in creek area both have interesting flowers. Devils club has heritage value
	Oplopanes horridus devil's club	1 gal	10			
Herbs and emergents						
La	*Lysichitum americanum* Skunk cabbage	1 gal	40	1 ft o.c.	Plant 40% in c1, 60% in c2 near stream in vicinity of salmonberry and other skunk	Planting to maintain current vegetation.
Ge	*Glyceria elata* Tall Mannagrass	plug	30	1 ft o.c.	Plant on edge of creek in C2	Intended to keep sediment in stream bed
Bs	*Blechnum spiccant* Deer fern	4"	200	1 ft o.c.	Plant at least 3 of these. Plant denser in conifer shaded areas in C1. Scatter through out winter lighted areas near planted trees. Plant in clumps of 5+ to decrease shrub overgrowth.	Ground cover intended to break up shrub layer in landscape and create areas of greater diversity. Ground cover Will become increasingly important as conifer tree canopy grows.
Tm	*Tolmiea menziesii* Youth on age/piggyback plant	4"				
Af	*Athyrium feliz menina* Lady fern	1 gal				
Md	*Maianthemum dilatatum* False lily of the valley	4"				
Ht	*Hydrophyllum tenuipes* pacific waterleaf	4"	50	1 ft o.c.	Plant on edge of creek in C1	Intended to keep sediment in stream bed
Co	*Carex obnupta* Slough sedge	plug	70			

Planting plan for zone 'D'

Key	Species	Size	Qty	Spacing	Location	Reasons for use
Trees						
AG	*Abies grandis* *Grand fir*	1 gal	6	10' o.c.	In D1 plant along top edge of slope for stabilization, dense shade under big leaf maples in groups of 3	Slope stabilization, fast growth rate. Seeds, cover & nesting sites for birds
PE	*Prunus emarginata* *Bitter cherry*	1 gal	10	10' o.c.	Plant in open canopy gaps in D2, interspersed with Douglas-fir	Ornamental value of flowers and bark, fruit for birds
Pl	*Philadelphus lewisii* *Mock orange*	1 gal	20	4' to 5' o.c.	Plant in D2 on slope	High ornamental value, grows in partial shade to sun and well drained soil
PM	*Pseudotsuga menziesii* *Douglas-fir*	1 gal	20	10' o.c.	Plant in open canopy gaps in D2, interspersed with bitter cherry	Slope stabilization, fast growth rate. To increase the number of confiers
RP	*Rhamnus purshiana* *Cascara*	1 gal	6	10' o.c.	In D1 plant in partial sun to dense shade in groups of 3	Small tree with open growth, nesting sites & fruit for birds, transplants well
TB	*Taxus brevifolia* *Pacific Yew*	1 gal	6	10' o.c.	In D1 plant in partial sun to dense shade in groups of 3	Understory tree in with grand fir in late successional forests. Nesting sites and fruit for birds
Shrubs						
Aa	*Amelanchier alnifolia* *Serviceberry*	1 gal	25	4' to 5' o.c.	Plant along upper slope of D4 with ocean spray	Ornamental value of flowers, fruit for birds, tolerates dry conditions
Gs	*Gaultheria shallon* *Salal*	1 gal.	390	18" o.c.	Mass in 10-15s with Mn in between throughout site. Below Bs at west in highest density	Likes moist woods, wildlife cover & food source, evergreen, erosion contrl
Mn	*Mahonia nervos* *Oregon grape*	1 gal.	373	18" o.c.	Mass in between Salal throughout site.	Likes shady woods, found in 2nd growth forests, wildlife food source, erosion contrl
Rm	*Rhododendron macrophyllum Pacific rhododendron*	1/2 gal	23	4' to 5' o.c.	Plant along lower slope of D4 and in D3 with highbush cranberry	Ornamental value, prefers moist sites in partial shade
Sr	*Sambucus racemosa* *Red elderberry*	1 gal	15	4' to 5' o.c.	Plant along lower slope of D4 near stream, blend with section B	Ornamental value, fruits. Grows in moist areas.
Ve	*Viburnum edule* *Highbush cranberry*	1 gal	23	4' to 5' o.c.	Plant along lower slope of D4 and in D3 with rhododendron	Grows in moist forests and forest edges. Ornamental value and fruit
Vo	*Vaccinium ovatum* *Evergreen huckleberry*	1 gal	90	2.5' o.c.	plant in clumps of 3 in shaded areas near down woody debris	Likes shade, especially coniferous; wildlife food source, evergreen, erosion control
Vp	*Vaccinium parvifolia* *Red huckleberry*	1 gal	90	2.5' o.c.		Likes shade of moist, esp. coniferous forest, deciduous, erosion control
Herbs						
Af	*Athyrium filix-femina* *Lady fern*	1 gal.	90	2.5' o.c.	Plant in shade of existing trees in D1.	LIkes moist shade, evergreen, adds diversity to fern species
Bs	*Blechnum spicant* *Deer fern*	1 gal.	90	2.5' o.c.	Mass with Md on western edge, rest of site group in wettest pockets	Likes moist soils, winter food source for deer, evergreen

Planting plan for zone 'D' continued **Herbs**						
Fv	*Fragaria vesca* *Woods Strawberry*	4"	94	12" o.c.	Group in 20s with triangular spacing in lower half with Fv surrounding	grows in moist soil, in lowland around seepage areas, evergreen, flowers
Hd	*Holodiscus discolor* *Oceanspray*	1 gal	45	4' to 5' o.c.	Plant in D2 and D4 along upper slope section	Grows well on disturbed sites, soil binding qualities, profuse flowers
Md	*Maianthemum dilatatum* *False lily-of the valley*	4"	101	12" o.c.	Arrange above Vh interspersing with it in irregular fashion	Tolerates any shady area, likes moist ravine bottoms, flowers and berries
Oo	*Oxalis oregana* *Wood sorrel*	4"	94	12" o.c.	Mass in wetter areas than Md in groups of 50	Likes wet woods, often forms large beds, evergreen, flowers and fruits
Or	*Oemleria cerasiformis* *Wood sorrel*	1 gal	50	4' to 5' o.c.	Plant in shade of existing trees in D1.	Fruits, early bloom, selected to provide shrub layer
Pm	*Polystichum munitum* *Sword fern*	1 gal	34	2.5' o.c.	plant in clumps of 3 near in shaded areas	Ability to grow in many conditions, tolerant of canopy shift, erosion control, evergreen, already successful on site
Sr	*Smilacina racemosa False* *Solomon's seal*	4"	24	18" o.c.	Mass in one broad mass along center of areas, intersperse slightly with Md & Tm	Likes moist forests or clearings, tendency to colonize in masses, flwrs & fruit
Tm	*Tolmiea menziesii* *Youth-on-age*	4"	200	12" o.c.	Arrange at top of sections, mass should be wavy band interspersed with neighbors	Prefers moist forests, glades and streambanks; extremely tolerant of disturbed soils, evergreen, flowers and fruit
Vh	*Vancouveria hexandra* *Inside-out flower*	4"	8	12" o.c.	Arrange at bottom meeting At in irregular band	Capable of growing in any moist soils, ornamental value with leaves similar to ferns in early spring, flowers

Planting plan for zone 'E'

Key	Species	Size*	Qty	Spacing	Location	Reasons for use
			Shrubs			
Mn	Mahonia nervosa Oregon grape	1 gal.	466	18" o.c.	Mass in between Salal throughout site.	Likes shady woods, found in 2nd growth forests, wildlife food source, erosion contrl
Gs	Gaultheria shallonSalal	1 gal.	466	18" o.c.	Mass in 10-15s with Mn in between throughout site. Below Bs at west in highest density	Likes moist woods, wildlife cover & food source, evergreen, erosion contrl
Vo	Vaccinium ovatum Evergreen huckleberry	1 gal	175	2.5' o.c.	Plant in shaded areas near course woody debris	Likes shade, especially coniferous; wildlife food source, evergreen, erosion control
Vp	Vaccinium parvifolia red huckleberry	1 gal	175	2.5' o.c.		Likes shade of moist, esp. coniferous forest, deciduous, erosion control
			Herbs			
Aqf	Aquilegia formosa Red Columbine	4"	36	12" o.c.	Group around existing Sword ferns, thinning out in between them	Edge species tolerant of any moist soil, attracts hummingbirds/butterflies, ornamental value
At	Achlys triphylla Vanilla leaf	4"	36	12" o.c.	Arrange along upper half of area with irregular wavy line separating it from Tt, Fv below	Tolerant of any moist soil, spreading rhizomes capable of covering large areas
Bs	Blechnum spicant Deer fern	1 gal.	175	2.5' o.c.	Mass with Md on western edge, rest of site group in wettest pockets	Likes moist soils, winter food source for deer, evergreen
Fv	Fragaria vesca Woods Strawberry	4"	490	12" o.c.	Group in 20s with triangular spacing in lower half with Fv surrounding	grows in moist soil, in lowland around seepage areas, evergreen, flowers
Md	Maianthemum dilatatum False lily-of the valley	4"	539	12" o.c.	Arrange above Vh interspersing with it in irregular fashion	Tolerates any shady area, likes moist ravine bottoms, flowers and berries
Oo	Oxalis oregana Wood sorrel	4"	455	12" o.c.	Mass in wetter areas than Md in groups of 50	Likes wet woods, often forms large beds, evergreen, flowers and fruits
Sr	Smilacina racemosa False Solomon's seal	4"	202	18" o.c.	Mass in one broad mass along center of areas, intersperse slightly with Md & Tm	Likes moist forests or clearings, tendency to colonize in masses, flwrs & fruit
Ss	Smilacina stellata Starry false Solomon's seal	4"	455	18" o.c.	Mass in one broad mass along center of areas, intersperse slightly with Md & Tm	Able to colonize areas, good in moist soils, flowers and fruits
Tt	Tiarella trifoliata Foamflower	4"	36	12" o.c.	Arrange along lower half of area with wavy line separating it from At above	Adaptability, likes moist coniferous forest, nectar, pollen and fruit attract wildlife
Tm	Tolmiea menziesii Youth-on-age	4"	84	12" o.c.	Arrange at top of sections, mass should be wavy band interspersed with neighbors	Prefers moist forests, glades and streambanks; extremely tolerant of disturbed soils, evergreen, flowers and fruit
Vh	Vancouveria hexandra Inside-out flower	4"	84	12" o.c.	Arrange at bottom meeting At in irregular band	Capable of growing in any moist soils, ornamental value with leaves similar to ferns in early spring, flowers

Planting plan for zone 'X'

Key	Species	Size*	Qty	Spacing	Location	Reasons for use
				Shrubs		
Vo	*Vaccinium ovatum* Evergreen huckleberry	1 gal	175	2.5' o.c.	plant in groups of 3 in shaded areas near course woody debris	Likes shade, especially coniferous; wildlife food source, evergreen, erosion control
Vp	*Vaccinium parvifolia* Red huckleberry	1 gal	175	2.5' o.c.		Likes shade of moist, esp. coniferous forest, deciduous, erosion control
Mn	*Mahonia nervosa* Oregon grape	1 gal.	466	18" o.c.	Mass in between Salal throughout site.	Likes shady woods, found in 2nd growth forests, wildlife food source, erosion contrl
Gs	*Gaultheria shallon* Salal	1 gal.	466	18" o.c.	Mass in 10-15s with Mn in between throughout site. Below Bs at west in highest density	Likes moist woods, wildlife cover & food source, evergreen, erosion contrl
				Herbs		
Aqf	*Aquilegia formosa* Red Columbine	4"	36	12" o.c.	Group around existing Sword ferns, thinning out in between them	Edge species tolerant of any moist soil, attracts hummingbirds/butterflies, ornamental value
At	*Achlys triphylla* Vanilla leaf	4"	36	12" o.c.	Arrange along upper half of area with irregular wavy line separating it from Tt, Fv below	Tolerant of any moist soil, spreading rhizomes capable of covering large areas
Bs	*Blechnum spicant* Deer fern	1 gal.	175	2.5' o.c.	Mass with Md on western edge, rest of site group in wettest pockets	Likes moist soils, winter food source for deer, evergreen
Fv	*Fragaria vesca* Woods Strawberry	4"	490	12" o.c.	Group in 20s with triangular spacing in lower half with Fv surrounding	grows in moist soil, in lowland around seepage areas, evergreen, flowers
Md	*Maianthemum dilatatum* False lily-of the valley	4"	539	12" o.c.	Arrange above Vh interspersing with it in irregular fashion	Tolerates any shady area, likes moist ravine bottoms, flowers and berries
Oo	*Oxalis oregana* Wood sorrel	4"	455	12" o.c.	Mass in wetter areas than Md in groups of 50	Likes wet woods, often forms large beds, evergreen, flowers and fruits
Sr	*Smilacina racemosa* False Solomon's seal	4"	202	18" o.c.	Mass in one broad mass along center of areas, intersperse slightly with Md & Tm	Likes moist forests or clearings, tendency to colonize in masses, flwrs & fruit
Ss	*Smilacina stellata* Starry false Solomon's seal	4"	455	18" o.c.		Able to colonize areas, good in moist soils, flowers and fruits
Tt	*Tiarella trifoliata* Foamflower	4"	36	12" o.c.	Arrange along lower half of area with wavy line separating it from At above	Adaptability, likes moist coniferous forest, nectar, pollen and fruit attract wildlife
Tm	*Tolmiea menziesii* Youth-on-age	4"	84	12" o.c.	Arrange at top of sections, mass should be wavy band interspersed with neighbors	Prefers moist forests, glades and streambanks; extremely tolerant of disturbed soils, evergreen, flowers and fruit
Vh	*Vancouveria hexandra* Inside-out flower	4"	84	12" o.c.	Arrange at bottom meeting At in irregular band	Capable of growing in any moist soils, ornamental value with leaves similar to ferns in early spring, flowers

Planting plan for zone 'Y'

Key	Species	Size	Qty	Spacing	Location	Reasons for use
Trees						
AC	*Acer circinatum* vine maple	1 gal	24	10 ft o.c.	Scatter evenly over site, planting with clumps of other	Grows well anywhere moist, has attractive fall color, provides seeds and nectar.
Sh	*Salix hookeriana* Hooker's willow	1 gal	24	10 ft o.c.	Plant evenly within a few meters of stream edge.	Establishes well at restoration sites.
Sl	*Salix lucida* pacific willow	1 gal	24	10 ft o.c.	Plant evenly within a few meters of stream edge.	
Shrubs						
Cs	*Cornus sericea* red osier dogwood	1 gal	34	4 ft o.c.	Plant evenly within a few meters of stream edge.	Grows well in moist areas, rovides nectar and pollen for wildlife, is versatile in
Cc	Corylus cornuta beaked hazelnut	1 gal	34	4 ft o.c.	Scatter evenly over site, planting with clumps of other shrubs.	Provides seeds and attracts insects, is a dependable species for restorations.
Li	*Lonicera involucrata* black twinberry	1 gal	34			Is fast growing, provides nectar, pollen, fruit and attracts wildlife.
Pc	*Physocarpus capitatus* pacific ninebark	1 gal	34			Grows well in moist areas, rovides nectar and pollen, is versatile in restorations.
Pp	*Phamnus purshiana* cascara	1 gal	34			Attracts insects, provides nectar, pollen, and fruit.
Rd	*Ribes divaricatum* Stragely gooseberry	1 gal	34			
Rp	*Rose pisocarpa* swamp rose	1 gal	34			
Sr	*Sambucus racemosa* red elderberry	1 gal	34			Provides nectar, pollen and fruit. Attracts hummingbirds.
Aa	*Amelanchier alnifolia* serviceberry	1 gal	34	4 ft o.c.	Plant evenly along edges of site, in more upland areas.	Grows well in sun, has flowers and nectar for wildlife.
Pm	*Polystichum munitum* swordfern	1 gal.	34			Has high establishment rates.
Herbs and Emergents						
Cc	*Carex comosa* bristly sedge	plugs	100	1 ft o.c.	Plant evenly along stream edge.	Grows well in wet, full sun conditions. Has a high establishment rate.
Co	*Carex obnupta* slough sedge	plugs	100			
Sm	*Scirpus microcarpus* small fruited bullrush	plugs	100			Establishes well.
Af	*Athyrium filix-femina* lady fern	1 gal	34	4 ft o.c.	Plant within clusters of shrubs, under shrubs.	Grows well in moist conditions.

Planting plan for zone 'Z'

Key	Species	Size	Qty	Spacing	Location	Reasons for use
			Trees			
AG	*Abies grandis* Grand fir	1 gal	6	10' o.c.	Plant along top edge of slope for stabilization, dense shade under big leaf maples in groups of 3	Slope stabilization, fast growth rate. Seeds, cover & nesting sites for birds
TB	*Taxus brevifolia* Pacific Yew	1 gal	6	10' o.c.	Plant in partial sun to dense shade in groups of 3	Understory tree, nesting sites & fruit for birds, common association with Doug-fir and hemlock
RP	*Rhamnus purshiana* Cascara	1 gal	6	10' o.c.	Plant in partial sun to dense shade in groups of 3	Small tree with open growth, nesting sites & fruit for birds, transplants well
			Shrubs			
Gs	*Gaultheria shallon* Salal	1 gal.	86	18" o.c.	Mass in 10-15s with Mn in between throughout site. Below Bs at west in highest density	found in moist woods, provides wildlife cover & food source, evergreen.
Mn	*Mahonia nervosa* Oregon grape	1 gal.	86	18" o.c.	Mass in between Salal throughout site.	Found in 2nd growth forests, wildlife food source, erosion contrl
Vp	*Vaccinium parvifolia* Red huckleberry	1 gal	74	2.5' o.c.	plant in shaded areas near course woody debris	found in moist coniferous forest, deciduous, erosion control
			Herbs			
Aqf	*Aquilegia formosa* Red Columbine	4"	27	12" o.c.	Group around existing Sword ferns, thinning out in between them	Edge species tolerant of any moist soil, attracts hummingbirds/butterflies, ornamental value
At	*Achlys triphylla* Vanilla leaf	4"	27	12" o.c.	Arrange along upper half of area with irregular wavy line separating it from Tt, Fv below	Tolerant of moist soil, spreading rhizomes capable of covering large areas
Fv	*Fragaria vesca* Woods Strawberry	4"	156	12" o.c.	Group in 20s with triangular spacing in lower half with Fv surrounding	Grows in moist soil , evergreen, flowers
Md	*Maianthemum dilatatum* False lily-of the valley	4"	36	12" o.c.	Arrange above Vh interspersing with it in irregular fashion	Tolerates shade, found in moist ravine bottoms, flowers and berries
Sr	*Smilacina racemosa* False Solomon's seal	4"	149	18" o.c.	Mass in one broad mass along center of areas, intersperse slightly with Md & Tm	Grows in moist forests or clearings, will colonize in masses, flowers & fruit
Tm	*Tolmiea menziesii* Youth-on-age	4"	121	12" o.c.	Arrange at top of sections, mass should be wavy band interspersed with neighbors	grows in moist forests, glades and streambanks; extremely tolerant of disturbed soils, evergreen, flowers and fruit
Tt	*Tiarella trifoliata* Foamflower	4"	27	12" o.c.	Arrange along lower half of area with wavy line separating it from At above	Adaptability, nectar, pollen and fruit attract wildlife
Vh	*Vancouveria hexandra* Inside-out flower	4"	36	12" o.c.	Arrange at bottom meeting At in irregular band	grows in moist soils, ornamental value with leaves similar to ferns in early spring, flowers

Trees, Shrubs, and groundcovers

Trees:

***Abies grandis* Grand fir**
Exposure: sun to full shade
Soil moisture: moist to dry
Transplanting success: high
Growth rate: moderate
Form: coniferous evergreen to 180 feet, deep, extensive root system

The main reasons that Grand fir was added to our site is that the parks department wanted to establish a conifer forest, it is adaptive to a wide range of habitats, is drought tolerate, has deep, wide-spread roots so it is a good choice for binding soil at the top of the slope, and survives in a shade understory from the maples. This tree also provides seeds, cover, and nesting sites for wildlife and is a strong competitor for space.

***Acer circinatum* Vine maple**
Exposure: partial shade to deep shade, full sun if ample soil moisture
Soil moisture: moist to dry
Transplanting success: high
Growth rate: moderate
Form: small deciduous tree or large shrub to 20 ft; moderately deep root system

Vine maple is relatively slow to establish, especially in the full sun, but it usually is a survivor. This native will help in establishing a diverse environment and bring wildlife into the area.

***Cornus nuttalli* Pacific Dogwood**
Exposure: full shade
Soil moisture: moist well drained soil
Transplanting success: moderate
Growth rate: 30 -50 ft mature size
Form: Deciduous tree, 30-40ft (9-12 m)

This tree is very attractive in all seasons, flowering with large white bracts from April to June and some reflowering in fall. Dogwoods have some wonderful wildlife value with there large clusters of bright red fruits in fall, which provide food for birds, and host butterfly and caterpillars. Valyable as an ornamental flowering tree that brightens the understory of dense conifer shade.

***Fraxinus latifolia* Oregon ash**
Exposure: full sun to partial shade
Soil moisture: wet to very moist; will tolerate standing water early in growing season
Transplanting success: high
Growth rate: rapid given adequate moisture
Form: deciduous tree to 75 feet; branching, moderately deep root system

We selected this hardy, fast growing tree for plantings on the stream. It is also found on the banks of lakes and streams on highly organic substrate and does very well. It prefers saturated soil, making it one of our wettest trees.

***Malus fusca* Western crabapple**
Exposure: full sun to shade
Soil moisture: wet to moist
Transplanting success: high
Growth rate: moderate to rapid
Form: deciduous tree or shrub up to 30 feet

Western crabapples provide excellent cover and food, which in turn will help wildlife return to the area. It has dense, thicket-like growth that deters predators and produces abundant crabapples. Transplants are tolerant of a relatively wide range of soil and light conditions, which can be planned anywhere in the site.

***Pinus contorta var. contorta* Shore pine**
Exposure: full sun to partial shade
Soil moisture: wet to dry
Transplanting Success: High
Growth rate: rapid
Form: coniferous evergreen tree to 60 feet; tap root

Shore pine is common on the coast and wetlands and can live just about anywhere else. It accepts an extraordinary range of moisture - from wet or even saturated to dry, rocky soil. It also will tolerate bare mineral soil under full sun, which means it can survive open, unimproved sites. It has an attractive form and long needles that reflect light beautifully. Shore pine grows quickly to about 60 feet and it makes a good focal point or evergreen screen. Some cones will open and release seed soon after maturing; others may unopened for several years allowing the tree to spread in the area.

Prunus emarginata **Bitter Cherry**
Exposure: full sun to part shade, intolerant full shade
Soil moisture: dry to moist
Transplanting success: low
Growth rate: rapid growth first 30 years
Form: 20 to 50 feet tall

These plants are short lived (40-60 years), but provide wonderful wildlife value. The fruits are an important food source for birds and small mammals and the attractive bark and flowers, are a wonderful honeybee nectar source. Would be a good choice to interplant with Douglas fir on site for cover in early stage of fir growth, then will contribute woody debris to forest floor around the fir trees when cherry trees die at maturity and firs become dominant.

Pseudotsuga menziesii **Douglas-fir**
Exposure: full sun to light shade
Soil moisture: moist to dry
Transplanting success: high
Growth rate: moderate to rapid
Form: evergreen tree to 200 or 300 feet; tap or modified taproot, shallow or deep, widespread root system

Doug-fir prefers open sites and grows well in mineral soils. It is drought tolerant and fast growing, which means that it can grow in harsh conditions which is ideal for the site. Also an excellent species for anchoring steep slopes like our areas of B and E; planted at the top or toe of a rise, its root system provides far-reaching stability. Will establish a wonderful conifer forest.

Rhamnus purshiana **Cascara**
Exposure: full sun to shade
Soil moisture: wet to dry
Transplanting success: high
Growth rate: rapid
Form: deciduous tree to 30ft; fibrous and taproot, moderately deep root system
Cascara transplants well, thrives in a range of conditions, and grows fairly quickly, making it useful for revegetation in a variety of situations. Great for our site to keep the kids out of the hill area because it grows so quick and can tolerate the compaction. It is a small tree with relatively open growth, and is a great choice for the upper slope where view preservation is important. Cascara is very

common in western Washington, often mistaken for red alder-they look very similar when full-grown.

***Salix lucida (lasiandra)* Pacific willow**
Exposure: full sun to partial shade
Soil moisture: saturated to moist
Transplanting success: high (both container-grown & live stakes)
Growth rate: rapid
Form: multi-stemmed deciduous tree to 60 feet; fibrous, moderately deep and widespread root system

Pacific willow is the tallest of the native and love the water. With the ample moisture of the site, it will grow in great abundance and can quickly become established to anchor soil at the base of the slope. Pacific willow grows very well from cuttings, although the wood is somewhat brittle and may split if pounded vigorously.

***Taxus brevifolia* Western or Pacific Yew**
Exposure: Partial sun to dense shade
Soil Moisture: Moist, well drained
Transplant success:
Growth Rate: mature size 10 to 25 feet
Form: Small tree or shrub, scraggly, drooping branches

This tree is a grand understory to large conifers in our site such as Douglas-fir and Western Hemlock, and will provide a nice diverse environment. Female plants have fruit August – Nov. which birds eat, but it is poisonous to humans.

***Thuja plicata* Western red cedar**
Exposure: partial shade to deep shade
Soil moisture: wet to moist, tolerates seasonal flooding
Transplanting success: medium
Growth rate: moderate
Form: coniferous evergreen tree to 200 feet; shallow, widely spreading root system

Western red cedar does not do well planted in open sites because the foliage sunburns easily and transplants often do not survive. Perfect for our site that is heavy shaded under all the maples. With mulch and ample moisture of the site, success will be high. If the site is somewhat dry, provide mulch and shade. If the site is wet, plant the cedar where it will not be saturated during the growing season.

Shrubs:

***Amelanchier alnifolia* Serviceberry**
Exposure: full sun to shade
Soil moisture: moist to dry
Transplanting success: medium
Growth rate: moderate, may be slow to establish
Form: large deciduous shrub or small tree to 25 feet; tap root; may spread by suckers

Service Berry is used all around the western states to bring wildlife to the area and to integrate into a native environment for some biodiversity. Berries and foliage are favored by wildlife; it is common along woodland margins and is drought tolerant.

***Athyrium filix-femina* Lady fern**
Exposure: partial shade to shade
Soil moisture: wet to moist
Transplanting success: high
Growth rate: moderate to high
Form: deciduous fern from stout rhizomes, fronds up to 6 feet

Lady ferns are sometimes a staple within the forests in the Northwest along with the sword fern. With ample moisture on the slopes of our site, lady fern will take the slope over; it is common on mucky streamside terraces like our stream. With very moist soil and fall installation, it may tolerate full sun.

***Blechnum spicant* (Deer Fern)**
Exposure: partial shade or full shade
Soil moisture: moist
Transplanting success: high
Growth rate: moderate
Form: shrub clump which gets around 1-3ft tall and wide

Deer fern is another wonderful native found in moist to wet forests and generally on heavily shaded sites. It is found on fresh to very moist nitrogen-poor soils and grows best on very sensitive to frost

***Cornus sericea (stolonifera ssp. Occidentalis)* Red osier dogwood**
Exposure: full sun to partial shade
Soil moisture: saturated to moist
Transplanting success: high for container-grown, low or medium for

live stakes
Growth rate: rapid
Form: deciduous large shrub or small tree; 3-20 feet depending on site conditions; fibrous, shallow root system, spreads by layering and suckers

Typically found in wet sites and ditches this is a perfect for the lower ravine area. Or even the slops because it can tolerate fairly dry conditions if shaded or mulched. Red osier dogwood can be grown from live stakes and other cuttings with variable success; but it is best to try the stakes we think.

***Corylus cornuta* Beaked hazelnut**
Exposure: sun to deep shade
Soil moisture: moist and well-drained to dry
Transplanting success: medium
Growth rate: moderate Form: deciduous shrub 4-12 feet; branching, roots, suckers occasionally

This species grows on moist but well-drained soils, typically in shade to part sun. Possibly can be grow anywhere in the ravine area as long as it is transplanted shade or into full sun if irrigation is provided during first few years. Nuts are coveted by a number of wildlife, and hopefully will bring back those squirrels.

***Crataegus douglasii* Black hawthorn**
Exposure: sun to partial shade
Soil moisture: wet to very moist
Transplanting success: high if adequate moisture
Growth rate: moderate to rapid
Form: deciduous shrub or small tree to 25 feet; branching, moderately deep root system

Black hawthorn grows well when planted into wet meadows and water edges, such as our streambank. It provides good forage and cover for wildlife. When strategically placed, it can also be a deterrent against unwanted trespassers.

***Gaultheria shallon* Salal**
Exposure: partial shade to deep shade
Soil moisture: moist to dry
Transplanting success: medium to high if shaded, low if not
Growth rate: slow until established
Form: evergreen shrub 2 to 10 feet; very shallow and fibrous root

system; spreads vigorously by underground stems once well established

Salal is not a pioneer species and suffers from severe transplant shock. If it survives, it generally takes at least a few years before its typical, rampant growth begins. For somewhat better results, plant into shade or partial shade and add woody mulch. It can survive full sun if irrigated and mulched, but growth is usually meager and doesn't look good.

***Holodiscus discolor* Oceanspray**
Exposure: full sun to shade Soil moisture: moist to dry
Transplanting success: high
Growth rate: rapid
Form: deciduous large shrub to 12 feet; branching, fibrous, moderately deep root system, sometimes spreads by root suckers

Oceanspray tolerates a wide range of environmental conditions and generally does well on all but the wettest and driest/hottest of sites. The one plant that is perfect for the whole ravine. It is widespread across the Puget Sound lowlands in habitats ranging from ocean bluffs to forest understory. Oceanspray can be a good choice for erosion control plantings on the slope of ours.

***Hydrophyllum tenuipes* Pacific waterleaf**
Exposure: partial shade to shade
Soil moisture: moist
Transplanting success: high
Growth rate: moderate to rapid
Form: herbaceous perennial from short, thick rhizome and fleshy roots to 30 inches

Waterleaf is common in moist, open forests in the lowlands. Can spread when planted but this is not much of a worry. This species must be planted in shade and will benefit from light organic mulching (not more than an inch). Around 4 inches is perfect.

***Lonicera involucrata* var. involucrata Black twinberry**
Exposure: full sun to partial shade
Soil moisture: saturated to moist
Transplanting success: high
Growth rate: rapid
Form: deciduous shrub to 12 feet; branching, fibrous, shallow roots

This hardy species will grow like gangbusters in the right situation; with plentiful moisture it will put on several feet a year; it is less vigorous in less wet spots but this plant would be great for the lower ravine. The berries are favored by a number of birds in the region.

Lysichitum americanum (Skunk Cabbage)
Exposure: partial shade to full sun
Soil moisture: moist soils
Transplanting success: high
Growth rate: moderate
Form: four feet to 10ft

Has a high tolerance for wet soils, and lives in swampy lands by streams and lakes. Gives off a smell like a skunk, which animals will stay away and not eat it.

***Mahonia (Berberis) nervosa* Low Oregon grape**
Exposure: shade
Soil moisture: moist to dry
Transplanting success: medium
Growth rate: slow
Form: evergreen shrub to 2 feet; taproot, spreads by underground stems

The common names "long-leafed", "low", and "dull" all apply to this one species of Oregon grape! Its needs are very different from tall Oregon grape. It requires shade to survive transplanting, and on drier or nutrient-poor soils, mulch such as wood chips is a good idea. But is difficult to establish on restoration sites, so some care for these plants is in store.

Menziesia ferruginea (False azalea)
Exposure: shade-tolerant
Soil moisture: well-drained
Transplanting success: moderate
Growth rate: moderate
Form: deciduous shrub 3.3 to 6.6 feet (1-2 m) tall

Grows in the canopies of openings and on cutover forestland, especially on slopes. A great number of these are found the in cedar-hemlock stands to be positively associated with low soil potassium content, and high organic matter content. Great for a different variety of plants in the site.

***Oemleria cerasiformis* Indian plum**
Exposure: partial shade to shade
Soil moisture: moist to dry
Transplanting success: high
Growth rate: moderate to rapid
Form: deciduous shrub to 15 feet; branching, fibrous, shallow root system

This species does fine in poor soil conditions with some shade. Planted in the sun, it may scrape by-provide mulch and irrigation or expect high mortality. The "plums" are sought after by birds. It grows well on slopes and is a good candidate for erosion control plantings where shade is available.

Oplopanes horridus (Devil's club)
Exposure: partial shade to shade
Soil moisture: well-drained to poorly drained
Transplanting success: high
Growth rate: moderate
Form: deciduous shrub from 3.3 to 10 feet

It is commonly found near springs and streams and in drainage, seepage, and wet bottom areas. Great for the lower ravine and stream area. It occurs on variable aspects, growing in soils that are sandy, loamy, or silty in texture. Soil nutrient levels are medium to very rich.

***Philadelphus lewisii* Mock orange**
Exposure: full sun to partial shade
Soil moisture: moderately moist to dry
Transplanting success: medium to high
Growth rate: rapid
Form: deciduous shrub to 10 feet; branching roots moderately deep

Mock orange is common only in the southern part of western Washington since it favors dry, rocky soils. However, its tolerance for dry conditions (and probably it's heavenly fragrance) means that it is commonly used for revegetation projects throughout western Washington. It may grow slowly if the soil is extremely dry or poor in nutrients, but in most cases this species grows by leaps and bounds. Mock orange is a nectar plant for butterflies.

***Physocarpus capitatus* Pacific ninebark**
Exposure: full sun to shade
Soil moisture: wet to moist
Transplanting success: high
Growth rate: rapid
Form: deciduous shrub to 15 feet; fibrous, shallow root system, spreads by suckers

Pacific ninebark is abundant along wet roadsides in the Washington area so it would to well along the stream and wetter places of the site. It favors moist to very wet soils, but also can sometimes be found on drier sites. It does fine with "flashy" hydrology-alternatingly wet and dry, which makes it useful for planting storm water ponds and other fluctuating water edges, which our area has. The twigs and greenery provide browse for wildlife.

***Polystichum munitum* Sword fern**
Exposure: partial shade to shade
Soil moisture: moist to dry
Transplanting success: high
Growth rate: moderate
Form: evergreen fern, fronds to 5 feet, woody rhizomes

We often see sword fern planted in full sun, but the transplants usually don't survive out in the open unless there is ample soil moisture. Sword fern is easy to establish when planted in at least partial shade and mulched in the upper area of the slopes; given appropriate conditions, this plant will thrive will little or no care after planting. It is tough and competitive against invasive species like the ivy in the site once established.

***Rhododendron macrophyllum* Pacific rhododendron**
Exposure: partial shade to shade
Soil moisture: moderately moist to dry
Transplanting success: low to medium
Growth rate: slow
Form: evergreen shrub to 20 feet; fibrous, massive, and shallow

Like other native species in the heath family (Ericaceae), Pacific rhododendron, the state flower of Washington, is tricky to establish successfully. With an organic mulch and part shade under the maple trees, transplanting success may be high, but even so, it is slow growing. Not a plant for quick results. Will take a number of years to even notice this plant on site.

***Ribes divaricatum* Straggly gooseberry**
Exposure: partial shade to shade
Soil moisture: wet to moist
Transplanting success: medium
Growth rate: moderate
Form: thorny deciduous shrub to 8 feet; branching root system

Gooseberries are important for wildlife in the area as hedgerows or individual plantings. The berries provide food and the dense, prickly growth is excellent cover. Wonderful plants to bring some wildlife to the area.

***Ribes sanguineum* Red-flowering currant**
Exposure: sun to part shade
Soil moisture: dry
Transplanting success: medium
Growth rate: moderate
Form: deciduous shrub to 10 feet; branching root system

The trick with red-flowering currant is not over watering, as it is susceptible to root rot. Defiantly a plant that should be planted for the upper slope. This species is scattered through many dry habitats throughout western Washington; it is widely planted for its sun and drought tolerance and its ornamental qualities. The flowers are a magnet for hummingbirds, and the fruit food for many other birds and mammals.

***Rosa gymnocarpa* Bald-hip rose**
Exposure: partial shade to shade
Soil moisture: moist to dry
Transplanting success: medium
Growth rate: moderate
Form: deciduous shrub to 8 feet; spreads from suckers

This rose is typical of dry or moist forests; this is the driest and shadiest of our three native roses. It can be successfully transplanted into the open if adequate moisture and mulch is provided, but full sun is definitely not it's preferred condition. Rose hips are eaten by wildlife.

***Rosa nutkana* Nootka rose**
Exposure: full sun to partial shade
Soil moisture: wet to moist, dry okay if shaded
Transplanting success: high
Growth rate: rapid

Form: deciduous shrub to 10 feet; branched, fibrous, shallow roots, spreads vigorously by suckers

Nootka rose is successful in a range of sun and moisture conditions and spreads easily. We have monitored harsh restoration sites where Nootka rose was not only surviving but spreading. It is also one of the few species that can compete with Himalaya blackberry! But like the black berry it will keep people from trespassing on property. Nootka rose likes it wetter than bald-hip rose but not as wet as swamp rose.

***Rosa pisocarpa* Swamp rose**
Exposure: full sun to partial shade
Soil moisture: saturated to moist
Transplanting success: high
Growth rate: rapid Form: deciduous shrub to 8 feet; branched root system, spreads vigorously by suckers

In wet soils, swamp rose grows quickly and spreads to create thickets, even holding its own against the aggressive Douglas spirea. It transplants well and is one of the most dependable plants for wetland revegetation. It prefers the wettest conditions of our three native roses and would love the lower stream area were it seems to flood a bit. It will do okay in merely moist soils as long as they don't dry up entirely during the summer.

***Rubus parviflorus* Thimbleberry**
Exposure: full sun to shade
Soil moisture: moist
Transplanting success: high
Growth rate: rapid Form: deciduous shrub to 7 feet; spreads vigorously by suckers

This common species grows very well planted into moist soils-it quickly becomes established, spreading to form thickets. It also can do well in relatively dry soil if initial irrigation, shade, or mulch is provided. Wet soils are fine, if well drained. Thimbleberry is often a good choice for erosion control plantings, since it is drought tolerant and spreads by underground stems. This species is an amazing survivor!

***Rubus spectabilis* Salmonberry**
Exposure: partial shade to shade
Soil moisture: wet to moist
Transplanting success: medium to high
Growth rate: moderate to rapid

Form: deciduous shrub to 12 feet; fibrous shallow roots, spreads by suckers

Salmonberry is a frequent choice for mitigation sites but mortality is sometimes high, probably due to droughty conditions that salmonberry seedlings cannot tolerate. Many seeds will not spread so the area will not be invaded with salmonberry. Given adequate moisture or shade during establishment, this species grows vigorously and spreads to form thickets. May be planted in full sun if soil remains moist through the summer

***Salix hookeriana* Hooker's willow**
Exposure: full sun to partial shade
Soil moisture: saturated to moist
Transplanting success: high (both container-grown & live stakes)
Growth rate: rapid
Form: deciduous tree or shrub to 20 feet; fibrous, moderately deep root system

Hooker's willow is generally found within a few miles of salt water but is excellent on stabilizing slopes and bluffs, as long as there is plenty of moisture. This is why it would be ideal for the site.

***Salix sitchensis* Sitka willow**
Exposure: full sun to partial shade
Soil moisture: saturated to moist
Transplanting success: high (both container-grown & live stakes)
Growth rate: rapid
Form: deciduous shrub to 25 feet; fibrous, moderately deep and widespread

Sitka is the most common native willow and is lovely. This species is a shrubby willow, but can still attain heights of 25 feet or more. To maintain a view, you can cut them down by half their height without significant harm. Sitka willow is our favorite choice for live stakes, because it has a very high success rate.

***Sambucus racemosa* Red elderberry**
Exposure: full sun to shade
Soil moisture: moist to dry
Transplanting success: medium
Growth rate: rapid
Form: deciduous shrub to 20 feet; fibrous, branching, shallow root system

***Symphoricarpos albus* Snowberry**
Exposure: full sun to shade
Soil moisture: very moist to dry
Transplanting success: high
Growth rate: rapid
Form: deciduous shrub to 6 feet; fibrous, shallow root system, spreads vigorously by suckers

Snowberry is an incredible survivor, flourishing in situations that would slay a lesser plant. It transplants well, tolerates sun or shade, withstands drought and/or occasional flooding, and spreads quickly even in poor soil or on steep hillsides. Another plus for snowberry is that it is one of the few native shrubs that stays small-it averages three or four feet tall-and thus is a good choice for areas where view corridors are important.

***Vaccinium ovatum* Evergreen huckleberry**
Exposure: partial shade to shade
Soil moisture: moist to dry
Transplanting success: medium
Growth rate: slow until established
Form: evergreen shrub to 12 feet; fibrous, shallow root system

Like some other natives Evergreen huckleberry can be difficult to establish, although it may be the easiest of the lot! Success will be higher if shaded under other plantings, but with rich soil or an organic mulch and sufficient moisture, sun plantings can work.

***Vaccinium parvifolium* Red huckleberry**
Exposure: shade to deep shade
Soil moisture: moist to dry
Transplanting success: low to medium
Growth rate: slow until established
Form: deciduous shrub to 10 feet; deep and spreading, woody roots

Typically, red huckleberry favors rotting wood as a substrate, which are a number of these types on site. Certainly, if there is rotten wood available, plant directly into it or break it up and mix it into the soil. Otherwise, provide organic mulch such as wood chips. Do not plant this species in the full sun only in shade, as it will shrivel and die.

Viburnum edule (Highbush cranberry)
Exposure: full sun to partial shade
Soil moisture: moist
Transplanting success: moderate
Growth rate: moderate
Form: course looking plant 4-8ft tall and 2-4ft wide

This upright attractive shrub with maple-like leaves bears showy clusters of white flowers in late spring, followed by bright red berries in fall. The berries, which often persist through much of the winter, are edible (with the seeds removed, they can be used like commercial bog cranberries). In winter, the berries are eaten by birds. At least two should be planted for fruit production!

Groundcover:

Achlys triphylla (Vanilla leaf)
Exposure: Partial to Full Shade
Soil moisture: moist soil; do not let dry out between waterings
Transplanting success:
Growth rate:
Form: 6-12 in. (15-30 cm)
15-18 in. (38-45 cm) spacing

Moist, deep woods to open parks and forest edges; common along streams.

***Aquilegia formosa* Red columbine**
Exposure: full sun to partial shade
Soil moisture: moist, well-drained okay, dry soil in shade okay
Transplanting success: high
Growth rate: moderate
Form: perennial herb to 3 feet with taproot

Red columbine grows in moist, open sites or in partial shade one the edge of woodlands. It may spread by seed, but generally doesn't compete well with invasives. So it needs to be kept away from most of the ivy on site. It is a nectar plant for hummingbirds and other wildlife.

***Carex obnupta* Slough sedge**
Exposure: full sun to shade
Soil moisture: moist to wet
Transplanting success: high

Growth rate: rapid
Form: dense tufts on long, fleshy rhizomes, to 60 inches

Slough sedge is the of emergent revegetation. It transplants very well, grows and spreads quickly, tolerates wide seasonal water level fluctuations, and is one of the few shade-tolerant sedges. This plant will pop up in no time after planting. If project conditions are at all suitable, it will perform impressively. It is one of the most competitive emergents against invasive species; established swards may resist even reed canarygrass and the ivy. Slough sedge is very common and is found in wet woods, ditches, meadows, lakeshores, streambanks, and marshes. Should be used by the water shore.

***Fragaria vesca* Woodland strawberry**
Exposure: full sun to shade
Soil moisture: moist
Transplanting success: high
Growth rate: rapid
Form: herbaceous perennial to 12 inches, spreads by runners

Woodland strawberry will accept a fairly wide range of soil and light conditions, from dry soil in shaded areas to moist soil in the open sun. It spreads very quickly, and if the soil is rich, it will grow lushly to provide good cover and weed competition. This is why it is a great plant for the upper edge of the walk. Fruit is eaten by birds and small mammals and humans if they're quick enough

***Glyceria elata* Tall mannagrass**
Exposure: full sun to partial shade
Soil moisture: moist to wet
Transplanting success: high
Growth rate: rapid
Form: somewhat tufted perennial with creeping rhizomes, almost succulent, to 4.5 feet

Tall mannagrass prefers open habitat and is typically found on streamsides, wet meadows, and lakeshores. It transplants well, and grows quickly.

***Maianthemum dilatatum* False lily-of-the-valley**
Exposure: partial shade to shade
Soil moisture: moist, dry in shade okay
Transplanting success: high
Growth rate: rapid

Form: herbaceous perennial (somewhat evergreen) from slender, branching rhizomes

False lily-of-the-valley does not like being in a pot, but once released into the soil, it spreads abundantly. For best results, with this species and many other native perennials, plant in at least partial shade on the slope and top-dress lightly with organic mulch.

***Oxalis oregana* Wood sorrel**
Exposure: partial shade to shade
Soil moisture: moist to dry
Transplanting success: high
Growth rate: rapid
Form: herbaceous perennial to 6 inches, from rhizomes

Wood sorrel spreads very well once established. It will tolerate fairly dry soil if planted in the shade on the hill. One of the most robust groundcovers, but still has trouble in open, weedy sites.

***Scirpus microcarpus* Small-fruited bulrush**
Exposure: full sun
Soil moisture: wet to shallow water
Transplanting success: high
Growth rate: rapid
Form: single, large stems to 5 feet, arising from rhizomes

Small-fruited bulrush is a vigorous grower in sloughs, streambanks, and disturbed sites such as ditches and wet clearings. This species likes to be wet year-round, so plant near the stream, although the soil may be dry at the surface during drought. It may tolerate some shade, but will grow less vigorously. Provides valuable food and nesting material for numerous wildlife.

***Smilacina (Maianthemum) racemosa* False Solomon's seal**
Exposure: partial shade to shade
Soil moisture: moist
Transplanting success: medium
Growth rate: moderate
Form: herbaceous perennial from stout rhizomes, to 3 feet

False Solomon's seal is found in moist forests and on stream banks in mature soils. Unless it will be receiving irrigation, transplant at the end of the growing season, in September through November. We consider

false Solomon's seal and other lilies for enhancement projects on the hill, rather than for revegetating open sites like the lower portion.

***Smilacina (Maianthemum) stellata* Starry false Solomon's seal**
Exposure: partial shade to shade
Soil moisture: moist
Transplanting success: medium
Growth rate: moderate
Form: herbaceous perennial from thin rhizomes, to 20 inches

Starry false Solomon's seal grows in similar habitats to false Solomon's seal, sometimes in slightly drier (or better-drained) substrate. For best results, put it into rich soil and transplant in the fall or provide irrigation.

***Tolmiea menziesii* Piggyback plant**
Exposure: partial shade to shade
Soil moisture: moist to wet
Transplanting success: high
Growth rate: rapid
Form: herbaceous perennial to 30 inches tall, well-developed rhizomes

Piggyback plant is very common along streamsides, wetland edges, and moist forests. It requires plentiful moisture and some shade so it should be planted next to the stream or close by. Given these conditions, it can establish itself quickly and spread.

Tiarella trifoliate (Foamflower)
Exposure: partial shade or full sun
Soil moisture: moist
Transplanting success: moderate
Growth rate: moderate
Form: perennial, 6ft tall with stalks 1 and half ft tall, spread by rhizomes

Maple-like leaves are evergreen or nearly so. Spreads moderately fast by runners, forming a solid cover. Bears masses of small flowers in feathery clusters on upright stems in spring. Among the best of the native plants for use as a ground cover.

***Vancouveria hexandra* Inside-out flower**
Exposure: partial shade to shade
Soil moisture: moist
Transplanting success: high

Growth rate: moderate
Form: herbaceous perennial from rhizomes, to 10 inches

Inside-out flower spreads extensively in fertile, mature soils. We advise planting it in at least partial shade under the maples and, if soils are poor in organic matter, mulching lightly with wood chips.