Kincaid Ravine
University of Washington Restoration Ecology
Network Capstone 2013-14

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Project Summary

Overview

This report outlines the restoration project that was installed at Kincaid Ravine in 2013-14 for the University of Washington. The site is located in the northeast corner of the campus and is bordered by the NE 45th Street viaduct to the north, the North Physics Laboratory to the south, the Burke-Gilman trail to the east, and McCarty Hall to the west. Between September 2013 and June 2014, with the support from our community partner Martha Moritz, a team of six University of Washington Restoration Ecology Network (UW-REN) students designed and implemented the restoration. The Kincaid Ravine project is one of many restoration projects that have occurred on the approximately 2.2 acre lot.

Figure 1: Before and after photos of the site (January 28, 2014 and May 5, 2014).

Pre-Project Site Conditions

Kincaid Ravine is an urban forest that is approximately 343 m² in area and is located on a slope that ranges from 10 to 17 degrees. The site was divided into three polygons based on elevation and moisture content. Before restoration the site consisted of a ground cover made up of sword fern (*Polystichum munitum*) and lady fern (*Athyrium filix-femina*), a shrub layer consisting of Oregon grape (*Mahonia nervosa*), laurel (*Prunus laurocerasus*), and Indian plum (*Oemleria cerasiformis*), and a rich upper canopy consisting of bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), red-osier dogwood (*Cornus sericea*), and Western red cedar (*Thuja plicata*). Also found on
the site were many invasive species such as, English ivy (*Hedera helix*), Himalayan blackberry (*Rubus armeniacus*), Reed canary grass (*Phalaris arundinacea*), and English holly (*Ilex aquifolium*).

**Ecological Concerns**

One of the major ecological concerns that Kincaid Ravine faced is the over competition of invasive species, especially that of English ivy. In many areas throughout all three polygons, native vegetation was unable to survive due to the density of the invasive species. With a canopy comprised mostly of deciduous trees, this gave ideal sunny conditions in the late winter and early spring for invasive species to grow and thrive. Many of the existing conifers on site were being suppressed by the ivy, and without intervention, would most likely have been overtaken.

**Project Goals**

- Promote the establishment and dominance of native vegetation typical of low elevation in the Puget Sound area; specifically a big leaf maple - red alder / sword fern - fringecup plant community (Chappell 2006).
- Improve the wildlife habitat and ecosystem function of the wetland as well as the ravine as a whole.
- Stabilize the upper slope in order to prevent further surface erosion.

**Major Accomplishments**

- Restored approximately 343 m² of urban forest on the University of Washington campus.
- Removed an area of approximately 275 m² of English Ivy from the site.
- Led successful work parties
  - One work party with over 30 volunteers.
- Installed 544 plants throughout all three polygons.
Figure 2: Team members (From left to right: Top row: Becky Mathews, Jeovany Huerta, and Malcolm Howard. Bottom row: Samantha Yeung, Rika Haruyama, and Tzeyan Chan)

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Acknowledgements

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- Our community partner, Martha Moritz for guidance and assistance throughout the project.
- The University of Washington chapter of the Society for Ecological Restoration for providing ESRM 100 volunteers and snacks during our work party on February 15, 2014.
- The University of Washington Botanic Gardens for providing us an opportunity to salvage plants.
- UW-REN professors, Warren Gold, Kern Ewing, Jim Fridley, and TA Crescent Calimpong for guidance throughout this project.
As-Built Report

Site description

Kincaid Ravine is located in the northeast corner of the University of Washington Seattle campus (Figure 3). It runs roughly west-east and is bordered by McCarty Hall to the west, the North Physics Laboratory to the south, the Burke-Gilman trail to the east, and the NE 45th St viaduct to the north (Figure 4). The project site is approximately 1/8 of an acre, in eastern corner of the ravine on the north facing slope. The easiest access to the site is from the Burke Gilman Trail.

Figure 3: Aerial Map of Site
Figure 4: Local aerial photo. Kincaid Ravine outlined in blue and site outlined in red.

Figure 5: Detailed Map of Site
The site is divided into 3 polygons, roughly by elevation and moisture content. Polygon 1 is the upper slope polygon, polygon 2 is the middle polygon, and polygon 3 is the lower polygon.

As a ravine, the site is noticeably steep. The north-facing slope runs down from polygon 1 to polygon 3. Polygons in the site have average slope range from 10 to 17 degrees. The slope greatly affects soil composition and water flow (Figure 7).

Polygon 1, the upper polygon, has the lightest colored and least moisture content soils. We suspect that this is due to the slope, and possibly fill from construction. The average slope of Polygon 1 is 15.58 degrees. The entire site is covered with English ivy (*Hedera helix*) and other vegetation; however there is a small patch in polygon 1 where no vegetation cover can be found. This may be due to slope sloughing on top of previously existing vegetation, as there is noticeable slope erosion above the cleared patch. Polygon 2, the middle polygon, has the steepest slope, which is 17.61 degrees on average. Polygon 3, the lower polygon, has the flattest slope, which is 10.13 degrees on average (Figure 7).

The northern boundary of the project site is at the toe of the south slope of the ravine. Along the northwest boundary of the project site (running along the toe of the south slope) there is a small stream channel. The stream channel is approximately 4 feet wide from bank to bank, with a channel depth of 14 inches. The stream exits the project site and forms a Category 4 depressional wetland near the Burke-Gilman Trail. This wetland contains a municipal storm drain (SDOT 2010). This wetland is immediately adjacent to the project site to the northeast. The northeast corner of the site likely contains a small portion of the wetland.

Current surface flow in the stream appears to come from an upper wetland within the ravine. This upper wetland is a Category 3 slope wetland that lies within the ravine to the west of the site (SDOT 2010). Sources of this water include seeps from the north and south slopes and stormwater runoff that runs through the ravine. Additionally, there is a drainage culvert coming off the south slope that has carved a channel that flows
into the stream above the site. At the time of the assessment, this secondary drainage channel was dry and there was no stormwater coming through the culvert.

The lower polygon of the project site is adjacent to the stream and wetland. It is also the wettest part of the site. Vegetation that is present provides evidence of this, as there are moisture loving plants located in this polygon. Species include common horsetail (*Equisetum arvense*), reed canary grass (*Phalaris arundinacea*), red osier dogwood (*Cornus sericea*) and bittersweet nightshade (*Solanum dulcamara*). Wetland soils in this lower portion also provide some evidence of saturation and anaerobic conditions. Up the slope, the soil moisture availability decreases.

**Restoration Needs and Opportunities**

The invasive species, especially English ivy (*Hedera helix*) are taking over the space for native plants to grow, preventing other plants from establishing root systems, and outcompeting native plants for light and moisture. Removing the invasives and planting various native species will create a diverse ecosystem with different plant layers; in addition it will provide habitats for animals and insects. Ivy has shallow root and provides limited erosion control. So by planting native trees and shrub, the plants can also help stabilize the soil. This also applies to the streambank, which is noticeably eroded and incised. The wetland is dominated by invasive species like reed canary grass; which creates a thick mat of grass monoculture and does not allow native wetland plants to become established.

The site has a low diversity deciduous canopy, and the current deciduous trees are reaching the end of their lifespan (Map 2). More canopy seedlings are not becoming established because of the high amount of English ivy ground cover. The low vegetation diversity also indicates low wildlife diversity at the site. The site currently has relatively poor habitat for amphibians, small mammals and limited bird habitat.

Also, the site has become an area used by the homeless population as an encampment site. The illegal use and dumping of trash has degraded the functioning of area. Cleaning of the site would improve the public safety around that area. In subsequent
years of the project, additional uses should be explored; those would include: installing pedestrian trails and interpretive signs, or opening the space for academic use.

Tasks and Approaches

**Goal 1**: Promote the establishment and dominance of native vegetation typical of low elevation Puget Sound in Kincaid Ravine, transitioning the understory and canopy to a mixed conifer forest vegetative class.

*Objective 1-1*: Removal of trash and debris left by the homeless population who previously encamped at Kincaid Ravine.

**Task 1-1a**: Remove trash and debris

**Approach**: Go around the site with trash bags and pick up all trash/debris that has been left behind from homeless populations as well as the trash thrown from the overpass walkway on 45th Ave.

*Objective 1-2*: Removal of invasive species in order to increase the number of native species present.

**Task 1-2a**: Remove all *Rubus armeniacus* (Himalayan blackberry) above and below ground biomass

**Approach**: In all polygons where there are *R. armeniacus* canes present, they will be cut to about two feet from the ground with prunes so they are visible for rootball removal. The rootballs will be removed with a shovel. All canes and rootballs will be piled and hauled away by Earthcorps and the UW Grounds department.

**Justification**: pruning to a height with access to root ball is the most successful form of removal (Bennett, 2007)

**Task 1-2b**: Remove all *Hedera helix* (English ivy) from site
Approach: in Polygons where English ivy is found, remove by pulling out, starting from an upper slope to down slope position. Where tangled with native species, be careful to untangle and resume rolling up the English ivy.

Justification: Of all removal methods, hand or manual pulling has been most plausible and effective (Sardy, 1997).

Task 1-2c: Remove all Solanum dulcamara. (Bittersweet nightshade)

Approach: In polygons where S. dulcamara is present, weeds will be pulled out as close to root as possible in order to get most of the root out.

Justification: According to King County, this is most effective method when dealing with young weeds. (Jacobson, 2001)

Task 1-2d: Remove all Clematis vitalba (old man’s beard)

Approach: In polygons where C. vitalba is present, small seedlings will be pulled out by hand. The larger stems will be cut and the roots will be grubbed out.

Justification: Just like Himalayan blackberry, this method of hand-pulling and removal of roots is the most effective (Porteus, 1993).

Task 1-2e: Remove Prunus laurocerasus (cherry laurel) and Ilex aquifolium (English holly)

Approach: For small cherry laurel and English holly shrubs/seedlings, they would be pulled out by hand. For the bigger shrubs of English holy and trees of cherry laurel, the Kincaid community partner will be applying herbicides to them.
**Objective 1-3**: Install native woody shrubs and trees that are structurally and biologically diverse.

Task 1-3a: Acquire a diverse group of deciduous and coniferous trees as well as lower canopy vegetation to assist the area in becoming a native looking site.

Approach: The budget from the community partner will be used for buying plants and trees from nurseries in the area. Trees will be salvage from the University of Washington’s Arboretum.

Task 1-3b: Plant a mix of deciduous trees that will shade out the re-establishment of non-native species and provide shade for slower growing coniferous species as well as provide habitat in the process.

Approach: Plant early successional species *Alnus rubra* (red alder) *Prunus emarginated* (bitter cherry), and *Prunus virginiana* (chokecherry).

Justification: These species add to the wetland diversity of wetlands will aid in the further establishment of native wetland plants, in addition to reducing the ability of non-native, weedy species to become established (Kim, 2006).

Task 1-3c: Plant a mix of conifer trees

Approach: Plant *Thuja plicata* (Western red cedar), *Tsuga heterophylla* (Western Hemlock), and *Pseudotsuga menziesii* (Douglas-fir)

Justification: These species will enable the site to transition towards a later successional mixed conifer plant community and will provide the site with ecologically valuable old growth trees well into the future.

Task 1-3d: Mulch the planted trees
Approach: Obtain mulch through the Community Partner, from the Grounds department of the University of Washington and apply mulch rings planted trees.

Justification: In result of the disturbance that the site has, the soil is poor, thus soil moisture is not very high. Mulching helps in keeping moisture that the soil can't hold. This helps the trees take up water, and reducing competition from weeds (Davies, 1985).

AD1: Due to time constraints, mulch rings were not applied around planted trees. Instead, a 2.54 cm layer was applied throughout all three polygons, with the exception of the lower, eastern corner of polygon 3. There, a 3.81 cm layer was applied to help suppress the P. arundinacea. An additional 3 cm layer of mulch will be spread across all site polygons on June 7th, 2014.

Goal 2: Improve the wildlife habitat and ecosystem function of the wetland of the ravine.

Objective 2-1: Plant along the stream bank with live stakes and plant native wetland species.

Task 2-1a: Obtain and live stake Salix lasiandra (Pacific willow), Salix scouleriana (Scouler’s willow), and Cornus sericea (Red osier dogwood) into stream bank.

Approach: the stakes will be obtained from trees in the neighboring areas of the site and stakes will be planted directly into the stream bank.

Justification: The live stakes will provide shade, create habitat, improve bank stability, and reduce channel incision (Sotir and Fischenich, 2007).

Task 2-1b: Introduce large shrubs to stream bank

Justification: *J. ensifolius* and *C. obnupta* will increase wetland structural complexity, provide habitat, filter sediments and uptake nutrients contained in runoff. *P. munitum*, *A. filix-femina*, *R. spectabilis*, *R. parviflorus* and *R. gymnocarpa* will create thick low brush which will create additional habitat for mammals and birds. *P. emarginata*, *P. virginiana* and *H. discolor* attract pollinators and provide valuable bird and wildlife forage. *A. circinatum* seeds are eaten by many birds including woodpeckers, and its flowers provide nectar for bees and butterfly larvae. *R. spectabilis* and *R. parviflorus* flowers attract pollinators and the berries attract many birds and small mammals.

**AD2:** *Carex obnupta* could not be obtained at local nurseries. Instead we planted more *Salix lasiandra, Salix scouleriana, and Cornus sericea* live stakes into the stream bank.

**Objective 2-2:** Introduce large woody debris into stream channel.

**Task 2-2a:** Large woody will be obtained from downed logs in the surrounding areas of the site.

Approach: Talk to the Community Partner, who is looking to get rid of a large downed tree that just recently fell in the ravine.

**Task 2-2b:** Place large woody debris in eroded channel.

Approach: Place woody debris in eroded channel
Justification: Large woody debris placed in the eroded channel will slow the runoff, reduce stream bank erosion, increase channel complexity, and provide habitat for amphibians.

**AD3:** Two small logs (~4” diameter, ~3’ length) were placed along the streambank. Larger woody debris was not available on site.

**Goal 3:** Stabilize the upper slope and prevent further surface erosion.

**Objective 3-1:** Plant the eroded area with adaptable shrubs.

Task 3-1a: Plant species that help with erosion control in polygon 1

*Approach:* *Symphoricarpos albus* (common snowberry), *A. circinatum*, *P. emarginata*, and *Acer macrophyllum* (big leaf maple) will be planted in and around the eroded slope in Polygon 1.

Justification: *A. macrophyllum* has a deep, wide roof system that thrives on gravelly slopes and provides excellent erosion control. *P. emarginata, S. albus and A. circinatum* are multi-stemmed, dense, sprawling shrubs that have vigorous roots and do well on slopes, providing additional erosion control in Polygon 1.

Objective 3-2: Install surface erosion control features on the eroded slope.

Task 3-2a: Obtain fallen limbs from the site and construct fascine bundles.

*Approach:* from the obtain limbs and woody vegetation, preferably of red osier dogwood and Scouler’s willow. Pile them together in a row and tie together with twine.

Task 3-2b: Install Fascine bundles

*Approach:* Dig shallow trenches parallel to the stream and bury the fascines.
Justification: The plant bundles sprout and develop a root mass that will hold the soil in place and protect the stream bank from erosion (Ohio DNR)

AD4: Due to time constraints, fascine bundles were not installed in the stream bank. Woody vegetation was instead densely planted in order to help stabilize the streambank (*Salix lasiandra*, *Salix scouleriana*, and *Cornus sericea* live stakes; *Rubus spectabilis* and *Thuja plicata* bare roots).

**Goal 4:** Create new management plans after completion of the project.

**Objective 4-1:** Revise and update the weed management plan and create a five to ten year management plan.

**Objective 4-2:** Create a long term stewardship plan that involves volunteer groups.

**Task 4-2a:** Work with CP to develop a long-term stewardship plan

Approach: Work will be done with the community partner to develop a long-term stewardship plan.

Justification: By the end of the project, a good relationship will be established with the Community Partner. Through this, as well as with communication, we will be able to work together to develop a plan that will keep the site in the right path for the goals she wants to accomplish.

**Task 4-2b:** Spread the word about the ongoing restoration project

Approach: Get on social networks, make flyers, and post on blogs about the restoration project.

Justification: When people see something going on in their community, especially when it comes to environmental problems, they are more inclined to participate.

**Objective 4-3:** Create a list of recommended plant species.
Task 4-3a: Develop a list of recommended plant species.

Approach: Use knowledge gained from experiences and class to develop a plant species list for the ravine.

Justification: Knowing the site and the background of it, we will be able to develop a plant list that encompasses plants that are not only native to the Pacific Northwest, but as well to wetlands.

Specific Work Plans

Current Conditions

The site is approximately 1/8 of an acre and runs from the bottom stream up to the top of the ravine. Elevation gain from the bottom to the top of the site is approximately 28 ft. (Figure 4).

The site is divided into 3 polygons, based roughly on available soil moisture (Map 1). Polygon 1 is the driest polygon, Polygon 2 is has increased soil moisture content and Polygon 1 moist soils with areas of year round saturation. All 3 polygons have loamy sand soils, with some variation (Map 1). In Polygon 1, there is an O Horizon and B Horizon. In Polygon 2, there is an O Horizon, A Horizon, and B Horizon. In Polygon 3, there was the O Horizon and A Horizon. There is no humus layer in any of the polygons (Figure 7).

Polygon 3 has the deepest layer of A horizon, while Polygon 1 has none. The difference in A horizon soil depth could be explained by the slope of the site location. Polygon 1 is at the top of a hill while Polygon 3 is at the bottom of the hill. As a result of this slope, erosion is occurring and minerals would naturally go down the hill. Polygon 1 has the driest soils. Soils in Polygon 2 have moderate moisture, and Polygon 3 has moist but not saturated soils.
Polygon 1 contains an approximately 12’ wide, 4’ high eroded section near the top of the ravine, where there is presently no vegetation. The soil around this eroded section is quite gravelly and sandy, with some cobble

**Figure 6: Site Logistics Map**

**Site Preparation Activities**

Before the restoration process began, the trash and debris was removed from the site. The next step before planting will involve removal of invasive species. All species will be removed manually, with the exception of a large *Prunus laurocerasus* (cherry laurel) in Polygon 3 and a large *Ilex aquifolium* (English ivy) Polygon 1, which will be treated by the UW Grounds Department with herbicide.

Every polygon will involve removal of *Hedera helix* (English ivy), which will be hand pulled, piled and hauled off site. Polygons 2 and 3 contain the most *H. helix*. Polygon 1 contains less; it contains a healthy coverage of *Mahonia nervosa* (low Oregon grape) groundcover, and sizeable portion of the polygon contains no vegetation due to the eroded slope.
Polygon 1 contains the greatest variety of invasive species, including *H. helix*, *Rubus armeniacus* (Himalayan blackberry), *P. laurocerasus*, *Clematis vitalba* (old man’s beard), *Solanum dulcamara* (bittersweet nightshade), *I. aquifolium* and *Phalaris arundinacea* (reed canary grass). *R. armeniacus*, a small *I. aquifolium* and a large woody *C. vitalba* will be dug out with shovels. *H. helix* will be hand pulled, as will *S. dulcamara*. The *P. arundinacea* will be hand sheared to the ground and mulched before planting. After mulching, shrubs will be planting in the mulch in an attempt to decrease the grass vitality by shading. The *P. arundinacea* will also be controlled by hand-shearing if grows through the mulch during the growing season, to prevent seed production and reducing competition with natives.

Polygon 2 contains numerous native species, mostly *M. nervosa* and *Oemleria cerasiformis* growing amongst the *H. helix*. Care will need to be taken during the ivy removal process in order to not pull and trample the natives. There is a cluster of small-medium sized *I. aquifolium* in the middle of Polygon 2. If they are too big to dig out, they will be controlled with herbicide with the other larger trees by the UW Grounds Department. Interspersed *R. armeniacus* will be dug out with shovels.

Polygon 1 contains *H. helix* which will be hand pulled, the occasional *R. armeniacus* which will be dug with shovels, and a larger patch of *C. vitalba* which will be dug. Fascine bundles will be installed for erosion control in the eroded upper section. There is a pile of brush on site that could be used for this purpose. A large *I. aquifolium* will be treated with herbicide by UW Grounds.

**AD5:** The Fascine bundles were not installed due to time constraints. Densely planted bare root *Symphoricarpos albus*, *Prunus virginiana*, and *Acer circinatum* were used for erosion control in the eroded upper slope in place of fascines.

Large woody debris will be placed in the eroded channel to slow the runoff, reduce streambank erosion, increase channel complexity, and provide habitat for amphibians. A large tree that recently fell in the ravine may be a source for this material, with UW Grounds Department cooperation and assistance.
AD6: Two small logs (~4" diameter, ~3’ length) were placed along the streambank. Larger woody debris was not available.

Logistical Considerations

The site presents some logistical challenges because it is steep and has limited access. There is an informal trail leading to the site which skirts the edge of the lower wetland and crosses the stream where it narrows. The stream is narrow enough to take a large step over; however, it would be best to obtain a temporary bridge (e.g. a large piece of plywood) to place over the stream during volunteer events. This would reduce potential streambank erosion, and prevent soil compaction and stream sedimentation.

Green waste staging piles will be placed near the bottom of the slope but away from the wetland to avoid soil compaction (Map 4). From the staging piles, green waste will be dragged on tarps to green waste bins placed adjacent to the Burke-Gilman trail. The bin will be placed on the ravine side of the trail, to avoid having to cross the trail while dragging plant debris. The mulch pile will be dumped adjacent to the green waste bins. Mulch will be moved from the pile to the site, using wheelbarrows, and plants will be mulched using 5 gallon buckets.

AD7: Green waste bins were never brought on site. Most piles were hauled near the site entrance and removed by EarthCorp. Several piles remain outside of site boundary.
A large variety of species were selected with different growth habitats, heights, forms and flowering times to enhance the biological and structural diversity of the site (Objective 1-3). Plant species were selected to represent multiple successional stages and were based on reference sites in similar *Acer macrophyllum – Alnus rubra / Polystichum munitum – Tellima grandiflora* plant communities (Chappell 2006). Selected species are relatively hardy and have been used successfully in restoration projects (Map 2).

All woody species planted will be bare root, with the exception of live stakes which will be collected locally. Ferns and other herbaceous species will be bought in plug trays, or whatever smallest form of established plants is available from the nursery.

Evergreen, deciduous and herbaceous species were included across all polygons to increase biological and structural complexity of the site. The combination of conifer and deciduous trees will encourage a tree canopy year round, minimizing opportunity for invasive species *Rubus armeniacus and Phalaris arundinacea* to spread (Objective 1-
Early successional species *Alnus rubra*, *Prunus emarginata* and *Prunus virginiana* will grow and establish quickly, providing wildlife habitat and shade for species like *Thuja plicata*. Conifer species with very long life spans *Thuja plicata*, *Tsuga heterophylla* and *Pseudotsuga menziesii* will enable the site to transition towards a later successional mixed conifer plant community and will provide the site with ecologically valuable old growth trees well into the future.

**Polygon 1**

Polygon 1 has similar conditions to Polygon 2, with some drier upland portions. The plant associations here will be similar to Polygon 2, with an *Acer macrophyllum* – *Pseudotsuga menziesii* – *Polystichum munitum* – *Rubus parviflorus* plant community (Niemiec 1995). However, this polygon also contains a drier top slope and eroded section, which will be planted with additional drought tolerant species that do well on slopes, including *Prunus emarginata*, *A. circinatum* and *Symphoricarpos albus*. All are versatile and relatively hardy plant species that tolerate drier conditions.

*A. macrophyllum* has a deep, wide root system that thrives on gravelly slopes and provides excellent erosion control. *P. virginiana*, *A. circinatum*, *S. albus* are multi-stemmed, dense, sprawling shrubs that have vigorous roots and do well on slopes, providing additional erosion control in Polygon 1 (WA DOE).

Five *A. macrophyllum*, five *P. emarginata* and three *T. menziesii* will be planted in this polygon. In the non-eroded section, shrubs will be planted in groups/clusters of two or three, on 3’ centers between existing native plants. In the eroded section shrubs will be planted on 1’ centers, in case of high mortality in the poor soil.

*A. macrophyllum* has a deep, wide root system that thrives on gravelly slopes and provides excellent erosion control. *P. virginiana*, *A. circinatum*, *S. albus* are multi-stemmed, dense, sprawling shrubs that have vigorous roots and do well on slopes, providing additional erosion control in Polygon 1. Five *A. macrophyllum*, five *P. emarginata* and three *T. menziesii* will be planted in this polygon. In the non-eroded section, shrubs will be planted in groups/clusters of two or three, on 3’ centers between...
existing native plants. In the eroded section shrubs will be planted on 1’ centers, in case of high mortality in the poor soil.

Polygon 2

Polygon 2 is the transition zone from the riparian area to upland. This zone will be planted with an *Acer macrophyllum – Pseudotsuga menziesii – Polystichum munitum – Rubus parviflorus* plant community. This polygon contains somewhat drier soils so more drought tolerant species like *A. macrophyllum* and *P. menziesii* were chosen as canopy trees. Increasing evergreen and deciduous canopy cover in this polygon will help shade *R. armeniacus* patches in Polygon 2, and will also help provide shade on Polygon 3.

This polygon was planted with diverse species to attract pollinators and wildlife, and provide a corridor for wildlife to connect riparian and upland habitats. *Prunus emarginata*, *Prunus virginiana*, *Holodiscus discolor*, and *Ribes bracteosum* attract pollinators and provide valuable bird and wildlife forage. *Acer circinatum* seeds are eaten by many birds including woodpeckers, and its flowers provide nectar for bees and butterfly larvae. *Rubus parviflorus* flowers attract pollinators and the berries attract many birds and small mammals (WMSWCD 2014).

AD8: *Ribes bracteosum* was not available from local nurseries. *Ribes sanguineum* was planted instead, which can attract pollinators and provide berries for birds and other wildlife.

Polygon 3

To help meet objective 1-3 and 2-1, Polygon 3 will be planted with a diverse suite of species to diversify the habitat structure of this potentially valuable riparian habitat. Plant associations in Polygon 3 will include a *Thuja plicata – Tsuga heterophylla – Alnus rubra – Rubus spectabilis – Tellima grandiflora* plant community (Tirmenstein 1989). The evergreen canopy will help create a year round canopy to shade out *R. armeniacus* and *P. arundinacea*. The added shade over the stream would help improve water quality as well as create more suitable conditions for amphibian populations.
Approximately 40 live stakes will be planted using *Salix lasiandra*, *Salix scouleriana*, *Cornus sericea* and *Physocarpus capitatus*. Stakes will be planted directly into the stream bank and in the patch of *P. arundinacea*. Live stakes will provide shade, create habitat, improving bank stability and reducing channel incision. All four species are semi-shade tolerant, and are locally available.

Ten *A. rubra*, five *T. plicata* and five *T. heterophylla* will be planted on 6 ft. centers in this polygon, with different species spread out evenly across the site.

*Juncus ensifolius* and *Carex obnupta* will increase wetland structural complexity, provide habitat, filter sediments and uptake nutrients contained in runoff. These species will be planted on one foot centers. *Polystichum munitum* *Athyrium filix-femina*, *Blechnum spicant*, *Rubus spectabilis*, *Rosa gymnocarpa* will create thick low brush which will create additional habitat for mammals and birds. These ferns and shrubby species will be planted in groups/clusters of 2 or 3 on 6’ centers.

**AD9: Rosa gymnocarpa** was not available from local nurseries - *Rosa nutkana* was planted instead, which provides similar low, shrubby habitat.

![Figure 8: Planting Plan Map](image-url)
<table>
<thead>
<tr>
<th>Species</th>
<th>#</th>
<th>Spacing (m)</th>
<th>Form*</th>
<th>#</th>
<th>Spacing (m)</th>
<th>Form</th>
<th>#</th>
<th>Spacing (m)</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer circinatum</td>
<td>15</td>
<td>1</td>
<td>b.r.</td>
<td>10</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acer macrophyllum</td>
<td>6-9</td>
<td>2</td>
<td>b.r., slvg.</td>
<td>5</td>
<td>2</td>
<td>b.r.</td>
<td>10</td>
<td></td>
<td>b.r.</td>
</tr>
<tr>
<td>Alnus rubra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athyrium filix-femina</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blechnum spicant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corylus cornuta</td>
<td>5</td>
<td>1</td>
<td>b.m. 1 gallon</td>
<td>5</td>
<td>1</td>
<td>b.m. 1 gallon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cornus sericea</td>
<td>5</td>
<td>2</td>
<td>b.r.</td>
<td>10</td>
<td></td>
<td>live stake</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cornus nuttallii</td>
<td>5</td>
<td>2</td>
<td>b.r.</td>
<td>6</td>
<td>1 plug</td>
<td>6-7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotoneaster disciflorus</td>
<td>17</td>
<td>1</td>
<td>b.r., slvg.</td>
<td>17</td>
<td>b.r., slvg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junci cuspidiflorus</td>
<td>10</td>
<td>1</td>
<td>b.r.</td>
<td>10</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mahonia aquifolium</td>
<td>10</td>
<td>1</td>
<td>b.r.</td>
<td>5</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mahonia nervosa</td>
<td>10</td>
<td>1</td>
<td>b.r.</td>
<td>10</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oemleria cerasiforma</td>
<td>10</td>
<td>1</td>
<td>b.r.</td>
<td>10</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physocarpus capitatus</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polygala munitum</td>
<td>48</td>
<td>12</td>
<td>plugs, slvg.</td>
<td>10</td>
<td>1 plug</td>
<td>plugs, slvg.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prunus emarginata</td>
<td>5</td>
<td>2</td>
<td>b.r.</td>
<td>5</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prunus vacciniana</td>
<td>10</td>
<td>1</td>
<td>b.r.</td>
<td>10</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudotsuga menziesii</td>
<td>6</td>
<td>2</td>
<td>slvg., b.r.</td>
<td>8</td>
<td>2</td>
<td>slvg., b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picea sitchensis</td>
<td>10</td>
<td>1</td>
<td>b.r.</td>
<td>10</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubus parviflorus</td>
<td>10</td>
<td>1</td>
<td>b.r.</td>
<td>10</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubus spectabilis</td>
<td>20</td>
<td>1</td>
<td>b.r.</td>
<td>5</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sambucus racemosa</td>
<td>10</td>
<td>1</td>
<td>b.r.</td>
<td>20</td>
<td>1 plug</td>
<td>live stake</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salix lasiandra</td>
<td>10</td>
<td>1</td>
<td>b.r.</td>
<td>5</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salix scouleriana</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symphoricarpos albus</td>
<td>30</td>
<td>0.5</td>
<td>b.r.</td>
<td>15</td>
<td>1 plug</td>
<td>10</td>
<td>1 plug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolima grandiflora</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thuja plicata</td>
<td>5</td>
<td>2</td>
<td>b.r.</td>
<td>5</td>
<td></td>
<td>b.r.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tsuga heterophylla</td>
<td>5</td>
<td>2</td>
<td>b.r.</td>
<td>6</td>
<td></td>
<td>b.r., slvg.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* b.r. = bare root, slvg. = salvaged

Table 1: Plant List

<table>
<thead>
<tr>
<th>Task</th>
<th>Materials</th>
<th>Qty</th>
<th>Source</th>
<th>Tools</th>
<th>Qty</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>arborist wood chips</td>
<td>5 6 cubic yards, with additional amount TBD</td>
<td>UW Grounds, hardware store/personal</td>
<td>shovels</td>
<td>10</td>
<td>UW - UHC</td>
</tr>
<tr>
<td>1-2</td>
<td>tarp</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2, 1-3</td>
<td>5 gallon buckets</td>
<td>5</td>
<td>UW - UHC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-1 b</td>
<td>wooden stakes</td>
<td>20</td>
<td>hardware store</td>
<td>pruners, loppers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-1 b</td>
<td>twine</td>
<td></td>
<td>hardware store</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Material List
### Table 3: Labor by Activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Team</th>
<th>Volunteers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site preparation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garbage removal</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Border demarcation</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Subtotal site preparation</strong></td>
<td>10</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td><strong>Invasive plant removal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Himalayan</td>
<td>24</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>Blackberry</td>
<td>24</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>English ivy</td>
<td>24</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td><strong>Subtotal Invasive plant removal</strong></td>
<td>48</td>
<td>24</td>
<td>72</td>
</tr>
<tr>
<td><strong>Plant acquisition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Nurseries</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Salvage</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Live stake collection</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td><strong>Subtotal plant acquisition</strong></td>
<td>32</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td><strong>Planting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polygon 1</td>
<td>15</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Polygon 2</td>
<td>15</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Polygon 3</td>
<td>15</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td><strong>Subtotal Planting</strong></td>
<td>45</td>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td>135</td>
<td>30</td>
<td>165</td>
</tr>
</tbody>
</table>

### Table 4: Revenue by Fund Source

<table>
<thead>
<tr>
<th>Fund Source</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course fee allotment</td>
<td>600</td>
</tr>
<tr>
<td>Kincaid</td>
<td>1000</td>
</tr>
<tr>
<td><strong>Cash Donations</strong></td>
<td></td>
</tr>
<tr>
<td>Cash Donations by sponsor</td>
<td>0</td>
</tr>
<tr>
<td>Cash Donations by neighborhood group</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Cash Donations</strong></td>
<td>0</td>
</tr>
<tr>
<td>In-kind donations</td>
<td></td>
</tr>
<tr>
<td>tool rental waiver ($ value)</td>
<td>0</td>
</tr>
<tr>
<td>Mulch ($ value)</td>
<td>300</td>
</tr>
<tr>
<td>food ($ value)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total in-kind Donations</strong></td>
<td>400</td>
</tr>
<tr>
<td><strong>Project Total</strong></td>
<td>1600</td>
</tr>
</tbody>
</table>

**Note:** The figures in the table represent the total hours worked by different activities and fund sources. The revenue figures are the amounts received from different sources.
<table>
<thead>
<tr>
<th>Plants</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahonia nervosa</td>
<td>49</td>
</tr>
<tr>
<td>Polystichum nutans</td>
<td>36</td>
</tr>
<tr>
<td>Pseudotsuga menziesii</td>
<td>9</td>
</tr>
<tr>
<td>Symphoricarpos albus</td>
<td>75</td>
</tr>
<tr>
<td>Cemeteria cerasiformis</td>
<td>48</td>
</tr>
<tr>
<td>Acer circinatum</td>
<td>48</td>
</tr>
<tr>
<td>Cornus sanguinea</td>
<td>14</td>
</tr>
<tr>
<td>Thuja plicata</td>
<td>14</td>
</tr>
<tr>
<td>Tsuga heterophylla</td>
<td>14</td>
</tr>
<tr>
<td>Sambucus racemosa</td>
<td>15</td>
</tr>
<tr>
<td>Physocarpus capitatus</td>
<td>16</td>
</tr>
<tr>
<td>Rubus spectabilis</td>
<td>32</td>
</tr>
<tr>
<td>Salix aculeata</td>
<td>14</td>
</tr>
<tr>
<td>Teucrium grandiflorum</td>
<td>30</td>
</tr>
<tr>
<td>Rubus parviflorus</td>
<td>48</td>
</tr>
<tr>
<td>Acer macrophyllum</td>
<td>15</td>
</tr>
<tr>
<td>Helodictyon discolor</td>
<td>48</td>
</tr>
<tr>
<td>Blechnum spicant</td>
<td>32</td>
</tr>
<tr>
<td>Alnus rubra</td>
<td>10</td>
</tr>
<tr>
<td>Athyrium filix- femina</td>
<td>25</td>
</tr>
<tr>
<td>Salix lasiandra</td>
<td>5</td>
</tr>
<tr>
<td>Carex obnupta</td>
<td>5</td>
</tr>
<tr>
<td>Juncus ensifolius</td>
<td>10</td>
</tr>
<tr>
<td>Rosa gymnocaera</td>
<td>16</td>
</tr>
<tr>
<td>Corylus cornuta</td>
<td>100</td>
</tr>
<tr>
<td>Prunus emarginata</td>
<td>8</td>
</tr>
<tr>
<td>Prunus virginiana</td>
<td>12</td>
</tr>
<tr>
<td>Ribes bracteatum</td>
<td>9</td>
</tr>
<tr>
<td>Mahonia aquifolium</td>
<td>10</td>
</tr>
<tr>
<td>Cornus nutUsia</td>
<td>None</td>
</tr>
</tbody>
</table>

Subtotal Plants: 759
Subtotal Mulch: 0
Subtotal Mulch: 0
Subtotal Total Rental: 0
Subtotal for Food: 0
Subtotal for Transportation: 0
Subtotal for Printing: 0

Project Total: 779

Table 5: Expenditures by Major Category
Design for the Future

The goal for Kincaid Ravine is to build a strong community stewardship network that will ensure success for this restoration project until full maturity is reached. Upon completion of the Kincaid Ravine 2013-2014 project, a detailed maintenance plan will be provided to the community partner (CP), which can be passed down as the position changes. In addition, connections with the University of Washington Society for Ecological Restoration (SER) have been built and they are working with members to recruit students for the work party events. These events will teach the importance of stewardship to students and demonstrate invasive species removal techniques as well as native species installation. Connections with professors of introductory environmental science courses are also being developed. The hope is to take advantage of entities on
campus that have students available for stewardship work, either through interest or through the offering of extra credit. The use of social networking sites are also being used to advertise and promote work parties. To encourage participation, we are asking for support from local businesses in the form of donated food and drink items for participants.

The ultimate goal for the Kincaid Ravine restoration project is to restore the urban forest and wetland through the removal of invasive species, the installation of native species, and stabilization of the slope. Success of these goals will not only improve ecosystem functions such as improved water quality and increased water filtration, it will also create habitat for small mammals, birds, and amphibians. Through the planting of native trees, shrubs, and low dwelling plants, shade will be created at different levels to help eliminate rooting and spread of invasive species. The plan outlines installation of both coniferous and deciduous trees, as well as several shrub and herbaceous species with the idea of creating a year round canopy, with a diverse understory. However, until the canopy is fully established, continuous removal of invasive species will be necessary. The goal is that this continued stewardship will be provided by not only our CP, but also through the connections as outlined above. Continued work with SER would be beneficial not only for the student help that they can provide, but also for the acquisition of native plants for future planting.
A. Financial Budget:
For the Financial budget, there was an underestimation of the amount of plants that we would be purchasing. This is mainly due to not being able to find a company to purchase the plants from at the time of the initial estimation. We were also able to get free mulch from the UW ground department which saved us around $300. In addition we were able to salvage some plants to help reduce our spending. So we have learned to form connections with others in order to get donations.

B. Labor Budget:
For most of the work parties, there was an overestimation in the volunteer labor budget. This is mainly due to the few volunteers we had on our second and third planting parties, as well for our mulching party. In contrast, our first
working party had over 30 volunteers helping on the site. We noticed that despite the large amount of volunteers that helped clean out a massive amount of invasive species, the site got so crowded that the work was ineffective. Approximately 10 volunteers had to be sent off site to remove invasive species at an adjacent site. We learned that maybe 20 volunteers is the best working size for our site. Due to the large amount of volunteers showing up on our first work party, we were expecting a similar volunteer size showing up for other work parties. However, only a few volunteers showed up for the remainder of the work parties. Overall, we overestimated the working labor we are going to have.

Because we did not have enough volunteers, our team had to work more hours than originally expected. We were scheduled to work on site almost every week, and planned to spend 2 hours each week. It turned out we sometimes had to work 5 hours a week to cover the labor budget we estimated for volunteers.

C. Planting Plan:

The actual planting generally matched our original planting plan, with a few exceptions. Due to nursery availability, we were not able to acquire three species that were on the original plan. These species were *Cornus nuttallii*, *Rosa gymnocarpa* and *Ribes bracteosum*. With the exception of *Cornus nuttallii*, we were able to substitute plant species that performed similar structural and biological roles. *Rosa nutkana* was used to substitute *R. gymnocarpa* and *Ribes sanguineum* replaced *R. bracteosum*. All plant forms purchased were as planned with the exception of *Corylus cornuta* and *Athyrium filix-femina* which were purchased as 1 gallon pots instead of bare root, due to nursery availability.

Plant spacing varied slightly from the original plan in that several of the smaller shrubs (e.g. *Mahonia nervosa* and *R. nutkana*) were planted in dense clusters
of 3 or 4 plants. However, average spacing remained consistent with the original planting plan, because although plants within clusters were spaced closer, each grouping was spaced wider than stated on the plan. Planting density and spacing also varied within polygons due to existing plant cover densities and desired function of specific planting areas. For example, *Symphoricarpos albus* was planted at a closer average density in Polygon 1 (0.5 m instead of 1 m), in order to provide erosion control in the eroded slope. Other species were planted more densely in bare areas of polygons 2 and 3. However, less species were planted in areas with the existing vegetation in these polygons, so average spacing remained consistent with the original plan.

Total plant species numbers differed in that we planted an additional sixty-four plants. Thirty-two plants were salvaged from the Washington Park Arboretum including five *S. albus*, four *H. discolor*, six *P. munitum*, six *P. menziesii*, one *T. heterophylla*, six *R. parviflorus* and three *A. macrophyllum*. Additionally, thirty bare root *M. nervosa* were purchased from the nursery which was not on the original plan.

Another factor that influenced plant placement was overhead power lines. We were not able to plant any of the large conifers or *A. macrophyllum* along the eastern border of our site, which will influence site structural development and canopy cover.

Overall the planting process went well. Most plants are currently alive, with the exception of two salvaged *Pseudotsuga menziesii* and a bare root *Tsuga heterophylla* which are showing significant discoloration/browning. High survival rates may be due to small scale planting events in which we were able to directly oversee and guide volunteer planting techniques. High plant survival could also be contributed to higher than average rainfall this winter and spring which has produced good conditions for plant establishment and growth.
Literature Cited


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