University of Washington Restoration Ecology Network Capstone 2016-17

# Richmond Beach Saltwater Park

**Location:** 2021 NW 190th St, Shoreline WA 98177

**Prepared for: Maureen Co**laizzi, Diane Brewster & Kay Lakey, City of Shoreline Park & King Conservation District Partnership


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# Project Summary

## Overview

This report describes the Richmond Beach Saltwater Park Restoration Project implemented in 2016 - 2017 for the City of Shoreline. The park is located at 2021 NW 190th Street, in Shoreline, Washington (Figure 1). It lies within the WRIA 8 Cedar-Sammamish watershed. It is surrounded by residential areas on the northern, southern, and eastern sides, and bordered by the Puget Sound on its western side. Parts of the area in the park have been restored previously by University of Washington Restoration Ecology Network (UW-REN) teams. This year a team of six students in the UW-REN Capstone course designed and implemented the restoration project between Octobers of 2016 to May 2017. This year's site is located at the top of the park closer to the picnic lookout area. The community partners for this project include Diane Brewster, Kay Lakey, Maureen Colaizzi, who work directly with the community as well as the City of Shoreline. With our community partners, volunteers, and professor support and involved in our restoration work, we were able to implement this project.

**Polygon 1 and 2**

Before | After

**Polygon 3**

Before | After

# Pre-restoration Description and Ecological Concern

The project site was once a sand and gravel mine before the City of Shoreline started the rehabilitation of what is today known as Saltwater Park. The previous land usage has not only ruined the soil but also completely eliminated any possibility of organic matter to thrive. Ecologically speaking, the main problem to all vegetative life in the vicinity of the park is their lack of establishment. Many plants and some trees that exist currently are much older than their biological features portray them as which proves just how stressful the conditions really are. The soil is very sandy, holds no water, and (site specific) has very steep slopes -- which exemplifies the moisture problem. In addition, the numerous amount of highly competitive invasive species makes native vegetation that much more difficult to incorporate into the landscape. To solve this issue, we purposed to (1) remove the invasive, (2) fascine the steep slopes to slow the movement of water, (3) heavily mulch over invasive rhizomes to hinder any return, (4) plant all native vegetation, and lastly (5) implement a new clay pot irrigation system to hold water within the soil for vegetation to take advantage of through the establishment phase.

# General Approach and Project Goals

With our project, we defined specific goals that would strengthen the native community and limit invasive species as well as improve some of the conditions within the site and its volunteer base. These goals were:

- Goal 1: Remove invasive species and implement preventative procedures to inhibit the regrowth of pests on the site.
- Goal 2: Facilitate the site to reach a condition in which there remains minimal risk of erosion or slope failure
- Goal 3: Improve soil and hydrology conditions that will contribute to native plant establishment.
- Goal 4: Enhance habitat for small animals and invertebrates.
- Goal 5: To promote local community engagement and strengthen volunteer involvement.

The approach for each goal was different with respect to what that each particular goal was accomplishing with our project. For Goal 1, a full removal of the present invasive population using both root removal and base clipping was conducted, and mulch was applied as a preventative measure to inhibit the regrowth of removed invasives. Goal 2 was approached by the use of bioengineered fascines to stabilize the sites slopes. These fascines were used in rows to terrace a portion of the site and aid in stabilization as well as control erosion. As a cost effective solution, fascines were made from Scotch Broom that was available on-site. The implementation for Goal 3 involved mulch rings around native species that were planted on the site to improve the soil conditions, and installing irrigation vessels that have proven to be effective in past projects for each cluster of native species was installed along with the plants. To further improve soil conditions, compost was used along with the current soil when planting to increase the organic content within the soil and improve its current condition.

To enhance the native habitat for Goal 4, we planted a number of species that both tolerated our sites conditions, as well as provided a food source for local fauna. As these plants mature, a new microclimate will be established that will increase the local fauna and flora population. Various plants were chosen to accomplish this goal to create a diverse ecosystem within our project site. To increase community engagement and volunteer involvement with Goal 5, we used Facebook to promote work parties and spread news and photos about our projects updates. For finding new volunteer base opportunities, a volunteermatch.org account was created to reach out to individuals who may have been unaware of our restoration efforts. Flyers, posters, and word of mouth advertising about our project also proved effective in engaging the community. The approaches used for each goal were efficient and effective to fully carry out our restoration project.

## Accomplishments

- 6 successful work parties, 3 of which had 20 or more volunteers.
- Full eradication of the invasive and no return thus far.
- 94% native plant survival rate.
- New close relationship with Kings High School’s environmental department which will provide the park with future volunteer help.
- Over 200 plants were planted on site.
- Reached out and received reputable donations to support our work parties.

# Team Photo

**Center moving clockwise: Bella Scillitani, Kelsie Crawford, Audrey Tay, Daisy Yu, Evan Mei, Sam Gustafsson.**

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We couldn't have done it without you!

CITY OF SHORELINE

King Conservation District

QFC
Quality Food Centers

UW Restoration Ecology Network

UNIVERSITY *of* WASHINGTON

# As-Built Report

## I. Background

### Site Description

Richmond Beach Saltwater Park is a 40-acre park located at 2021 NW 190th Street, Shoreline, WA in Township 26N, Range 3E, Section 2. It lies within the WRIA 8 Cedar-Sammamish watershed. The park is surrounded by residential areas on the northern, southern, and eastern sides, and bordered by the Puget Sound on its western side. During the early 1900's, the Richmond Beach Saltwater Park was used for mining purpose, which accounts for the current steep slopes and bowl-shaped landscape[1].

The 2016 – 2017 University of Washington's Restoration Ecology Network (UW-REN) Saltwater Park restoration site (hereafter referred to as "site") is approximately 0.23 acres of steep slopes varying in percent with moderate invasive species coverage (Figure 1). Due to native nearshore habitat destruction by past gravel mining operations, these slopes also have a high potential for erosion. The site's borders include a parking lot to the north, a picnic area with a lookout to the east, an entry/exit road to the west, and unrestored varying slopes and vegetative communities to the south.


**Figure 1: Richmond Beach Saltwater Park restoration site and polygon assignments.**

The site is composed by soils with loamy-sand texture and loose granular structure that contain little to no organic material. This soil condition created a barrier for native plant species survival and little capacity for water retention resulting dry soil environment. The moderate to steep slopes further makes the soil unstable which increase the potential of erosion.

We divided the site into 3 individual polygons based on topography and vegetation characteristics (Figure 1). The vegetation community in the site is of low diversity and each polygon is considered to be in the 'pioneer stage', with polygon 3 nearing the end of the pioneer stage. The ground layer in both polygons 1 and 2 have a 95% coverage of either Small hair moss (Oligotrichum aligerum), Annual bluegrass (Poa annua), or Nootka reedgrass (Calamagrostis nutkaensis). Polygon 3's vegetation community consists of 85% Scot’s broom (Cytisus scoparius) and Himalayan blackberry (Rubus armeniacus).

Saltwater Park itself provides habitat for a wide range of wildlife such as crows (Corvus hawaiiensis), and various Eastern gray squirrels (Sciurus carolinensis). However, the region within our site does not provide nesting grounds for various avian wildlife due to lack of vegetation coverage. The site has a noticeable potential for fostering habitat for insects, smaller mammals and providing food sources for avian wildlife.

### Restoration Needs and Opportunities

Due to the site's mining history, poor soil environment, steep topography, and limited hydrological conditions, the entire site is dominated by invasive vegetation that tolerates such conditions; as a result, this inhibits the growth of native plants. Restoration is needed to promote native vegetation dominance by removing invasive species and installing native vegetation that tolerates such extreme conditions. The soil quality comprises little organic matter and its specific characteristics limit the amount of native vegetation that may survive. Thus, improving soil condition will be required in order to increase survival rate of native vegetation. In addition, the steep slopes within our site do not provide the stability that native vegetation requires for growth, so stabilizing the slopes would not only decrease the chance of erosion but also further support the growth of native vegetation. Lastly, the site also needs consistent human intervention to ensure the success of native vegetation survival and invasive removal.

## II. Tasks and Approaches

We divided our site into polygon 1, 2, and 3, as mentioned in the site background. We will only be planting on polygon 1 and 2, as only site preparation is planned for polygon 3 in Phase 9 of the Richmond Beach Saltwater Park Restoration Project. Therefore, goals have been separated into two categories: polygons 1 and 2, and polygon 3.

### Polygon 1 & Polygon 2

**Goal 1:** Enhance the native near shore ecosystem and promote dominance of native vegetation.

> **Objective 1-1:** Plant native species to further increase organic content in the soil and better facilitate the growth of native vegetation in the future .
>
> **Task 1-1a:** Install native vegetation with extensive root system that are suitable for our site condition on polygon 1 and 2 to increase the survival rate.
>
> > **Approach:** During our 3rd and 4th work parties, we will be installing native plants with extensive root systems, such as Mahonia aquifolium. We will be installing our plants in a cluster form consisting of 2 plants each (of mixed

species) in a grid fashion instead of individually. Taller shrubs will be placed in polygon 2, while shorter shrubs will be placed in polygon 1. We will also be planting the majority of the grass within polygon 1, with the remaining allocated to polygon 2. Spacing for shrubs will be 2 meters between clumps, 4 meters in between individual trees, and 1 meter for grasses. Installation of the native vegetation will be done by volunteers and the restoration team during the last two work parties. The team will arrive early to place the plants in the correct layout so that volunteers will follow the planting protocol with ease.

**Approach Justification:** In accordance to prior experiences with similar restoration sites within the park, coupled with our site's harsh conditions (steep slopes, poor soil, and little native vegetation), the survival rate is estimated to be 0 to 1% for newly installed plants. Therefore, we opted for plants that have an extensive root system and are tolerant to high sun and drought, such as Mahonia aquifolium.[2] Mahonia aquifolium is commonly found in dry and open areas.[2] Planting in clusters allows for us to create irrigation vessels and apply mulch at a significantly lower cost than on a per plant basis. Planting mixed species clumps will facilitate diversity; whist the grid pattern for the layout of clumps will evenly disperse the vegetation across the site. Additionally, cluster planting is much more efficient in terms of maintenance; only one pot will need to be filled per cluster of plants. The addition of new plant material in polygons 1 and 2 will facilitate the growth of future native vegetation and contribute to the organic matter content in the soil.

**AD1: Plants were sorted by placing roughly 75% of shorter plants in polygon 1 and 25% in polygon 2, while 25% of tall plants went in polygon 1 and 75% in polygon 2 so as not to obstruct the view. This gave the vegetation on the site more variable structure. Plants within each polygon were randomly assigned to clusters, with a focus on placing different species together, to further achieve variation. Rubus leucodermis were planted separately across polygons 1 & 2, due to delays in receiving the plants and upon request from our community partner. Grasses were spread out evenly among polygon 1 & 2 in attempts to increase variation across the site. Majority of the planting occurred during work parties 4 and 5 due to delays.**

**Task 1-1b:** Install native vegetation found in the site area to ensure the survival rate of plants within polygon 1 and 2.

**Approach:** During our 3rd and 4th work parties, we will be adding additional plant individuals to the native communities already present on site, one of which species is Leymus mollis.

**Approach justification:** Due to previous low survival rates, we decided to enhance the native communities currently inhabiting the site and the surrounding area to increase the survival rate of species planted. We specifically selected Leymus mollis due to its low cost and inherent fitness within the site conditions. To further cut costs, we will be transplanting Leymus mollis individuals from larger communities in the surrounding area to the communities within polygons 1 and 2. Transplanting individuals from nearby will ensure the new plants will have the adaptive capacity to survive the site conditions.

**Objective 2-1:** Create microclimates in order to diversify the site and increase plant species richness.

**Task 2-1a:** Install native plants of varying heights to create a diverse vertical understory.

**Approach:** During our 3rd and 4th work parties we will be installing native plants, such as native grasses, shrubs, and trees, to create a variation in height differences. Planting layout will be the same as that outlined in Task 1-1a.

**Approach Justification:** We have integrated plant species of all heights in our plant selection in order to facilitate species richness of the site. Larger shrubs, such as Mahonia aquifolium, will provide protection from the intense sunlight and lower ground temperatures to allow for other understory vegetation to flourish in the increased shade. When planting, different species will be clumped together. Variances in a vertical understory will produce an array of microclimates with different sun and shade intensities, creating more ecological niches to be filled by other species.

**Goal 3:** Improve soil and hydrology conditions that will contribute to native plant establishment.

**Objective 3-1:** Add mulch to increase organic content and improve soil quality.

**Task 3-1a:** Lay arborist mulch around the base of the installed plants to facilitate moisture retention.

**Approach:** We will lay mulch in an 8 inch circumference around the base of each cluster (containing two plants) approximately 6 inches deep. An inner ring of 2 inches adjacent to the stem of the plants will be left clear of mulch to allow moisture and light to penetrate the root system.

**Approach justification:** The mulch will be applied in this manner in order to create microclimates where shade can increase survival rates of sun-intolerant understory plants. In addition, the cluster approach is a more cost-effective solution. Arborist mulch contains the nutrients essential to the plant's survival in polygon 1 and 2.[3] It also increases moisture retention, lending plant's a greater ability to survive through drought condition, should they occur, and promoting resilience.[3]

**AD2: Along with mulch rings, vegetation was planted using a mixture of compost and native soil to help facilitate moisture retention, nutrient availability, and overall survival of the plants.**

**Objective 3-2:** Employ an efficient, effective, and affordable irrigation method to facilitate the survival of native plants

**Task 3-2a:** Install a clay pot irrigation system to provide a withstanding water supply for plants growing in soils of low water retention.

**Approach:** Two clay pots will be used in each vessel, glued together with silicone glue by the restoration team and allowed to adhere several days in advance of installation. The vessels will be installed during the 3rd and 4th work parties with the help of volunteers.

**Approach justification:** Since the soil onsite mostly consists of sand, water retention is very low as fluids quickly drain through the substrate. Furthermore, the site's topography contains many steep slopes where water rapidly flows downhill, leaving little behind to nourish the vegetation. Therefore, an irrigation system would supply the developing ecosystem enough water to survive through harsh conditions year-round, until the plants have reached a level of maturity where their rate of survival has increased. We are implementing the clay pot method because it is efficient, effective, and affordable. Using clay pots as irrigation vessels is also less labor intensive than other methods, like subsurface irrigation for example[4], and has a higher water efficiency use to a lower cost than traditional methods like sprinklers.[4] Since water is drained so rapidly through the sandy soil, the vegetation will need to be supplied water often and clay pots efficiently accomplishes this task, while requiring little maintenance. The clay pot irrigation vessels should only need to be refilled with water about once a week once they are installed.[4]

**AD3: Irrigation vessels were installed during work parties 4 and 5, as well as during a scheduled team maintenance event. This was due to the delay in the start of planting, as well as defects in irrigation vessels which required repair and replacement.**

**Goal 4:** Enhance habitat for small animals and invertebrates.

**Objective 4-1:** Provide functional habitat to provide shelter and protection for local fauna.

**Task 4-1a:** Plant native species that promotes a diverse ecosystem.

**Approach:** Refer back to Task 2-1a

**Approach justification:** During plant selection, caution was taken to be sure a wide variety of plants serving multiple ecological niches were chosen to enhance the site's present ecosystem. The goal was to increase diversity by creating more microclimates and thus opening up opportunity for more ecological niches to be filled. To do this plants of varying heights and sizes were selected with an array of morphological features within three different vegetation types; grasses, shrubs, and trees. Increasing vegetation diversity should attract a range of different animals and invertebrates to the area, the increasing the overall ecosystem species richness and diversity. Diversity is a topmost priority in any ecosystem since it promotes resistance, especially when challenged by changes in the environment, and resilience.

**Objective 4-2:** Plant species that provide nutritional support for local fauna.

**Task 4-2a:** Integrate native species into the present ecosystem that are adapted to the site conditions which also produce berries, nectars, and or other elements of nutritional support to local fauna.

**Approach:** During our 3rd and 4th work parties, we will be planting Rubus leucodermis, Mahonia aquifolium, Oemleria cerasiformis, Ribes sanguineum and Arbutus menziesii in polygons 1 and 2.

**Approach justification:** Each species listed above confers high fitness to the site conditions, many of which, such as R. leucodermis, is present in the area surrounding the site. These species also produce berries, seeds, and nectars that contribute valuable food resources to the local fauna. The sweet berries produced by R. leucodermis most notably attract bird and larger wildlife, while leaves and stems may be eaten by small rodents and herbivores. Even the bark of the shrub provides nutritional benefits to some animals. M. aquifolium, R. sanguineum, and Arbutus menziesii attract hummingbirds, bees and other pollinators throughout the warmer parts of the year while O. cerasiformis yields plum-like fruits during the winter season. Thus, the selection of plants should accommodate fauna year-round.

**AD4: Again planting occurred during 4th and 5th work parties due to delays caused by underestimation of time needed for restoration of polygon 3.**

**Goal 5:** Promote local community engagement and strengthen volunteer involvement.

**Objective 5-1:** Recruit volunteers to participate in the restoration process.
**Task 5-1a:** Create a Facebook page dedicated to the Richmond Beach Saltwater Park Restoration Project, email past volunteers, and schedule work parties in the city calendar.

**Approach:** We have requested an email list from our client to email previous volunteers. We have also added our work party dates on the City of Shoreline's calendar and plan to create a Facebook page for our events in order to advertise the work parties and reach all audiences within the surrounding Shoreline community.

**Approach justification:** Advertising via multiple communication and networking pathways will allow us to reach a wider range of audiences. The goal is to facilitate relationships with the Shoreline community to procure an active volunteer culture in regards of the park. We want to be sure to keep past volunteers involved and up-to-date in the restoration process while enlisting the help of new volunteers as well.

**AD5: The park already has a Facebook page, which we used to advertise work party events, along with emails and the city calendar. We also used sites such as Meetup.com and volunteermatch.org to gain more new volunteers. In addition, we reached out to Kings High School and Washington Native Plant Society for volunteers. This abled us to increase our efforts to bring in new volunteers for the park.**

**Objective 5-2:** Supervise, educate, and facilitate cooperation of community volunteers during work parties.
**Task 5-2a:** Educate volunteers of the park history and proper restoration methods.

**Approach:** Before getting to work, a brief history of the park will be given to the volunteers during each work party. Groups will be randomly generated and assigned to a task under the supervision and instruction of at least one team

member. These groups will intermittently switch between tasks.
**Approach justification:** Providing a background of the park's history before the actual labor commences will allow the community to come to know the park and understand how harmful human activity can disrupt an ecosystem in the long-term, as well as learn the phases of restoration. We want our volunteers to not only be assisting in the labor, but to understand the valuable work they are providing so as to facilitate a greater work ethic and appreciation throughout the process. Dividing the volunteers into groups will decrease the amount of people working in one area and use the volunteers time more efficiently to complete a variety of tasks. The volunteers will work together to accomplish each task, and switching between tasks will allow volunteers to learn about multiple restoration activities as well as avoid boredom throughout the duration of the work party.

**Objective 5-3:** Cooperate with local businesses to further increase community involvement in the restoration of the park via donations for volunteers.
**Task 5-3a:** Contact local companies for donations to be used as refreshments during work parties.

**Approach:** The local QFC and Starbucks has been contacted and agreed to assist in the restoration of the park by donating refreshments for all four of our work parties to keep volunteers nourished and hydrated during intense labor and keep morale up
**Approach justification:** Since our budget for restoration work does not include food or refreshments for our hard-working volunteers, donations were graciously accepted to keep the volunteer nourished and hydrated during work parties. Snacks and coffee provide a well-earned break between work projects, keeps morale up, and provide a better overall experience for our volunteers. Offering refreshments  additionally provides incentive to continue quality work and return for later work parties.

## Polygon 3

**Goal 1:** Remove present invasive species to inhibit the establishment of other invasive pests in the site.

**Objective 1-1:** Preserve the existing native plants on the site, while removing the invasive species and suppressing recurrence in polygon 3.
**Task 1-1a:** Remove Rubus armeniacus in polygon 3

**Approach:** In preparation of the site, the team and volunteers will clear out R. armeniacus over the first two work parties. All individuals must be removed by pulling out the plant body along with the entire root system so that the plant will not be able to regrow the following year.
**Approach Justification:** R. armeniacus is a well known invasive species in the Pacific Northwest that plagues a large portion of polygon 3. Removal of R. armeniacus will significantly reduce seed dispersal of the species on the site and provide opportunity for existing and new native species to inhabit the area. Manually pulling out R. armeniacus is the most effective and cost efficient method of removal known to date besides applying herbicide[5], which will not be used due to the park's regulations and additional harm that herbicides may cause. However, this will mean the park's maintenance team will need to constantly monitor the area to watch for reemergence of any R. armeniacus throughout the site.

**Task 1-1b:** Remove Cytisus Scoparius in polygon 3
**Approach:** The same tactics will be used removing C. Scoparius as with the removal of R. armeniacus except that the larger C. Scoparius (stems with a diameter of >2in) will only be cut even with the ground level while smaller individuals (stems with a diameter of <2in) will be pulled out with the entire root system. Loppers and wood saws, rather than weed wrenches, will primarily be used for this task.
**Approach Justification:** Removal of C. Scoparius will significantly reduce seed dispersal of the species onsite; therefore leaving room for existing and new native species to establish in the area. Smaller C. Scoparius will be pulled out because removing the entire plant body decreases the chance of reestablishment.[6] However, do to the large size of more mature C. Scoparius, it is too difficult to pull out the entire plant boyd and root system so these individuals will just have to be cut. Cutting is still a very effective method in older plants that are no longer green at the base, which is the case with the C. Scoparius individuals of stem diameters greater than 2 inches found on the site.[6] Additionally, volunteers will be instructed to cause as little disturbance to the site as possible while working in order to minimize human impact and the possibility of disrupting or germinating seeds within the soil. The park maintenance team will also need to monitor regrowth C. Scoparius over the year as with R. armeniacus.

**Goal 2:** Enable the site to reach a condition in which there remains minimal risk of erosion or slope failure.

**Objective 2-1:** Implement best practices for stabilizing slopes in an affordable and efficient manner in polygon 3.

**Task 2-1a:** Use arborist mulch to protect bare soil from drying out and reduce the impact of erosion in polygon 3.

**Approach:** Lay 6 - 8 inches of arborist mulch over all of polygon 3 where R. armeniacus was removed. Lay 2 inches of arborist mulch over all of polygon 3 where C. Scoparius was removed. This is part of the site preparation and will be done by volunteers and the restoration team over the first two work parties.

**Approach justification:** According to Ph. D Linda, professor at Washington State University research, arborist mulch is highly recommended "in areas where trees are a dominant feature of the landscape".[3] Arborist mulch contains beneficial nutrients for plant life and will improve the soil structure, prevent erosion, and inhibit compaction.[3] Six to eight inches of mulch will be applied to the steeper slopes where little soil is present and R. armeniacus will be removed. The two inches of mulch where C. Scoparius will be removed from is more level terrain and will therefore require less additional mulch to prevent erosion.[5] Mulch also suppresses regrowth of invasive species that have been recently removed such as R. armeniacus and C. Scoparius because it blankets the cut stems and creates an impenetrable barrier from the sun .[5]

**AD6: Instead of the intended 6 - 8 inches of arborist chip mulch, 4 inches were applied to polygon 3 where both R. armeniacus and C. Scoparius were removed. The original 8 inches was reduced to prevent potential landslide opportunities that would have been caused by additional layers of mulch. The team and the park biologists determined that the goal of slope stabilization was still satisfied with this reduction.**

**Task 2-1b:** Install fascines to prevent erosion of the soil and steep slopes in polygon 3.

**Approach:** After removing C. Scoparius from the site, we will collect and dry the dead branches to create bundles of C. Scoparius branches during the first two work parties.. C. Scoparius branches will be the material for the fascines, which will then be installed during the second work party on the steeper slopes of polygon 3.

**Approach justification:** Utilizing the extra material that was removed from the site for the construction of fascines significantly lowers the restoration budget and allows for better quality plants to be purchased. Fortunately C. Scoparius branches serve as excellent fascine bundles when dried. The drying step is crucial because any live branches or seeds have the potential to grow and re-establish the invasive species in the area. Drying the bundles ensures that no live branches remain and renders seeds unviable. The idea behind laying bundles of branches, or fascines, on steeper slopes is to trap sediment and protect against erosion. The dried bundles will be positioned horizontally along the slope in a step-like fashion to lock soil particles in place and prevent further erosion of the slopes.[5] Fascines were selected over other methods, such as brush layers, due to low costs and immediate resolution to the sites intense erosion problems.

# III. Specific Work Plans

## Site Preparation Plan

### Current Site Conditions

#### Topography

The topography of our site can be described as a steep slope. The bottom of the slope borders a small road with the top of the incline meeting a parking lot on the east side. Approximating 10,000 sq ft., the slope of our site is roughly ~120% on an west northwest decline (facing the Puget Sound), varying by polygon. Because of this steep incline on our site, it has suffered erosion, which has had effects on the soil, vegetation, and hydrology. These slopes and their soil conditions also strain slope stability, which can limit vegetation, and in a worst-case scenario make the slope unstable. There was also a noticeable potential for erosion seen with shifting soils, especially in polygon 3.


**Figure 2: Topographical map of restoration site.** [7]

## Soil

The soil found at the site was difficult to classify. Using the USDA soil series survey, we determined the soil was closest in similarity to an Indianola soil series.[9] This was because the soil found had a small O horizon and loose sand texture often found on hills. Again, it is difficult to say for sure if this is correct because so much disturbance has occurred in the area due to the Richmond Beach Sand and Gravel Company. The hillside was destroyed, and in the process the soil profiles found in the park were altered as well, because of this it could be classified as an urban soil.

## Hydrology

We determined that the portions of the east border of our site has moderate to steep slopes that with up to a 120% grade inclination in the southern end of polygon 3. The steep slope means erosion is a highly potential issue that considerably affects the stability of the area. Since there is more vegetation coverage on the slope of polygon 3, this expanse of areas has lower erosion potential compared to polygon 1 and 2. The soil texture in this area is gravelly and sandy, which means the soil has little capacity for water retention and a high rate of infiltration. The main water source is from precipitation and flows vertically down the slope, carrying organic matter and nutrients from upland to ground level. Excess water runs further down to the next site across the pathway. In addition to the slope, there is no standing surface water present on the site; the area remains relatively dry, a significant contrast to the humid Northwest climate. As a result, the insufficient amount of water and nutrients becomes an important limiting factor to the growth of the plants in this area.

## Vegetation

The vegetation community within our site is one of low diversity. The closest vegetation community that can be paired with the site is Fero-Cale.[10] This is because it contains short grasses that are similar to those of the area, however, the site is highly susceptible to exotic invasive species and only has approximately 3 to 4 native species present. Of the 3 polygons the site has been separated into, 95% of the vegetation covers are Small hair moss (Oligotrichum aligerum), Annual bluegrass (Poa annua), or Nootka reedgrass (Calamagrostis nutkaensis) in the 1st and 2nd polygons. In the 3rd polygon, 85% of the dominant species covers are Scot's broom (Cytisus scoparius) and Himalayan blackberry (Rubus armeniacus).

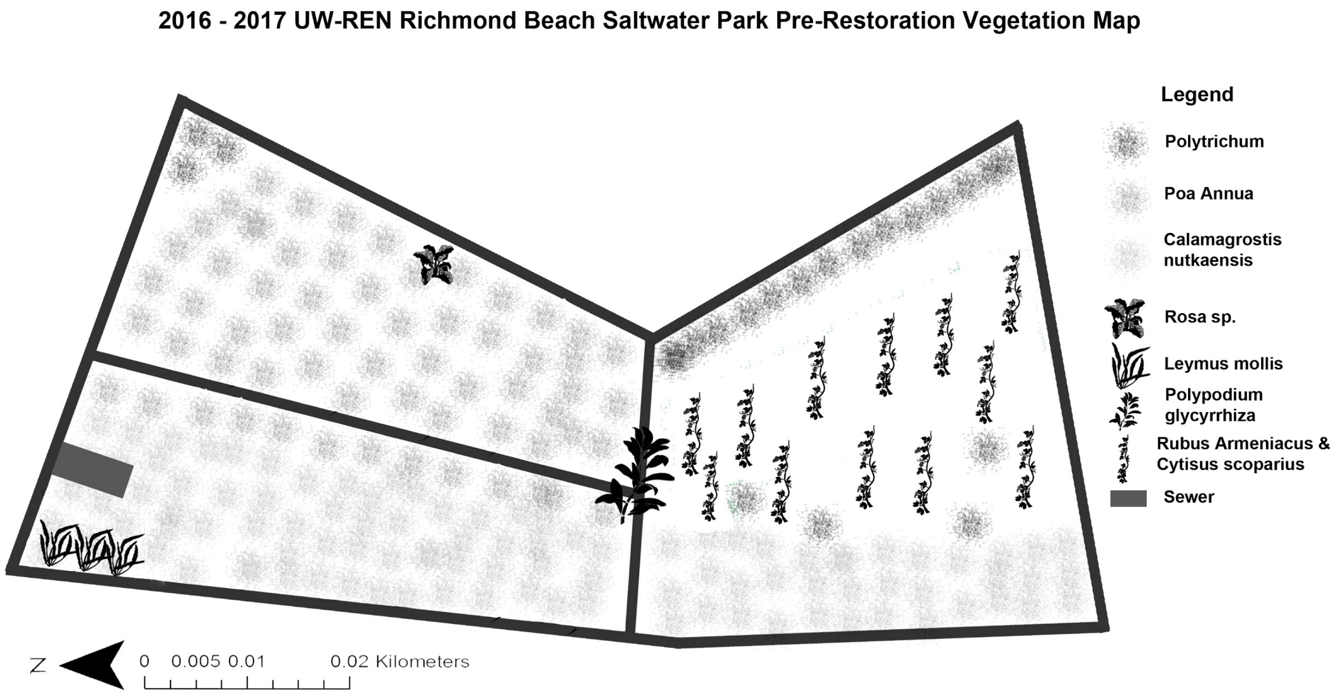


**Figure 3: Vegetation on site before any restoration work.**

## Disturbance

The entire site is highly disturbed by both environmental and human factors. The site was historically used for mining purposes, of which the aggregate mining significantly influenced the soil condition making it hard for native plants to survive, but providing suitable habitat for invasive species like the Himalayan blackberry and Scot's broom to move in. The success of these invasive species is due to their ability to adapt to a variety of soil types.

### Environmental Conditions

| | Polygon 1 | Polygon 2 | Polygon 3 |
|---|---|---|---|
| **Polygon area (m^2)** | 278.7 m^2 | 278.7 m^2 | 371.6 m^2 |
| **Soil Texture** | Loamy sand | Loamy sand | Loamy sand |
| **Soil moisture** | Mesic to dry | Mesic to dry | Mesic to dry<br>10cm of mulch at the bottom |
| **Slope** | West-Northwest facing decline<br>Slope of 100% | West-Northwest facing decline<br>Slope of 100% | West-Northwest facing decline<br>Slope of ~120% |
| **Light availability** | Intense sunlight during the summer<br><br>No overstory to create shadow | Intense sunlight during the summer<br><br>No overstory to create shadow | Intense sunlight during the summer<br><br>No overstory to create shadow |
| **Present vegetation** | Oligotrichum aligerum | Oligotrichum aligerum | Oligotrichum aligerum |
| | Poa annua | Poa annua | Poa annua |
| | Calamagrostis nutkaensis | Calamagrostis nutkaensis | Calamagrostis nutkaensis |
| | Polypodium glycyrrhiza | Polypodium glycyrrhiza | Polypodium glycyrrhiza |
| | Rosa sp. | Leymus mollis | Rubus armeniacus |
| | | | Cytisus scoparius |
| **Human Impacts** | Poor soil and unstable slope from intense disturbance | Poor soil and unstable slope from intense disturbance | Poor soil and unstable slope from intense disturbance.<br>Addition of mulch. |

| | | | |
|---|---|---|---|
| **Other Considerations** | Preserve views;<br>Preserve native species present;<br>Enhance native ecosystem | Preserve views;<br>Preserve native species present;<br>Enhance native ecosystem | Preserve views;<br>Plant to prevent recolonization of removed invasives |

**Table 1: Environmental conditions of individual polygons.**

# IV. Planting Plan

Once we have culminated our site preparation, our team will begin planting with respect to the soil conditions as well as the view of the Puget Sound from the lookout points. Planting will be followed through within polygons 1 and 2. Polygon 3 will only involve the removal of invasive species Rubus armeniacus in addition to the bioengineering of the fascines and finalized with eight inches of arborist wood chip mulch.

We plan to incorporate plants that have high survival rates in highly stressful conditions. Our site is very water limiting and receives intense sunlight during the summers so our choice of vegetation had to be closely researched to prevent the wasting of funds from not only our clients but also the University of Washington. We decided that spacing would be around 2 meters for shrubs, 4 meters for trees, and 1 meter for grasses. We are going to be creating some clusters due to our lack of funds for clay pots so our spacing will not be from individual plants but more so between clusters. The four Arbutus menziesii will be placed along the side of the entry parking lot within the regions of both polygon 1 and 2. Our clients have had previous success in the growth of a Arbutus menziesii in other restoration programs so we wanted to incorporate a few into this project. The overall form of our vegetation is going to be in 1 gallon buckets with at least 12 inches of growth to ensure a higher survival rate. Larger more mature saplings will be able to accommodate for themselves much more efficiently compared to smaller, younger seedlings. We found that 12 inch, 1 gallon bucket saplings were large and mature enough for the cost.

## Planting List

| | Polygon 1 | | |
|---|---|---|---|
| **Species** | **#** | **Spacing (m)** | **Form** |
| **Grasses** | | | |
| ~~***Festuca roemeri***~~ | ~~50 clusters~~ | ~~1~~ | ~~Seed packet (1 oz. packets ≈ 3042 seeds)~~ |
| ***Leymus mollis*** | ~~50~~<br>**60** | 1 | 1 gal |
| **Trees** | | | |
| ~~***Arbutus menziesii***~~ | ~~2~~ | 4 | ~~1 gal~~ |
| **Shrubs** | | | |
| ***Mahonia aquifolium*** | 10 | 2 | 1 gal |
| ***Oemleria cerasiformis*** | ~~10~~<br>**5** | 2 | 1 gal |
| ***Holodiscus discolor*** | ~~10~~<br>**5** | 2 | 1 gal |
| ***Ribes sanguineum*** | ~~10~~<br>**9** | 2 | 1 gal |
| ***Rubus leucodermis*** | 10 | 2 | 1 gal |

| | Polygon 2 | | |
|---|---|---|---|
| **Species** | **#** | **Spacing (m)** | **Form** |

| | | | |
|---|---|---|---|
| **Grasses** | | | |
| ~~***Festuca roemeri***~~ | ~~50 clusters~~ | ~~1~~ | ~~Seed packet (1 oz. packets ≈ 3042 seeds)~~ |
| ***Leymus mollis*** | ~~50 clusters~~ **60 individual** | 1 | 1 gal |
| **Trees** | | | |
| ***Arbutus menziesii*** | 3 | 4 | 1 gal |
| **Shrubs** | | | |
| ***Mahonia aquifolium*** | 10 | 2 | 1 gal |
| ***Oemleria cerasiformis*** | ~~10~~ **15** | 2 | 1 gal |
| ***Holodiscus discolor*** | ~~10~~ **14** | 2 | 1 gal |
| ***Ribes sanguineum*** | ~~10~~ **30** | 2 | 1 gal |
| ***Rubus leucodermis*** | 10 | 2 | 1 gal |

**Table 2: Individual planting list for each polygon.**

**AD7: Plant numbers for polygon 1 & 2 were revised according to changes addressed in AD1 (75% of taller plant in polygon 2 and 75% of shorter plants in polygon 1). We did not plant any Festuca roemeri seeds due to timing and logistical challenges. We also determined after planting the immature plants that we had satisfied our vegetation goals and the seeding was not necessary. We did not plant Arbutus menziesii on polygon 1 so as to not block the view.**

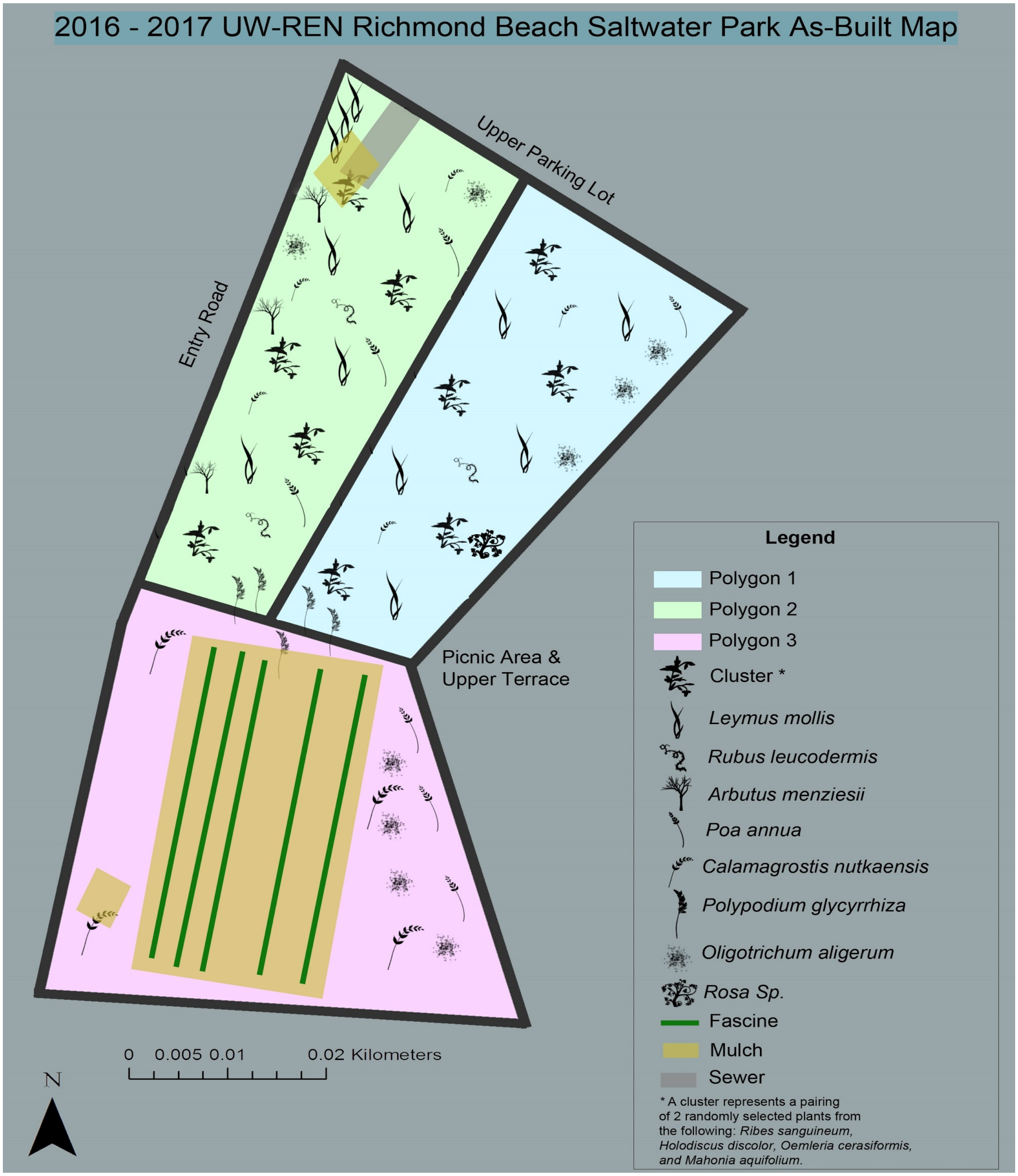


**Figure 4. 2016 - 2017 UW-REN Richmond Beach Saltwater Park As-Built Map**

# V. Budget Plan

## Labor Budget

| Project Labor(hours of effort) budget and actual | | | | | |
|---|---|---|---|---|---|
| | | **Project Budget** | | **Project To-Date (as of 02/04/2017)** | |
| | | Team | Volunteers | Team | Volunteers |
| **Tasks** | | (hours) | (hours) | (hours) | (hours) |
| Prepare Site | | | | | |
| | Remove Garbage | 4 | 3 | 1 | 2 |
| | Border Demarcation | 1 | 0 | | |
| | Remove Himalyan Blackberry | 40 | 90 | 16 | 24 |
| | Remove Scotch Broom | 20 | 30 | 8 | 8 |
| | **Subtotal** | **65** | **123** | **25** | **34** |
| Plant site | | | | | |
| | Plant Polygon 1 | | | | |
| | Purchase Polygon 1 Plants (incl. tax and delivery charges) | | | | |
| | Pick up polygon 1 plants (from nursery or salvage) | 20 | | | |
| | Install plants on Polygon 1 | 40 | 30 | | |
| | Plant Polygon 2 | | | | |
| | Purchase Polygon 2 Plants (incl. tax and delivery charges) | | | | |
| | Pick up polygon 2 plants (from nursery or salvage) | 20 | | | |
| | Install Polygon 2 plants | 35 | 30 | | |
| | **Subtotal** | **115** | **60** | **0** | **0** |
| Apply Mulch | | | | | |
| | Find and acquire mulch | 4 | 0 | | |
| | Spread mulch on Polygon 3 | 20 | 60 | | |
| | Creating mulch ring around the plants | 12 | 20 | | |
| | **Subtotal** | **36** | **80** | **0** | **0** |
| Apply Fascines | | | | | |
| | Create fascine | 40 | 90 | | |
| | Installation | 40 | 50 | | |

| | | | | |
|---|---|---|---|---|
| Care for site post-Installation | | | | |
| Irrigation vessels creation | 8 | 30 | | |
| Irrigation vessels installation | 28 | 40 | | |
| Replace plants as needed | | | | |
| **Subtotal** | **36** | **70** | **0** | **0** |
| | | | | |
| Plan and manage work parties | | | | |
| Collect and return tools for 2/4 team work party | 2 | 0 | 2 | 3 |
| Organize and instruct 2/4 VWP | 8 | 0 | 9 | 1 |
| Solicit and obtain refreshments for 2/4 VWP | 6 | 0 | 6 | |
| Collect and return tools for 2/25 team work party | 2 | 0 | | |
| Organize and instruct 2/25 VWP | 8 | 0 | | |
| Solicit and obtain refreshmments for 2/25 VWP | 6 | 0 | | |
| Collect and return tools for 3/18 VWP | 2 | 0 | | |
| Organize and instruct 3/18 VWP | 8 | 0 | | |
| Solicit and obtain refreshments for 3/18 VWP | 6 | 0 | | |
| **Subtotal** | **48** | **0** | **17** | **4** |
| | | | | |
| Prepare and deliver reports and presentations | | | | |
| Develop and deliver presentation to City Council | 6 | 0 | | |
| Produce as-built report | 20 | | | |
| Design, prepare, print final poster | 10 | 0 | | |
| **Subtotal** | **36** | **0** | **0** | **0** |
| | | | | |
| **TOTAL** | **416** | **403** | **42** | **38** |

**Table 3-1: Projected Labor Budget.**

| Labor by source (revenue) | Total (hours) |
| --- | --- |
| **Team** | ~~416~~<br>423 |
| **Volunteers** | ~~403~~<br>464 |
| Work Party #1 | 38 |
| Work Party #2 | 122 |
| Work Party #3 | 122 |
| Work Party #4 | 121 |
| ***Total Volunteer*** | ~~403~~<br>463 |
| **TOTAL** | **~~819~~**<br>**887** |

**Table 3-2: Labor Budget Totals.**

**AD8: After closely examine our tasks, we found out that we did not take some of the tasks into consideration, such as time needed for preparing reports and site maintenance. On the other hand, we overestimated the hours taken for plant acquisition and planting, so we reduced the project time for these tasks to make better estimation. Overall, we increased our project labor hours for both team members and volunteers.**

## Financial Budget

| Item | Form | Quantity | Cost per unit | Cost |
|---|---|---|---|---|
| **Plants** | | | | |
| *Mahonia aquifolium* | 1 gal | 20 | ~~$8.25~~<br>**$6.00** | ~~$165.00~~<br>**$120.00** |
| *Oemlaria cerasiformis* | 1 gal | 20 | ~~$7~~<br>**$3.25** | ~~$140.00~~<br>**$65.00** |
| *Holodiscus discolor* | 1 gal | ~~20~~<br>**19** | ~~$8~~<br>**$3.25** | ~~$160.00~~<br>**$61.75** |
| *Ribes sanguineum* | 1 gal | ~~20~~<br>**18** | ~~$8.75~~<br>**$4.00** | ~~$175.00~~<br>**$72.00** |
| *Ribes sanguineum* | 1 gal | **21** | ~~$8.75~~<br>**$3.50** | ~~$175.00~~<br>**$70.00** |
| ~~*Festuca roemeri*~~ | ~~Seeds (1oz)~~ | ~~1~~ | ~~$12~~ | ~~$12.00~~ |
| *Leymus mollis* | Relocation | ~~100~~<br>**65** | $0 | Free |
| *Arbutus menziesii* | 1 gal | ~~5~~<br>**3** | ~~$14.00~~<br>**$10.00** | ~~$70.00~~<br>**$30.00** |
| *Rubus leucodermis* | 1 gal | 20 | ~~$7.00~~<br>**$3.00** | ~~$140.00~~<br>**$60.00** |
| **Mulch** | | | | |
| Arborist chip | | 40 yards | $21.00 | $919.80 (include tax) |
| **Tools** | | N/A | N/A | $496.05 |
| **Irrigation** | | | | |
| Clay pots | | 150 | $1.50 | $225.00 |
| Silicon | | ~~3~~<br>**10** | ~~$7.50~~<br>**$3.89** | ~~$22.50~~<br>**$38.90** |
| **Fascine** | | | | |
| Wood Stakes | | 48 | | $37.78 |

| | | | |
|---|---|---|---|
| **Printing** | | | |
| Poster | 1 | | $20 |
| **Work Parties (food & coffee)** | | | |
| Food and coffee | 20 | $0 | Donations |
| **Total** | | | ~~$2583.13~~ **$2196.28** |

**Table 4-1: Budget Allocations**

**AD9: We were able to source many of our plants though the SER UW Nursery, which lowered prices considerably. We also did not buy *Festuca roemeri* seeds due to reasons stated previously in this report. These decreases in prices allowed us to buy all the plants we needed, as well as obtain more Ribes sanguineum with the extra money left over. Unfortunately finding high quality Arbutus menziesii that would establish on our disturbed site was difficult, but we were able to find three trees at a decent price.**

| **Revenue by fund source** | |
|---|---|
| **Course fee allotment** | $600 |
| **Fundraising** | $0 |
| **Donations** | Food (QFC) and Coffee (Starbucks) |
| **City of Shoreline** | $1,500 |
| **King Conservation District** | $500 |
| **Total funds given** | **$2,600** |
| **Project Total** | **$2595.35** |

**Table 4-2: Budget Summary.**

## Logistics

<table>
<tr><th colspan="3">Site Preparation Activities</th></tr>
<tr><th>Polygon 1</th><th>Polygon 2</th><th>Polygon 3</th></tr>
<tr><td>Stage the North side with mulch piles, tools, and plants.</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Assemble clay pot irrigation systems and have them ready to install alongside vegetation after conclusion of site preparation.<br>The addition of 2 in. deep Arborist Chip mulch to increase organic matter levels in the soil and water retention.</td><td>Removal of invasives Rubus armeniacus and Cytisus scoparius</td></tr>
<tr><td>Manufacturing fascines with the stocks of Cytisus scoparius roped together in large bundles.</td></tr>
<tr><td></td><td></td><td>Tie together several dormant branches 1/2 to 2 inches in diameter and at least 3 to 4 feet long[11].</td></tr>
<tr><td></td><td></td><td>Digging 1 ft. trenches for the fascines on the hillside spacing out the rows by 15 ft[11].</td></tr>
<tr><td></td><td></td><td>Place bundles end-to-end or slightly overlapping to form a continuous planting that should follow the contour of the slope[11].</td></tr>
<tr><td></td><td></td><td>Stake the fascines in place with wooden stakes[11].</td></tr>
<tr><td colspan="2">The addition of 2 in. deep Arborist Chip mulch to increase organic matter levels in the soil and water retention.</td><td>The addition of 8 in. deep Arborist Chip mulch to increase organic matter levels in the soil and water retention.</td></tr>
</table>

**Table 5: Logistics Table for individual polygons.**

## Logistics Map

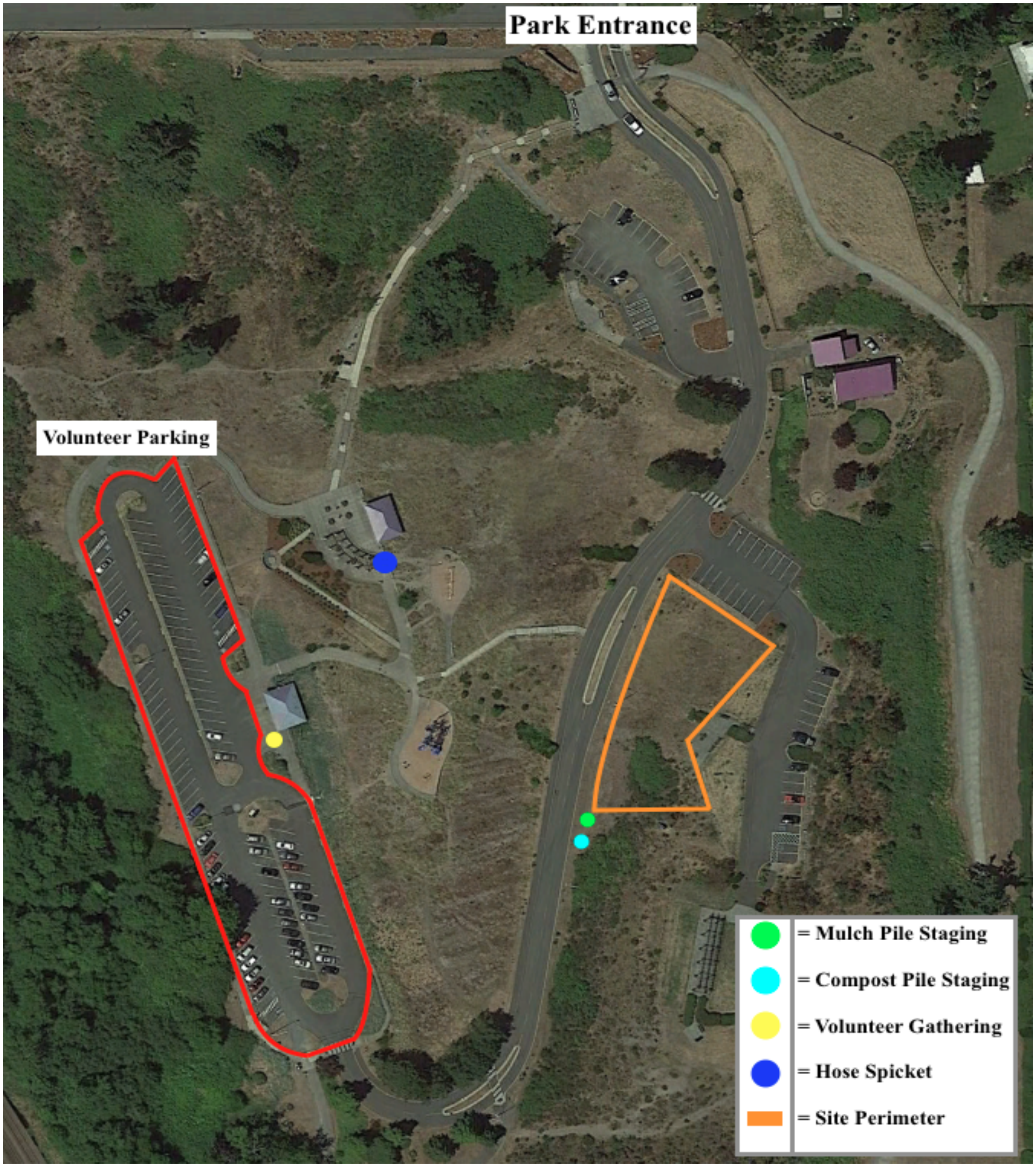


**Figure 5: Logistics Map of Restoration Site.** [12]

# VI. Other Plans

## Clay Pot Irrigation System

In addition to the planting taking place in Polygon 1 and Polygon 2, we plan to have volunteers assist in the making of clay pot irrigation systems. The clay pot irrigation system is a simple device that allows an assisted retention of water for each individual plant on our planting list. The soil conditions make the establishment of plants very difficult and with the establishment of seeds the success rate is below 1% which makes this irrigation system a vital part of the restoration project. During the second or third work party (depending on how much work gets done) we will have the volunteers assist in the construction of gluing tops of clay pots together. We have to glue together 150 clay pots (two per shrub/tree). Clay pots will not be used for the grass seeds. Our hope is that with the large amount of clay pot irrigation systems we are installing will provide water more spatially in addition to the addition of mulch to retain water from rainfall so that the seeds can survive through the first few stages of growth. The grasses are drought-tolerant species so they should have good survival rates if they get past the seedling stage.

**Figure 6: Clay Pot Irrigation Vessels.** [8]

## Fascines

For Polygon 3, our plan is to stabilize the steep slopes as well as enhance the water retention with not only 8 inches of arborist wood chip mulch but also fascines. Fascines are a very useful piece of bioengineering that slows down the water moving down the slope so that it can be soaked up by the mulch to hold water and create a thick organic layer in the soil over time. During the first and second work parties we will have our volunteers assist in harvesting invasive Cytisus scoparius stalks, which we will then form long bundles that will be tied down with a biodegradable twine. The stalks will first need to be dried out significantly for at least a week or two to reduce the chance of seeding and regrowing. Once the bundles are made and dried out, we will be building small trenches around 1 ft. depth following the contour of the slope. Next is simply placing the fascines in the trench and fastened with wooden stakes to keep them in place. We won't be using live stakes because we do not want to encourage growth in Polygon 3 which has a view of Puget Sound that must be preserved as per request by our clients of Saltwater Park.

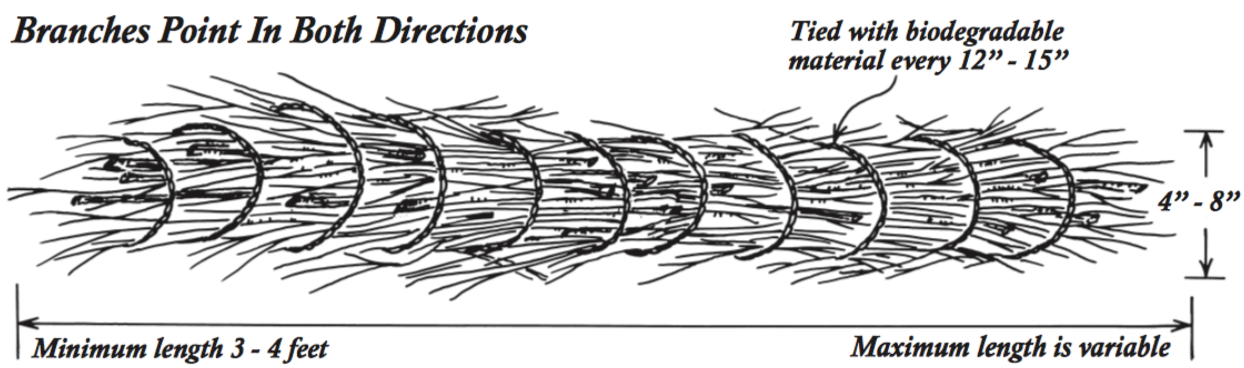


**Figure 7: Fascine structure.**[11]

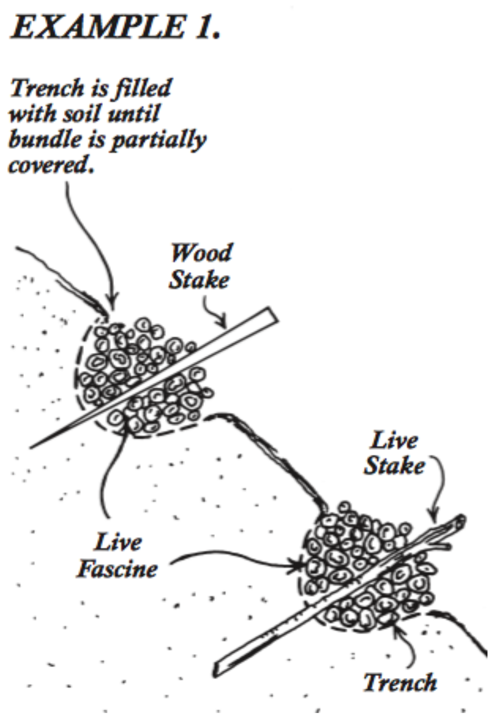


**Figure 8: Fascines placed within trenches on the side of a slope.**[11]

# VII. Work Timeline

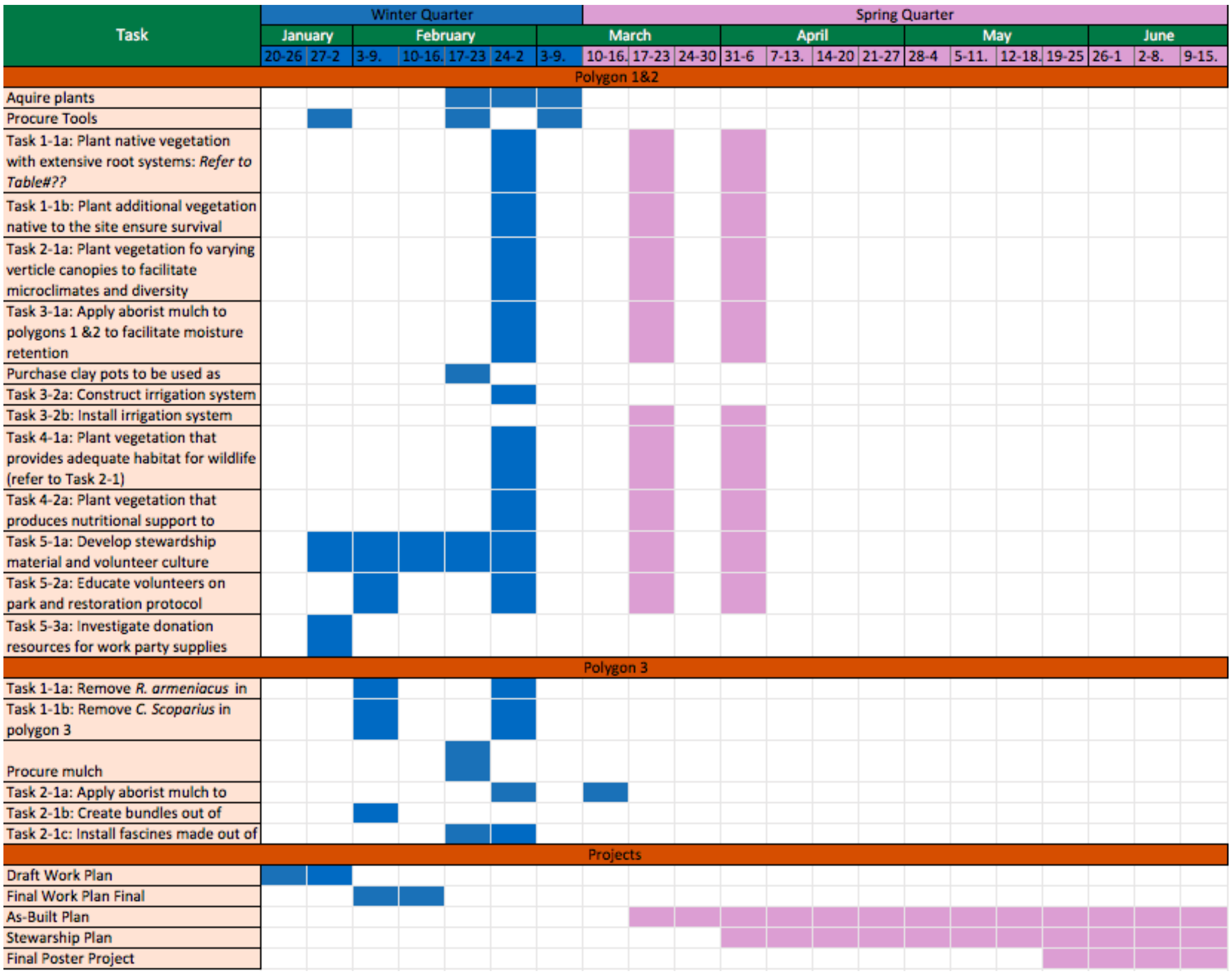


**Table 6: Gantt Chart of Work Timeline**

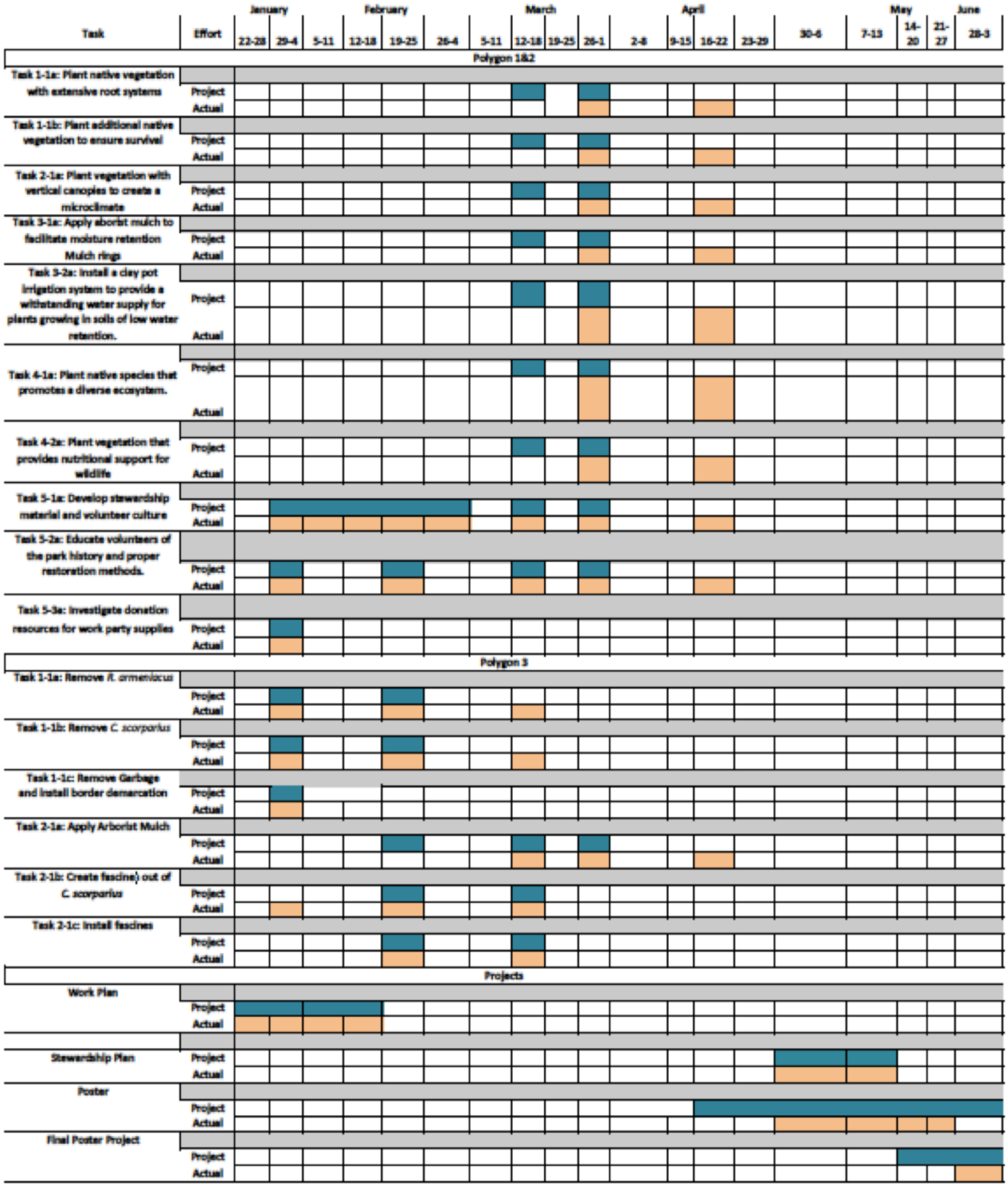


**Table 7: Revised Gantt chart of Timeline**

# VIII. Design for the future

Fortunately, Richmond Beach Saltwater Park already has a well-developed long-term stewardship relationship with the surrounding community. Our community partners already have an established Facebook page where they announce stewardship events occurring in the park. Our plan to develop the stewardship necessary for our site to succeed is to build upon what is already established. This will be done by broadening our volunteer audience and promoting volunteer returns.

We have four work parties scheduled on the city event calendar. To promote attendance, we plan to announce event details on the park's restoration Facebook page. We also have access to the email list of past volunteers. We plan to reach out to them directly with emails describing work party event details. These strategies will hopefully encourage the return of volunteers from previous events. We also want to promote the attendance of new volunteers. To do this, we plan to create public Facebook events for each work party. These event pages will reach more of the public and allow people to invite their friends. Links to the park's Facebook page located in the event details will allow new potential volunteers that are interested to easily follow the park's page for other stewardship opportunity announcements. If possible, theses event pages will allow people to sign up to receive email announcements about future work parties. Event pages will also give an estimation for how many volunteers will likely attend each work party.

To make sure people enjoy themselves at volunteer events, we will encourage communication through icebreaker exercises at the start of each work party. We will also break people into small or partnered pairs so they have more personal interactions with both us as well as other volunteers. This way we can get to know our volunteers and can educate them about how and why we may be doing a talk or activity on site. There will also be coffee, tea, and snacks provided to keep volunteers happy and energetic.  There is already a somewhat permanent volunteer group that comes out during spring and summer to provide maintenance on different areas of the park. This includes refilling irrigation vessels and controlling invasive regrowth. When we finish our project, we will give this volunteer group instructions on what will need to be maintained. Hopefully we will have created a large enough volunteer base by the end that some of our volunteers will become semi-permanent members to aid with continued maintenance.

In 50 years, our expectation is to see the survival of planted native vegetation, a minimal return of the invasive Himalayan blackberry, and native species starting to grow on our bare stabilized slope. In 100-200 years, it is our vision to see the site become well shaded with native trees and bushes, improved soil quality, and a moderate return of invasive. Our main obstacles for making this vision possible are the stressful conditions of the site that limit the survival rates of the plants. These include the lack of water available in the soil and the constant threat of invasive overgrowing the area. Our first task for preparing the site involves invasive removal. This will occur during the first work party. We will demonstrate and teach volunteers how to properly remove Himalayan blackberry and Scot's broom. If we can effectively encourage the return of volunteers then they will be equipped with the skills to control these invasive populations during future maintenance events. To combat the low survival rates of plants, we are planting species which are stress tolerant. Even though these plants have a greater chance of survival, they still need close monitoring until they are developed enough to support themselves. We are attempting to create shade with trees and shrubs, which will improve soil quality, but it will take a long time for this to happen. To help our plants survive until they are large enough, we are installing irrigation vessels. These will need to be watered weekly. If we can inspire our volunteers during restoration work parties, they may be more concerned about maintaining the site into the future. If volunteers are educated about the stressful environment these plants are being placed in, they may be more willing to continue refilling irrigation vessels after the project is over.

# IX. Lessons Learned

### Financial Budget

With our expenditures, we were under the financial budget that was planned in our work plan. This is due to the changes in the cost of our plants. Many of our plants can be purchase thru University of Washington Nursery. Therefore, this lower our cost for purchasing the plants we need.

| Expenditure | Projected | Actual |
|---|---|---|
| **Plants** | $478.75 | $550.35 |
| **Mulch** | | |

| | | |
|---|---|---|
| Arborist chip | $919.80 | $919.80 |
| Compost | $0.00 | $140 |
| **Fascine** | | |
| Wood stakes | $37.75 | $37.75 |
| Tools | $496.05 | $496.05 |
| **Irrigation** | | |
| Clay pots | $225.00 | $203.67 |
| Silicon | $22.5 | $58.95 |
| **Refreshment** | $0.00 | $26.91 |
| **Poster printing** | $20.00 | $20.00 |
| **Total** | **$2199.88** | **$2453.48** |

**Table 8. Financial Budget Expenditures Projected vs. Actual**

Lesson learned:

1) We have learned was the importance of not planning to use up all the amount of money that was given to us. At the very beginning of the project, we get the estimated amount of funds that was provided to our project. Based on the estimated amount, our original planned was to use up every single penny of the given funds. We didn't realized there are sale tax, delivery fees, extra refreshment money, traveling fees, etc. All of those miscellaneous was not what we have expected, until we bought our first purchased, the mulch-- arborist chips. Based on our clients requested, we bought 40 yards of mulch. Due to this purchased, we realized that there are some extra charges that we was not aware

of, such as delivering fees, sale tax, and environmental conditions fees, etc. After that, we adjusted our budget and tried to have more money to spare for any emergency usage. Since we realized this problem at the early stage of the project, before purchasing any more items, we didn't run into any shortage of money. In fact on **Table 9.** you will see that we still have $286.52 left in our given funds. This was also made possible was because UW Nursery have most of our requested plants in stocks. Therefore, it cuts down our expenditures in plants significantly.

2) We have learned was how to manage funds from different sources, that included UW-REN, City of Shoreline, KCD, and donors/ sponsor due to the disbursement time. At the early stage of our project, we were given the notice from our clients that we won't be able to use the KCD funds until the beginning of March. This had initially caused us a lot of problems for purchasing order arrangement, especially after we had just purchased a 40 yards of mulch. From that, we learned that before we purchased any big items, we should have made an arrangement of priorities purchase list. This will help us know which items should be purchase first, and which items should not be. Since this situation cause a short time period of money shortage for our group, we have to communicate with our clients and try to find a solution for it. Our clients solved it by having an agreement with KCD that we will be able to do it as a reimbursement format. All the extra money that was spent before March of 2017, will be cover by City of Shoreline initially.

| Revenue by fund source | Funds |
| --- | --- |
| **Course fee allotment** | $600.00 |
| **Donations** | Food (QFC) and Coffee (Starbucks) |
| **Donations** | Compost from Cedar Grove |
| **City of Shoreline** | $1,640.00 |
| **King Conservation District** | $500 |
| **Total funds given** | **$2740.00** |
| **Actual Expenditure** | **$2453.48** |
| **Total Revenue** | **$286.52** |

**Table 9. Final Budget Summary**

## Labor Budget

| Labor by Activity | UW Team Hours | Volunteer Hours | Total |
|---|---|---|---|
| **Site Preparation** | | | |
| Expected | 5 | 3 | 8 |
| Actual | 7 | 3 | 10 |
| **Invasive Plant Removal** | | | |
| Expected | 50 | 120 | 170 |
| Actual | 48 | 80 | 128 |
| **Mulching** | | | |
| Expected | 44 | 100 | 144 |
| Actual | 61 | 107 | 168 |
| **Apply Fascines** | | | |
| Expected | 40 | 110 | 150 |
| Actual | 25 | 60 | 85 |
| **Plant Acquisition** | | | |
| Expected | 20 | 0 | 20 |
| Actual | 12 | 0 | 12 |
| **Planting** | | | |
| Expected | 40 | 60 | 100 |
| Actual | 31 | 66 | 97 |
| **Irrigation Vessels Creation, Installation and Refill** | | | |
| Expected | 28 | 70 | 98 |
| Actual | 57 | 66 | 123 |
| **Plan and manage work parties** | | | |
| Expected | 64 | 0 | 64 |
| Actual | 48 | 19 | 67 |
| **Community Engagement** | | | |
| Expected | 32 | 1 | 33 |
| Actual | 30 | 0 | 30 |
| **Reports Preparation** | | | |
| Expected | 100 | 0 | 100 |
| Actual | 216 | 0 | 216 |
| **Total Hours** | | | |
| Expected | 423 | 464 | 887 |
| Actual | 535 | 401 | 936 |

**Table 10: Labor Budget Expected Vs. Actual**

When examining total expected vs. total actual labor hours, we actually did less hours than originally planned, 845 actual hours vs. 1017 hours planned. This is still true when you look at both team hours and volunteer hours.

Lessons learned:

1) Mulching is the most time-consuming restoration activity ever. We definitely did not expect to spend so much time simply spreading mulch. It was the only task where our actual labor values for both team and volunteer were more than expected. It takes a lot of time and manpower. It didn't help that we were tasked with mulching a steep slope. Mulching can easily be overlooked, but it's an important and extremely tedious step.
2) Volunteers make the world a better place. A lot of the activities would have taken a lot longer without help from volunteers. A lot of the days when we had large groups of volunteers present, the actual team labors hours were a lot less. For example, on the day of planting the Washington Native Plant Society came out and we actually finished that work party early.
3) Always check that your irrigation vessels are working properly BEFORE burying them in the ground. We realized a lot of the clay pot irrigation vessels had defects and were leaking water. Unfortunately, we did not realize this until most of them were already buried in the ground. This caused us to spend a lot more labor hours on the irrigation, because we had to recheck, re-glue, and replace a lot of the clay pots.

## Planting Plan

| | Original Planting Plan | Actual Planting Plan |
|---|---|---|
| **Species** | • *Leymus mollis* (100)<br>• *Arbutus menziesii* (5)<br>• *Mahonia aquifolium* (20)<br>• *Oemleria cerasiformis* (20)<br>• *Holodiscus discolor* (20)<br>• *Ribes sanguineum* (20)<br>• *Rubus leucodermis* (20)<br>• *Festuca roemeri* (100) | • *Leymus mollis* (120)<br>• *Arbutus menziesii* (3)<br>• *Mahonia aquifolium* (20)<br>• *Oemleria cerasiformis* (20)<br>• *Holodiscus discolor* (20)<br>• *Ribes sanguineum* (39)<br>• *Rubus leucodermis* (20) |
| **Densities** | Spacing:<br>-clusters= 2 meters<br>-individual trees=<br>4 meters b<br>-grasses= 1 meter | Spacing:<br>-clusters= 2 meters<br>-individual trees=<br>4 meters b<br>-grasses= 1 meter |
| **Dispersion** | Grid fashion | Random, non grid-like |
| **Method** | -Trees planted individually with vessel<br>-All shrubs planted in random clusters of 2 with an irrigation vessel<br>-*Leymus mollis* transplanted randomly between clusters<br>-Seeds dispersed randomly between clusters | -Trees planted individually without vessel<br>-All shrubs with the exception of *Rubus leucodermis* planted in random clusters of 2 with an irrigation vessel<br>-*Leymus mollis* transplanted randomly between clusters<br>-*Rubus leucodermis* planted between clusters individually each with its own vessel and mulch ring |

**Table 11: Planting Plan Original Vs. Actual**

Lessons Learned:

1) Due to the challenging conditions of the site, seeds would most likely not survive the first year, and so we opted to only include sprouts in our planting lists.
2) Planting randomly rather than in a gridded fashion better represents a naturally occurring dispersion of vegetation found in ecosystems. Random dispersion also facilitates a greater variation in microclimates, which was included in our goals.
3) *Arbutus menziesii,* the only trees we included in our planting list, requires very little water to survive and has actually been known to die with too much water. Therefore vessels were not installed with the trees planted.
4) *Rubus leucodermis* grows to be a very large bush, so this species was planted individually with its own mulch ring and irrigation vessel so as not to overcrowd other species.

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