The North Creek Forest

Bothell Washington

University of Washington Restoration Ecology Network

2012 -2013

Final Report

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Project Summary

This report was authored to convey information related to the restoration project implemented by The University of Washington, Restoration Ecology Network, (UW-REN 2012-2013), for the City of Bothell and community partners from the Friends of North Creek Forest (FNCF). The North Creek Forest (NCF) is a sixty-four acre mixed deciduous conifer lowland forest. It is the last of its kind within the North Creek watershed and presides within the city limits of Bothell, Washington. The (NCF) UW-REN project is accessed from 112th Avenue NE at the approximate cross street of NE 201st and consists of over 850 square meters on the south eastern side of the forest and is the second phase of a continuous restoration project. The UW-REN 2012-2013 team, comprised of six University of Washington students, designed and installed the restoration while working closely with community partners from FNCF, Jim Freese and Jeanie Robinson, and Pat Parkhurst from the City of Bothell, as well as various professors from the Restoration Ecology Network from November 2012 through June 2013.

Figure 1. The images above are photographs taken by Kent Parkinson of the pre-existing and present vegetation communities of the UW-REN 2012-13 site over the course of the project.

Site Characteristics

The site is approximately 850 square meters and sits at the toe of a leeward, moderately steep east-facing slope. The aspect of the site is from the southwest to the northeast with a slope of approximately 9%. For purposes of *R. armeniacus* removal, the site was divided into two sections based upon native and nonnative plant species composition. A main trail which runs approximately 45° to 112th Ave Ne beginning on the northeastern edge of the Robinson property was cut to divide the restoration site by dominant plant community. The removal activities were different in the two sections because section one required more careful removal to avoid inadvertent removal of *Rubus spectabilis* (salmonberry). Section one begins at the eastern border of the 2011-2012 restoration site and extends east to section two (Fig. 5). Section one has an established native vegetation community and increased species richness. Section two covers the majority of the site, extending from the western border of section one to the drainage ditch along 112th NE. Both sections have Indianola sandy clay loam soils; section two, on average, has

higher levels of clay content with increasing clay content moving east approaching the drainage ditch along 112th. Within section two there are soil patches with higher than expected clay content leading to slower water infiltration and highly irregular hydrology throughout the site. After nonnative species removal was completed, the site was divided into polygons for planting. The significant habitat characteristics of the site create three distinct microhabitats, which have been divided into three polygons for planting activity. Polygon one encompasses the southernmost section of the site and has sandy loam soils. Polygon two is defined by a slight topographical depression with increased surface and subsurface water flow. Polygon three is defined by silty clay loam soils, high seasonal hydrologic variability, and receives the most sun of the three. Polygon three also has highly disturbed soils and a substantial amount of fill, consisting largely of 5-6" rocks.

Habitat Value

Given the amount of *R. spectabilis* in section two, as well as other seeding and fruiting vegetation *Malus sp.* (apple tree), *Alnus rubra* (red alder), and *Acer macrophyllum* (bigleaf maple) (Fig. 8); the area is prime habitat for many types of animal species. The *R. spectabilis* and surrounding trees create cover and nesting sites for the many types of avian species that visit this site. The other animals observed on the site are *Tamiasciurus douglasii (*Douglas squirrel), *Odocoileus hemionus columbianus* (black-tailed deer), and voles. In section two there is major evidence of *Aplodontia rufa* creating tunnels throughout the site. The quantity of large woody debris in section one and the southwestern portion of section two create substantial habitat for small mammals, as well as habitat for insects, reptiles, and amphibians.

Ecological Concerns

The greatest challenge faced on the site is the removal of the *R. armeniacus* monoculture and the prevention of re-invasion. The prevention of reinvasion also depends upon the establishment of a resistant native plant community on site. This will require the establishment of effective buffer zones and continued maintenance to combat spread by humans and birds. The potential for invasion of *Phalaris arundinacea* (reed canarygrass) from the ditch adjacent to 112th NE is also a serious concern because *P. arundinacea* favors disturbed soils with high water content. There is concern that the *Aplodontia rufa* (mountain beaver) tunneling in Polygon 2 may consume the roots of newly planted vegetation causing higher than expected mortality. In turn, the presence of other herbivores, such as deer, is a lesser concern.

Project Goals:

- Promote native plant and animal biodiversity by establishing a Puget Sound lowland forest ecosystem.
- Create opportunities for meaningful human engagement.

General Approach

The approach we wish to take on the restoration at North Creek Forest starts with the removal of all of *R. armeniacus* (Objective 1-1). Removal will include cutting stems and digging out the

root structure. This will be done with the help of a volunteer base from UWB/CCC and the Bothell community. Operations in the removal process shall be done by hand with various tools supplied by the Friends of North Creek Forest. Removing all the *R. armeniacus* on site will alter the conditions of the site leaving the majority of Polygon 2 devoid of plant material. We intend to add a heavy mulch layer throughout the site after the removal of invasive vegetation to help retain moisture for the native plants being installed and suppress seed growth of *R. armeniacus*. The variety of native Puget Sound lowland plants and trees to be added will develop a robust vertical structure. In turn these plants and trees will provide habitat, and shade to the restoration site. The establishment of these native plants and trees will be a high priority, particularly around the perimeter of the site where *R. armeniacus* may still exist. We wish to create shade quickly in these areas to deprive *R. armeniacus*, thus reducing its ability to reclaim the site. Ecological monitoring will be established within a variety of areas. These areas can be studied for success using a variety of parameters such as habitat production, shade, mortality, and growth rate. These areas should be easily accessible to foot traffic reducing disturbance in other sectors of the site. It is our intention to plant a variety of conifer tree species and plants in areas that are conducive to the soils and hydrologic features of the site. By taking this approach we are confident that the establishment of these plants and trees will commence rapidly providing the habitat and shade the site needs.

Major Accomplishments

- We restored approximately 850 m² of lowland forest
- Planted 462 plants which consisted of 35 different species
- Removed 80 cu. yds. of invasive material
- Over 1,200 hours of volunteer time was devoted to this project

Team Members

Figure 2. Team members: (Left to Right) Back Row: Corey Gorle, Josh Sanford, Duncan Medlin, Kent Parkinson; Front Row: Scott Le, Jody Johnson

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University of Washington,

Restoration Ecology Network Team 2012-2013

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Acknowledgements

The University of Washington Restoration Ecology Network of 2012-2013 team for the North Creek Forest would like to thank and acknowledge the following people and corporations for their selfless contributions of time, painstaking labor, guidance, support and materials we utilized throughout this project. Surely we could not have done it without your support:
First, to all the volunteers from the University of Washington Bothell campus, the University of Washington Seattle Campus, Cascadia Community College, Bothell High School, Woodinville High School, The Cub Scouts of America Troop 64, and all the other members of the surrounding community. With your support we logged well over 1000 hours on this project. Second, we wish to acknowledge the following individuals whose support was unrelenting throughout the entire project: Jim Freese, Carolyn Freese, Dr. David Bain, Jeanie Robinson, Sarah Witte, all the other members of Friends of North Creek Forest, Marty Friese and Family, Linda Cung, Kristen Parkinson and Family and the UW-REN instructors, Warren Gold, Kern Ewing, Jim Fridely and Lindsey Hamilton. The UW-REN team wishes to thank you all for your amazing personal sacrifice of time, labor, guidance and support even when we wondered if the project was going to endure challenges we had no control over. Finally, we wish to acknowledge the following corporations for their generous donations to the project: Northwest Arboriculture LLC, Superior Arboriculture, Albertsons of Clearview WA, Albertsons of Canyon Park WA, QFC of Canyon Park WA, Safeway of Canyon Park WA, Top Foods of Woodinville WA, Waste Management, Starbucks of Clearview WA and Starbucks of Woodinville WA. It is with the generous donations of these corporations we were able to support our volunteers and have the materials needed to make this project happen. It is because of people and corporations like you, the North Creek forest will remain to enrich the lives of all for generations to come. We thank

you all.


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As-Built Report

Background

Site Description

Location

The 2012-2013 University of Washington Restoration Ecology Network (UW-REN) North Creek Forest (NCF) site is located within North Creek watershed in the Puget Sound region within the Pacific Northwest in Bothell, Washington. The North Creek watershed feeds North Creek, a tier two salmon-bearing stream. The North Creek watershed extends roughly 19,000 acres from south Everett through Mill Creek and ending in Bothell near the proposed restoration site. The North Creek watershed contains approximately forty nine percent impervious surfaces (King County 2012) and has been channeled in locations near the proposed restoration site. The 64-acre North Creek Forest is located in the northeast corner of Bothell and is bordered by residential developments with the exception of Interstate 405, which is east of the proposed site. The North Creek Forest is currently a mixture between public (35 acres) and private (29 acres) lands (FNCF 2011- 2012). Both the 2011-2012 and 2012-2013 UW-REN restoration sites sit on private land currently owned by the Robinson family (6 acres). The Friends of North Creek Forest (FNCF) are in negotiations with private owners and the city of Bothell to establish the entire North Creek Forest as protected public land.

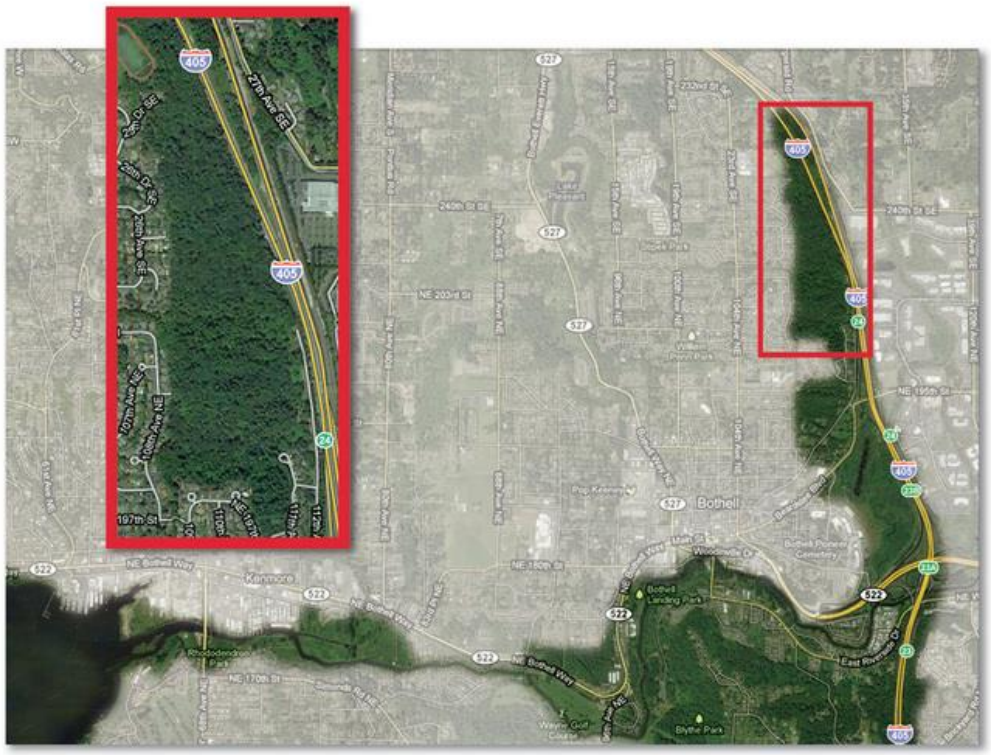

Figure 3. Map of the location in which North Creek Forest is located in relation to Bothell, Washington

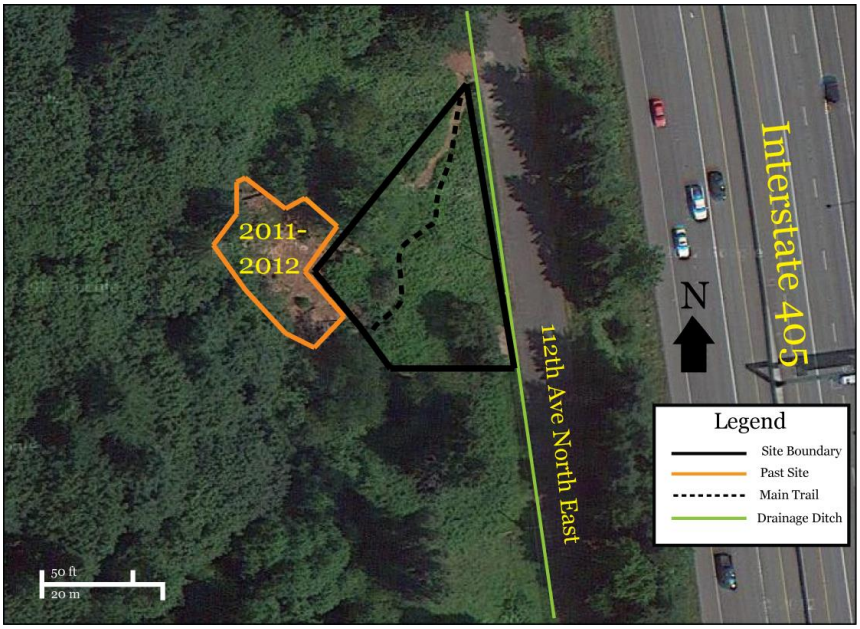

Figure 4. Map of North Creek Forest with proposed site (in black) and the 2011-2012 restoration site.

Site Selection

The proposed site extends west from a drainage ditch running parallel to the western edge of 112th Ave NE approximately 30 meters to the eastern border of the 2011-2012 UW-REN restoration site (Fig. 8). This site was selected for its location as a major entry point to the North Creek Forest. Its close proximity to previous restoration efforts will enhance the likelihood of successful restoration and lessen the chance for reinvasion of non-native species. With implementation of this restoration site, an effective buffer will be established decreasing the chance of invasive encroachment on the 2011-2012 restoration. Restoration of this site will help the Friends of North Creek Forest maintain and expand other restoration efforts by removing a large seed source of invasive *Rubus armeniacus (*Himalayan blackberry) as well as other undesirable species.

Text Revisions

The goals for this project come from a combination of the desires of the Friends of North Creek Forest as well as the combined ecological knowledge of the team. Discussions with the Friends of North Creek Forest have yielded the following overlying Goals:

Goal 1) We are to promote native plant and animal biodiversity, by establishing a Puget Sound lowland forest ecosystem.

Objective 1-1: Remove, and prevent the re-establishment of invasive, exotic plant species.

AD1-Cardboard has been placed at the front of the site (adjacent to 122th), and covered with mulch to prevent the expansion of *Phalaris arundinacea* (reed canary grass) which has

a strong presence in the ditch at the front of the site, and has increased in dominance in the last season.

AD2-*Convolvulus arvensis* (Morning glory, bindweed) has been removed wherever possible but will require continued maintenance; pulling vine and rhizome from the ground. *Convolvulus arvensis* has a much more significant presence on the site than was apparent when the site was cleared.

Task: 1-1A: Remove all *R. armeniacus* plants throughout and surrounding polygons one, two and three.

Approach 1-1A: *R. armeniacus* shall be cut to approximately 18 inches in height by hand with the use of loppers and/or clippers. This allows for the identification of the location of the plant's rhizome bulb and root systems. The rhizomes will then be grubbed out by hand with the use of shovels and clawed mattocks in polygons one, two and three.

Approach Justification 1-1A: *R. armeniacus* is considered an invasive plant species because it displays a higher reproductive fitness than most native species when afforded ample light. Thisinvasive plant has the capability to spreading by tip-rooting from vines when they rest upon the ground creating a new rhizome. It has been established that the most effective way to remove this plant requires the removal of these rhizomes. (Miller, 2009)

Task 1-1B: Mulch will be used to hinder the reestablishment of *R. armeniacus*.

Approach 1-1B: Wood chip mulch provided by Northwest Arbor Incorporated shall be placed at a depth of six inches by hand. The mulch shall be spread over the entire area of polygons one, two and three (Table 3).

Approach Justification 1-1B: *R. armeniacus* has the capability of spreading via berry production and, it has been established that an effective way to prevent this plants spread from berry production is to apply a thick blanket of mulch preventing germination and seed establishment (Miller, 2009).

Objective 1-2: Install a variety of native plant species that create a structurally diverse canopy.

Task 1-2A: Install a variety of tree and plant species that will produce an upper, mid and lower canopy.

Approach 1-2A: Live stakes of *Salix sitchensis* (sitka willow), *Cornus sericea* (red osier dogwood), *Spiraea douglasii* (hardhack spiraea) and *Symphoricarpos albus* (snowberry) with at least 5 nodes total will be installed. Stakes will be installed with 3 nodes underground and 2 to 3 nodes aboveground. Tree species such as *Pseudotsuga menziesii* (Douglas fir), *Tsuga heterophylla* (western hemlock), *Thuja plicata* (western redcedar), *Picea sitchensis* (sitka spruce) will be planted as bare root specimens. Species that are received in pots will be root-washed prior to installation.

Approach Justification 1-2A: Installing live stake shrubs is the most economical way to produce a shaded canopy in a short time frame (Ewing 2013). This will help prevent the growth of nonnative species as well as provide a better habitat for late successional species. The conifer tree species to be installed will complete the structurally diverse canopy.

AD3-*Symphoricarpos albus* live stakes were not installed. It was determined that the damage to available source plants was not warranted.
AD4-Potted as well as bare root evergreen species were planted. Additional plants were donated to the project.

Objective 1-3: Provide year round fruits and forage to both observed and potential animal species.

Task 1-3A: Install native tree and shrub species that will produce food throughout the greatest extent of the growing season possible.

Approach 1-3A: Install species that will produce fruit from late March through late September. *Oemleria cerasiformis* (indian plum) blooms earliest in the year, bearing fruits in late March to early April. *Lonicera involucrata* (twinberry) is the latest bloomer, producing fruits through late September and early November.

Approach Justification 1-3A: The site has been ecologically devoid of any diversity due to the infestation of *R. armeniacus*. The removal of *R. armeniacus* has given rise to the opportunity to introduce a more diverse community of plants that are inviting to resident and migratory animals alike. (J. Freese and D. Bain, Personal Communication)

Objective 1-4: Improve habitat features such as woody debris and maintain underground tunnels.

Task 1-4A: Protect existing habitat features and enhance them whenever possible.

Approach 1-4A: Keep existing underground tunnels undisturbed as much as possible while removing the *R. armeniacus* and planting new vegetation. The woody debris structures that already exist shall be enhanced with native vegetation that produces a shade creating canopy.

Approach Justification 1-4A: The tunnels are habitat structures used by the resident *A. rufa* currently active in other areas of the forest (K. Parkinson and D. Medlin, personal observation). Therefore disturbance of these tunnels should be kept to a minimum in an effort to promote the habitat of this species. The woody debris that is currently on site can be used to enhance habitat structure and function for a variety of native plants and animals (e.g. Ferns, Conifers, Avian species, and rodents). The nurse logs should be preserved, and the micro environments around them enhanced for the variety of species living on them.

Goal 2) We are to create opportunities for meaningful human engagement.

Objective 2-1: Establish monitoring plots in each polygon, which will be studied in the future for compatibility, structure, and functionality.

AD5- Five monitoring plots were established. This was done to more accurately represent the varying habitat conditions (Fig 6).

Task 2-1A: Define a monitoring plot within polygon one to study the comparative success of plant species installed in this low light, upland environment.

Approach 2-1A: Install a monitoring post in the southwest corner of polygon one, with a view of the installed upland species in these sandy loam soils (Fig 6).

AD6- Polygon one has its photo pole located up behind the old house foundation located on the west side of polygon one (Fig 6).

Approach Justification 2-1A: The land grant with which the property is being purchased requires ecological monitoring to document the success of the site.

Task 2-1B: Define a monitoring plot within polygon two to study the comparative success of plant species installed in this moderate light environment with ample water.

Approach 2-1B: Install a monitoring post near the middle of polygon two with a view of the species growing in the wetland environment at the east edge of the site (Fig 6).

AD7- Polygon two had its photo post placed just to the west of the cross sectional trail (Fig 6).

Approach Justification 2-1B: The land grant with which the property is being purchased requires ecological monitoring to document the success of the site.

Task 2-1C: Define monitoring a monitoring plot within polygon three to study the comparative success of plant species installed in this moderate light environment with high seasonal variation in water availability.

Approach 2-1C: Install a monitoring post near the middle of polygon three with a view of the species growing in highly inconsistent water availability and silty soils (Fig 6).

AD8- Polygon three has a photo pole situated at the corner of the main trail and the cross sectional trail (Fig 6).

Approach Justification 2-1C: The land grant with which the property is being purchased requires ecological monitoring to document the success of the site.

Task 2-1D: Reduce the probability of disturbance due to access of the site.

Approach 2-1D1: Locate monitoring plots that are easily accessible, to reduce the possibility of disturbances when utilizing monitoring units (Fig 6).

Approach Justification 2-1D1: Live stake plantings near pedestrian footpaths will act as a buffer from more sensitive areas within the polygons reducing the likelihood of human disturbances.

Approach 2-1D2: The live stake plantings will be in areas of polygons two and three near designated footpaths to deter social trails.

AD9- Footpaths are designated by large branches from off the site which line pathway.

Approach Justification 2-1D2: The placement of the observation areas is necessary to prevent unwanted foot traffic into other more sensitive sectors of all three polygons and at the same time allow new students and the general public the opportunity to examine nature at work (J. Freese and D. Bain, personal communication) (Fig 6).

Objective 2-2: Expand community awareness of the North Creek Forest by encouraging UW and high school classes to utilize NCF as an asset for developing awareness and education.

Task 2-2A: Coordinate volunteer events and network with local educators to maximize community exposure to the site.

Approach 2-2A: Promote events in which students from community schools can get involved and develop an awareness of the benefits of community stewardship. The UW-REN Liaison will also promote these events electronically and in person on the UWB.

Approach Justification 2-2A: Electronic communications are faster than any other form of communications to get ideas moving forward. However, it is recognized that interpersonal relations can be beneficial in the motivation of people to act (Koehn, E. 2001).

Objective 2-3: Maintain an active relationship with the city of Bothell Parks Department.

Task 2-3A: Keep the city of Bothell Parks Department informed of all activities and invite comments on the project.

Approach 2-3A: Personal and electronic communications will be maintained through the UW-REN Liaison and the North Creek Forest Board of Directors.

Approach Justification 2-3A: The restoration project will eventually be turned over to the City of Bothell as a park, making it accessible to the community; therefore, it is important to keep an active dialogue with the proper officials.

Objective 2-4: Foster engaging and meaningful volunteer events, allowing participants to gain a better understanding of their local ecology and participate in restoring a native forest.

Task 2-4A: Promote volunteer work events on UWB campus and with community leaders.

Approach 2-4A: The UW-REN Liaison will create electronic announcements and advertisements of upcoming events in which students and community members can get involved. This will be done via E-mails to various staff members throughout the UWB campus and the leaders of the Friends of North Creek Forest. The liaison and other members of the UW-REN NCF team will also solicit classrooms with the approval of the professors involved.

Approach Justification 2-4A: This approach encourages students, staff and community members alike to get engaged with volunteer events near the UWB campus that are directly related to the ecological restoration of a Pacific Northwest lowland Forest (J. Freese, personal Communications).

Objective 2-5: Install an organic art component themed as a habitat structure, designed to contribute both aesthetically and ecologically.

Task 2-5A: Construct a sitting bench made of live willow stakes, which will, ideally, take root and promote a personal connection with nature.

Approach 2-5A: Cut and install a series of willow branches intertwining them to create a bench along the south side of polygon three on the east side of the trail (Fig. 5).

Approach Justification 2-5A: It is the intention of the NCF UW-REN 2013 team to encourage a meaningful engagement with this restoration project for all who wish to encounter it. It is our belief that man is a part of this forest and should be recognized as such through the implementation of functional artistic enhancements.

AD10- An art component was not installed, because the language of the grants used to acquire this property prohibits any permanent installation.

Site preparation plan

Current Conditions

Site polygons:
The site was divided into three polygons based upon the general habitat conditions. The site receives uneven amounts of sunlight, with polygon three receiving the most direct sun, and one receives the least. The site has a substantial amount of seasonal surface and subsurface water, flowing west to east through polygon two and three. The polygons were chosen to segregate the three habitat types. Polygon one will support species that are adapted to well drained soils and low sunlight. Polygon two will support species that are adapted to saturated soils. Polygon three will support species that are adapted to partial sunlight, disturbed soils and irregular water availability (Fig. 5).

Site Vegetation:
The native vegetation on site consists largely of *R. spectabilis*, which forms two large clumps at the westernmost extent of polygons two and three. These clumps are dense enough to reduce the need for native plantings in these areas. There are additional *R. spectabilis* in the west end of polygon one, but they are not as dense. There is one *A. rubra* at the western tip of polygon three. There are two *Sorbus aucuparia* (European mountain ash) at the southeast corner of polygon one. In polygon one there are some small colonies of *Tolmiea menziesii* (Piggy-back plant), and *Tellima grandiflora* (Fringe-cup) There are a few *Athyrium filix femina* (Lady fern), *Polystichum munitum* (Sword fern), and *Equisetum arvense* (Field horsetail) scattered across the western end of polygons one and two. *Epilobium ciliatum* (Purple leaved willow-herb) was observed onsite last year and has already re-colonized the existing UW-REN site to the west (Fig 4).

Site Preparation Activities

The preparation activities on the site were divided differently than the planting activities. When this project began, the site was substantially impacted by *R. armeniacus*, preventing the team from assessing the underlying soil and hydrologic conditions. The most significant way to define these sections at that time was to segregate the upper portion to the west from the lower portion. The westerly portion of the site had significant *R. spectabilis* populations intertwined with *R. armeniacus*. These areas needed special attention when removing the *R. armeniacus* to ensure the *R. spectabilis* was not removed, and volunteers were not allowed to work in these areas. For this portion of the work, the site was divided into two sections. The removal of *R. armeniacus* requires the cutting and removing of the above ground vegetation as well as well as the digging and pulling of the rhizomes. The removal of canes has been completed across the site, but due to the required jurisdictional approval for the use of the Recreation and Conservation Office grant, the digging of rhizomes was delayed by several months.

Logistical Considerations

The site is directly adjacent to 112th Ave. NE and has two existing, paved access-aprons (at the north and south ends) that have been used to store mulch and biomass debris. The site is on a dead-end road; team members and volunteers were and will continue to be allowed to park on the east side of the road during restoration activities. The most complicated portion of the logistical planning was the removal of the *R. armeniacus*. Disposing of the aboveground biomass and rhizomes has proven to be complicated. The aboveground biomass collected was nearly 80 cu. yds. The adjacent neighbor to the south has allowed us to place a large waste container from Waste Management on his property for the *R. armeniacus*.. We were fortunate enough to receive a donation of approximately 200 cu. yds. of mulch from Northwest Arboriculture (Fig. 5).

AD11- 80 cu. yds. of debris was actually removed from the site.

Planting Plan

Polygon One

This polygon is located on the south side of our site (Fig. 5) and has the most shade; only getting about one hour of direct light. The soil in this polygon consists of sandy loam and slopes slightly toward the north, getting damper farther north towards polygon two. Therefore, the species selected for this site were chosen based on their moisture and light requirements (Table 1) Quantities of species chosen for this polygon were based on suggested planting densities of 6'and 10' on-center and the square footage of the polygons which is the highest attainable planting density within the planting polygon (Objective 1-1, 1-2) (Table 1) (USDA 2013). The forms of the species to be planted are primarily bare-root and some in small pots (Table 1). This was based on cost and the best ability for the plants to succeed under the habitat conditions in this polygon.

The conifer species chosen for this area are *P. menziesii*, *T. heterophylla*, *T. plicata*, and *P. sitchensis* which will provide canopy structure, nesting and roosting sites, and forage for a variety of species later in succession (Table 7) (Objectives 1-2, 1-3). *Pseudotsuga menziesii* and *T. heterophylla* require drier well drained soils, so they will be planted primarily on the upper (southern) half of polygon one. *T. plicata* will be planted on the sloping section and northern border of this polygon which consistently gets wetter the further north you go. The dispersion pattern for the conifer species will be 10 feet on center but these species will not be planted in straight rows, instead they will be placed in a zigzag pattern with alternating species to broaden the canopy structure. To create structure in the upper canopy of this polygon, the deciduous *Betula papyrifera* (Paper birch) (max. height ~100ft) will be installed on 10 foot centers on the northern side of this polygon which gets more sunlight than the rest of the polygon (Pojar and Mackinnon 2004).

AD12- *Betula papyrifera* was not planted in this polygon because the desired tree density was achieved with species that were determined to be more viable and ecologically significant.

Shrubs such as *Acer circinatum* (Vine maple), *Rosa nutkana* (Nootka rose), *O. cerasiformis*, and *Corylus cornuta* (Beaked hazelnut) were chosen for this site because they have a tendency to grow in dry to moist soils and ability to provide forage for a variety of avian and animal species (Objective 1-3) (Table 1, Table 7) (Pojar and Mackinnon 2004). For example, *O. cerasiformis* blooms the earliest in the year, bearing fruits in late March to early April, then moving on to *Gaultheria shallon* (salal), fruiting in late spring to early summer, and *C. cornuta* provides nets in mid-summer. The shrubs will be planted with a dispersion pattern of 6 feet on center and again alternating plant species as to create diversity of species in a given area (Table 1) (Objective 1-1). They will be planted in the open spaces between conifer species, filling in the gaps. Low lying ferns and shrubs such as *P. munitum, Blechnum spicant* (deer fern), and *G. shallon* will be planted on 6 foot centers in alternating arrangements to allow for greater low level diversity. These three species will also be planted around *P. menziesii*, *T. heterophylla* and *T. plicata* because of their moisture requirements. The groundcovers chosen for this polygon are two ferns *P. munitum, B. spicant.* These will be planted at 6' on-center in an alternating pattern and as mentioned they will be planted in close proximity to conifer species.

AD13 - *Blechnum spicant* was not planted in this polygon due to availability and price.

A 10 foot by 10 foot monitoring plot will be mapped out in the southwest corner of polygon one (Objective 2-1) (Fig. 6). This area was chosen because this portion of the site has the most shade, sandy loam soils, and upland species (Table 3). A post will be placed on the southwest edge of this plot, which will allow photos to be taken at an exact point every six months. The post will be placed in an area that is on the border of the site to allow easy access and create minimal disturbance. The purpose is to have a point in this polygon where the Friends of North Creek Forest can set up a camera and take photos to compile a database of images that will allow them to gather data and study the compatibility, structure, and survival of the upland species planted.

AD14- For this permanent photo point we used a Samsung 18X Zoom, 24mm Wide angle digital camera. The photo pole is located up behind the old house foundation on the west side of polygon one just south of quadrat (1B) and is labeled with a reflective letter "A". A camera should be placed approximately five feet off the ground and aimed east (compass bearing 36 degrees NE) to view most of the polygon.

AD15- Two 4 meter by 4 meter monitoring quadrats were added in this polygon instead of one 10 foot by 10 foot quadrat so that quantitative monitoring of growth can be done within the different environments in this polygon.

Polygon Two

This polygon has moderate sun exposure, getting roughly two to three hours of direct sunlight per day. The soil texture is a sandy loam towards the top (west) and sandy clay loam towards the bottom (east). The soil moisture is very high in the middle and bottom portions of this polygon, due in part, to the tunnels created by *A. rufa* and subsurface water-flow. Water is channeled by the *A. rufa* tunnels and flows to the east, dispersing at the bottom of the polygon creating small pooling areas before the roadside ditch. Therefore, the plants chosen for this polygon have to be able to withstand substantial amounts water during the wettest months. Careful planting and mulching techniques of this polygon will keep the *A. rufa* tunnels intact and protect other

existing habitat structures (Objective 1-4). The quantity of species chosen is based on suggested planting densities of 12', 6', and 3' on-center and the square footage of this polygon which is the highest attainable planting density within the planting polygon (Objective 1-1 and 1-2) (Table 1) (USDA 2013). The forms of species chosen for this polygon are plugs, live stakes, bare-root, and pots (Table 1). The reason potted *T. plicata* was chosen, instead of bare root, is because they were donated.

The dispersion pattern for the conifer trees in this polygon is 12 feet on center, placed in a zigzag type pattern with alternating species of *T. plicata* and *P. sitchensis*. The potted *T. plicata* will be planted in the wettest areas because they are the largest plants and will likely survive the best in those conditions (Fig. 7). Where possible *T. plicata* will be planted in shaded microenvironments (W. Gold, personal communication). The majority of shrubs will be planted with a dispersion pattern of 6' on-center, and again alternating plant species as to create diversity of species in a given area as well as create a diverse canopy structure (Objective 1-2).

AD16- *Pseudotsuga menziesii* was added to this polygon on the Westside which is uphill in a drier area where conditions would support this species.

The shrubs chosen vary in heights with *S. sitchensis* being one of the tallest and the shortest being *S. douglasii* which will create diversity in the shrub layer. The only shrubs that will be planted at 2'-3' on-center are the *S. sitchensis and C. sericea,* because of the fact that they are live staked and will provide quick dense cover and establish well in this setting (personal communication, K. Ewing 2012) to prevent reinvasion of *R. armeniacus* (Objective 1-1). *Salix sitchensis* is a very fast growing shrub that will create a rapid canopy cover helping with early successional plants and decreasing ability of *R. armeniacus* to reinvade the area (Objective 1-1 and 1-2).

AD17- *Salix sitchensis* was not added to this polygon instead *Salix lucida ssp. lasiandra* (Pacific willow) was added, as a result of availability.

The rest of the shrubs in this polygon will provide a multitude of benefits to existing and future avian and animal species that will inhabit the site (Objective 1-3). *Ribes sanguineum* (red flowering currant) is one of the species chosen for this polygon that requires drier soil and adequate light so it will be placed on the northwestern side of the polygon (Table 1) and it will provide a food source for animal and avian species (Table 7). The ground cover layer will be planted at 3' on-center and consists of *Aruncus dioicus* (goat's beard), *Carex obnupta* (slough sedge), *Juncus patens* (spreading rush), and *Schoenoplectus tabernaemontani* (softstem bulrush) (Table 1). These species will be in planted clusters of the three species mixed together in the wettest areas, in the eastern half of the polygon, and will be in close proximity to *L. involucrata*, *S. douglasii*, *C. sericea* and *S. sitchensis* which are the species that tolerate the amount of moisture in this polygon.

AD18- One *Populus balsamifera ssp. trichocarpa* (Black cottonwood) was added to this polygon to provide woody debris in the future which will provide habitat to many species.

AD19- *Juncus patens* and *Schoenoplectus tabernaemontani* were not planted in this polygon due to availability however, *Juncus tenuis* (Slender rush), *Carex stipata* (Sawbeak sedge), *Deschampsia caespitosa* (Tufted hairgrass), and *Eleocharis palustris* (Creeping spikerush) were planted instead.

AD20- *Mimulus guttatus* (Yellow monkey flower), *Mahonia nervosa* (Dull Oregon grape), and *Stachys cooleyae* (Cooley's hedge-nettle) were added as another food source for avian species and animals.

A 10 foot by 10 foot monitoring plot will be mapped out in the middle of polygon 2 (Objective 2-1) (Table 3). This area was chosen because this portion of the site receives moderate sun exposure, has wetland type soils (sandy clay loam), and a mixture of water loving species typified in this polygon (Table 3). A post will be placed on the west edge of this plot, which will allow photos to be taken at an exact point every six months. The post will be placed in an area that is along the trail to allow easy access and create minimal disturbance to the site. The purpose is to have a point in this polygon where the Friends of North Creek Forest can set up a camera and take photos to compile a database of images that will allow them to gather data and study the compatibility, structure, and survival of the upland species planted in the plot.

AD21- We used a Samsung 18X Zoom, 24mm Wide angle digital camera. This photo post was placed just to the west of the cross sectional trail, Labeled "B" with a reflective letter (Fig. 6). It was placed in this particular position to be used as a three hundred and sixty degree photo point. Place camera onto the post approximately five feet off the ground (Repeat on all four sides). Compass bearings for all the exposures: Eastern exposure at 53 degrees NE, Southern exposure at 157 degrees SE, Western exposure at 247 degrees SW, and a northern exposure at 334 degrees NW.

AD22- Two 4 meter by 4 meter monitoring quadrats were added in this polygon instead of one 10 foot by 10 foot quadrat so that quantitative monitoring of growth can be done within the different environments in this polygon.

Polygon Three

This polygon has the most sun exposure at roughly four hours per day. The soil texture is sandy loam on the top (west) gradually changing to a silty clay loam farther east. The soil moisture is lower at the top and higher at the bottom where water runs through the site into the ditch in the northeast corner. The species chosen for this polygon had to have a range of moisture variability due to the fact that it changes so much throughout the polygon. We were able to add a wider diversity of species to this polygon because of the larger amount of light available throughout the day. The quantity of species chosen is based on suggested planting densities of 10', 6', and 3' on-center and the square footage of the polygon which is the highest attainable planting density within the planting polygon (Objective 1-1 and 1-2) (Table 3) (USDA 2013). The forms that will be planted on this polygon are live stakes, bare root and pots.
The dispersion pattern for the conifer species will be 10' on-center and they will be placed in a zigzag pattern with alternating species depending on the habitat type to broaden the canopy structure and allow for a variety of foraging stops for many avian and animal species (Table 7)

(Objective 1-3) . The conifer species planted here will provide long term high canopy structure and provide evergreen shade (Objective 1-1 and 1-2). The shrubs will be planted with a dispersion pattern of 6' on-center, and again alternating plant species to create a diversity of species. The shrubs chosen for this particular polygon will provide quick cover which will foster the suppression of *R. armeniacus* and increase the diversity in the shrub canopy while conifer species begin to grow (Objective 1-1 and 1-2). *Salix sitchensis* and *C. sericea* will be planted in the northeast corner to disperse surface water and slow flow volumes in this area. *Spirea douglasii* and *C. sericea* will be planted along the east side of this polygon to create a buffer from the possible invasive species in the ditch as well as create quick cover to block sound from the freeway. *Ribes sanguineum* will be planted along the driest borders (northwest along trail) on this site to provide attractive color and also a food source for animals and avian species (Objective 1-3) (Table 7. The proposed ground cover in this polygon consists of *A. dioicus, C. obnupta* and *Scirpus microcarpus* (small-flowered bulrush) which will be planted at 3' on-center and *P. munitum* which will be planted at 6' on-center. *Carex obnupta* and *S. microcarpus* will be planted on the northeastern side of this polygon, where water from off-site flows through and there is increased sunlight. They will be associated with *C. sericea, S. douglasii* and *S. sitchensis*. *Polystichum munitum* will be dispersed throughout the polygon with exception of the wettest area (northeast) and will also be planted in association with *T. plicata.*

AD23- *Juncus tenuis, Carex stipata, Deschampsia caespitosa,* and *Eleocharis palustris* were also planted in this polygon.

AD24- Pseudotsuga *menziesii* was added to this polygon in areas that are drier and on an existing mound located in the southeast corner of this polygon.

AD25- *Fragaria chiloensis* (Coastal strawberry) and *Fragaria virginiana* (Woodland strawberry) were added to the existing mound in this polygon which will provide additional forage for a variety of avian and animal species.

A 10 foot by 10 foot monitoring plot will be mapped out in the middle of polygon 3 (Objective 2-1) (Fig 6). This area was chosen is because this portion of the site has the most sun, silty clay loam soils, and mixture of species which typify the polygon habitat conditions (Table 3). A post will be placed on the northwest corner of this plot, which will allow photos to be taken at an exact point every six months. The post will be placed in an area that is along the trail to allow easy access and create minimal disturbance to the site. The purpose is to have a point in this polygon where the Friends of North Creek Forest can set up a camera and take photos to compile a database of images that will allow them to gather data and study the compatibility, structure, survival of the species planted in the plot.

AD26- We used a Samsung 18X Zoom, 24mm Wide angle digital camera. This photo pole situated at the corner of the main trail and the cross sectional trail (Fig 6)**. It is labeled with a reflective letter "C" for identification. Place the camera approximately five feet off the ground with a compass reading of 112 degrees SE.**

AD27- One 4 meter by 4 meter monitoring quadrat was added in this polygon instead of one 10 foot by 10 foot quadrat so that quantitative monitoring of growth can be done (Fig 6).

3.) Art Plan

Our goal is to install an organic art component which will be designed to contribute both aesthetically and ecologically to the site (Objective 2-5). The organic art component will be installed in the south side of polygon three, on the east side of the trail (Fig 1.1). The art component to be installed will be a bench constructed out of live *S. sitchensis* stakes which will be collected from UW Bothell campus. The purpose of this art component is to engage a personal connection to nature. As the bench grows it will create a living structure that will visually and conceptually encourage people to sit with nature. The living bench will also contribute ecologically to the site by creating a dense thicket of *S. sitchensis* which will increase soil stability and create a highly shaded microhabitat.

AD28- An art plan was not installed due to factors beyond UW-RENs control. The original thought was to place a permanent structure within the polygon complex, however, due to the language of the Land/water grant UW-REN had to work under, it was not allowed. A second option of creating a "living" sculpture came up, but due to the political delays, the progression of events in the field had to shut down. The need for more essential components of installation, and the logistics surrounding those needs became priority. Due to these factors by the time the UW-REN team could approach the issue it was seasonally unviable to pursue the idea.

Budget

The majority of planned expenditures will be purchasing trees and shrubs. In an effort to reduce our total expenditure on plants, we have incorporated many deciduous tree species which can be live staked. Live stakes and salvaged plants have been donated by UWB Facilities as well as private parties. The vast majority of our purchased plants will be obtained from the King Conservation District Plant Sale, Storm Lake and Tadpole Haven. The mulch that we intend to use on site will be provided by local arborists, and has been dropped off twice to date. Doughnuts and coffee for volunteers have been donated by Albertsons of Clearview and Starbucks of Clearview Respectively, and we anticipate their continued support into the future. The Friends of North Creek Forest and the capstone course tool supply will provide all necessary tools for volunteer work parties. FNCF has provided financial support for barbecues on volunteer parties with high attendance and intends to continue providing funds for BBQ's as the project moves forward. The financial support of FNCF will allow us to focus our funds toward plant density. Since the North Creek Forest is within walking distance of the University of Washington Bothell, which all team members attend, there will be no need to reimburse driving expenditures. We have asked for $230.00 from our CP to cover extra plant costs and plan to utilize the $580.00 dollars from the course fee allotment to pay for the rest of our planning plan. The total plant expenditure may change over time as our team is hoping to secure more salvaged plants. The current expenditure budget assumes we do not receive any more salvaged plants. Printing our

poster board will be afforded by team members in the case we do not receive additional; salvage plants.

AD29-The 230.00 dollars was not received from the FNCF, due to the fact that a stop-work order prevented us from acquiring the intended plants.

AD30-Additional donated plants; plants ultimately donated did not match original expectations, and therefore were valued differently than expected.

Polygon Map

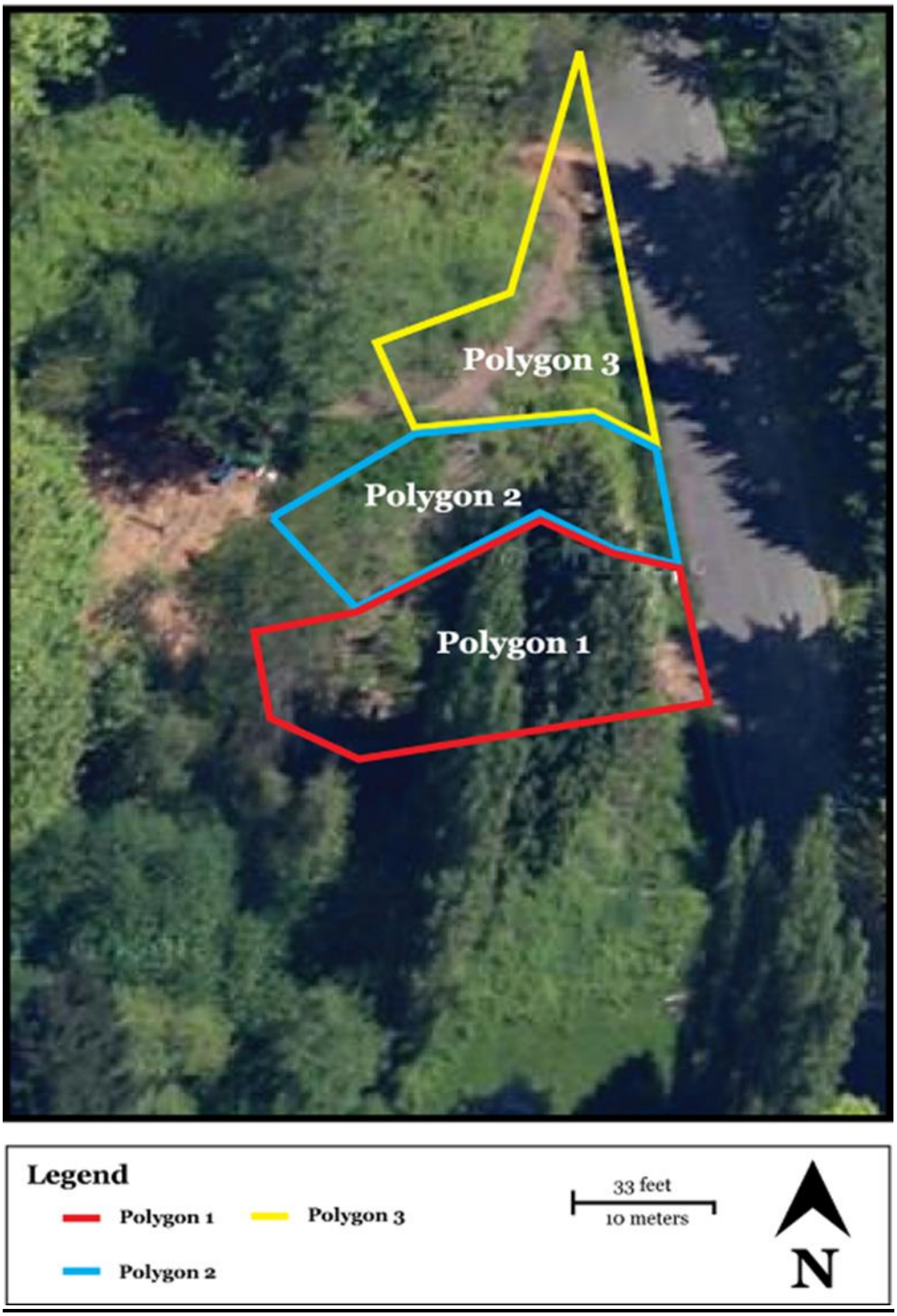

Figure 5. Site boundaries and polygon delineation

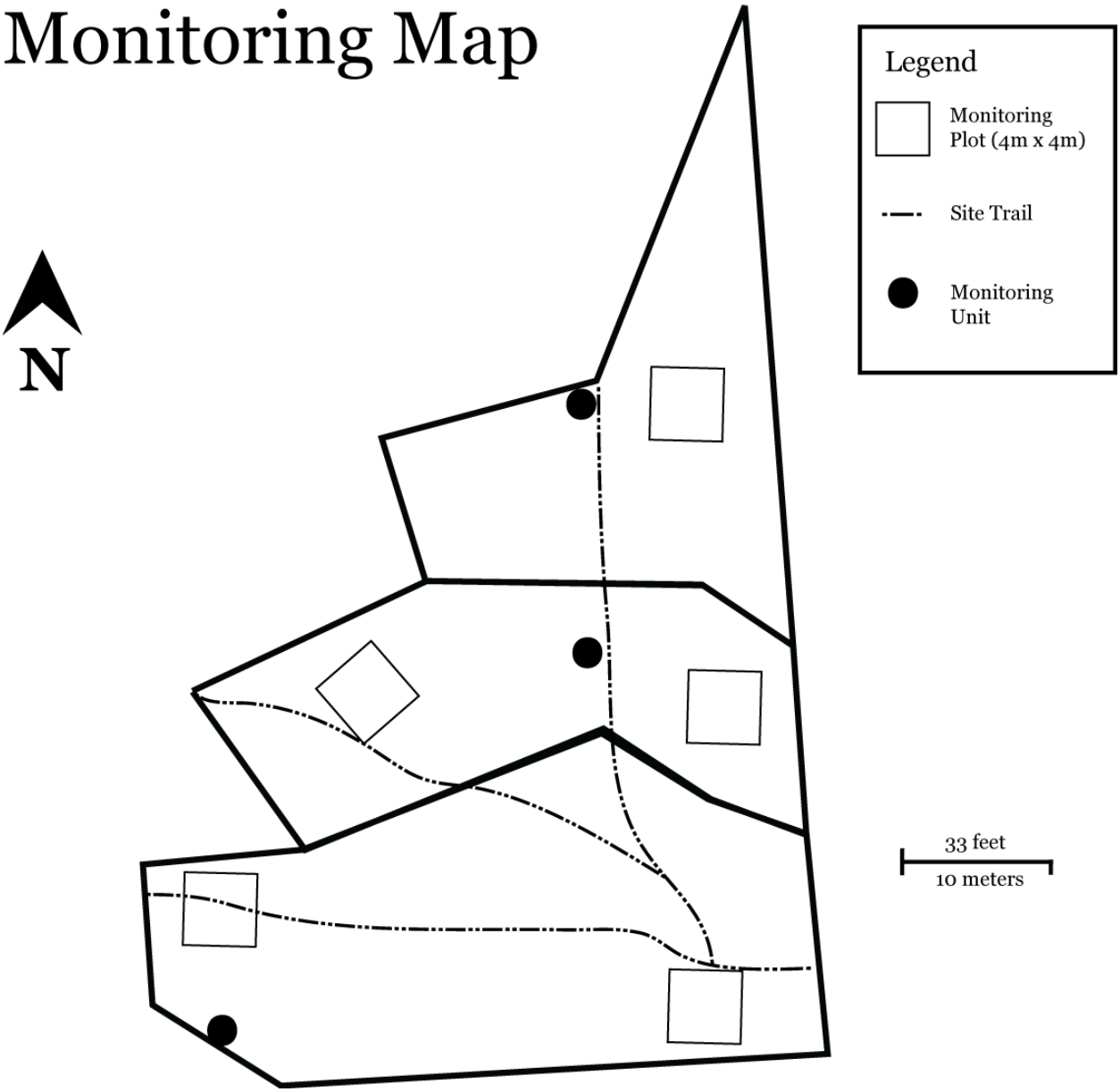

Figure 6. Monitoring map, shows the location of photo monitoring units and quadrats

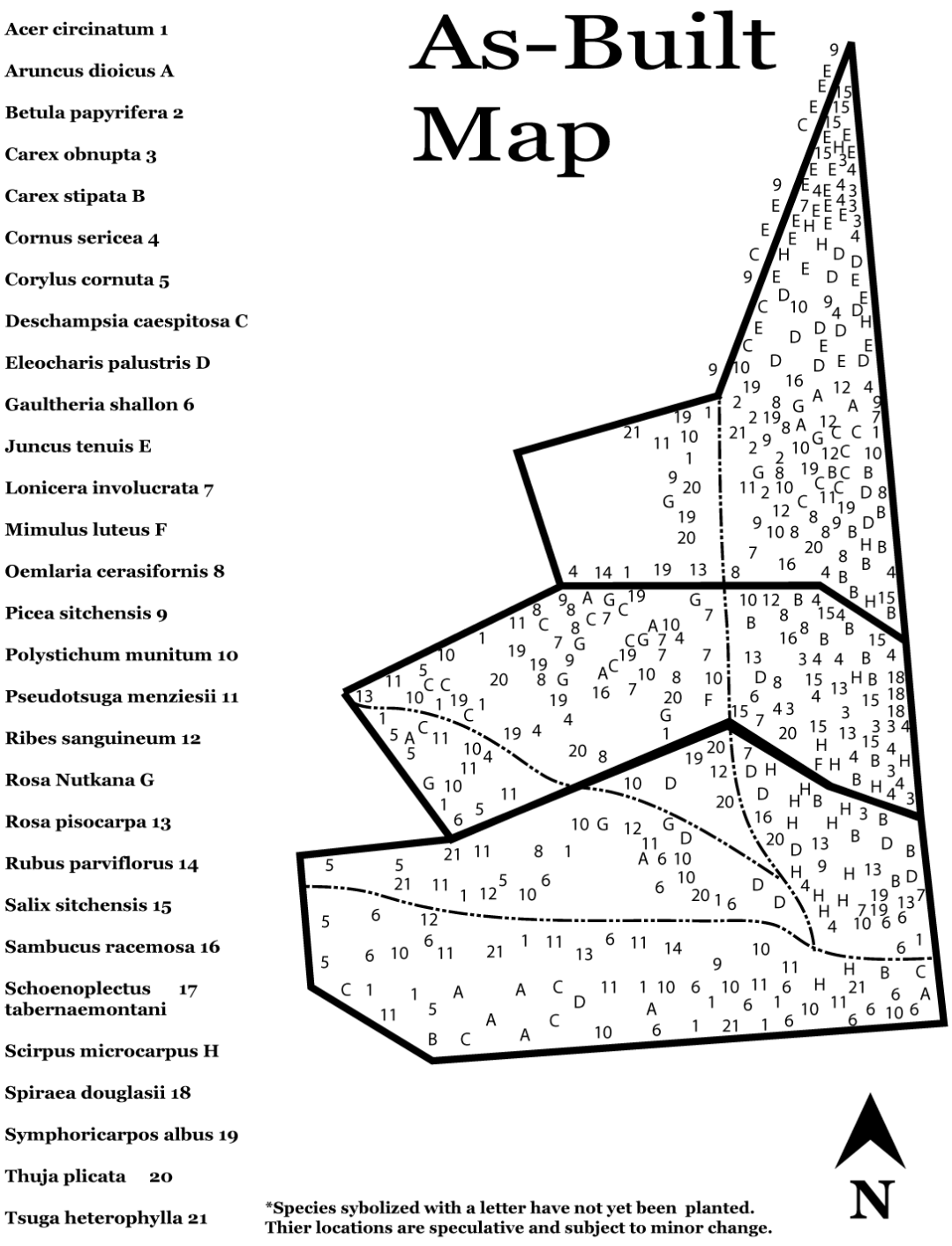

Figure 7. As-built map shows location of all installations on site

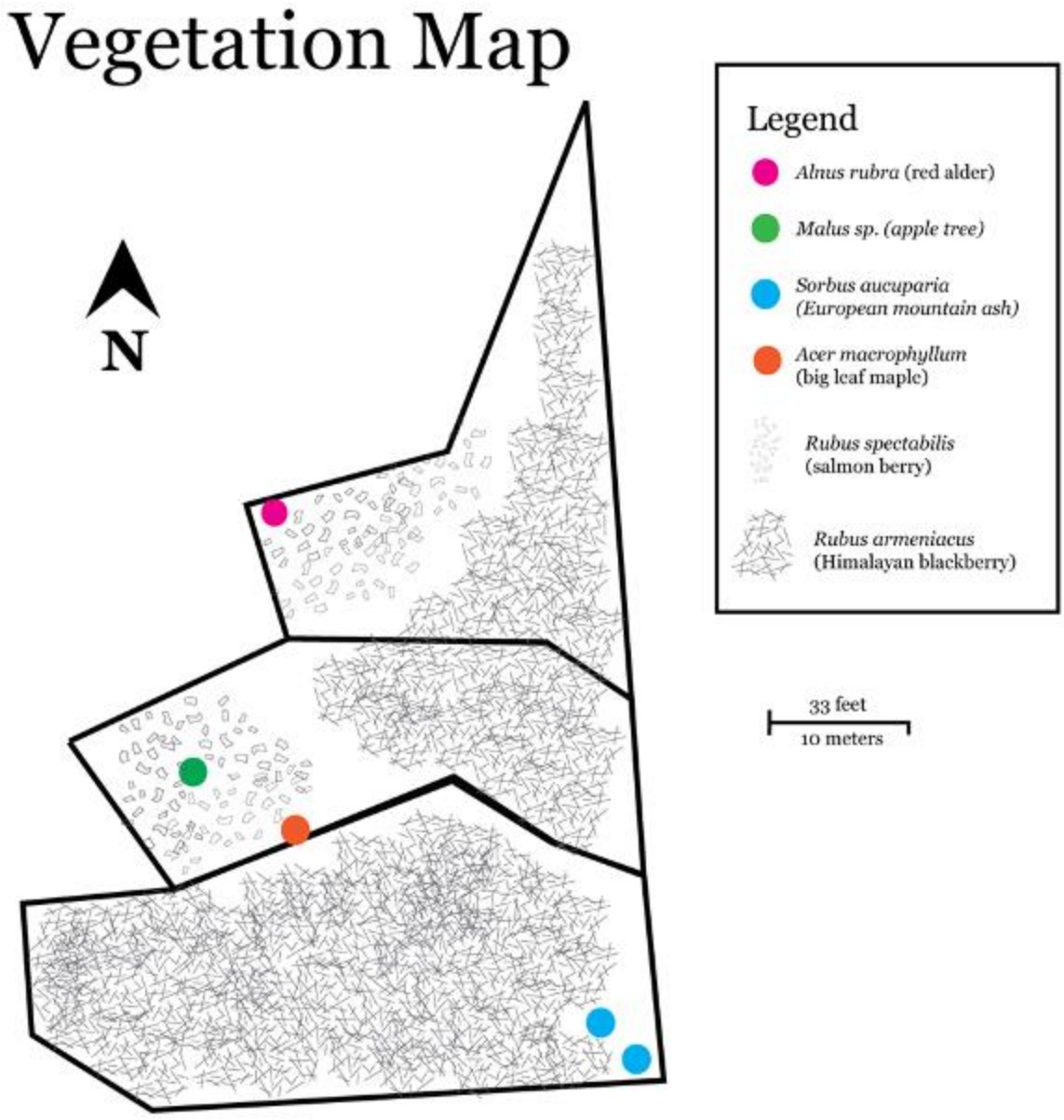

Figure 8. Vegetation map that illustrates the pre-existing native and non-native vegetation

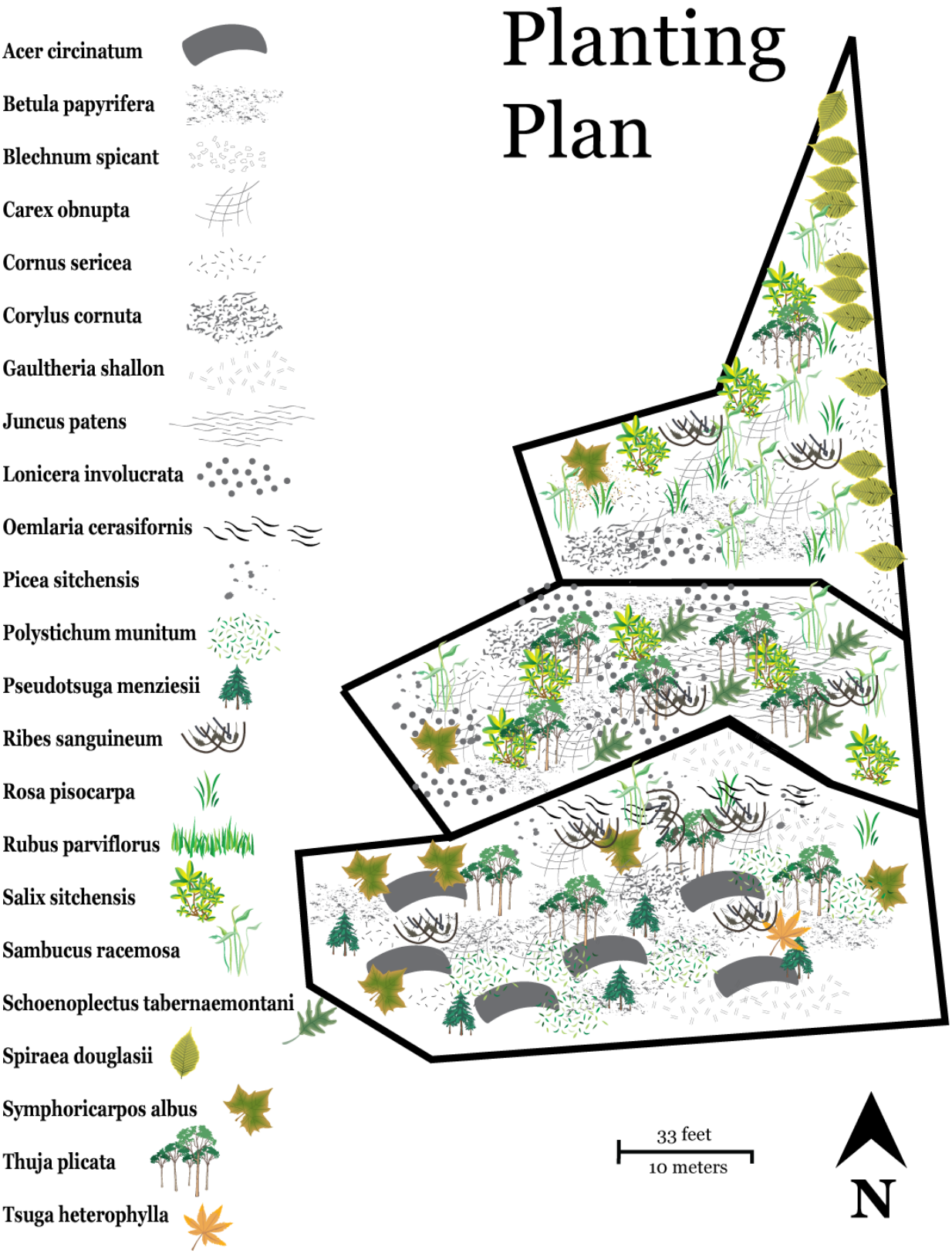

Figure 9. Planting plan for species intended for installment

Tables Revisions

	Polygon 1 (4,046 sq.ft.)			Polygon 2 (2,478 sq. ft.)			Polygon 3 (2,499 sq. ft.)		
Species	#	**Spacing (ft)**	**Form**	#	**Spacing (ft)**	**Form**	#	**Spacing (ft)**	**Form**
Acer circinatum	10 12	6' O.C.	BR	6	6' O.C	BR	4	6' O.C.	BR
Aruncus dioicus				5	2-3' O.C.	Pot	10	2-3' O.C.	Pot
Betula papyrifera	4	10' O.C.	Pot						
Blechnum spicant	10	6' O.C	6"-8" Pot				4	6' O.C	6"-8" Pot
Carex obnupta				20 11	3' O.C	Plugs Sal	10 5	3' O.C	Plugs Sal
Carex stipata				13	2-3' O.C.	10" Tube	12	2-3' O.C.	10" Tube
Cornus sericea				25 16	3' O.C.	LS 6" Pot	50 8	3' O.C.	LS
Corylus cornuta	13 6	6' O.C.	1 gal. Pot				6 4	6' O.C.	1 gal. Pot
Deschampsia caespitosa				12	2-3' O.C.	10" Tube	13	2-3' O.C.	10" Tube
Fragaria chiloensis							8	2-3" O.C	4" Pot
Fragaria virginiana							8	2-3" O.C	4" Pot
Gaultheria shallon	10 20	6' O.C.	4" Pot Plug	3	6' O.C.	Salvage			
Juncus effusus				5	2-3' O.C.	Salvage	5	2-3' O.C.	Sal
Juncus patens *Juncus tenuis*				20 15	2-3' O.C	Plugs 10" Tube	10	2-3' O.C	10" Tube
Lonicera involucrata				13 7	6' O.C.	1 gal. Pot BR	4 3	6' O.C.	1 gal. Pot BR
Mahonia nervosa	4	6' O.C.	Sal	2	6' O.C.	Sal			
Mimulus guttatus				2	6' O.C	1 gal. Pot			
Oemlaria cerasiformis	10 1	6' O.C.	BR	9	6' O.C.	BR	4 10	6' O.C.	BR
Picea sitchensis	2		BR	11 1	12' O.C.	BR	12 9	10' O.C.	BR
Polystichum munitum	10 13	6' O.C.	6"-8" Pot Plug	8	6' O.C.	Plug	4 7	6' O.C.	6"-8" Pot Plug
Populus balsamifera ssp. trichocarpa				1	12' O.C.	1 gal. Pot			
Pseudotsuga menziesii	12 11	10' O.C.	Pot	5	10' O.C.	Pot	3	10' O.C.	Pot
Ribes lacustre				2	1' O.C	6" Pot			
Ribes sanguineum	4	6' O.C	BR	5 2	6' O.C.	6"-8" Pot BR	4	6' O.C.	6"-8" Pot BR
Rosa gymnocarpa	10	6' O.C.	6"-8" Pot						
Rosa nutkana	10	6' O.C.	BR	6	6' O.C	BR	4	6' O.C.	BR
Rosa pisocarpa	10 4	6' O.C.	6"-8" Pot	4	6' O.C	6"-8" Pot	4	6' O.C.	6"-8" Pot
Rubus parviflorus	3	6' O.C	Bare-root		6' O.C	BR	4	6' O.C.	6"-8" Pot BR
Salix lucida ssp. lasiandra				10	2-3' O.C.	LS	3	2-3' O.C.	LS
Salix sitchensis				40	2-3' O.C.	LS	10 4	2-3' O.C.	LS
Sambucus racemosa							4 5	6' O.C.	1 gal. Pot
Schoenoplectus tabernaemontani *Eleocharis palustris*				20 13	2-3' O.C	Plugs	12	2-3' O.C	10" Tube
Scirpus microcarpus				12	2-3' O.C	10" Tube	10 13	2-3' O.C	Plug 10" Tube
Spiraea douglasii				10 4	6' O.C.	LS	15	6' O.C.	LS
Stachys cooleyae				1	6' O.C.	6" Pot			
Symphoricarpos albus	10 3	6' O.C.	BR	7	6' O.C	BR	4 6	6' O.C.	BR
Thuja plicata	12 4	10' O.C.	Pot	6	12' O.C.	5 gal. Pot	12 4	10' O.C.	Pot
Tsuga heterophylla	12 4	10' O.C.	BR	1	10' O.C.	Bare-root	3	10' O.C.	BR
Totals	**88**			**189**			**185**		
Grand Total: 462									

Table 1. Plant list: Plant list identifies where what was installed on site.

Task	Materials	Qty	Source		Tools	Qty	Source
Task 1-1a	Tarp	4	FNCF		Loppers	10	FNCF
					shovels	20	FNCF
					clawed mattocks	5	FNCF
					gloves	50	FNCF/Us
					Wheelbarrows	3	
Task 1-1b	Mulch	200 cu. yrds	Local arborists		Wheelbarrows	3	FNCF
					Shovels	20	FNCF
					Pitchforks	5	FNCF
					Rake	4	FNCF
					Gloves	30	FNCF/Us
Task 1-2a	Plants	~~404~~ 462	Various		Shovels	20	FNCF
					Gloves	30	FNCF/Us
					Rake	4	FNCF
Task 1-3a	Plants	~~404~~ 462	Various		Shovels	20	FNCF
					Rake	4	FNCF
					Gloves	30	FNCF/Us
Task 1-4a	Marking tape	1	Us				
Task 2-1a	Marking tape	1	Us		Gloves	6	FNCF/Us
	Wood Post	1	TBD		Shovels	1	FNCF
Task 2-1b	Marking tape	1	Us		Gloves	6	FNCF/Us
	Wood Post	1	TBD		Shovels	1	FNCF
Task 2-1c	Marking tape	1	Us		Gloves	6	FNCF/Us
	Wood Post	1	TBD		Shovels	1	FNCF
Task 2-1D	Live Stakes	TBD	UWB Campus		Gloves	6	FNCF/Us
Task 2-2a	Online flyers/ Personal communication		Various sites		Internet sites		
Task 2-3a	Personal communication		Bothell Parks				
Task 2-4a	~~flyers~~/ Personal Communication	TBD	various				
~~Task 2-5a~~	~~Willow Cuttings~~	~~TBD~~	~~On site/UWB Campus~~				

Table 2 Materials list. The materials list outlines the tools necessary for installation success.

Polygon 1		Polygon 2		Polygon 3	
Quadrat	**Species**	**Quadrat**	**Species**	**Quadrat**	**Species**
1-A	*A. circinatum*	2-A	*C. obnupta*	3-A	*A. dioicus ^*
	C. cornuta ^		*C. sericea*		*C. sericea*
	E. ciliatum		*C. stipata ^*		*Carex stipata*
	G. shallon		*D. caespitosa ^*		*D. caespitosa ^*
	M. nervosa		*E. arvense*		*E. palustris ^*
	P. munitum		*E. palustris ^*		*J. tenuis ^*
	T. grandiflora		*J. tenuis ^*		*L. involucrata*
	T. heterophylla		*M. guttatus*		*O. cerasiformis*
1-B			*O. cerasiformis*		*P. menziesii*
	C. cornuta ^		*P. balsamifera ssp. trichocarpa*		*P. munitum*
	G. shallon		*R. lacustra*		*P. sitchensis*
	O. cerasiformis		*R. pisocarpa*		*R. sanguineum*
	P. munitum		*S. cooleyae*		*S. albus*
	R. spectabilis		*S. lucida ssp. lasiandra*		*S. microcarpus ^*
	T. grandiflora		*S. microcarpus ^*		*S. racemosa ^*
		2-B	*O. cerasiformis*		
			P. menziesii		
			P. munitum		
			R. nutkana		
			R. parviflorus		
			R. pisocarpa		
			*R. repens **		
			S. albus		
			T. grandiflora		
			T. plicata		

Species not in plot but providing cover, also labled as native- "
Exotic species, may not be invasive - *
species still need to be planted - ^

Table 3 Species by monitoring quadrat

4. Timeline Revisions

__As indicated by comparing the included Gantt charts (emailed separately), the initial timeline was delayed by approximately 5 months while waiting for approval to continue the project. This setback created some scheduling complications and likely contributed to increased mortality for the plants that had to sit in a staging area while ground-breaking activity was prohibited. For the purposes of this report, the delay simply moved the planned activities later into the year.

5. Lessons Learned

(A) Financial Budget –

__The most difficult part of the budgeting was predicting how expenses would change throughout the project. In particular; it is very hard to predict what sort of donations will be received, and what their value will be. The team had access to funds from the FONC that were unused because so many plants were donated. Incorrectly guessing which species of plants would be available, and what their cost would be, also caused us to alter our planting plan. The FNCF donated food for the volunteer events, so the project was not hindered by the effect that numerous small work parties had on funds for supplies; but the additional expense associated with more frequent smaller work parties was a surprise.

Revenue by fund source	
Course fee allotment	~~**580**~~ **532.09**
Total fundraising	0
Cash donations	0
cash donations by team members	100
cash donations by sponsor	0
cash donations by neighborhood group	0
Total cash donations	~~**230**~~ **100**
In-kind donations	
tool rental waiver ($ value)	~~2453~~ 3233
Food for volunteers ($ value)	~~996~~ 1588
Mulch	~~5125~~ 4100
Plant donation	~~236~~ 1236.54
Dumpster donation	~~775~~ 1550
Total in-kind donations	~~**9585**~~ **11707.54**
Project Total	~~**10395.00**~~ **12339.63**

Expenditures by major category	Cost - SEFS Budget	Cost - Other Funds	In Kind	
Plants				
conifer trees	~~203~~ 39.42		~~55~~ 316.1	
broadleaf trees	~~85~~ 35.04		~~114~~ 88.2	
shrubs	~~222~~ 272.66	~~230~~	~~67~~ 516	
Herbaceous layer	~~70~~ 195.1		$316.24	
Subtotal plants	**~~579~~ 521.41**	**~~230~~**	**~~236~~ 1236.54**	
Mulch				
Subtotal mulch	**0**	**0**	**~~5125~~ 4100**	
Dumpster Rental				
Subtotal For Dumpster Rental	**0**	**0**	**~~775~~ 1550**	
Tool rental				
tool rental for 11/10/12			496	
tool rental for 11/17/12			~~339~~ 246	
tool rental for MLK day work party			~~224~~ 197	
tool rental for 2/23/14			~~404~~ 251	
tool rental for 3/09/214			~~339~~ 0	
tool rental for ~~late march~~ 3/23/2013			~~339~~ 246	
tool rental for ~~early may~~ 4/06/2013			~~339~~ 402	
tool rental for 4/13/2013			402	
tool rental for 4/20/2013			402	
tool rental for 4/27/2013			197	
tool rental for 5/11/2013			197	
tool rental for 5/25/2013			197	
Subtotal for tool rental	**0**	**0**	**~~2453~~ 3233**	
Food for volunteer events				
Work Party on 11/10/12			108	
Work Party on 11/17/12			148	
Work Party on MLK day work party			148	
Work Party on 2/23/14			148	
tool rental for ~~late march~~ 3/23/2013			148	
tool rental for ~~early may~~ 4/06/2013			148	
Work Party on 4/13/2013			148	
Work Party on 4/20/2013			148	
Work Party on 4/27/2013			148	
Work Party on 5/11/2013			148	
Work Party on 5/25/2013			148	
Subtotal for food	**0**	**0**	**~~996~~ 1588**	
Timber for phto unit				
Subtotal for timber for photo unit	0	**100**	0	
Transportation				
Subtotal for transportation	**0**	**0**	**0**	
Printing				
Subtotal for printing	**10.68**	**0**	**0**	
Project Total	**~~580~~ 532.09**	**100**	**~~9585.00~~ 11707.54**	**~~10395~~ 12339.63**

(B) Labor Budget -

The number and dedication of volunteers was a great asset. We planned for large events, and recruited volunteers from many sources, but the quantity of volunteer hours is no less impressive. While the wealth of volunteer labor was essential it presented its own challenges; preparing for the variation in the numbers of volunteers and the impact of weather on the events required the ability to adapt our management plan. Keeping volunteers from damaging desirable vegetation also become a source of concern.

Labor by source (revenue)	Total hours
Team	~~**255**~~ **457**
Volunteers	
Work Party on 11/10/12	~~*47*~~ *90*
Work Party on 11/17/12	~~*133*~~ *90*
Work Party on MLK day work party	~~*67*~~ *60*
Work Party on 2/23/14	~~*100*~~ *126*
Event on 3/09/2013	~~100~~ ~~0~~
Work Party for ~~late march~~ on 4/06/2013	*105*
Work Party on 4/13/2013	*122*
Work Party ~~late March~~ on 4/20/2013	70
Work Party ~~early April~~ on 4/27/2013	90
Work Party on 5/11/2013	3
Work Party on 5/25/2013	4
TOTAL	~~**902**~~ **1,217 hours**

Labor by activity (expenditure)	Team	Volunteers	Total
Site preparation			
Garbage removal	2	2	**4**
Border demarcation	12	0	**12**
Plant organization	10	10	**20**
Removing debris from abandoned house	3	12	**15**
Remove cut canes from site	16	62	**78**
Removing Holly from upper forest	0	30	**30**
Subtotal site preparation	~~**14**~~ **43**	~~**2**~~ **116**	~~**16**~~ **159**
Invasive plant removal			
Himalayan blackberry	~~100~~ 135	~~420~~ 390	~~*520*~~ ~~*525*~~
Subtotal invasive plant removal	~~**100**~~ **135**	~~**420**~~ **390**	~~**520**~~ **525**
Plant acquisition			
Planning	10		
Nurseries	10		
Salvage	15		
live stake collection	31		
Subtotal plant acquisition	**66**	**0**	**66**
Planting			
polygon 1	~~25~~ 32	~~75~~ 93	125
polygon 2	~~25~~ 30	~~75~~ 58	88
polygon 3	~~25~~ 32	~~75~~ 61	93
Subtotal planting	~~**75**~~ **94**	~~**225**~~ **212**	~~**300**~~ **306**
Watering			
Subtotal watering	10		**10**
Spreading Mulch			
Subtotal spreading Mulch	**109**	**42**	**151**
TOTAL	~~**255**~~ **457**	~~**647**~~ **760**	~~**902**~~ **1,217 hours**

(C) Planting Plan –

The numerous changes to the planting plan created a variety of learning experiences. The most dramatic changes to the planting plan were ultimately caused by the approval-delay in the project which caused die-off and made acquiring the intended plants more difficult. It is difficult to make sure that dynamic plans are adhered to when working with large groups of volunteers. The same fervor that was such a service when pulling invasive became difficult to manage when planting. The donation of several different species of plants created changes in the planting plan that could not have been anticipated, but incorporating these species into the planting plan adds to the ecologic value of the site. The adjustments made to the planting plan created a need to re-map the site for the as-built, which proved to be quite time consuming. Maintaining the

appropriate spacing for the plants became complicated when working with volunteers, and as a result of the existing vegetation (Fig. 7 & 5).

Design for the Future

The ultimate goal for the future of the site is to develop a mature coniferous forest. The removal of *R. armeniacus* and addition of mulch will allow for the plants introduced during the initial restoration to succeed and develop into a native multi-layered canopy. The absence of the *R. armeniacus* monoculture will also allow for flora of the surrounding forest to slowly return to the site, allowing for a more cohesive integration with the rest of North Creek Forest. We intend to keep some of the natural features on the site, such as the existing woody debris and the existing tunnels. In time, it is expected that native animals will slowly re-establish to this portion of the forest.

To ensure the success of the restoration efforts, proper site maintenance must be executed. The largest concern for the future of this site is the risk of invasive species returning. Unfortunately there is no lack of invasives surrounding the site. *Phalaris arundinacea* dominates the drainage ditch situated between the street and the site. The city of Bothell supposedly mows this drainage ditch four times annually. Ideally the addition of *S. douglasii* at this border of the site will curb any advances of the *P. arundinacea*. *Rubus armeniacus* populations border the northern and southern portions of the North Creek site and the I-405 corridor that sits a couple hundred feet to the east provides ample opportunity for the colonization of nonnative species. Our largest concern rests with the collapsed buildings undergoing a cultural study site that straddles the border between the 2011-2012 and the 2012-2013 restoration sites. The foundations are full of *R. armeniacus*, and we are currently unable to clear this thicket of *R. armeniacus* due to concerns of the city and current land owners. It is likely that the *R. armeniacus* will be removed at some point following the archaeological/cultural study.

With proper attention to invasive species, the only other maintenance required is the watering of planted flora through the spring and summer months. This level of attention from the community partners will allow for a variety of draught intolerant plants to exist on the site that normally wouldn't be as successful such as *T. plicata* and the variety of sedges we intend to plant The Friends of North Creek Forest will continue to work with the local community and will continue to host community events including work parties and educational excursions to maintain the site. One of the main goals of the Robinsons and the FNCF is to develop the site with education in mind. North Creek Forest has the unique quality of being located within close distance to a number of schools, including the University of Washington's Bothell campus. The addition of the three experimental plots spanning each polygon will encourage cooperation with the university and allow for living labs for scientific study. The ability to reach out to the youth will also provide an opportunity to educate students about ecology and the importance of conservation, restoration, and the necessary role that sites like North Creek Forest play within the community.

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Appendix A

Species	Benefits For Wildlife
Acer circinatum '	Seeds: eaten by squirrel and deer and a variety of avian species and shoots provide browse for deer
Aruncus dioicus '	Seeds: eaten by many native songbirds Flowers: visited by a variety of native pollinators.
Betula papyrifera '	Seeds: eaten by variety of native birds and some animals Browse: large and small animals
Carex obnupta "	Seeds: eaten by a variety of avian species; Provides cover and nesting sites for some avian species and small mammals.
Cornus sericea '	Fruits: Eaten by variety of avian species and animals. Browse: important for for deer and rabbits in winter months Nectar: Butterflies. Leaves: Butterfly larvae. Cover: avian species and small animals
Corylus cornuta '	Seeds eaten by squirrels and avian species. Cover: avian species and small mammals. Insects: eat foliage and nest and get eaten by birds
Gaultheria shallon '	Fruits: eaten by avian species Browse: deer
Lonicera involucrata ' "	Fruits provide food for variety of avian species and animals, flowers provide nectar for humming birds and butterflies, can be host to some butterfly larva
Oemlaria cerasifornis '	Fruits provide food for variety of avian and animal species
Picea sitchensis '	Seeds: eaten by small animals Browse: eaten by rabbits Nesting sites: for a variety of avian species Cover: small and large animals and avian species Insects: avian species eat insects
Pseudotsuga menziesii '	Seeds: eaten by some avian species and small mammals Nesting: osprey and eagles and other small avian species. Browse: foliage, bark and twigs eaten by many animals including mountain beaver and deer. Cover: many avian species and large animals. Insects: live and get eaten by avian species and small mammals
Ribes sanguineum ' "	Fruits: eaten by many wildlife species including mountain beaver; Nectar: hummingbirds and butterflies; Forage: butterfly larve and birds eat berries
Rosa gymnocarpa '	Fruits: rosehips eaten in fall and winter by some avian species
Rosa nutkana '	Fruits: rosehips eaten in fall and winter by some avian species
Rosa pisocarpa '	Fruits: rosehips eaten in fall and winter by some avian species
Rubus parviflorus '	Fruits: eaten by a variety of avian species including hummingbirds
Salix sitchensis '	Seeds: eaten by some avian species Browse: twigs and leaves eaten by animals Cover: animal and avian species Insects: get eaten by birds
Sambucus racemosa '	Fruits: eaten by small animals and many avian species Browse: foliage and twigs eaten by deer
Schoenoplectus tabernaemontani "	Seeds: foodsource for many avian species; Cover: racoons and other small mammels
Spiraea douglasii '	Insects: butterflies and butterfly larvae
Symphoricarpos albus '	Fruits: persistant fruits eaten by avian species Browse: eaten by deer Cover: avian species and small mammals
Thuja plicata '	Seeds: eaten by variety of avian species Browse: deer eat seedlings and spouts Nesting: Variety of avian species and small animals in cavities Cover: Large animals and avian species Insects: forage and nest and get eaten by avian species
Tsuga heterophylla '	Seeds: eaten by variety of avian species and small animals such as squirrels Nesting: many avian species Cover: many avian species and animals as well as roosting sites for feeding Insects: Use bark and foliage for food and nesting and get eaten by avian species
Reference: Stinson and Fisher '	
USDA Plants Database "	

Table 7 Shows the ecological benefit offered of species installed on site