North Creek Forest Stewardship Plan

University of Washington-Restoration Ecology Network
Capstone Course 2018-2019

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Prepared for
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Project Description

The overall restoration site is within the Puget Sound region near the north end of Lake Washington by the Sammamish River. It is located in the City of Bothell just north of University of Washington - Bothell Campus, and west of the North Creek (Figure 1). The restoration site is at the south end of North Creek Forest right next to the park entrance sign along 112th avenue (Figure 2).

Figure 1. North Creek Forest regional location

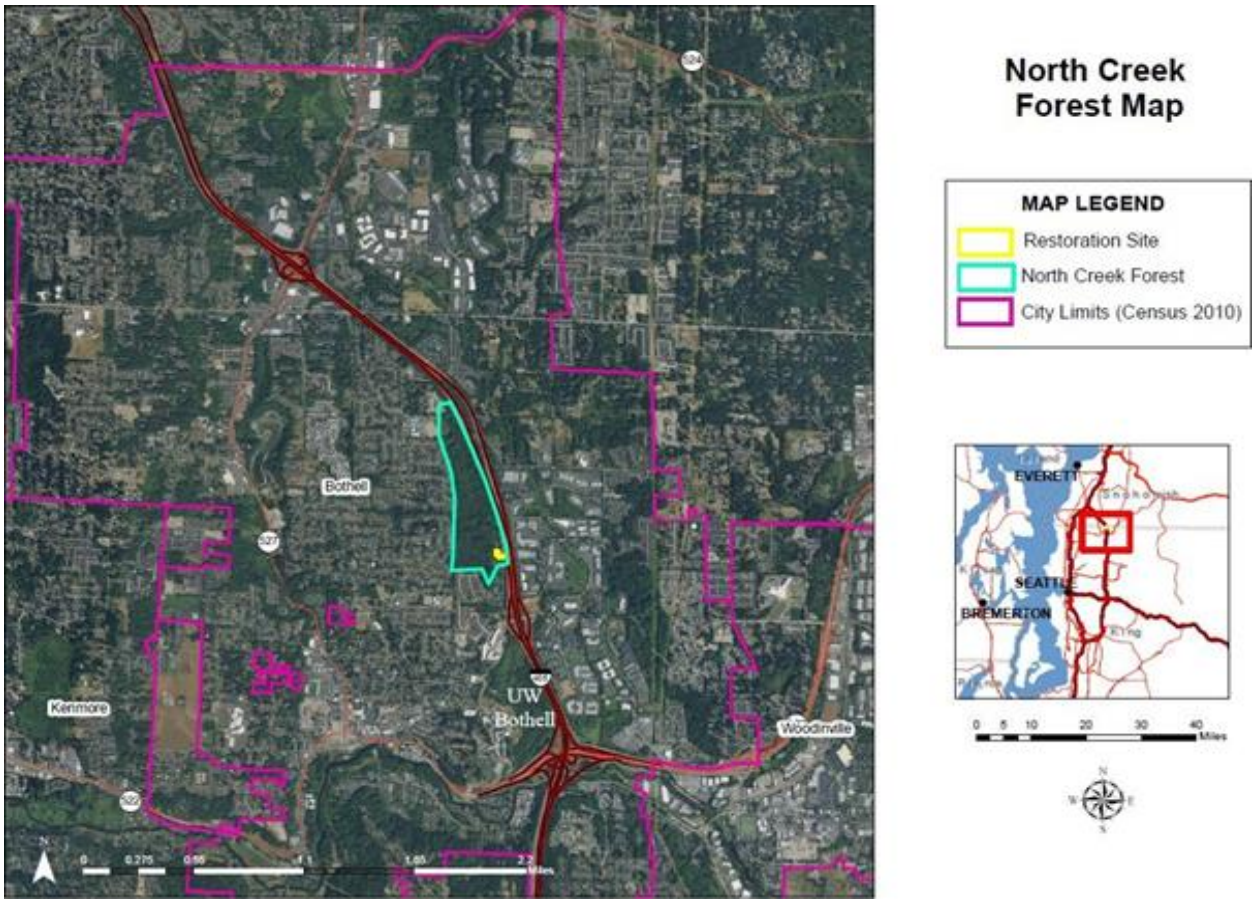


Figure 2. North Creek Forest restoration project site location

Our site area surrounds a previous restoration effort and is 7,960 square feet. Our team also removed dense thickets of Himalayan blackberry (*rubus armeniacus*), mulched and planted an additional 2,330 square feet along a seasonal stream located to the south of our site. An additional 1,460 square feet of Himalayan blackberry (*rubus armeniacus*) was removed to the east of our site. Finally, 1,250 square feet of Himalayan blackberry (*rubus armeniacus*) was

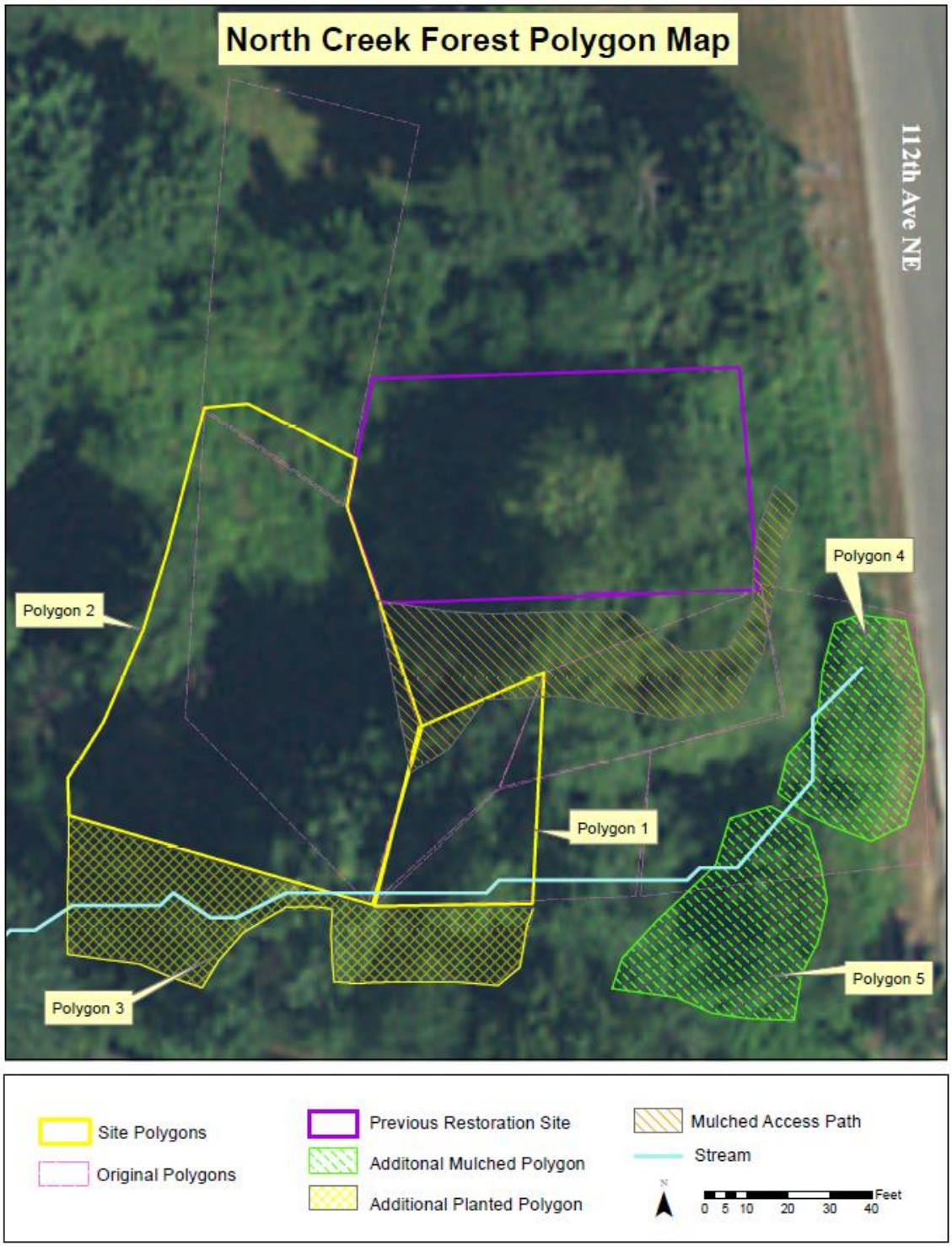
removed, with 2 inches of mulch applied to the site and the Friends of North Creek Forest (FNCF) installed native plants within the area.

The mulched access path to the previous restoration effort and our site was re-mulched twice throughout the past year. Originally, our site included six polygons but were renamed to better ensure a high planting density. Polygon 1 (previously named updated polygon 4) consisted of moist and shady conditions, considerably different from Polygon 2 (previously named updated polygon 6), which consisted of dry, sunny and upland conditions.

Our entire site was invaded by Himalayan blackberry (*rubus armeniacus*) with English ivy (*Hedera helix*) located at the eastern edge of Polygon 2. Our immediate goal for the site included removing these invasives species and preventing them from re-establishing by installing native species found in the North Creek Forest. This would establish native vegetation in a similar structural matrix to the rest of the forest. With the help of volunteers and staff from the Friends of North Creek Forest, we removed all of invasives species from the site, applied a 12-18'' layer of mulch, and installed a wide range of bare root plants in our two different site polygons. Our team also coordinated with the City of Bothell to remove large Himalayan blackberry (*rubus armeniacus*) thickets and fruit trees that were touching Puget Sound Energy Power Lines. This helped increase safety for volunteers when working and beautified the area, which is located just as one enters the park along 112th Ave.

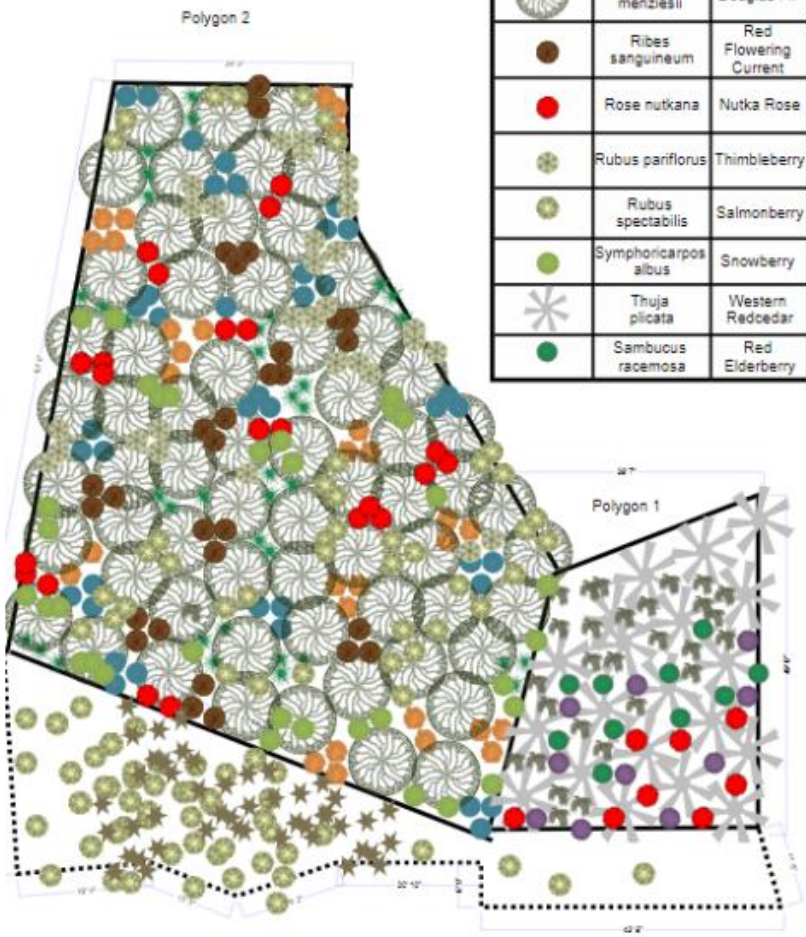
There is significant Himalayan blackberry (rubus armeniacus), English ivy (*Hedera helix*), and Holly (*ilex aquifolium*) just to the west of our site. We created a thick 3-5 foot buffer of mulched area surrounding our polygons. It will be critical to monitor the edges of our site for invasive species as well as continue removing invasive species further upslope to the west. Friends of North Creek Forest already have follow-up volunteers work parties to continue mulching and removing blackberry to the areas immediately to the east of our sites.

Figure 3. North Creek Forest polygon map



Post-Installation Site Description

Figure 4. Planting map of polygon 1 and 2 in North Creek Forest



Plant Schedule

Symbol	Botanical Name	Common Name	Size/Spacing	Quantity
	Corylus cornuta	Beaked Hazelnut	BR/ 4ft O.C.	20
	Rosa pisocarpa	Pea-Fruit Rose	BR 4ft O.C.	50
	Holodiscus discolor	Oceanspray	BR / 4ft O.C.	40
	Mahonia aquifolium	Tall Oregon Grape	BR / 4ft O.C.	40
	Oemleria cerasiformis	Indian Plum	BR / 4ft O.C.	10
	Polystichum munitum	Western Swordfern	Plug 50p/ 4ft O.C.	10
	Pseudotsuga menziesii	Douglas Fir	Plug / 10ft O.C.	63
	Ribes sanguineum	Red Flowering Current	BR / 4ft O.C.	40
	Rose nutkana	Nutka Rose	BR / 4ft O.C.	20
	Rubus pariflorus	Thimbleberry	BR / 4ft O.C.	40
	Rubus spectabilis	Salmonberry	BR / 4ft O.C.	80
	Symphoricarpos albus	Snowberry	BR / 4ft O.C.	30
	Thuja plicata	Western Redcedar	Plug / 10ft O.C.	20
	Sambucus racemosa	Red Elderberry	BR / 4ft O.C.	20

Polygon 1

A) Basic polygon information

Polygon 1 lies in the NE corner of the project site and is 1,620 square feet. This area had been dominated by a thicket of Himalayan blackberry (*Rubus armeniacus*).

B) Restoration approach

The Himalayan blackberry was removed completely by the roots. Wood chip mulch was applied 15 cm deep and western red cedar (*Thuja plicata*), red elderberry (*Sambucus racemosa),* Indian plum (*Oemieria cerasiformis),* nutka rose (*Rose nutkana*), and western swordfern (*Polystichum munitum*) were installed behind the staked woody debris about 4 ft O.C. (Figure 4; Table 1).

Table 1. Polygon 1 plant inventory May 5, 2019.

Polygon 1				
Latin name	**Common name**	**# or Area (m^2) [1]**	**Form installed[2]**	**Planted or Existing**
Trees				
Thuja plicata	western redcedar	20	**BR**	**P**
Shrubs				
Sambucus racemosa	red elderberry	20	**BR**	**P**
Oemieria cerasiformis	Indian plum	10	**BR**	**P**
Rose nutkana	nutka rose	20	**BR**	**P**
Ferns				
Polystichum muntinum	western sword fern	10	**BR**	**P**

[1] number of plants or area occupied (if number is not practical)

[2] C = container; LS = live stake; BR = bare root; P = plug; ST = salvage transplant

Polygon 2

A) Basic polygon information

Polygon 2 lies in the NW corner of the project site and is 30 x 10 m (300 m^2) with the short axis parallel to the slope (Figure 4). The steep 20-30% slope had been dominated by a thicket of Himalayan blackberry (*Rubus armeniacus*).

B) Restoration approach

The Himalayan blackberry was removed completely by the roots and the slope was stabilized using jute matting and coarse woody debris staked into the slope. Wood chip mulch was applied 15 cm deep and snowberry (*Symphoricarpos albus*) and baldhip rose

(*Rosa gymnocarpa*) were installed behind the staked woody debris about 1 m apart (Figure 4; Table 1). Two western redcedar (*Thuja plicata*) were installed at the bottom of the slope 3 m apart.

Table 2. Polygon 2 plant inventory May 3, 2019.

Polygon 2				
Latin name	**Common name**	**# or Area (m^2) [1]**	**Form installed[2]**	**Planted or Existing**
Trees				
Pseudotsuga menziesii	douglas fir	63	**BR**	**P**
Corylus cornuta	beaked Hazelnut	30	**BR**	**P**
Shrubs				
Holodiscus discolor	oceanspray	40	**BR**	**P**
Rubus spectabils	salmonberry	80	**BR**	**P**
Mahonia aquifollum	tall Oregon grape	40	**BR**	**P**
Rubus pariflorus	thimbleberry	40	**BR**	**P**
Ribes sanguineum	Red flowering currant	40	**BR**	**P**
Symphoricarpos albus	snowberry	30	**BR**	**P**
Ferns				
Polystichum muntinum	western sword fern	12	**BR**	**P**

[1] number of plants or area occupied (if number is not practical)

[2] C = container; LS = live stake; BR = bare root; P = plug; ST = salvage transplant

Maintenance Plan

Approach

The maintenance plan goals are to ensure successful plant performance is maintained for a healthy forest and future changing conditions surrounding the site. Project Site 7 is located adjacent to developed land, therefore consideration of human activity must be incorporated in maintenance plan as for future human activity. Invasive species re-growth is suppressed and controlled on Project Site 7. Maintenance of invasive species allows juvenile native plants on the site to establish proper growth. Ensure wildlife has the ability to reclaim Project Site 7 and

provide human recreational and educational use. Wildlife reclaiming the site will lead to proper forest ecology and maintain the health of the forest and utilize the space for recreational and educational purposes.

Maintenance Task List

1. **Plant Care**
    a. **Watering – Bareroots and Container Stock**

    Why: Newly installed native plants should be watered frequently to increase their chance of survival on the site. Frequent watering during the drier, hotter months will help the newly transplanted plants withstand drought (Chalker-Scott L., Chapter 12, 2009).

    Where: The entire project site.

    When: During the drier season of May through September 2019 and 2020, plants should be watered twice a week or as needed. During the wet season of October through April 2019 and 2020, plants should be watered at least once a week or as needed. Monitor plants during watering sessions for any signs of wilting.

    How: Watering will be done by using our community partner's water tanks provided near polygon 2. Since some plants are located above the water tanks (on a slope) water buckets can be used. Before watering observe any plants that experience wilting. Plants that show signs of wilting will be watered first using low flow pressure at the base of the plant for about 1-2 minutes to ensure soil maintains moisture. Plants that do not show wilting could be watered for about 30 seconds to 1 minute. Watering in early mornings or late afternoons if possible.

    Resources and Tools: Water tanks and hoses near polygon 2, water buckets located in tool shed.

2. **Invasive Removal**
    a. **Pulling English ivy and cutting/digging up Himalayan blackberry roots**

    Why: It's important to ensure that invasive species – English ivy and Himalayan blackberry – are removed from the site and do not compete with the native plants' resources and space in the site (Chalker-Scott L., Chapter 22, 2009).

    Where: The entire project site.

    When: When English ivy and Himalayan blackberry are beginning to re-sprout. This could be done during watering sessions or during stewardship events when extra volunteers are available.

How: During watering events, look for signs of invasive species re-sprouting out of the mulch. For English ivy use a hand shovel to dig up the ivy and re-cover the hole with excess mulch (if available) to prevent re-sprouting. The same goes for Himalayan blackberry, especially removing the entire root to prevent re-growth.

Resources and Tools: Using hand shovels and if available, mulch to fill in open patch.

3. Wildlife habitat

a. Adding bird habitat features

Why: Creating habitat features for animals that live in the forest can help maintain successful ecological cycles that a forest needs in order to stay healthy. Brining in wildlife can also help increase the native plants in the area by dispersal of seeds; especially with birds (Audubon, 2017).

Where: In polygon 2.

When: Could be done during academic school years (September 2019 – June 2020)

How: Building birdhouses can will help increase bird population in the site. This could be done by Friends of North Creek Forest (FNCF) or by schools in Bothell, bringing in the environmental component in school.

Resources and Tools: Wood from a nearby hardware store, hammers, nails and posts to put finished birdhouses on.

4. Community Outreach

a. Provide information on how restoration has impacted North Creek Forest

Why: The importance in engaging the community can help them understand why restoration projects are important to the forest. Sharing data and knowledge of how restoration has impacted the forest can help retain volunteers on future restoration projects in the North Creek Forest (Software Advice, 2018).

Where: The entire project site as well as other past UW-REN sites.

When: Two Saturdays a month; no change to what FNCF are doing currently.

How: Friends of North Creek Forest does this very well by hosting stewardship events two Saturdays a month. It would also be beneficial to collect and present data on the impacts done by restoration through pamphlets during work parties and on website to the public.

Resources and Tools: Printing pamphlets and uploading information on website.

5. Trail Maintenance

a. Constructing trail and maintenance

Why: Constructing a trail can help prevent people stepping on native plants, increasing the lifespan of plants and allowing the soil to be undisturbed – allowing new plants to emerge.

Where: It will begin at the bottom of polygon 1 and move up the slope west of polygon 2, and advance north along the buffer zone of polygon 2.

When: Constructing the trail can begin after the native plants have establish themselves for the first year (January 2020). As for maintenance, the trail should be checked during watering plants season (May through September 2020) and every other month during the wet season (October 2020 through April 2021).

How: Starting from the center of the trail, the trail should be at least 5 feet wide to fit two people standing side-by-side. Using small flagged wooden stakes to separate the vegetation from the trail can be used and should be separated every 10 feet. As for maintenance should be checked during watering periods and every other month

Resources and Tools: Stakes with a bright flag and a tape measure.

Maintenance Schedule

Table 3. Maintenance schedule

2019-2020	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Plant Care Tasks												
Water newly installed plants												
General Site Care Tasks												
Remove invasive species												
Create habitat for wildlife												
Maintenance of the trail												
Check for mulch replacement												
Track vertebrate abundance												
Other Maintenance Tasks												
Reach out to community												
Install tree shelters												

Monitoring Plan

An important component to the success of our restoration project in the North Creek Forest is the proper monitoring of our site. To better understand the progress and success of our restoration site, the type of monitoring necessary for the success of this project will involve monitoring vegetation (in community and structure), and habitat structures. Monitoring these aspects will help us understand whether our restoration site is succeeding by meeting our functional requirements (Appendix 1), and better understand whether it is on track towards our goal in supporting a successional and proliferating forest. The functional requirements which will guide our community partners assessment on whether our site is succeeding. Monitoring these aspects will help us better understand the direction our restoration site is going, and allow us to assess how our site is changing overtime. The information we gain from monitoring these will be informative to the kind of maintenance that will need to be done on the site to support and improve restoration. The information we gain will also be largely informative to future restoration projects.

Vegetation Monitoring

When creating our work plan for our restoration site, we have created certain expectations as to what direction we expect the site to go overtime. We expect our trees to create more forest canopy (FR 2-1), and we expect that the plant species we planted will provide habitat for wildlife such as birds (FR 3). Monitoring vegetation will allow us to better understand whether our site is meeting these expectations and functional requirements (Appendix 1), what kind of plant community is establishing, and how it is changing overtime. By monitoring what kind of plant communities are establishing overtime, we can better understand the degree at which non-native species establish, inform the maintenance of non-native species removal, as well as understanding the kind of structural habitat our site is supporting. The kind of plant communities that are establishing may shape the plant and animal species that will establish our site overtime. Monitoring vegetation aspects such as structural characteristics, vegetation cover, and species and non-native species cover will help us assess how our site is progressing through time.

Quantitative Vegetation Monitoring

Approach

Quantitatively monitoring vegetation will allow us to assess the overall structure of our site by monitoring what plant species and plant communities are establishing, as well as what vegetational diversity is being supported. Using a representative line transect within each polygon, canopy cover, native and non-native plant species cover will be estimated, as well as the health of the plants, and structural diversity of the site for each polygon, through the assessment of the number of layers in the vegetation, and frequency of gaps within the vegetation (Green City Partnership, 2012). Monitoring these aspects will show whether our site is meeting our functional requirements (Appendix 1). Over the years, this same method can be replicated which will allow our community partners to easily compare changes in the vegetation composition and structure. The process of quantitatively monitoring vegetation will help our community partners monitor our sites progress towards a successional forest (with the ultimate expectation of becoming an old growth forest). The structural diversity, plant cover, and specific plant species that occupy our site will be informative in what successional stage it is in.

Monitoring Design & Methods

Transect line

The surveyor will be assessing vegetation canopy and cover of non-native species and native species, as well as assessing the vertical and horizontal diversity in vegetation. To do this, the surveyor will create one transect line for each of the two polygons (polygon 1 and 2) creating a total two transect lines that will be representative of polygon 1 and 2 (Figure 6). Currently, these transect lines are marked with wooden stakes with yellow ribbon.

Estimating plant coverage and plant condition

For each polygon, plant coverage and plant condition will be estimated. Monitoring these aspects will provide insight as to whether our site is meeting FR 1. For polygon 1 beginning in the Additional Planting Area within polygon 3, the surveyor will create a straight line with a tape measure starting at 47.77318 °N, -122.19144 °W until 47.77329°N, -122.19150°W, creating a 12m meters long transect line which will run across polygon 1 (Figure 6). The surveyor will then begin walking that line (from 47.77318 °N, -122.19144 °W), and as they walk, they will estimate vegetation cover by noting the amount of distance each plant species occupies on the forest floor on either side of the transect line (Appendix 2). They will do this for sub-canopy species as well, and will continue surveying until they reach the end of the transect line 47.77329°N, -122.19150°W (Figure 6). As they note the intercept distance each plant species occupies, they should also rate the condition of the plants on a scale from 0-5 (0 being dying and 5 being very healthy plant). Once the surveyor finishes surveying the transect for vegetation cover and plant condition, the surveyor can calculate percent coverage of each species, by summing the intercept distances for each species and divide it out of the total distance of the transect line, and multiply by 100. This number will represent the vegetation coverage percentage for that species (US Department of the Interior Bureau of Land Management, 1996). This method should also be repeated for the transect line located in polygon 2 (Figure 6).

Estimating canopy cover

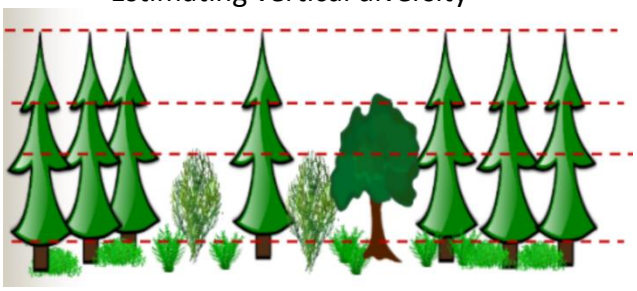
Estimating canopy cover will help us better understand how the site is meeting FR 2. As the surveyor walks the transect line within each polygon, they should measure the canopy coverage every 2 meters they walk. The surveyor will look up above and measure canopy cover from 0-100% (Appendix 2).

Estimating structural diversity

Estimating structural diversity quantitatively will help us better understand how the site is meeting FR 3. Structural diversity may indicate how complex the overall structure of our site is, which may form the foundation for habitat diversity. As the surveyor walks each transect line, they will count the number of vertical layers they see in the vegetation, and the number of gaps between vegetation (Figure 5). These structural aspects may help harbor wildlife habitat and will help us understand how the forest may be meeting FR 3-2.

Figure 5. Estimating structural diversity (Gold, 2017)

Estimating vertical diversity



Estimating horizontal diversity

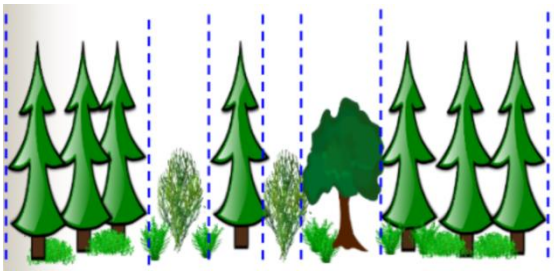


Figure 6. North Creek Forest monitoring map

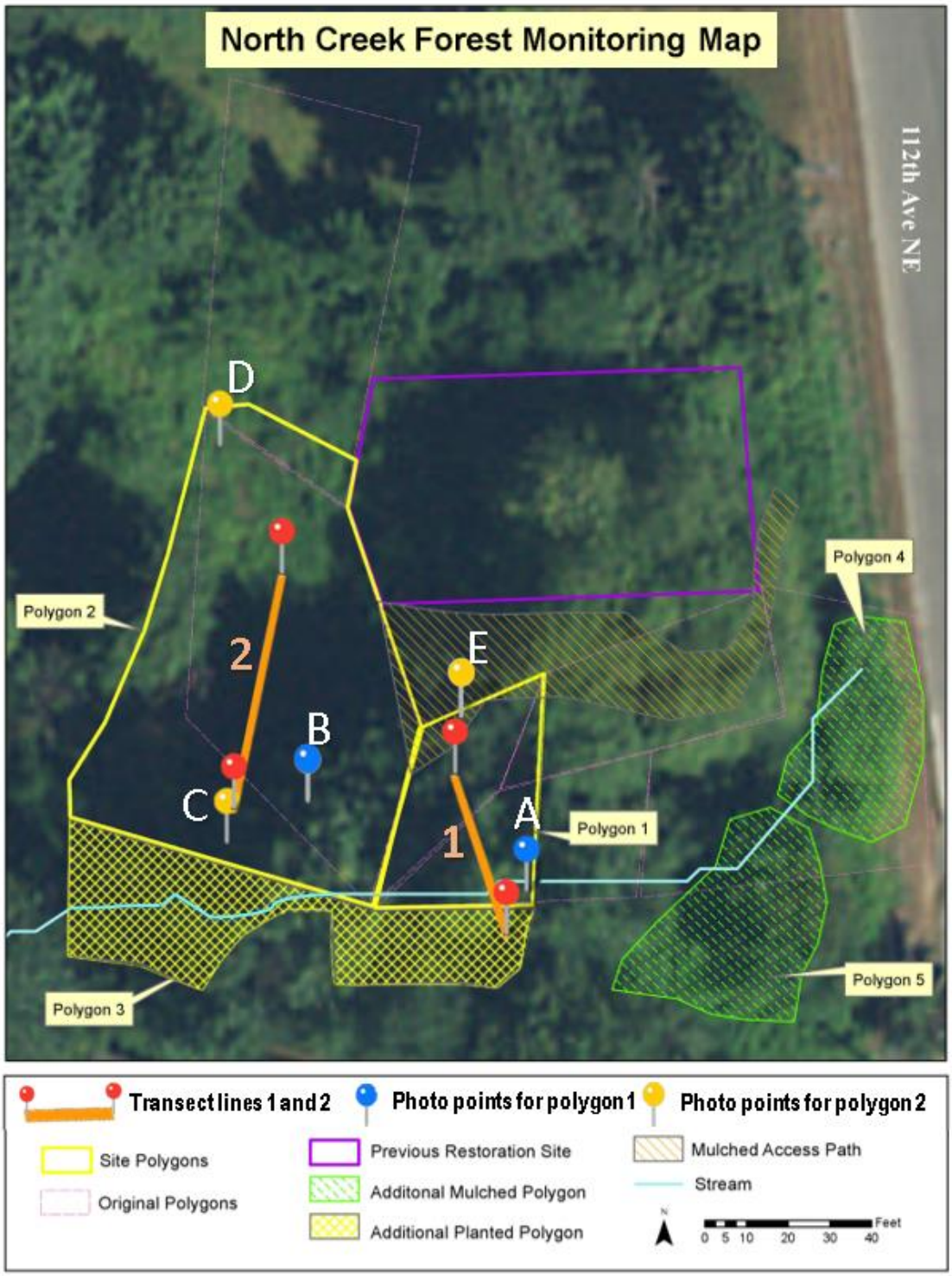


Table 4. Location and size of sampling plots for vegetation data

Sampling Unit	Size	Polygon location	Description	Transect line start (Latitude, Longitude)	Transect line end (Latitude, Longitude)
Transect line 1	12m	Polygon 1 and Additional Planting Area	Line begins from SW corner of Polygon 1 by the bigleaf maple tree and runs across the middle of polygon 1	47.77318 °N, -122.19144 °W	47.77329°N, -122.19150°W
Transect line 2	18m	Polygon 2	Line begins at the south end of polygon 6 and runs north of the middle of polygon 6	47.77326 °N, -122.19171 °W	47.77341 °N, -122.19167 °W

Management Responses

If estimated plant coverage of non-native species is over 10% within a transect line, community partners must consider removing non-native species once possible. This will prevent the non-native species from establishing more robustly and may help facilitate native species growth.

If more than 10% of native plants die within in a transect line, community partners should consider replacing dead plants with new plants. Community partners may consider planting new plants such as shrub species who may be more robust and can combat non-natives better (such as salmonberry). There are helpful guidelines which may help our community partners decide on what plant species they would like to plant located in Literature Cited from Sound Native Plants.

Resources

Table 5. Equipment and supplies required for quantitative vegetation monitoring

Equipment	Qty	Purpose
12-m (or greater) tape measure	1	Establishing transect lines
Writing utensil	1	Transcribing survey information
Clipboard	1	Holding data sheets

Data sheets	2 of each sheet	Data sheets for recording results from transect line surveying

Logistical Considerations

This procedure for quantitatively monitoring vegetation should be done for each polygon using the same transect lines (Figure 6). The surveyor should perform this survey once a year during spring season in mid-April. At this time, plants may be fruiting and flowering which will make it easier to identify plant species (Department of Fish and Wildlife, 2018). During the spring, the weather may forecast rain. Our site may have moist or wet soil, and having volunteers wear appropriate clothing such as waterproof jackets and waterproof shoes such as boots is recommended.

Executing quantitative monitoring for vegetation may be something our community partners can engage students or the community with if they have interest in learning about surveying methodology.

Qualitative Vegetation Monitoring

Approach

Vegetation monitoring will also be done qualitatively through photo monitoring. We have chosen photo points which indicate specific locations in each polygon where our community partners will take a photo from. The photos taken from these photo points will capture a large portion of each polygon and will reflect how each polygon is changing. Our community partners will be able take photos at these same locations throughout time and be able to easily compare photos from different years and see how the site has progressed. Photo monitoring will help others visualize how our site is changing overtime.

Photo Monitoring Methods

There are five photo points in total, and each are currently marked with a wooden stake and red ribbons. We will coordinate with Friends of North Creek Forest about marking each photo point with birdhouses on wooden posts.

Polygon 1 has two photo points. One photo point (A) is located south of the bigleaf maple, and will be marked with a propped-up birdhouse on top of a post and the letter A on it (Figure 6; Photo point A). The second photo point (B) is located west of the bigleaf maple within polygon 2, and will be marked with a propped-up birdhouse on top of a post and the letter B on it (Figure 6; Photo point B)These two photo points will capture two opposing views of polygon 1, capturing all of the plant species we planted.

Photo point A

Taken by: Jackelyn Garcia

Photo point B

Taken by: Jackelyn Garcia

Polygon 2 has three photo points (Figure 6). Photo point C is located southwest of the bigleaf maple, and will also be marked with a propped-up birdhouse with the letter C on it (Figure 6; Photo point C) Photo point D is located at the north end of polygon 2, and will be marked with a propped-up birdhouse and the letter D on it (Figure 6; Photo point D). Lastly, photo point E is located north of and underneath the bigleaf maple, and will be marked with a propped-up birdhouse and the letter E on it (Figure 6; Photo point E). These photo points individually and collectively are able to capture a large proportion of polygon 2, and offer a north, south, and east view of the polygon, covering all of the plant species we planted in polygon 2. These photo points also show some of the surrounding plant species that are already well-established in our site which can also show how our site is changing overtime.

Photo point C

Taken by: Jackelyn Garcia

Photo point D

Taken by: Jackelyn Garcia

Photo point E

Taken by: Jackelyn Garcia

Photos should be taken at these photo points twice every year. Once during mid-April in the spring, and another time mid-July during the summer. The photos taken in the spring will be able to capture plants in flowering or fruit, making it easier to identify plant species when comparing photos taken in the spring overtime (Department of Fish and Wildlife, 2018). The photos taken in the summer will show the plants at typically their most growth and will also provide an overall visualization of how the site is changing overtime (Department of Fish and Wildlife, 2018). These baseline photos (Photo points A-E) were taken using an iPhone X camera with an equivalent of 28mm (in 35mm camera terms). We recommend using a camera with a similar focal length for future photos to easily compare the differences between photos.

Table 6. Photo point and camera details

Photo point	Description	Marker	Compass Bearing of Photo	Height (ft)	35mm equivalent focal length
A	South of the bigleaf maple within polygon 1	Birdhouse on top of wooden post with the letter A	313°	5’ 3”	28 mm
B	West of the bigleaf maple within polygon 2	Birdhouse on top of wooden post with the letter B	144°	5’ 3”	28 mm
C	southwest of the bigleaf maple	Birdhouse on top of wooden post with the letter C	14°	5’ 3”	28 mm
D	north end of polygon 2	Birdhouse on top of wooden post with the letter D	144°	5’ 3”	28 mm
E	north of and underneath the bigleaf maple	Birdhouse on top of wooden stake with the letter E	317°	5’ 3”	28 mm

Management Responses

If the surveyor notices visually overtime from these photos that there is a rising abundance of non-native plant species establishing in the site, they should consult their survey on

quantitative vegetation monitoring. If the quantitative vegetation monitoring survey shows that there is over 10% of non-native plant species established within a transect line, community partners should consider removing non-native species once possible. This will prevent the non-native species from establishing more robustly and may help facilitate native species growth.

Resources

Table 7. Equipment and supplies required for quantitative vegetation monitoring

Equipment	Qty	Purpose
Camera / smart phone (with 28 mm lens)	1	Take photos
Writing utensil	1	Transcribing survey information
Clipboard	1	Holding data sheets
Data sheets	1 of each	Data sheets for recording notes to accompany photos

Logistical Considerations

Photos should be taken at these photo points twice every year. Once during mid-April in the spring, and another time mid-July during the summer. The photos taken in the spring will be able to capture plants in flowering or fruit, making it easier to identify plant species when comparing photos taken in the spring overtime (Department of Fish and Wildlife, 2018). The photos taken in the summer will show the plants at typically their most growth and will also provide an overall visualization of how the site is changing overtime (Department of Fish and Wildlife, 2018).

While the surveyor is visiting the site, we recommend they make note of any observations on wildlife presence, and wildlife using vegetation for habitat, such as birds' nests and wildlife eating fruits. Assessing this will help our community partners better understand overtime how our site may be meeting FR 3. This may be a great opportunity to engage the public and educate them on ecological restoration (FR 4).

During the spring, the weather may forecast rain. Our site may have moist or wet soil, and having volunteers wear appropriate clothing such as waterproof jackets and waterproof shoes such as boots is recommended.

Mulch Monitoring

Mulch monitoring in our project goal includes spreading at least 8-12” thick layer of woodchip mulch in each polygon in order to reduce erosion, control non-native species, and maintaining soil moisture. Any time of the year when mulch levels are lower than 8-12” we recommend ordering new mulch and spreading them on site. Use shovels to fill in a bucket, bring the mulch to the area and spread the mulch in desired polygons.

Monitoring schedule

Table 8. Monitoring schedule

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Quantitative Vegetation Monitoring												
Estimate cover of native plant species												
Estimate cover of non-native plant species												
Assess the transect line												
Estimate canopy cover												
Estimate structural diversity												
Qualitative Vegetation Monitoring												
Take photos at photo points												
Mulch Monitoring												
Replenish mulch to depth of 8”												

Baseline Data

Our final work party (May 4, 2019) consisted of mulching our entire site to ensure adequate mulch depth in planting areas and buffers. After the work party, a survival inventory was conducted for our installed plantings throughout the entire site. This did not include the additional planting area to the south of Polygons 1 and 2.

Table 9. Results from vegetation survey data collection on May 4, 2019 for polygon 1.

SPECIES	#LIVE	#DEAD	RECRUITMENT?	LAYER
O. cerasiformis	8	2	N	S
R. nutkana	10	0	N	S
T. plicata	15	5	N	C
P. munitum	20	0	N	S
S. racemosa	20	0	N	S
TOTALS	83	7		

Table 10. Results from vegetation survey data collection on May 4, 2019 for Polygon 2.

SPECIES	#LIVE	#DEAD	RECRUITMENT?	LAYER
P. menziesii	55	8	N	C
C. cornuta	20	0	N	S
H. discolor	28	12	N	S
R. sanguineum	40	0	N	S
R. spectabilis	78	2	N	S
S. albus	25	5	N	S
M. acquifolium	30	10	N	S
R. pariflorus	38	2	N	S
TOTALS	314	39		

Long Term Site Management Plan

Our site in North Creek Forest has development on the east and south side, with young forest on the north and west sides, thus, it is considered an edge habitat and autogenic repair is unlikely because of constant influence from habitat and development outside the forest. Because our site is unlikely to repair itself, monitoring and maintenance will be necessary to identify and clear out any re-invasion of invasive species.

Functional requirement 1 is to help promote autogenic repair by establishing native vegetation in a structural matrix similar to the rest of North Creek Forest. The sub-requirements are to remove invasive species and prevent them from re-establishing and to install native species that will start progression into the next stage of succession. Monitoring of this site may include checking re-establishment of non-native species, watering installed native flora installing native flora where others have died, and possibly installing tree shelters on some species. It was found that Western red cedar "In the first year after planting, both height and diameter growth of western redcedar were significantly increased by all shelter types (Devine and Harrington 2008). Once shade has been established in most of the site, monitoring for re-establishment of non-natives can happen less frequently.

Water filtration is an important aspect to consider as the nearby North Creek has high amounts of contaminants, particularly E. coli. North Creek Forest plays a large role in filtering runoff and groundwater before it reaches North Creek and eventually the Sammamish river. Planting native flora will eventually help with this process, once they have been fully settled and established a root system. Covering the site with mulch will help prevent sediments from entering water runoff and eventually entering the creek as well. Replacing mulch as it thins may be necessary until the new plants have developed enough leafage in order to intercept rain and prevent sediment runoff.

By meeting functional requirement 1 we also inadvertently meet functional requirement 3 which is to improve wildlife habitat. Sub-requirements mention providing food and shelter for local wildlife. Monitoring of wildlife in the new site can be done with walkthroughs. Keeping a record of animal use by tracking species that use the site in the form of visual confirmation, scat identification, print identification, or sound identification. This tracking of information is useful as it can give an idea for the general wildlife makeup in the area. Generally, more biodiversity is desired as it is a good indicator that the forest has complex structure and makeup because it provides more niche habitat for wildlife to take advantage of. As the site becomes more complex in structure and species makeup, it may become important to control predators or competing organisms (Crandell 2019), like the nearby crows, in order for other species to have a chance at settlement.

Functional requirement 4 is to promote community outreach and education. This includes the already well-established practice of facilitating weekend work parties that community members can participate in. Another sub-requirement mentions creating a welcoming space for community members to utilize the forest. This may include clear signage signifying when the

park is open for the community, a board at the forest entrance that tells the history of the forest and that may also mention possible activities for community members to do while in the forest like forest bathing, meditating, yoga, etc.

Stewardship Plan Contributions

Team Member	Responsibilities & Contributions
Angelina Monary	Helped write post-installation site description for polygon 1 and 2 and add in figures.
Calvin Kim	Wrote monitoring and maintenance schedule.
Jackelyn Garcia	Wrote the monitoring plan, vegetation monitoring, quantitative and qualitative, and monitoring forms. Also was the final editor.
Katie Woolsey	Project description, baseline data survival/mortality tables, updated site polygon map and final planting plan as built.
Michael Sanchez	Wrote maintenance task list and approach.
Sara Wang	Wrote maintenance schedule and long-term site management plan.
Yang He	Wrote mulch monitoring.

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Appendices

Appendix 1: Functional Requirements

Functional Requirement 1: Promote autogenic repair by establishing native vegetation in a similar structural matrix to the rest of North Creek Forest and target climax forests.

- FR 1-1: Remove invasive species and prevent them from re-establishing.
- FR 1-2: Install native species found in North Creek Forest and native species that help the process of autogenic repair that will eventually lead to a climax forest.

Functional Requirement 2: Improve natural water filtration.

- FR 2-1: Install vegetation that will provide more canopy cover and increase rain interception and reduce overland runoff.

Functional Requirement 3: Improve wildlife habitat.

- FR 3-1: Install a variety of plant species that are native to the Puget Sound lowland forests and can provide food for local wildlife.
- FR 3-2: Install a variety of plant species that are native to the puget sound lowland forests and can provide shelter or nest sites for wildlife.

Functional Requirement 4: Promote community outreach and education

- FR 4-1: Facilitate restoration work parties for community members to actively engage in urban forest restoration and learn why this work is important.
- FR 4-2: Create a welcoming space for community members to use in the forest.

Appendix 2: Monitoring Forms

Surveyor name:
Date:
Weather:

Quantitative Vegetation Assessment

Transect line:

Distance on transect line	Canopy coverage (0-100%)	# Horizontal gaps	# Vertical layers
2m			
4m			
6m			
8m			
10m			
12m			
14m			
16m			
18m			

Quantitative Vegetation Assessment

Transect line:

Species name	Floor species							Sub-canopy species							
Totals															
% cover															

Quantitative Vegetation Assessment

Transect line:

Scientific Species	Common name	Plant health (scale 0-5) 0=☹ 5=☺	Additional notes

Qualitative Observations	
Photo point A	**Notes**
Photo point B	
Photo point C	
Photo point D	
Photo point E	

Qualitative Observations

Animal species	Observations Ex: What are they doing?	Additional notes Ex: Any evidence of animal habitat?

Appendix 3: Project Contact Information

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