Removal of Himalayan Blackberry in the Bowker Creek Headwaters

University Club Woods: Photo by Jane Healey

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1.0 Introduction:

British Columbia is home to the greatest amount of biodiversity in Canada (Starzomski, 2013). As invasive species become more prevalent and aggressive throughout natural ecosystems, they threaten to out compete and potentially drive native species to extinction. With that being said, it is important to implement restoration programs before the problem becomes irreversible. The spread of invasive species can have tremendous negative effects on the natural environment including loss of biodiversity, habitat degradation, and loss of ecosystem services. Ecosystem services are one of the numerous reasons why it is important to restore. Other reasons why people restore are for spiritual, religious, ethical, educational, or recreational use, as well as creating a sense of place and a connection to the land. Our restoration project is based on the prevalence of the invasive Himalayan blackberry that is widespread throughout the University of Victoria (UVic) campus, specifically the Bowker Creek Headwaters area. We will examine in depth how Himalayan blackberry is spread and the problems it causes, followed by a restoration design plan, implementation plan, and monitoring plan. By adding signs within our restoration site, we hope to engage the public and provide information on the importance of biodiversity and the effects of invasive species such as Himalayan blackberry. If our restoration project is successful, we hope to apply it to other areas on the UVic campus and throughout the Capital Regional District that suffer from the spread of Himalayan blackberry.

2.0 Site Analysis: Bowker Creek Headwaters

2.1 Site Location

The Bowker Creek Headwaters is located on the western side of the University of Victoria's campus, just outside of Ring Road. The area encompasses 5.7 ha (14 acres), surrounding UVic landmarks such as the Fraser building and University Club (Harrop-Archibald, 2007). Bowker Creek, which flows southeast from the headwaters, follows an 8km path entering the ocean in the municipality of Oak Bay, close to the Oak Bay Marina (CRD, 2003). Today, the creek is very highly urbanized as only 2.5km of the creek's 8km

channel runs above ground, with the remaining being diverted through pipes and culverts (CRD, 2003). Being one of the largest watersheds in the region, university staff have worked to revitalize this urbanized area through creek clean ups and riparian restoration projects (Harrop-Archibald, 2007).

2.2 Site History

Bowker Creek was once a low-gradient and meandering stream that split off into many smaller wetland areas (CRD, 2003). Interestingly, a map of the region from 1858 shows no direct connection between the UVic campus and Bowker Creek, insinuating that the connection we see today is due to an increase in storm water diversion (Harrop-Archibald, 2007). Prior to that, the UVic campus was home to the Coast Salish people who managed the landscape in a variety of traditional ways such as burning techniques and the cultivation of multiple root vegetables including camas (Harrop-Archibald, 2007). In the past, Bowker Creek hosted many different species of wildlife including coho and chum salmon. This provided a food source for the local First Nations groups who benefited from the rich stream that was high in nutrients, further benefiting marine life where the creek discharged in Oak Bay. In the late 1800s the landscape was altered as European's began to settle, and by the mid 1900s, logging, farming, and a built environment were common (Harrop-Archibald, 2007). In 1959, Victoria College was constructed, and then further transformed into the University of Victoria in 1963 (Harrop-Archibald, 2007).

2.3 Native Vegetation

Bowker Creek hosts many native tree species in the area including; bigleaf maple (*Acer macrophyllum)*, Douglas-fir (*Pseudotsuga menziesii)*, arbutus (*Arbutus menziesii)*, black cottonwood (*Populus trichocarpa)*, red alder (*Alnus rubra)*, Garry oak (*Quercus garryana)*, and western red cedar *(Thuja plicata)* (Lloyd, 2004). Other native shrub species that can be found throughout the Bowker Creek Headwaters area are mostly oceanspray *(Holodiscus discolor)*, snowberry *(Symphoricarpos albus)*, and dull Oregon grape *(Mahonia aquifolium)* (Lloyd, 2004).

2.4 Invasive Species:

There are multiple invasive species present in the Bowker Creek Headwaters area of the University of Victoria campus. These include English ivy *(Hedera helix)*, English hawthorn *(Crataegus laevigata)*, English holly *(Ilex aquifolium)*, daphne *(Daphne odora)*, and Himalayan blackberry *(Rubus armeniacus)*, which will be the focus of our restoration project (Lloyd, 2004).

2.5 Species Profile - Himalayan blackberry:

Himalayan blackberry, also know as *Rubus armeniacus*, is an invasive species that is prevalent throughout southern British Columbia, and one of the most aggressive species on the UVic campus. Beyond BC, it has expanded throughout South Africa, Asia, Eastern Europe, and many parts of North America (Global Invasive Species Database). Figure 2.1 shows the distribution of Himalayan blackberry in green. Originating from North Africa and Western Europe, *Rubus armeniacus* is thought to have been brought to North America for crop cultivation and for ornamental purposes (Global Invasive Species Database). This woody perennial shrub produces blackberries and can form large, dense, and thorny thickets making it difficult to maintain. Himalayan blackberry can grow up to three meters high with stems of the plant reaching up to twelve meters long (Global Invasive Species Database). As the stems lengthen, they begin to arch and eventually reach the ground where they re-root as daughter plants (King Country, Washington, 2013). The leaves of the plant are egg

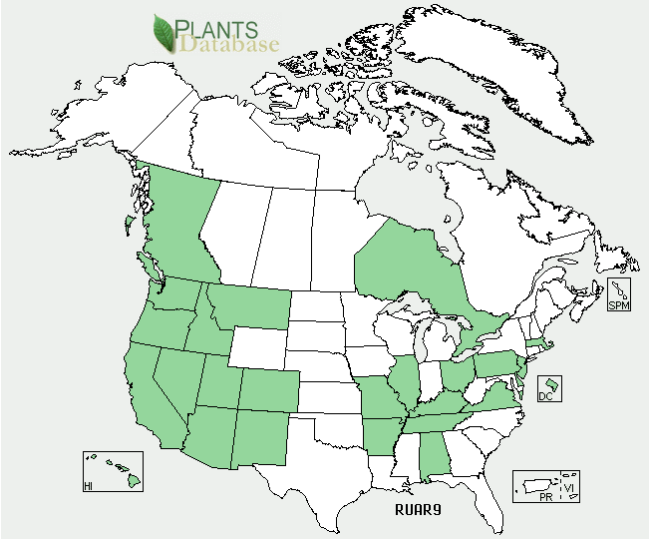

Figure 2.1 Distribution of Himalayan blackberry (*Rubus armeniacus*) in North America. Picture from http://www.usda.gov/wps/portal/usda/usdahome

shaped and is identifiable by its double saw-toothed edges and sharp pointed tip (see figure 2.2). The top of the leaves are bright green and smooth with a grey-ish underside (Klinkenberg, 2013). In the summer months the plants grow small white to light pink coloured flowers, following with the growth of the blackberries till the end of September (King Country, Washington, 2013). *Rubus armeniacus* thrives in very wet and moist areas, especially riparian zones. The species has also been known to be highly productive in areas of degradation or near irrigated fields (Global Invasive Species Database). The Bowker Creek headwaters are likely the cause of the abundance of Himalayan blackberry on UVic's campus. *Rubus armeniacus* reproduces mainly through seed dispersal with each plant producing many seeds which remain viable within the soil for several years (King Country, Washington, 2013). Mammals and bird species also play an important role in dispersing the seeds. Not only do the animals disperse the seeds to other areas, but it is known that the passing of the seeds through their digestion system can enhance germination (Global Invasive Species Database). The problem with Himalayan blackberry is that it outcompetes native species by building up leaf litter and blocking the sunlight from reaching lower growing plants. In addition to outcompeting native species, the large thorny thickets become too dense that animals cannot pass through them, as well, the thorns prevent the majority of the plant from being cultivated. Another downside to *Rubus armeniacus* is that it is shallow rooted and can increase flooding and erosion by displacing deeper rooted native shrubs. Although Himalayan blackberry is a known invasive species, it does possess some positive attributes which can sometimes make it difficult to justify it's removal. Most obviously, people enjoy picking their berries throughout the summer as the Himalayan blackberry is known to be a very tasty, antioxidant packed fruit. Other

Figure 2.2 Himalayan blackberry leaves. Photo from http://www.issg.org/database/welcome/

positive aspects of the plant is that it provides shelter and is a food source for other animals such as deer, rabbits, squirrels, black bears, beavers, and many more.

3.0 Project Goals and Objectives

3.1 Vision Statement

This project aims to enhance the overall integrity of the Bowker Creek Headwaters ecosystem, with increased native species biodiversity, and increased social engagement with the site.

3.2 Goals & Objectives

Goal 1. Increase native species richness, and the overall biodiversity of the Bowker Creek Headwaters within three years.

Objective 1. Remove all intended Himalayan Blackberry from the area. Increase management of the area to remove any returning blackberry.

Objective 2. Establish native community assemblages that will benefit the area and deter the return and growth of Himalayan Blackberry.

Goal 2. Increase engagement with the Bowker Creek Headwaters and the awareness of the issues with Himalayan blackberry.

Objective 1. Leave a small part of the Himalayan Blackberry after removing the rest. Manage the remaining blackberry for people to enjoy while preventing the plant from overtaking native plant assemblages.

Objective 2. Implement a sign displaying information about the Bowker Creek Headwaters, Himalayan blackberry, and the issues caused by it.

Objective 3. Engage students to participate in monitoring and long-term management of the Bowker Creek Headwaters.

4.0 Plan Design

4.1 Plan Introduction

In order to restore Bowker Creek headwaters to a more natural and diverse state, we must first remove the most destructive invasive species in the area, Himalayan blackberry (*Rubus armeniacus*). Himalayan blackberry's high tendency to degrade the quality of riparian habitats such as the one around Bowker Creek headwaters drives our plan of removal and the reintroduction of native species. Our plan for removing Himalayan blackberry from Bowker creek headwaters consists of several important steps including an area assessment, placement of educational signs around the area, removal of Himalayan blackberry, reintroduction of native species, and ongoing monitoring. The full plan totals at around 3 years and if proven successful, will be repeated. The steps for our restoration plan will be further explained below.

4.2 Assessment and Evaluation

For this single and initial step we assessed the blackberry invaded areas of Bowker Creek headwaters to evaluate which areas were most affected by the invasive species. We then divided the patches of blackberry into 3 areas ranking in order from highest to lowest concern (Section 1, 2, and 3). Apart from the three sections which will eventually have Himalayan blackberry removed, will be Section 4, an area intended for keeping Himalayan blackberry as to satisfy those who still collect and eat the berries. The 3 sections designated for blackberry removal will each have a year of focus making the full restoration cycle 3 years. The first year of the cycle will start in early spring and focus on the highest priority area, Section 1.

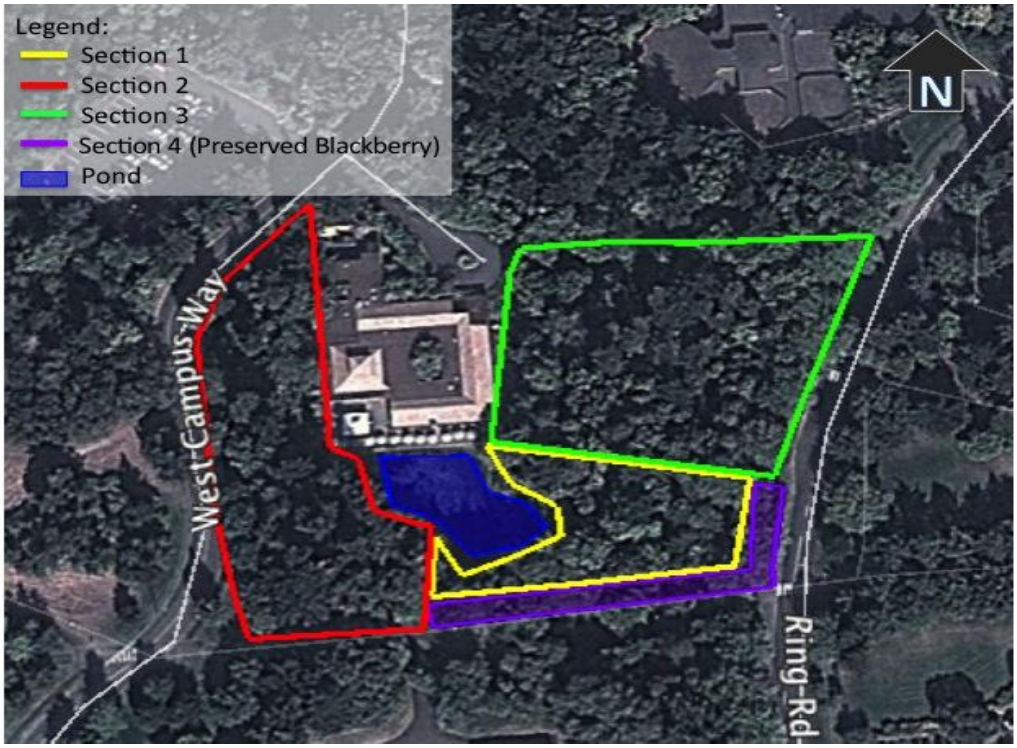

Figure 4.1 Section overview of Bowker Creek Headwaters at University Club. Image taken from Google Earth 2013, adapted by Jane Healey.

We chose to begin with Section 1 because it has the most coverage around the pond and has been out-competing the most native species out of the 3 sections. As seen from the figure above, Section 4 lines the outside of Section 1. This patch will need to be continuously monitored and managed to prevent it from invading back into our restored sections. Our assessment of the area favours both the values of people who enjoy collecting the berries and the necessity for a diverse healthy ecosystem around Bowker Creek Headwaters.

4.3 Sign Implementation

We will introduce educational signs in the area which explain our project and why the removal of Himalayan blackberry is an important process which benefits the Bowker Creek Headwaters ecosystem. This step will be put into action right before the removal process begins as to spread early awareness and possibly attract volunteers. There are

mixed views towards Himalayan blackberry so it is important to have an easy to understand sign which explains our motives. The signs will explain the importance of biodiversity and how invasive species such as Himalayan blackberry out-compete native species and eventually drive them out of the ecosystem. A working example of what one of these signs may look like can be seen below. The final version of the sign will have to be decided once the project is in place as it is possible that certain aspects of the project will change along with the ecological dynamics of Bowker Creek Headwaters.

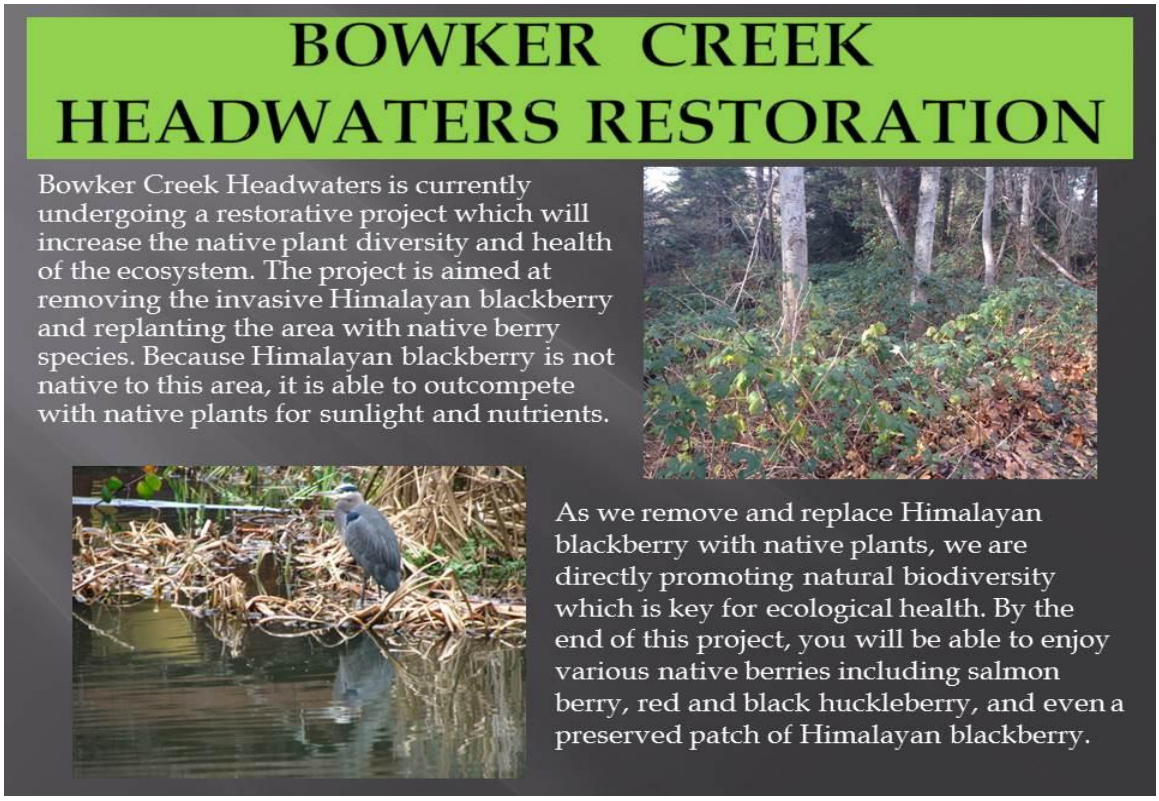

Figure 4.2 Working version of an educational sign explaining our project.

4.4 Himalayan Blackberry Removal

The first three months of our plan will be designated to the physical removal of blackberry branches using Ecological Restoration Volunteer Network and tools borrowed from the UVIC groundskeepers. The volunteers will need to be equipped with thick gloves, protective glasses, long sleeves, and have access to loppers and pitchforks. The initial removal process involves cutting off the main branches with loppers leaving approximately a foot of stem sticking out of the ground. We chose leaving a foot of stem

out because it makes the next separate step, removing the stems and roots, much easier to manage as the prickly branches will not be in the way. The cut branches can be relocated with pitchforks and organized into a readily accessible pile ready for disposal with assistance from the UVIC groundskeepers.

The next step, removing the protruding stems and roots from the ground, will have another three months designated to it. Using shovels and pitchforks once again borrowed from UVIC grounds, the volunteer force will remove the remaining stems and roots by digging and ripping them out. Once again, the removed vegetation will be arranged in a pile ready to be trucked off by the grounds keeping facilities. Once the current section is free of Himalayan blackberry, we can implement our objective of re-naturalizing the area by planting a variety of particular native species.

4.5 Reintroduction of Native Plant Species

The removed patch of blackberry will be replaced by a variety of native species including black huckleberry (*Vaccinium membranaceum)*, red huckleberry (*Vaccinium parvifolium*), salal (*Gaultheria shallon)*, salmon berry (*Rubus spectabilis)*, nootka rose (*Rosa nutkana*), skunk cabbage (*Lysichiton americanum*), fringecup (*Tellima grandiflora*), sword fern (*Polystichum munitum),* Sitka willow (*Salix* sitchensis), Douglas fir (*Pseudotsuga menziesii*) and red alder (*Alnus rubra)* (Streamside Native Plants, 2012). We chose these plants because they are commonly found in riparian ecosystems and other areas around UVic which are not invaded by Himalayan blackberry. These plants can be purchased from wholesale nurseries and the planting process will be powered by the volunteer workforce. Many of the plants we chose have edible berries on them to help counteract the loss of blackberries which are commonly collected and eaten. The planting process will also have a designated timeframe of three months and planting should occur on a rainy or overcast day to ensure that plant roots do not dry up (Streamside Native Plants, 2012). Using shovels borrowed from UVIC grounds again, volunteers will dig holes slightly deeper than what would fit the plant, take the plant out of its pot, place the plant into the hole without damaging any roots, and then while filling in any gaps in the soil. There should be a slight depression in the soil several inches deep

centered around the new plant to allow for a thorough watering and easy collection of ambient moisture. The watering consists of pouring at least a full bucket of water, which can be taken from the pond, over the recently planted vegetation. This kind of watering will occur during the first year after planting on a biweekly schedule and weekly during dry periods. Smaller plants of the same species should be planted in groups of three and within a close radius of each other because that is how plants are commonly found in nature (Streamside Native Plants, 2012). While most of the plants can be planted in unsystematic locations of the section as to mimic the randomness of nature, some species have more restorative potential if planted in specific areas. Skunk cabbage ideally will be planted near the water on the edges of the pond because the species is specially adapted to wetland habitats (Klinkenberg, 2013). Red alder and Douglas fir should be planted in a less shaded area more upland from the pond because it will need lots of light to grow and will eventually provide the shade for benefiting other plants and deterring the growth of new Himalayan blackberry (Klinkenberg, 2013). Sword fern is a species that requires lots of shade for it to thrive so it should be planted in the already shaded areas (Klinkenberg, 2013). Sitka willows should be planted relatively close to the waters edge for shade and bank stabilization (Streamside Native Plants, 2012). Fringecup is prefers moist soil and shade, and is a good pollinator so it should be plated close to the water (Habitat Acquisition Trust, n.d.). The rest of the various plants can be planted and spread out in small groups of three and dispersed randomly. After revegetation has occurred we will apply Plantskydd, an environmentally safe deer deterrent, to the plants to ensure that the ever prominent deer in Victoria do not eat them (Streamside Native Plants, 2012). During the next step of monitoring, we will observe how the reintroduced native plants are developing in their new habitat and if the Himalayan blackberry is making an invasive return. We will also observe how the newly planted species are doing and if there are particular species that are thriving more than others. This will help us to determine which species to plant in other sections in the following years.

5.0 Implementation

5.1 Introduction

Implementation of a good restoration project will involve conducting the restoration, communication progress, and maintenance and modification of the project over time (Canadian Parks Council, 2008). Our restoration project will include these steps in our implementation. Communication with various stakeholders is an integral part of the restoration process (WCPA-IUCN, 2004). We will continually update Facilities Management on the progress of our project and update adaptations to our management plan so facilitators can be aware of any updates to the project. We will have a publicly accessible online document including progress updates and adaptive management plans. The general public along with the university community are considered stakeholders for this project because they are the people that can directly see the changes happen and can benefit from the implementation of our restoration. Social media is our way of keeping the general public up to date on our project as well as recruiting volunteers for our restoration work parties.

The implementation of our project will take place over a period of three years. Each year, a single section of our total area will be tackled. Each year will be broken down into four stages of three months each. The stages are:

1) Cut down present Himalayan blackberry branches and stems in the section. Leave roots.
2) Pull out or dig out root systems.
3) Plant new replacement plants.
4) Monitor and change course of action as required.

The acquisition of volunteers and supplies is included in the timeframe of each of these stages. Ongoing monitoring and adaptation will occur in all stages, but the monitoring stage will be more focused and in depth. Volunteer efforts are essential for this project's success, so recruiting volunteers is an important part of the implementation process. Setting a reasonable timeline is also an important part of making the project work. Communicating and working with Facilities Management at the university will be

an ongoing process, but is key to working on this project, as Facilities Management is a support tool, and the people that work there have a breadth of knowledge on the area, and are able to lend out tools that we may need.

5.2 Volunteers

There is an obvious need for volunteers to participate in all stages of the project. During the first three stages, volunteers will be recruited for work parties, usually on weekends throughout the year. Volunteers are essential for the success of the implementation of our restoration project. Without several people working together it would take a very long time to complete the work that needs to be done. Also, volunteers gain a sense of connection to the area which will also be important for our project and give our work more meaning. The more volunteers we gain the more the word of our project will spread. Volunteers will be sourced from a variety of places, but mostly from UVic student organizations. The UVic Ecological Restoration Volunteer Network will be our main source for promoting this project and recruiting volunteers. The volunteer network is also able to provide some tools for work parties. We will also advertise work party days through the Society of Geography Students (SOGS), Environmental Studies Student Association (ESSA), the University of Victoria Sustainability Project (UVSP), and possibly other student clubs or course unions. We will also advertise to the community through social media, including Facebook and Twitter.

Volunteers will be brought together at a designated meeting place on work party days and will be given a safety overview, tools, and specifics on how to cut down the blackberry bushes, how to remove the roots, and how to plant new replacement plants; depending on the stage of the project. Volunteers will also be guided with information about the Himalayan blackberry, and why we are choosing to remove it.

5.3 Communication

Communication about the ongoing progress of our restoration project is essential in keeping the project going and recruiting more volunteers. The Ecological Restoration Volunteer Network will be our main means of communications to the university

community and the public on the progress of our project. The ERVN sends out occasional newsletters and when we have updates to communicate, we can send it through this. Also, speaking in Environmental Studies classes at the university we are able to inform students about the project, how it is going, and about how to get involved and volunteer with us. Also, designated Facebook and Twitter pages can be implemented to communicate to the broader public about the progress of this project. Communication is an essential part of this to keep it going, to gain funding, to recruit volunteers and to really make this project a success. It is important that people are aware of the project and what benefits it can have on the campus ecosystem. If people are aware of what is going on in the area, they can gain a connection to the area and can experience a strong sense of place. Communication of our project is important to help people understand why we restore. This restoration project will promote biodiversity, bring the area back to a natural state, and provide a connection with nature. These are all reasons why we restore and the extrinsic values associated with restoration (Higgs, 2013).

5.4 Timeline

The plan for this project is to tackle three sections over the course of three years. After the three years, continuous monitoring will take place. Each year, one section will have the blackberry removed, new plants be planted, and have overall monitoring. As mentioned earlier, each section is broken down into four stages, to be complete in a one-year timeframe. Stage 1 will include cutting down the branches and stems of all of the Himalayan blackberry in one area. Depending on the number of volunteers, this will likely take place over a period of three to four work party days in the span of three months. This stage will be best done in the early spring, because the blackberry will be low on energy reserves and will not be able to grow back as much. The overall goal of this stage is to leave just short stems (about one foot tall) of all the blackberry plants. This stage may take less than three months, and if so, we will employ adaptive management and move on to Stage 2 sooner. Stage 2 involves fully removing all the stems and root systems of the blackberry plants from the entire section. Again, work parties will be used and may take approximately three to four days spread out across about three months. If

this stage takes fewer than three months, we can move on to Stage 3 sooner. Stage 3 is where new non-invasive, native plants will be put into the section. Work parties of volunteers will take part in planting a variety of plants throughout the section. This stage will be done over the course of about three to five work party days. It is important that this stage is started right after all of the Himalayan blackberry has been removed to avoid any encroachment of other invasive species in the area. In Stage 4, monitoring will take place. In this stage, we will go out to the site and look over the section. If it is evident that more work needs to be done, a volunteer work party can again be organized. Once we are satisfied with the completion of the section, we will be able to move on to the next section. Monitoring of all the sections will take place throughout the year, but most extensively at the end of the removal and planting stages.

5.5 Steps

The steps in the first three stages will look something like this:

1) Set date and time for each work party day

2) Contact Facilities Management to organize the lending of tools for work party

3) Advertise upcoming work party through social media, Ecological Restoration Volunteer Network, and other student clubs; starting two weeks in advance of work party date.

4) A few days before work party, mark out general outline of section to be covered (Section 1, 2 or 3) using coloured flagging tape.

5) On work party day, round up supplies, snacks, and drinks beforehand.

   a) Meet at designated meeting spot with volunteers.

   b) Discuss what we are doing and why, safety measures to be taken, the steps for what we are doing (removal of branches, removal of roots, or planting new plants), and answer any questions.

   c) Supervise volunteers and assist with work (removing blackberry, planting new plants, spraying Plantskydd etc)

   d) Have a break with volunteers, hand out drinks and snacks, reflect on work done so far.

e) Near the end of the work party, gather up remaining branches, stems, roots or other material to be discarded.

f) Reflect on work party successes and what still needs to be done.

g) Contact Facilities Management for removal of old blackberry remnants.

6) Continue process through until the stage is complete.

7) Prepare to move on to next stage.

The final monitoring stage is different because fewer volunteers are required and there is less physical labour involved. Monitoring our sections will involve volunteers who are knowledgeable about Himalayan blackberry and the project in general. More details are provided in the Monitoring section of this report.

5.6 Budget

The budget for this project is quite small, because we will have limited funding available. Our connections to the Ecological Restoration Volunteer Network as well as Facilities Management are crucial for the success of the project. The volunteer network will be able to provide us with volunteers, tools, as well as some funding. Facilities Management will also be able to provide us with some tools. We will also request that volunteers bring their own tools if possible. Through the lending of tools that we will use, there will be no need to purchase or rent any tools. Facilities Management has offered to use their contracted service to remove the piles of removed Himalayan blackberry plants for us. This also reduces our costs greatly. We are anticipating that snacks and drinks will be donated to us from various campus and community donors, such as University Food Services, Tim Hortons, Safeway, Thrifty's or other businesses. The main costs for our project will be the cost of buying new plants. Each year the budget will vary as we monitor and get a better sense of what types of plants thrive in this area, and how many of each type of plant we will need. The first year of the budget is broken down below. Costs for the plants are found from the Streamside Native Plants Wholesale Price Guide (Streamside Native Plants, 2012). Costs for Plantskydd are found from Plantskydd Deer and Rabbit Repellent wholesaler (Plantskydd, 2013).

Budget Breakdown:

Year 1		
	6 x1 gallon Salal	$28.50
	6 x1 gallon Evergreen Huckleberry	$39
	6 x1 gallon Black Huckleberry	$36
	10 x1 gallon Nootka Rose	$36
	10 x1 gallon Salmonberry	$36
	10 x1 gallon Red Alder	$36
	5 x1 gallon Douglas Fir	$18
	10 x1 gallon Sitka Willow	$30
	15 x1 gallon Sword Fern	$45
	20 x1 gallon Fringecup	$45
	10 x 1 gallon Skunk Cabbage	$60
	Total plant cost	$477
	Flagging Tape	$5
	Plantskydd Deer Repellent	$63.52
	Signage	$40 (estimate)
	Tools (gloves, pitchforks, shovels, loppers, safety goggles etc)	$0 - donated (loaned) by ERVN, Facilities Management, volunteers

	Snacks (water, juice, sandwiches, hot chocolate, donuts etc)	$0 - donated by campus food services/local businesses
	Total Cost	$585.52

Section 6. Long Term Management, Monitoring and Evaluation

6.0 Introduction – Why do we need to monitor and manage long term?

After a restoration project has been implemented, monitoring and evaluation are needed to ensure the project is proceeding towards the desired goals and objectives. Successful monitoring involves collecting, evaluating, analyzing, interpreting, and synthesizing data to inform future management decisions (WCPA-IUCN, 2004). These decisions can involve adapting management practices to better achieve the desired goals and objectives, or even changing the goals to better aid the ecosystem being restored. In addition, monitoring keeps people engaged in the project and the area promoting awareness, a sense of stewardship, and interest in future projects.

For monitoring to be effective, it must be easy and cost efficient to encourage groups with little experience or resources. Monitoring will also need to involve detailed data collection that properly evaluates whether the project is moving along a desired trajectory and that objectives and goals are being met. Data collection must be done repeatedly in order to inform future management efforts regarding the future of the Bowker Creek Headwaters. Data collection will help to identify issues that can be fixed quickly with the lowest trouble and cost. All collected data should be compiled, published, and be obtainable online so all shareholders or involved parties can view it.

Restoration projects also require long-term management and commitment. Without long-term management the ecosystem may revert to previous conditions, especially when invasive species are involved. For Himalayan blackberry, persistence determines success. There is no point clearing Himalayan blackberry and restoring an area if we do not have the ability to maintain it. A significant concern is the potential germination of new plants from seeds left in the soil after the existing plants

have been eradicated. Himalayan blackberry can produce vast numbers of seeds reaching up to 13,000 per square meter (Hoshovsky, 1989). These seeds can remain viable in the soil for several years (Tirmenstein, 1989). After germinating, Himalayan blackberry grows quickly with the first year cane (primocane) growing 5 to 8 cm a day (Davies 1998). Long term, Himalayan blackberry can grow over 102 cm in a growing season and 1.8-2.4m in 2-4 years. Himalayan blackberry grows even faster and more vigorously by vegetative reproduction (asexual reproduction) from large vine and root pieces left after the cutting and removal. In less than two years a vine cutting can produce a thicket 5m in diameter (Amor, 1973). Initially, areas need to be weeded of Himalayan blackberry very intensively, (6–10 times per year) especially during the spring and summer seasons (Bennet, 2004). Over time, less weeding will be required but some management will always be needed. Removing Himalayan blackberry is a life-long, ongoing project.

6.1 Methodology – Principles

The monitoring for our project will focus on five principles. These principles are based on the projects goals and objectives.

1. Ensure the removal of Himalayan blackberry for all intended areas on site.

2. Ensure maintenance and control of remaining Himalayan blackberry. Himalayan blackberry should not be expanding/growing into new areas or overtaking native plants.

3. Ensure planted native species are successfully thriving.

4. Ensure high biodiversity in native plants. One planted native species should not be outcompeting other species and causing new problems.

5. Ensure the general integrity of the Bowker Creek Headwaters ecosystem. (General principle to consider any other problems with the area while monitoring. These problems can be caused by the restoration project or were issues before. Examples include soil quality, erosion, growth in English Ivy, or the appearance of a new invasive.)

Data collection and measurements will be used to evaluate whether these principles are being met. These measurements include.

Species richness – Count the number of berry producing species in the area.

Species abundance – Count the number of each berry producing species.

Development of planted species – make note of species not growing well or appear to be dying. Include whether this involves all plants of this species or ones in a specific area. Include any general observations about the plants. Are deer or insects eating it?

Himalayan blackberry return – number of plants founds and the general location (use areas from Figure 4.1). If a blackberry plant has grown into two areas, count it for the area the root system is in.

Remaining Himalayan blackberry – amount removed and the general location it was removed from (example: South East corner where Ring Road and the southern path meet.)

General observations – Any additional notes about other issues. New invasive species present, soil erosion etc.

Additional measurements can be added later as the project changes based on our monitoring and the Bowker Creek Headwaters area changes due to the projects implementation.

6.2 Methodology – Removal of Himalayan Blackberry

Monitoring areas where Himalayan blackberry has been removed should involve detailed data collection of species richness, species abundance, growth and development of planted species, location and number of returning Himalayan blackberry plants, and any additional observations.

Continuous collection of this data will allow for comparisons with past data to better evaluate if the project is progressing towards the desired goals and

objectives. Since the project is divided into three, yearlong phases, phase two and phase three will involve monitoring while the project progresses (monitoring section one during phase two, monitoring sections one and two during phase three). This will allow us to learn from our experiences and adapt our project design based on the data obtained during the monitoring of previous areas. For example, we may find a certain planted species is not growing well or is growing so well it is outcompeting the other native species. We would remove this plant from our design and replace it with another suitable plant in future phases. Towards the end of the project, our design will have been altered to be more effective and efficient based on the monitoring of past phases.

Initially, monitoring will need to be done biweekly to water all the planted vegetation with weekly monitoring during dry periods. This will continue for one year to allow the root systems to establish. Additionally the first year will have the highest number of new Himalayan blackberry plants. Past projects have suggested that a quarter of the previous blackberry is expected to return in the first year (Cox, 2003). After one year, monitoring will be less regular and will only involve checking for new blackberry plants, and making sure the native species are diverse and abundant. If data shows an increase in Himalayan blackberry then monitoring should be made more frequent to ensure all of it is removed. If data shows little growth in blackberry, this would allow for less frequent monitoring saving time and money. Over time we should be able to prioritize our monitoring towards expected periods of high Himalayan blackberry growth, increasing efficiency.

6.3 Methodology – Controlling the Remaining Himalayan Blackberry

Section one will require the most extensive monitoring and management due to the Himalayan blackberry that is being kept for use by people. This area is the first to be restored in order to allow for extensive monitoring of the remaining Himalayan blackberry and to allow us to assess whether controlling it is possible. Initially monitoring should be biweekly and involve cutting back any newly grown vines. Data collection should involve recording any cuttings to the blackberry and how much was removed. This record should give us valuable information including when the plant

grows the fastest, how much it grows, and how much time and money is needed to maintain the plant. We can use this data to adapt our management practices to efficiently and effectively control the Himalayan blackberry. The rate of monitoring can decrease or increase depending on how fast the plant is growing. Mostly likely monitoring will be more intensive in the spring and summer than in the fall and winter.

After restoring sections two and three and having monitoring the remaining Himalayan blackberry, all shareholders and parties involved should come to a decision on whether the blackberry can be maintained long term. If not, then the parties should decide on a new course of action. This could include removing part of the blackberry plant, increasing funds for managing the blackberry or hiring more people to manage it, or possibly removing the blackberry entirely. If the Himalayan blackberry is removed entirely then new plants to replace it must be decided. This could include Trailing blackberry or some of the plants already being planted in the area including huckleberries. Ideally, the replacement plants would have some edible berries to replace the Himalayan blackberries for people walking through the area.

6.4 Student/Volunteering Participation

The monitoring and long-term management of the Bowker Creek Headwater area will require volunteers and students. Initially, volunteers who helped implement the project will hopefully continue on helping through monitoring. Over time, participation from future generations of students will be necessary to replace leaving volunteers and students and ensure the projects success. Environmental studies classes can be used to increase awareness and encourage new students to participate in the project. ES 240 classes should take students to the Bowker Creek Headwaters as part of the campus nature tours and discuss the ecology, Himalayan blackberry, and the project. ES 200, and 341 can involve the project in lectures, teaching about various aspects of the project and encouraging students to help. The environmental studies students association (ESSA) can also help engage and organize students to help with the project.

6.5 Photography

Photographic monitoring is a simple, low-cost method of monitoring that can provide useful evidence over time. Photos should be taken every year in the spring. Fixed photographic points have been selected to ensure the photos depict the same area through time. This allows for comparisons between the photos to show how the area has changed throughout the project and during management.

Photo Spot 1 – Facing pond, right side of University Club

Photo Spot 2 – Facing pond, left side of University Club

Photo Spot 3 – Facing South (towards the pond) Middle of path to University club

Photo Spot 4 – Facing pond, middle of the East side of the area. Next to Ring Road.

Photo Spot 5 – South East corner of area, where Southern path and Ring Road meet.

Photo Spot 6 – Facing pond, middle of the Southern path

Photo Spot 7 – South West corner of the area, slightly north of where the south path and West Campus Way meet.

Figure 6.1 Overview of the Bowker Creek Headwaters with photo sites shown. Photo sites numbered 1-7. Image taken from Google Earth, adapted by Max Hamilton.

6.6 Future Goals for Project

If the removal and control of Himalayan blackberry is successful, we would like to see the project uses in other areas on campus such as South woods. The South Woods could employ a similar plan with a different number of phases depending on the amount of Himalayan blackberry present. We would also like to see further work be done on the Bowker Creek Headwaters. Future projects could involve removing English ivy (second biggest invasive species in the area) or involve improving the stability of the banks along the pond. The extensive monitoring data and photos from this project will provide tangible evidence of the success and impact restoration projects can have on an area. This will hopefully help to encourage shareholders to agree on these future projects and possibly provide greater funding to make these projects even more successful.

Photo taken by Julia Buckingham

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Group Contributions

We all met up on multiple occasions at the library to work on the project.

Jane Healey: Implementation and budget, photos of the areas, creating map of the area, organized group meeting times.

Riley Kenning: Design of the plan, peer editing, group communicator.

Julia Buckingham: Introduction, Site Analysis, Species Profile, and Vision statement and goals and objectives. Created table of contents and title page. Took photos of the area.

Max Hamilton: Monitoring and long-term management, Vision Statement, Goals and Objectives. Helped pick out native species, where to keep Himalayan blackberry. Formatting.