

University of Victoria  
School of Environmental Studies

# Elliott Native Plant Garden



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ES341 Ecological Restoration  
Class Project  
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Dr. John Volpe

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# 1. Introduction

The goal of this project was to convey the pillars of environmental restoration to the general populous of the University of Victoria. Given the unique nature of this small site and its' location in the center of the university campus, the potential that the site holds is endless. Over the past two years Environmental Studies classes have worked under the guidance of Dr. Val Schaefer and the Sara Webb to bring the teachings of the department into a tangible, interactive component of the university mosaic. This includes honouring the First Nations tradition in the land, conveying their traditional ecological knowledge, illustrating the diversity in flora and fauna of Southern Vancouver Island, and with the ultimate goal of creating a functioning native plant garden that will enrich the university on those many levels.

Previous projects stressed the idea of the Elliott site being a naturescape, defined as a landscape that allows people and nature to coexist through the rehabilitation of the landscape with native species. While in theory this would be the most appropriate description of the Elliott Garden space, the project was misdirected in its' foundation. Fundamentally the past design was based upon a fenced off site, that could only be appreciated from outside the split-cedar fencing (see Appendix A for previous projects' goals and objectives and Appendix B for timeline). We chose to create a space that could be experienced from within, effectively creating a garden. Thus, our aim was to modify the original naturescape design into a garden space where one could creatively dwell.

Ingold's (2000) dwelling perspective is the 'ecological philosophy' into the human need to modify the landscape for habitation. This human drive to alter the landscape is persistent in the human story and arguably addressing this perspective would make the garden more applicable to the UVIC community. Cooper (2006) identifies garden appreciation as a unique human phenomenon distinct from both the appreciation of art and the appreciation of nature, coupling this philosophy with Ingold's theories on how humans prefer a built environment our belief is that by transforming the Elliott naturescape into an interactive Native Species Garden would be more effective.

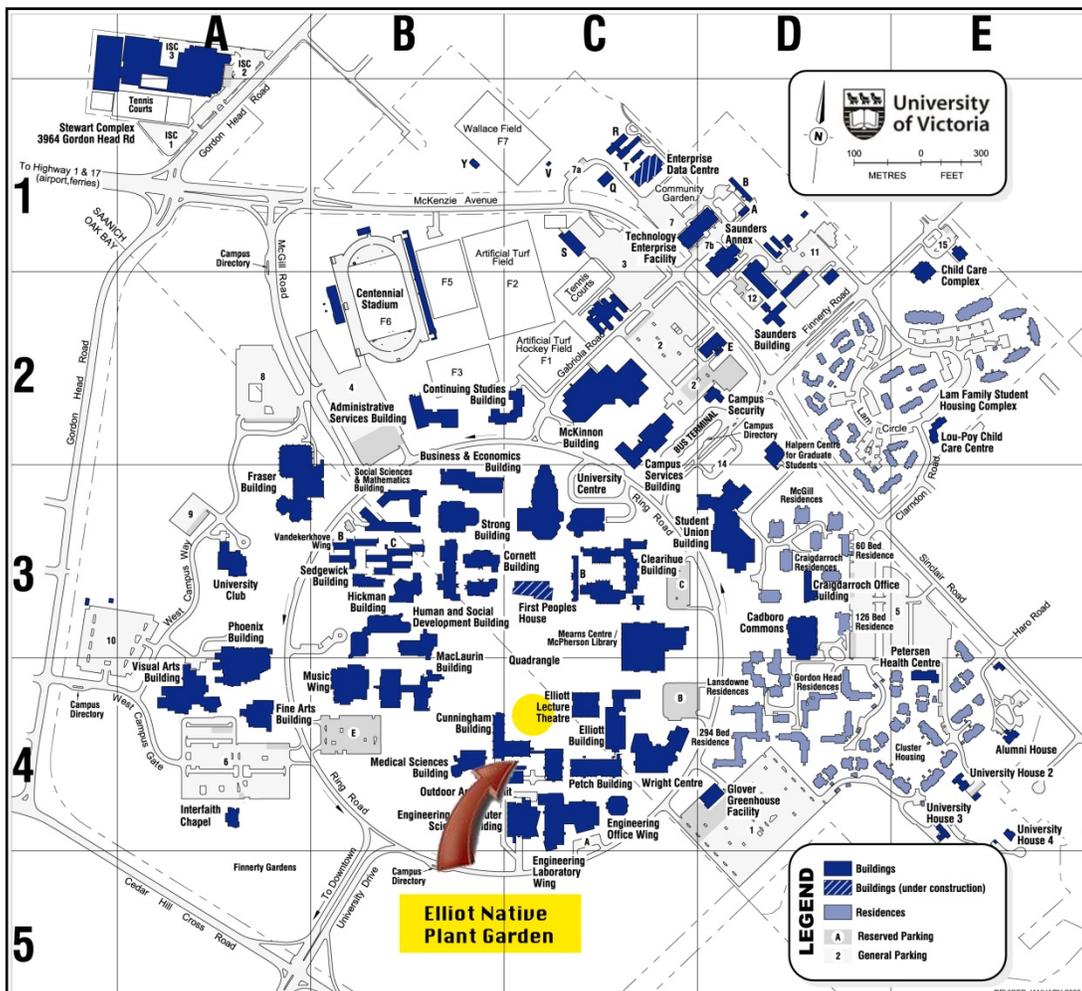
To create a garden space that could be functional, inviting and educational our new design includes enclosing the fence on the far end of the garden (Cunningham Building side), installing a gate, creating a meandering pathway to allow maximum engagement with the garden and constructing many signs to facilitate and convey our desired message. These messages included:

increasing the ecological integrity of the campus natural areas as promoted by the University of Victoria (UVic) Sustainability Office, increase social awareness about the ecological restoration initiatives on campus and honouring the social, cultural and ecological history of the UVic campus land.

## 2. Site

### 2.1. Location

The Elliott Native Plant Garden is on campus, within Ring Road, located off the central quadrangle between the Elliott Lecture Theatre and the Cunningham building. It is surrounded on all sides by paved walkways and is in a high traffic zone. See the figure below for the map of campus indicating the site location.



## 2.2.Site History

This photo was taken on the 18<sup>th</sup> of October, 1964. In the upper right corner the edge of the Douglas Fir Forest that once extended to Mystic Vale can be seen. The Douglas Firs in the Elliott Native Plant Garden were once part of this larger forest. The Gary Oaks are speculated to have grown since the building of the Elliott Lecture Wing in 1964, because of archival photos that show the area completely flattened for landscaping. Below is the archival evidence to substantiate this.



### **3. History of the Elliott Garden Restoration Project**

#### **3.1. Summary of Previous Restoration Efforts**

The Elliott Native Plant Garden has been an ongoing project at the University of Victoria since fall 2007 when it was initiated by Dr. Val Schaefer and his Environmental Studies 341 class. The project continued in fall 2008 when another ES 341 student group created a proposal to implement signage at the garden. In their proposal, this group primarily focused on the theory behind interpretive signage, what sort of information should be conveyed by the signs, and how to best do so. Our group picks up where they left off, creating the signs themselves and providing a retrospective report on the success of the project thus far.

This section of our report is a summary of the goals and objectives of the initial restoration effort, how they set about achieving these goals, and how successfully they believed these goals had been met. Now that the garden has been around for a full season, we will additionally report on the whether or not the goals of the initial team are still being met today.

Despite some difficulties, all of the groups involved in the initial planting of the garden felt it was a success on various levels. All groups agreed that as an educational experience, the project was a complete success. Many students had no experience with restoration projects prior to this, but all of them left the class with a robust understanding of the challenges and processes involved. They felt that by involving so many groups and individuals, including the Environmental Studies Department, Facilities Management, the student body, Queenswood Nursery and the Vice President Academic that they had strongly succeeded in their goal of community building through focal practices. They also note that by engaging the community in this way, the project is much more likely to succeed in the long term.

In their evaluation, the design group noted that the final design of the garden differed significantly from the original design. As they took flexibility to be a central tenant of restoration projects, they felt that this was in no way a bad thing, and that the majority of the differences can be viewed as improvements.

### **3.2. Previous Restoration Challenges and Future Suggestions**

The initial restoration team met many challenges in their project, and offered their suggestions to future restoration projects to minimize their frustration and increase their chances of success.

#### **I. Communication**

- The more people there are involved in a project, and the more responsibilities get divided, possible avenues of miscommunication increase exponentially. A specific communication issue that some groups identified was discovering on the day of the planting that 150 additional plants had been made available. This caused confusion and forced a last minute redesign of the garden. Organization, and above all recognition of the need for flexibility in restoration projects can help to greatly minimize these risks.
- Additionally, poor communication with Facilities Management was blamed for not having the rabbit fence installed prior to the planting of the garden.

#### **II. The Rabbit Problem**

- The UVic rabbits are responsible not only for structural damage to campus facilities, but they also pose the largest risk to the success of a campus restoration project if not properly managed. The rabbits dig up bulbs, eat new sprouts, tear up the ground and dig burrows. All the groups identified the lack of a rabbit fence to be the largest issue facing the garden, and arranged to have one added at a later date. A fence was eventually added at the site but not in sufficient time to stop the rabbits from browsing small shrubs and plants. This damage is still evident in the garden and is likely a large contributor to plant mortality. As a result replanting will be necessary in order to bring the garden back to its original state, following the planting in 2007.

### III. Maintenance

- Though the garden was intended to be self-sustaining, its location and structure require some level of human regulation. Specifically, Ocean Spray, Indian Plum and Snowberry need to be pruned regularly in order to prevent them from dominating the garden. Additionally, there are many exotic species in the surrounding areas, and these will need to be removed from the site should they re-establish themselves there.

### IV. Monitoring

- The final step of any restoration project is monitoring. This is an ongoing requirement to ensure a particular site is still meeting its intended goals and design principles. It allows for a real measure of the success or lack thereof of a project. The previous team suggests that this responsibility could be partially shifted to facilities management, but that ES students should remain involved.

### V. Art and Aesthetics

- Some groups believed the space could be further enhanced by the addition of art pieces, most optimally through collaboration with the Visual Arts Department of the University. There has been no progress on this particular suggestion, but once the garden is repaired and completed, this should be pursued.

### VI. Signage

- The previous groups also all identified a need for signage explaining the purpose of the garden and to give information about the plants within it. The signs have been completed by our project and will be implemented in the future.

Our group evaluated these suggestions and found them all to be very helpful. Of them, we have identified the need for adequate and ongoing monitoring to be the most important to the future health of the site.

## 4. Elliott Native Plant Garden

### 4.1. Project Goals and Objectives

4.1.1. **Goal 1** – Create a dwelling space, open and inviting for people to engage with nature. Our objectives to achieve this are as follows:

- Create a gate to make the space accessible
- Close off fence to reduce through traffic and make a formal garden space
- Create rock borders around plant beds to mark their boundaries and ensure they are not trampled on by visitors
- Create a zigzagging path to make the garden interesting, engaging and increase contact with ecosystems

4.1.2. **Goal 2** – Educate public about native ecosystems, invasive species to the area, history of the site, history of restoration at the site. Our objectives to achieve this are as follows:

- Labelling of species and plants in the gardens to help people identify them
- Create interpretative signage about the site to educate the reader about ecological restoration in general and its importance and educate the reader about the three local ecosystems being represented, and the specific plants within them. This will include the cultural significance of the plants. Specifically, signage will aim to conform to the following values:
  - *Aesthetics*: The design must be pleasantly colourful and include a good mix of images to accompany the text. We want these signs to call out “I’m interesting, come read me!”
  - *Simplicity*: Research indicates that signage is far more effective if it presents short, easy to understand facts and doesn’t overwhelm the reader. Each sign should be readable in about no more than 1-2 minutes at a maximum (Ham 1992).
  - *Educational Value*: Though each sign will only provide basic information about plants, ecosystems and restoration, they will also include references to where readers may learn more about the subjects should they be interested (Ham 1992).

- 4.1.3. **Goal 3** – Create protocol for the assessment and maintenance of the site and previous restoration efforts. The project simply cannot succeed if it is not monitored and maintained on a regular basis.

## **4.2. Current Site Description**

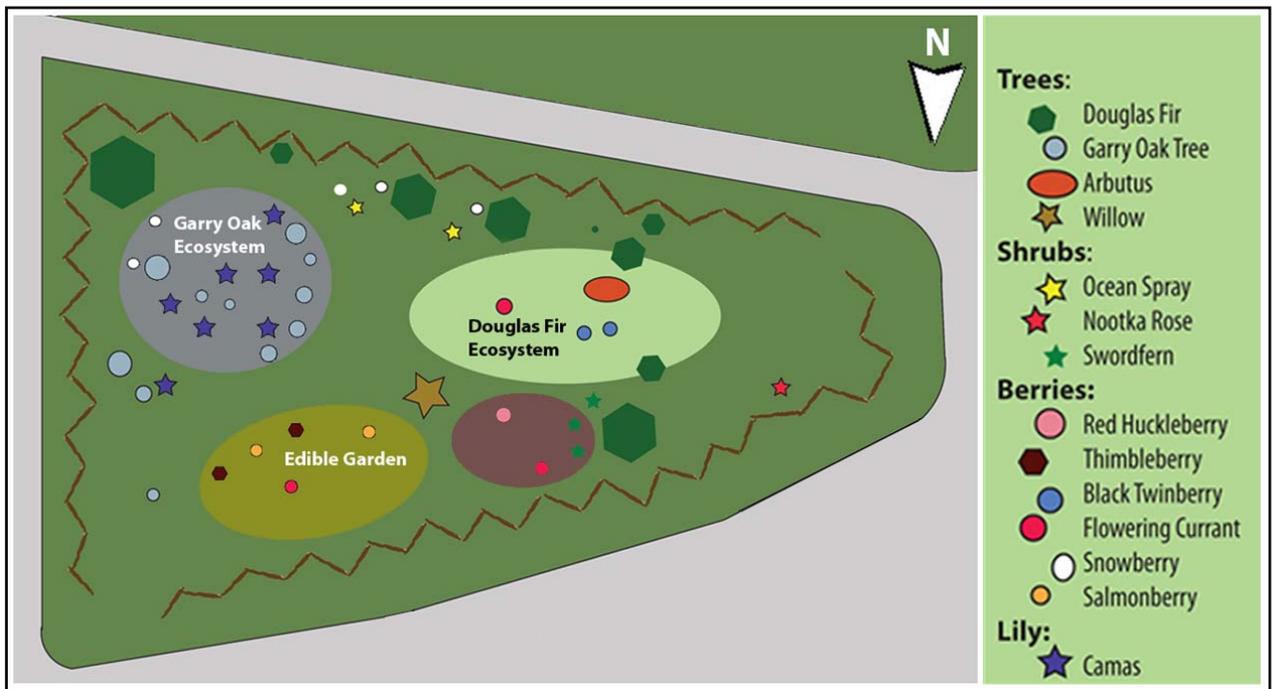
Since the initiative to restore the Elliott Garden in the fall of 2007 there has been minimal, if any, effort put into the upkeep and monitoring of the site. We are just developing a monitoring scheme for the site so we do not have information on the health of the garden following the restoration in 2007. Because of this, we are unsure of the initial status of the restored ecosystem and cannot say for sure how things have changed over time since the restoration took place. In order to track the changes over time in the garden, we require the use of this monitoring scheme. The baseline data for monitoring will begin with the first set of data that is collected based on this proposed scheme.

If one were to visit the site at this point in time (March), you would note that plant growth is minimal and as a result, any assessment of plant health would be difficult due to the lack of vegetative growth. Because of this we can conclude that the monitoring scheme will be most successful if it is carried out in the summer months. Currently, plants are just beginning to appear and initiate spring growth. Since the restoration attempts in 2007, many of the larger shrubs have died-off or been browsed by rabbits, whereas the health of the smaller shrubs seems to be better. The large trees, both Garry oak and Douglas fir appear to be in good health.

The table provided in Appendix C provides the species names that were present during the month of March 2009, during a visual survey of the site. The use of this table will be helpful in recording the presence or absence of species in each ecosystem over time. By comparing the plants that are present each year, we can make some conclusions regarding the establishment and propagation of plants in the ecosystem. The species assemblages are also illustrated in a site map on the following page of the Elliott Garden site as of March 2009.

We believe that by taking the actions proposed in this document, the quality of the Elliott Garden site can be improved in a way that will maintain the biotic and aesthetic qualities of the site, as well as provide an educational element to the garden. By following the monitoring scheme provided, and with a few adjustments to the site, we are confident that this site will improve the overall quality of life on the University of Victoria campus.

**Elliott Native Plant Garden Site Map  
Current Conditions  
March 2009**



## **5. Target Ecosystem Descriptions**

Previous projects concerning the Elliott Garden site have concentrated heavily on the descriptions of both Garry oak and Douglas fir ecosystems, as well as providing descriptions of the reference sites. This information can be found in more detail, by accessing these projects courtesy of Val Schaefer. For the purposes of our project, we wish to keep this section short and to the point as we aim to provide only the information to be communicated to the public through signage.

The Elliott Garden is an area of CDF ecosystem that was restored in the hopes of performing several functions. As we know, the connectivity of this space to larger ecosystems is not in the foreseeable future and we acknowledge that the Elliott Garden will never resemble a fully intact, and healthy CDF ecosystem. However, the garden will serve as a useful educational tool on the university campus and will hopefully provide some sort of refuge for passing birds and mammals. In this way it will add to local biodiversity and provide a small connective corridor to other nearby ecosystems. The monitoring of this site will allow us to maintain the aesthetic and biological value that is present at the site, which is the primary goal of the restoration groups that established this garden site. We aim to provide the information and method that is required in order to maintain this ecosystem and track its success over time.

### **5.1. Coastal Douglas Fir (CDF)**

Douglas fir ecosystems are prominent along the coastal regions of Vancouver Island. These ecosystems are important in providing various ecosystem functions such as soaking up rain water, filtering contaminants in runoff, purifying air as well as providing aesthetic beauty (CRD 2009). Coastal Douglas fir ecosystems host a variety of animal species and are home to the most diverse plant community of any ecosystem type in British Columbia. As a result CDF ecosystems are instrumental in promoting a diverse community of native plant and animal species. The connectivity of these ecosystems is integral to maintaining ecosystem function and the health of species found within.

Along the B.C. coast this ecosystem has suffered due to intense logging techniques and expansion of urban centers that have lead to the loss of valuable habitat. The CDF ecosystem, despite its biological diversity, comprises only 0.3% of provincial

land and is the smallest of the 14 British Columbia ecosystem types. By restoring, maintaining and monitoring this ecosystem on campus, we hope to increase the local biodiversity of native plants and animals and communicate the importance of CDF ecosystem services to the public.

## **5.2. Garry Oak**

Garry oak ecosystems, with their rich mosaic of associated plant and animal species, comprise a subcomponent of the CDF ecosystem. Garry oak trees are able to exist in areas that cannot easily be inhabited by other plant species because they are able to adapt and survive in extreme heat, shallow soil and low water retention. Both shallow and deep soil types are known to support Garry oak trees, however there are only a handful of deep-soil meadows that still exist today (Pers. Comm., Brenda Beckwith).

Garry oak ecosystems are themselves recognized nationally as an endangered ecosystem as a result of habitat loss due to urban development, fire suppression, and the introduction of invasive species (GOERT). It is estimated that only 5% of Garry oak habitats exist today, in their 'natural' state (GOERT). A diverse community of associated plant species helps to attract many animals to the living space provided by Garry oak trees. Six hundred and ninety four plant taxa have been found and identified in Garry oak ecosystems, sixty-one of which are currently at risk. In total, 116 species of associated plants and animals in Garry oak ecosystems are at risk of extinction (GOERT).

Garry oak ecosystems thrive in moderate climates, which are becoming more widespread throughout British Columbia, with current climate warming trends. As global temperatures continue to moderate it is predicted that a large portion of Douglas fir forests will be replaced by Garry oak meadows, as their climactic zone expands (GOERT). By restoring and maintaining these ecosystems today we may help them to spread and repopulate the area, as global climate change progresses into the future.

In the past, First Nations land-management practices were instrumental in maintaining healthy Garry oak ecosystems. The First Nations traditional practice includes the use of small, low intensity fires that allow camas, berries, nuts and Garry oak to prosper (GOERT). Fire suppression and the introduction of invasive species are two main problems, which are known to contribute to the decline in the health of Garry oak ecosystems.

### 5.3. Edible Plant Garden

The presence of an edible plant garden as part of the CDF ecosystem highlights the importance of this system to First Nations people. The edible plant garden as part of the garden ecosystem illustrates the practices of First Nations people in the past and also encourages the growth of local food in a sustainable way.

## 6. Site Plan

### 6.1. Vision

Our project is designed to promote the experience of dwelling in the garden, as Tim Ingold (2000) explains, humans construct their environment so that they can dwell within it, a garden in essence is an extension of this philosophy and by altering the physical parameters of the garden as our design does, our hope is that this invitation to dwell and experience the space will be optimized.

This would be done by extending the split rail cedar fence at the side of the Cunningham Building entrance so that it is enclosed; extending the fencing at the main entrance, facing the quadrangle and installing a gate; creating a meandering pathway; delineating the edible garden and Gary Oak meadow with stones; and installing small label signs, similar to those found within Finnerty Phase 1 Garden.

#### Our Plan:

- ✓ Design educational signs on the Native Species Garden
- ✓ Enclose the fence at the Cunningham side.
- ✓ Install a gate and extend the fence at the quadrangle side.
- ✓ Create a meandering pathway.
- ✓ Delineate the Edible Garden and Gary Oak meadow with rock borders.
- ✓ Create and install small label signs for plants of interest.

Experiential learning could be gained through the creation of a meandering pathway, as it would allow for greater engagement with the landscape. Our group concluded that a meandering pathway would optimize the limited space of the garden and allow the public to maximally engage with the space. Using rock borders to identify the

Edible Garden plant beds and the Gary Oak meadow bed would not only protect the plants in their early stages of development from being trod on but it would also create a more interesting space to look at. In addition to using rocks to delineate the unique areas within the garden we propose that adding small identification plaques or labels would enhance the educational experience of the space. Labels would be especially useful to differentiate the plants in the Edible Garden.

## **6.2. Communication**

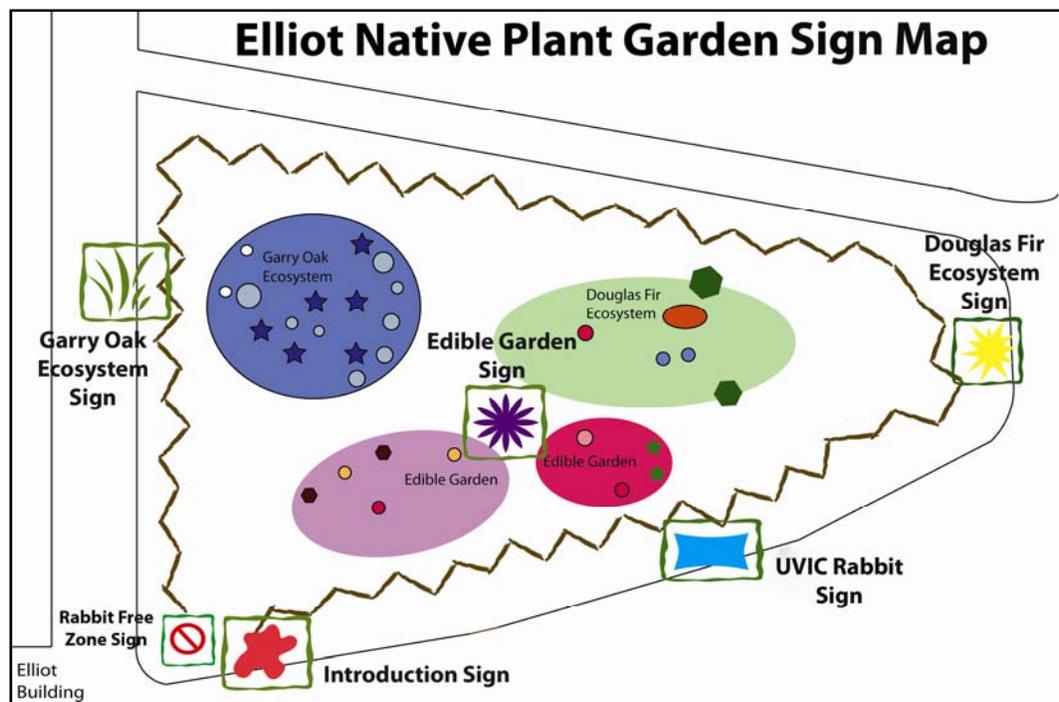
### **6.2.1. Rationale for Signage**

The act of communication is arguably one of the most important aspects in the restoration process that is initiated during the final implementation stage (Canadian Parks Council, 2009). The ability to successfully inform others of the work that has been done allows a project to continually grow and contribute to the field of restoration. Communicating the outcomes of restoration projects is useful for stakeholders, the public, and policy makers (Canadian Parks Council, 2009). This stage of a project contributes to existing restoration research database and methods and also attracts public attention and support (Sutherland et al, 2004). Successful communication to stake-holders and policy makers can often lead to increased and ongoing economic support (Canadian Parks Council, 2009). This is also a benefit for other restoration projects as the reputation of this sort of work to grow positively.

The ability for us to communicate our work in the present restoration project is unique, as we have the use of signs, which are a long-lasting source of information for a diverse and large audience of people. The merging of scientific and artistic knowledge is a key theme in our work, and both are conveyed our final product. In this section we propose the production and use of four interpretive signs, as well as a 'rabbit-stop-sign'. In these signs we hope to communicate the history of the site, the history of the restoration project, the involvement of the ES department and students, and the diversity of flora and fauna.

Signs are particularly useful in communicating this type of local restoration initiative because they provide a visually pleasing and engaging experience for the observer. The combination of photographs, symbols and text are an effective way to impart knowledge in a quick and memorable way. The visual images included on our signs allow people to internalize information easily and take away the most important messages that we are trying to convey. Many people learn best visually, and hence the use of signs is appropriate for educating most people. We hope that these signs will promote experiential learning by providing important factual information that entices observers to enter the restored space and experience it in their own way. As emphasized by David Cooper (2006) gardens are neither nature nor art, but with signage we are merging the two.

### 6.2.2. Proposed Locations for the Signs



### **6.2.3. Proposed Sign Designs**

The following pages include images of our proposed sign designs. For digital documents of the layouts, please use the accompanying CD-ROM. Digital Files are in Photoshop and JPEG formats.

Sign 1 – Introduction Sign

Sign 2 – Garry Oak Ecosystem Sign

Sign 3 – Douglas Fir Ecosystem Sign

Sign 4 – Edible Garden Sign

Sign 5 – University of Victoria Rabbit Sign

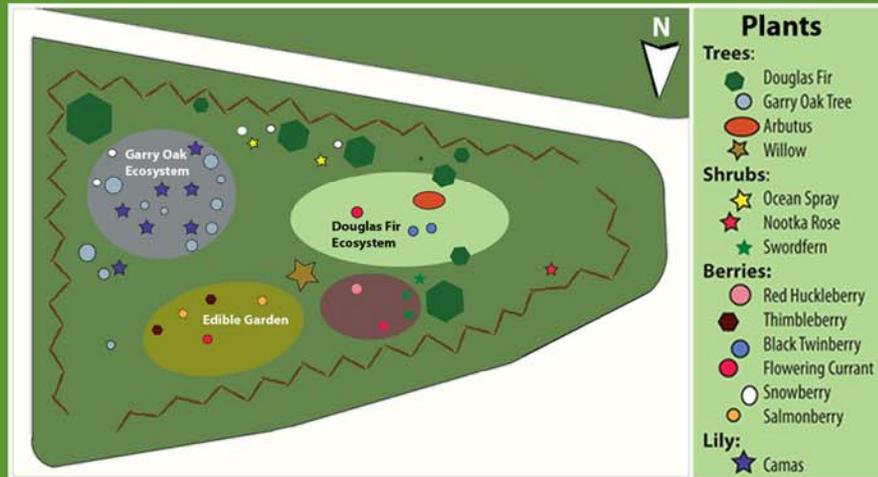
Sign 6 – Rabbit Free Zone Fence Sign

## Sign 1 – Introduction

# The Elliot Native Plant Garden

The Elliot Native Plant Garden has been an ongoing University of Victoria Environmental Studies project since fall 2007 when it was initiated by Dr. Val Schaefer and his Environmental Studies 341 class. This garden is representative of some of our native vegetation and ecosystems from Southern Vancouver Island.

### Map of the garden:



This garden includes a Garry Oak ecosystem, a Douglas Fir ecosystem and an edible garden.



### Special Thanks to:

Queenswood Nursery,  
Dr. Val Schaefer,  
Ms. Sarah Webb,  
The Environmental Studies department,  
The Environmental Restoration department,  
Mr. Bently Sly, Grounds Manager  
Ms. Rhonda Rose, Grounds Supervisor



### Images:

1. Flowering Currant
2. Salmon berry
3. Douglas Fir
4. Garry Oak
5. Native Plant Garden

Images from:  
E-Flora BC: Electronic Atlas of the Plants of British Columbia  
[[www.eflora.bc.ca](http://www.eflora.bc.ca)]. University of British Columbia.

## Please come inside and enjoy!



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## Sign 2 – Garry Oak Ecosystem Sign

### The Garry Oak Ecosystem



**Garry Oak:** *Quercus garryana*. This tree is the only native oak tree in western Canada. The species is named after Nicholas Garry who was deputy governor of the Hudson's Bay Company from 1822–1835. They are well-known for their gnarly silhouettes and unique adaptations to the Mediterranean-like climate found in the rainshadow of the Vancouver Island.

Garry Oak Ecosystems are one of Canada's most diverse and also most endangered ecosystems. These ecosystems are unique to a small part of South Western British Columbia.



**" Bulbs of camas were an important native root vegetable in the economies of Straits Salish peoples. Intensive management not only maintained the ecological productivity of this valued resource but shaped the oak-camas parklands of southern Vancouver Island. "**

- Brenda Beckwith

**Camas:** *Camassia quamash*.

This plant was an important food source to the First Nations and plays a role in ceremonies. The plant is still one of the most important roots of western North American indigenous peoples.

The bulb is nutritious and can be eaten raw. The bulbs were cooked in 'pit cooks'. The root becomes sweet and tastes like sweet chestnuts once cooked. The bulbs are harvested primarily in summer but can be harvested all year. It is a Lily that flowers with beautiful violet flowers between March and June.



**Snowberry:**

*Symphoricarpos albus*. This plant has the nickname *Ghost Berry*. Please do not eat the snowberries; they are poisonous.



**Images:**

1. Garry Oak Meadow
2. Garry Oak Acorn
3. Garry Oak Leaves
4. Snowberry
- 5,6,7. Camas



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Images from: E-Flora BC:  
Electronic Atlas of the Plants of British Columbia  
[[www.eflora.bc.ca](http://www.eflora.bc.ca)]. University of British Columbia

Note: Figure 6 shows Death-camas (white flowers). It is very hard to tell the bulbs apart from edible camas. These bulbs are highly toxic and potentially fatal. Never try to harvest camas on your own if you do not know how to tell the difference.

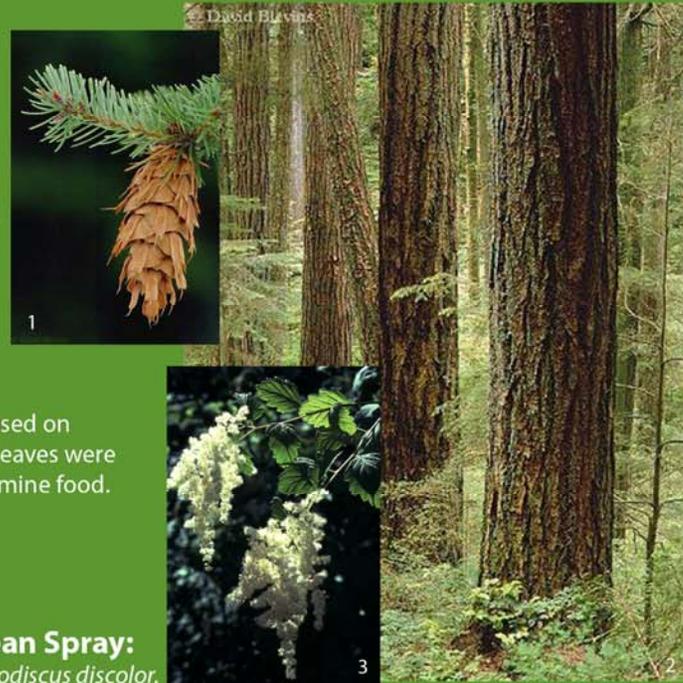
## Sign 3 – Douglas Fir Ecosystem Sign

### The Douglas Fir Ecosystem

Douglas Fir ecosystems are prominent along a narrow strip along the southeastern coast of Vancouver Island, including several of the Gulf Islands. Coastal Douglas Fir ecosystems are home to a wide assortment of animals including the Black Bear, Cougar, and Black tailed Deer. They are important in providing functions such as soaking up rain water, filtering contaminants in runoff, purifying air as well as providing aesthetic beauty. Along the coast, this ecosystem has suffered due to intensive logging and expansion of urban centers.

#### **Sword fern:** *Polystichum munitum*.

Every part of the sword fern was used by the First Nations. The fronds were used on berry drying racks, to separate food in storgae, and to line backing pits. The leaves were also used as mattresses. The roots were could also be peeled and used as a famine food.



#### **Ocean Spray:**

*Holodiscus discolor*.

Also know as Cream Bush, this plant has white to cream colored fragrant clustered pyramid-shaped flowers that bloom in late June and July.

The fruits can be eaten raw or cooked and are small and yellow-brown in color. The seeds are a blood purifier and First Nations people would use an infusion of them to treat smallpox, chickenpox and black measles. The bark can be dried, powdered and then used with oil as a dressing on burns.

A leaf poultice can be applied to sore lips and feet. Powder of the dried leaves has been used on sores and a decoction of the leaves has been used to treat influenza. The wood is very hard and does not burn easily and so it was utilized to make many different tools.

#### **Images:**

1. Douglas Fir Cone
2. Douglas Fir
3. Ocean Spray
4. Sword Fern
5. Sword Fern
6. Ocean Spray
7. Black Bear Cub



Images from:

E-Flora BC: Electronic Atlas of the Plants of British Columbia  
[www.eflora.bc.ca]. University of British Columbia.



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## Sign 4 – Edible Garden Sign

### The Edible Garden

The Saanich Peninsula was once a land of plenty, the meadows, forests and surrounding seas comfortably sustaining the First Nations Peoples who lived upon it. This edible garden showcases some of the most widely utilized plants from that time. We invite you to sample the labeled plants at your discretion, but please harvest sustainably so that others may enjoy the garden as well!



**Salmonberry:** *Rubus spectabilis*. This plant has beautiful large rosy-red to dark reddish-pink flowers from May to June. The berries ripen from August to October, as they become increasingly juicy with a great flavour. They can be eaten raw, cooked or dried for later use. The leaves can be used as tea substitute and young shoots can be harvested in spring, peeled and eaten raw or cooked. The medical uses of this plant are many: Leaves and root are astringent and a poultice can be made of chewed leaves or bark and used on burns, sores, wounds and to ease pain of aching teeth. The root bark is analgesic, astringent, disinfectant and stomachic and a decoction of the root bark has been used to lessen the pains of labour and treat stomach complaints.



**Flowering Currant:** *Ribes sanguineum*. This plant is also known as red-flowering currant and has fragrant flowers varying from dark pink to white. The flowers are tubular-shaped and bloom from April to May. The fruits are black currants that can be eaten raw or cooked and can be harvested from August to November.

#### Images:

1. Prescribed Burn
2. Salmonberry Flower
3. Salmonberries
4. Salmonberry
5. Flowering Currant
6. Flowering Currant Berries
7. Flowering Currant

Images from:

E-Flora BC: Electronic Atlas of the Plants of British Columbia [www.eflora.bc.ca]. University of British Columbia.



#### Did you know?

First Nations Peoples on Vancouver Island practiced crop management by prescribed burns of Garry Oak Meadows. This practice resulted in a greater number and higher quality of edible Camas plants the following season.

In a world plagued by climate change and increasing hunger, food security has become an ever more important issue. One way that people can increase their food security is to eat locally and organically. This is a great way to get back in touch with delicious foods that have been largely forgotten by globalization.



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Environmental  
Studies

## Sign 5 – University of Victoria Rabbit Sign

### The University of Victoria Rabbit:

The Elliot Native Plant Garden is a **rabbit free zone**. These animals damage the vegetation and are not native to this area.

Although rabbits are part of UVic campus life, they can also have an impact on human health and safety, and on plants and property. To help reduce this impact, the university is developing a long-term management plan for rabbits. Changing how people interact with the rabbits is essential to this plan.



Abandoning rabbits on campus is illegal.



The feral rabbits at UVic are unwanted pets or descendants of unspayed or unneutered pets abandoned on campus by members of the community.

#### Spread the word...

- Don't abandon your pet rabbit on campus.
  - Don't pet or feed the rabbits.
- Don't chase, harass or handle the rabbits.



#### Images:

1. Feral Rabbit
2. Rabbit damage to a tree
3. Rabbit browsing
4. Rabbit holes

#### Why does UVic have to manage the rabbit population?

- Concern for athlete safety due to rabbit holes and fences on playing fields
- Rabbit damage to this garden, heritage plants in Finnerty Gardens, and native plants used in teaching programs
- Rabbits cause tunneling and plant damage around the university buildings
- Residence in adjacent neighbourhoods are concerned about damage to their gardens

Images from:

E-Flora BC: Electronic Atlas of the Plants of British Columbia  
[[www.eflora.bc.ca](http://www.eflora.bc.ca)]. University of British Columbia.



University  
of Victoria  
Environmental  
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**Sign 6 – Rabbit Free Zone Sign**  
**(To be mounted on Gate)**



**Please close the gate behind you.**  
***RABBIT FREE ZONE***

## 6.3. Action Plan for Signage

### 6.3.1. Sign Production

The first course of action would be to have the Director of Facilities Management authorize the proposed sign designs; as part of the UVIC Policy Manual, section 6715, which states that suggestions of additional signs must be presented to the Director of Facilities Management for review. The process would then proceed by contracting an outside company to make the signage, as well as the fence and gate, upon approval from Sarah Webb and the ES Department.

Research was conducted to see which local companies would be available and suitable to produce the materials needed. Criterion was based upon the companies environmental accountability, their relationships with the university (if they had worked with any departments in the past), and their overall quality of product. Below is a list of the most suitable candidates.

- **Stacked Style Cedar Split Rail Fencing:** Box Lake Lumber, a local company. Contact Information: <http://www.boxlakelumber.com>
- **Gate:** The same company could be contracted to produce a custom gate made of split cedar. Below is a photo taken from their website, illustrating an example of the custom gates that they can produce. In the case of the Elliott Native Plant Garden creative alterations would need to be made to address the rabbit issue.



- **Signs:** Signs of the Time, a local business that has worked with the University of Victoria in the past and has an environmental policy. Contact information: <http://www.signsofthetimes.ca>

### **6.3.2. Technicalities**

The technical specifics of the signs would be finalized by the contracted company; the most important aspects would be to ensure that the signs are aesthetically pleasing and durable. Proposed measurements for the signs is 10 by 8 inches.

As previously arranged Facilities Management will continue to look after the site under the recommendations set out by Environmental Studies and Restoration Departments. The signs would need to be implemented by the ES Department with the assistance of Sarah Webb and once erected the maintenance of the signs would be conducted by Facilities Management.

### **6.3.3. Budget**

After having spoken with Bently Sly, the Facilities Management Grounds' Manager and Ms. Rhonda Rose, the Grounds Supervisor it became apparent that because of fiscal constraints that decisions regarding the budget of the site would be dealt with by the Environmental Studies Department facilitated by Sarah Webb of the Office of Campus Sustainability and Planning. I was informed by Rhonda Rose that the materials needed for the Elliott Native Plant Garden project were not under the jurisdiction of Facilities Management and would need to be outsourced, to the discretion of the Environmental Studies/Restoration Department.

## **7. Monitoring**

### **7.1. Importance of Biological Monitoring**

Biological monitoring is the activity of consistently measuring and recording characteristics of a site or region over time (Haber 1997). Monitoring is important to the understanding of patterns and changes taking place in ecosystems. Even more importantly, monitoring can allow us to make informed decisions regarding the future target of a system through effective restoration plans and programmes. Although an ecosystem integrity assessment cannot be done with a single measurement, suitable indicators can be used in combination to give an estimation of the system status and

trends that are likely to occur in the future (Ferretti 1997). Ultimately, monitoring strategies are an essential component to all restoration initiatives. Determining if goals have been reached or if further inputs are required to reach the target trajectory, is not possible without an appropriate analysis of restorative efforts.

In the conceptual model for ecosystem degradation and restoration, as emphasized by King and Hobbs (2006), there are biotic and abiotic barriers that separate the fully intact from the degraded site. In a restoration project these different barriers require certain types of energy input in order to restore the degraded site back to its intact ecosystem. It is often difficult to determine which barriers an ecosystem has crossed and therefore what state it is in at a given point in time (King and Hobbs 2006). Measures of ecosystem attributes can be used in a monitoring protocol in order to determine the state that an ecosystem is in, and the barriers that may need to be overcome in order to fully restore a given site. These monitoring protocols help to ensure that a restoration attempt is ecologically effective, economically efficient and socio-culturally engaging (King and Hobbs 2006).

## **7.2. Background and Rationale for Monitoring Metrics**

### **7.2.1. Tree Density, Coverage and Condition Assessment**

Annual monitoring of individual trees is important for assessing the condition, growth and longevity of this key ecosystem component. Assessment of tree density, coverage and dominance are good indicators of the overall composition of the system. Diameter at breast height (DBH) is the most common technique used by arborists to assess tree size. The method provides a nearly universal, standardized method of calculating diameter, from which further computations and inferences can be made (Roberts-Pichette and Gillespie 1999).

Although tree characteristics will likely change on a longer timescale than other ecosystem attributes, they are still essential components of the assessment process for determining community composition and growth. Furthermore, these measurements can provide the imperative baseline information currently lacking, preventing a shift in baseline perception from occurring, which is of particular importance for the endangered Garry Oak species.

In addition to size and composition measurements, condition assessment of individual trees is important for monitoring specific records of tree health. Although this is to be measured qualitatively and is exposed to some subjectivity, the tree condition protocol has been set out to be as specific as possible to minimize this confounding effect.

### **7.2.2. Shrub and Small Plant Community**

Evaluation of small plants is of particular importance to the monitoring of the Elliott Garden due to efforts put forth to set up an edible garden within the site. The lack of monitoring or re-evaluation of the garden since its original implementation in the Fall of 2008 makes the evaluation of species survival essential for determining future restoration plans for the site. It is likely some species will not have persisted due to unsuitable conditions at the site, and therefore can provide useful information about which species are best suited for the site and which should continue to be planted.

The tagging protocol put forward by the monitoring plan will also be a useful tool for future assessments. As the evaluation of many ground species is difficult during the winter season in the absence of green leafy structure for identification, marking the location of each species with small wooden stakes can make annual assessment of survival not only easier, but also more accurate.

### **7.2.3. Plant Exotics**

Exotic species can have many detrimental impacts on native ecosystems, such as tree stress, competition with native shrub species, reduction of recruitment for young trees and altering the overall species composition or vegetation dynamics (Vitousek et al. 1997). Recording the presence or absence of exotics is useful in monitoring, as it can serve as an indicator of the level of disturbance and the overall vulnerability of the system. Monitoring over long time scales can also help bring a greater understanding of the system dynamics with respect to exotic species patterns. Noting the arrival of new species that have established in the area and the proliferation rate of such species can be useful information in

determining the level of threat these exotics pose to the system (Haber 1997). All of these factors must be considered and understood for the development of informed project objectives and an effective restoration plan for the site.

In the case of the Elliott Garden site, the non-native grass poses an interesting question in monitoring and restoration. Although the grass covering much of the site is by definition exotic, it does fulfill the role of ground cover in the least expensive way, with minimal impact relative to other forms of ground cover. Although planting a native grass species would be ideal, this would not be a reasonable request due to the upkeep required by the University's Facilities Management team. The grass also serves to trap moisture in the ground, allowing the soil to remain adequately damp for plant growth; without the grass, soil at the site would most likely become much too dry and organically deprived of nutrients as water would simply run off with minimal absorption. Furthermore, although the grass is exotic, it does not necessarily fit the characteristics of invasive. By definition, an exotic species is only really considered to be invasive when it threatens the survival or reproductive abilities extant species, thereby posing a threat to the natural biodiversity and indigenous community composition (Evans et al. 2008). Not only does the grass not seem to be inhibiting the survival of trees and plants in the system, it actually could be considered a benefit. Therefore, we have concluded that although the presence of grass may not be the perfect scenario for the site, it does serve an important functional purpose in the system that would be unrealistic to replace within the scope of this project. Consequently, the grass within in the site will not be evaluated as either native or non-native in this assessment.

#### **7.2.4. Physical Soil Structure**

The physical structure of soil is equally as important to a plant community as the site's biotic composition. The bulk density of soil provides an evaluation of how densely packed a sample of soil is, determined by measuring the mass of dry soil per unit of volume in g/ml (Chan 2006). The measure will vary with the composition of the soil particles, how closely they are packed together and the

number of pores or air spaces within the soil. The bulk density of soil is also dependent on the relative composition of mineral and organic components. Loosely packed soil with high organic matter content is typically in the range of 0.5g/mL, while heavily compacted mineral rich soils have a much higher bulk density in the region of 2.0g/mL (Chan 2006). The primary reason for measuring the bulk density of the soil in this assessment is to assess the degree of compaction within the site. Compaction results from compression of surface soil, often as a result of human activity and traffic on the land, which increases the weight to volume ratio. Increased soil compaction can have negative impacts on ecological processes, such as restricting plant growth by physically limiting roots from penetrating (Kok et al. 1996; Sudduth and Chung 2005). Compaction also affects water movement through the soil, with heavy compaction limiting the soil's holding capacity. In previous assessments of the University of Victoria's campus ecology, the soil has typically been characterized as being dark gray with a high coverage of impermeable clay layers (Hocking 2000). Thus, this metric is essential for ensuring soil conditions of the site are within an appropriate range for growth of the biotic community.

### **7.2.5. Chemical Soil Composition**

Soil chemistry can provide a great deal of information about the suitability of conditions for plant growth. The acidity of the soil, measured by pH, can be helpful in determining the solubility of nutrients, and whether plants will be able to readily utilize the nutrient sources within the soil. In conditions that are either too acidic or too alkaline, plants are unable to absorb nutrients and as a result their nutrition and growth are impaired.

Nitrogen is another key chemical factor that must be in appropriate balance for proper plant growth. Although nitrogen is essential for stimulating plant development, an excess of the element can cause rapid top growth, weakening the under structure of the plant and jeopardizing the stability of the plant (Bohn et al. 2002). Phosphorus is also an important chemical component of soil, playing a vital role in photosynthesis and the internal energy transfer and storage process in

plants. Phosphorus can stimulate early root and stalk growth to aid in stable maturation of the plant. Despite its importance for natural plant maturation, excess input of phosphorus can result in water pollution and therefore need to be monitored closely. Potassium is another essential element of soil required for plant growth. Potassium regulates water retention and the internal chemical processes of plants, particularly the metabolic processes necessary for energy use (Bohn et al. 2002). Plants lacking potassium have reduced survival during periods of water deficiency, such as harsh winters or dry summers (Bohn et al. 2002).

The monitoring process in this assessment protocol will recommend the use of a standard gardener's soil testing kit. The readily available and relatively inexpensive nature of these universal kits will allow this protocol to be carried out by any interested party. Although more precise and thorough tests are available for the measurement of chemical soil properties, it was decided these expensive, complicated and time consuming tests would limit the practical approach of the design and would therefore not be fitting. The kit recommended here is the Rapitest Soil Test Kit, available online for a cost of less than \$20.



### **7.2.6. Disturbance**

Although it is unlikely to observe the major system disturbance events that would occur in wild systems, such as fires, the system is still vulnerable to large scale natural disturbance due to the small size and location. The roots of trees will typically be shallow in such a system as a result of the surrounding concrete and impermeable compacted soil that does not allow for strongly rooted trees. This can greatly increase the likeliness of a blow down event in a storm or other harsh conditions (Hocking 2000).

Of even greater concern is anthropogenic disturbance resulting from human foot traffic and activities in the surrounding area. Although some human disturbance is inevitable as a result of the site locale on the university campus, efforts have been made to minimize this disturbance. Assessing the degree to which the system is being negatively impacted by humans is a challenge and is done most effectively through qualitative observations.

Rabbits are the one of the greatest threats to the natural landscape on campus and the plants in the system. Less than one rabbit per hectare can actually prevent the regeneration of many of our native tree and shrub species (Cooke 2008). Intensely populated areas of rabbits can prevent small remnant patches of native vegetation from continuing as self-sustaining plots of plant life. Without measures to prevent these invasive animals from eating small plants and shrubs, the constant pressure of the nibbling rabbits is enough to result in complete destruction of vegetation. Although the area has been fenced off, rabbits have still been observed within the area, which could severely limit the succession of the system, in particular the edible garden beds and small plants. The rabbits may also disturb the restoration efforts put forth to label and identify the plants by damaging signage. Fortunately, evaluating rabbit disturbance can be assessed by the browse line in the area, as rabbits are known for leaving distinct angular cuts on seedlings and small plants (Cooke 2008). Given that deer presence in this area of campus is extremely rare, the assessment of the browse line is made easier as the rabbits represent the predominant browsers in the area.

### **7.2.7. Photopoints**

A technique becoming more common to restoration is the establishment of photopoints. These are points which photographs will be taken over a series of years to provide qualitative data. They can be used comparatively to illustrate the change of the system over time, and in the case of the Elliott Native Plant Garden they will become a key tool in the maintenance of the site. Photopoint locations are selected for their ability to convey the desired information. They photographs are taken at the same specific location at the same time of year, with the same horizon. This ensures minimal variance and therefore allows for accurate comparison between timescales.

## **7.3. Monitoring Protocol**

### **7.3.1. Tree Density, Coverage and Condition Assessment**

#### 7.3.1.1. Survey

- Initial assessment requires the identification, numbering and potential tagging all living and standing trees greater than 2m in height. Starting at the Southeast corner of the site in System 1, move in a clockwise spiral from the periphery inwards. Identify and record each tree by species and number.
- Subsequent monitoring should add new tags to trees that have crossed height threshold (>2m).

#### 7.3.1.2. Mapping

- Record the location of all tagged trees on map and update if new trees are tagged.

#### 7.3.1.3. Diameter at Breast Height (DBH)

- Measure exactly 1.3m from the ground.
- Wrap metric measuring tape around tree, ensuring it remains taut and is perpendicular to stem axis and record diameter.
- If measurement cannot be taken at 1.3m due to irregular tree form, record the height at which the measurement was taken

7.3.1.4. Calculations

- Use Table D1 found in Appendix D for calculations using the measurements collected above.

7.3.1.5. Condition

- Assess through observation and record condition of all tagged trees using the symbols laid out below in the table below. Use the figure below for guidance with condition assessment.

| Alive |                        | Dead |               |
|-------|------------------------|------|---------------|
| AS    | Standing Alive         | DS   | Standing Dead |
| AB    | Broken Alive           | DB   | Broken Dead   |
| AL    | Leaning Alive          | DL   | Leaning Dead  |
| AF    | Fallen/Prone Alive     | DF   | Fallen Dead   |
| AD    | Standing with Dead Top |      |               |

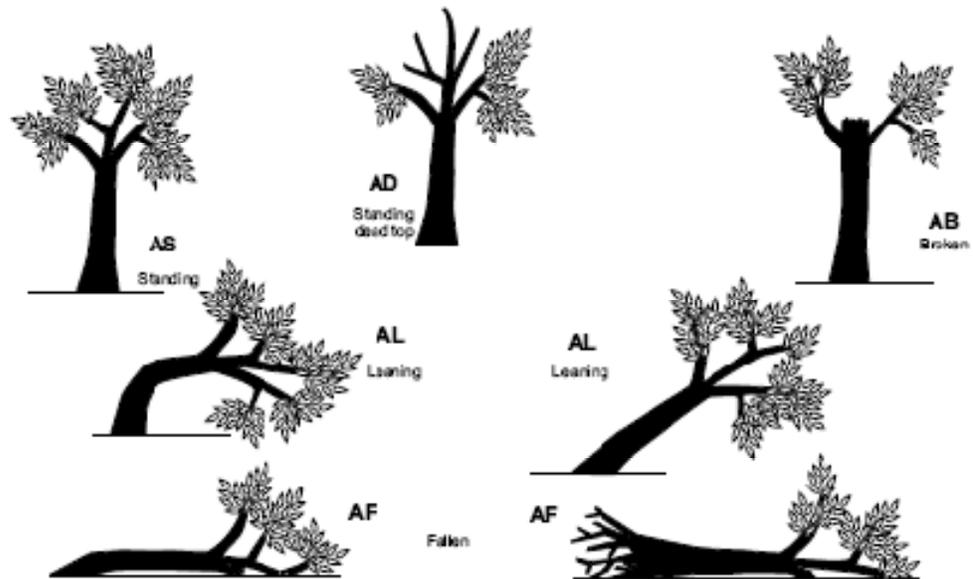


Figure from Environment Canada Ecological Monitoring and Assessment Network.

### **7.3.2. Shrub and Small Plant Community**

#### 7.3.2.1. Survey

- Initial assessment requires the identification, numbering and labelling with small plant posts of all living shrubs, herbs and small plants less than 2m in height. Just as with the large tree assessment, starting at the Southeast corner of the site in System 1, move in a clockwise spiral from the periphery inwards.
- Identify and record each living species, mark its specific location on the map, and place a small wooden post in front of the plant.
- Subsequent monitoring should add new tags to plants that have been planted, and note the survival of trees that were previously labelled.

#### 7.3.2.2. Mapping

- Record the location of all tagged shrubs and small plants on map.
- Update if new plants are added or previous ones have deceased.

### **7.3.3. Plant Exotics**

#### 7.3.3.1. Survey

- Assessment of the relative ratio of native to exotic plants, not inclusive of the grass ground cover, will be done using the information gathered in the tree and shrub assessments.
- Use the raw species counts to make calculations as laid out in the table below.

| <b>Rank</b> | <b>Description</b>                                  |
|-------------|---|
| 0           | No evidence of rabbit damage                        |
| 1           | Slight damage – confined to some seedlings          |
| 2           | Obvious damage to more than a few seedlings         |
| 3           | Many seedlings moderately damaged                   |
| 4           | Heavy damage however some seedlings retain foliage  |
| 5           | Foliage, twigs and bark stripped from all seedlings |

### **7.3.4. Physical Soil Structure**

#### 7.3.4.1. Soil Collection

- Surface Horizon Soil
  - Using a block of wood or sledge hammer, drive a metal ring of 10cm diameter, such as from a section of metal piping, into the soil approximately 10cm in depth.
  - If the metal ring is not filled to the top, measure the height to which the soil level comes up to as this is essential for the accurate calculation of volume to follow.
  - Use a small shovel to dig around ring and remove evenly from soil. Use a blunt edge, such as a dull kitchen knife, to level soil at end of pipe and remove excess. Avoid touching soil as much as possible.
  - Again using a blunt end, push soil through metal ring into a clean, unused bag. Label with collection location.
- Compacted Horizon Soil
  - Using a long metal pole, probe the soil for the compacted layer. When it has been located, using a small shovel clear surface soil to expose the layer of compaction.
  - Repeat the procedure for inserting the metal ring into soil as described for surface soil.

#### 7.3.4.2. Sample Weighing

- Using a gram precision balance, weigh the soil while in the bag.
- Weigh an empty plastic bag and subtract from first weight to account for weight of the bag.
- Extract subsample to determine water content and dry soil weight by mixing soil thoroughly while in bag and then taking a 30mL scoop of loose soil and placing it in a paper cup.
- Determine the weight of the soil in the cup, being sure to measure the weight of an empty paper cup and subtracting it from the first weight to account for the weight of the cup.

- Dry subsample by placing sample in microwave for several 4-minute cycles. After each minute, open door of microwave to allow the escape of moist air. Weight sample when completely dry, again accounting for the weight of the paper cup. To determine when sample is dry, weigh sample in between 4-minute cycles, and when the weight does not change after a drying cycle, the soil is dry.

#### 7.3.4.3. Calculations

- Use the weights collected above to carry out the calculations laid out Table D2 found in Appendix D.

### **7.3.5. Chemical Soil Composition**

#### 7.3.5.1. Soil Sample Collection

- Collect soil using a clean instrument, such as a trowel, spoon or small shovel. Take caution and do not touch soil with hands as test results are particularly sensitive to external factors.
- Several soil samples should be collected from each of the systems within the site, and taken from approximately 10cm below the surface.
- Place samples in clean containers labelled with System collected from and sample number obtainable from either the Biology or Chemistry stores on campus.

#### 7.3.5.2. Chemical Characterization

- If soil is extremely wet, allow to air dry naturally (not using direct heat) before proceeding.
- Without touching the soil with hands, remove solid debris such as stones and wood chips. Place soil into clean plastic bag and crumble as finely as possible using either a rolling pin or hand pressure.
- Using the soil test kit as recommended in the background information to soil chemistry, carry out tests of soil pH, nitrogen, phosphorous and potassium levels as per kit instructions.

### 7.3.6. Disturbance

#### 7.3.6.1. Rabbit Disturbance

- Note the actual presence of any rabbits within the gated area and evaluate simply as “Absent” or “Present” at time of assessment.
- Conduct a search around the site in a spiralling clockwise pattern to closely examine small seedlings and plants less than 0.5m tall. Record any observations of oblique 45° angle shear-like cuts or defoliation and gnawing of bark on lower branches.
- If all seedlings have been removed or there are non present, the damage can be assessed in a similar fashion by examining larger plants and older saplings for the presence of a distinct browse-line at a height of approximately 0.5m, in which rabbits would be capable of reaching lower foliage.
- Quantify the seeding abundance score using the rubric laid in the table below.

| <b>Rank</b> | <b>Description</b>                                  |
|-------------|---|
| 0           | No evidence of rabbit damage                        |
| 1           | Slight damage to some seedlings                     |
| 2           | Obvious damage but confined to some seedlings       |
| 3           | Many seedlings moderately damaged                   |
| 4           | Heavy general damage, some seedlings retain foliage |
| 5           | Foliage, twigs and bark stripped from all seedlings |

#### 7.3.6.2. Human Disturbance

- Note any apparent human disturbance, including but not limited to litter, human foot tracks within plant beds and fence damage.
- Record human disturbance as laid out the table below.

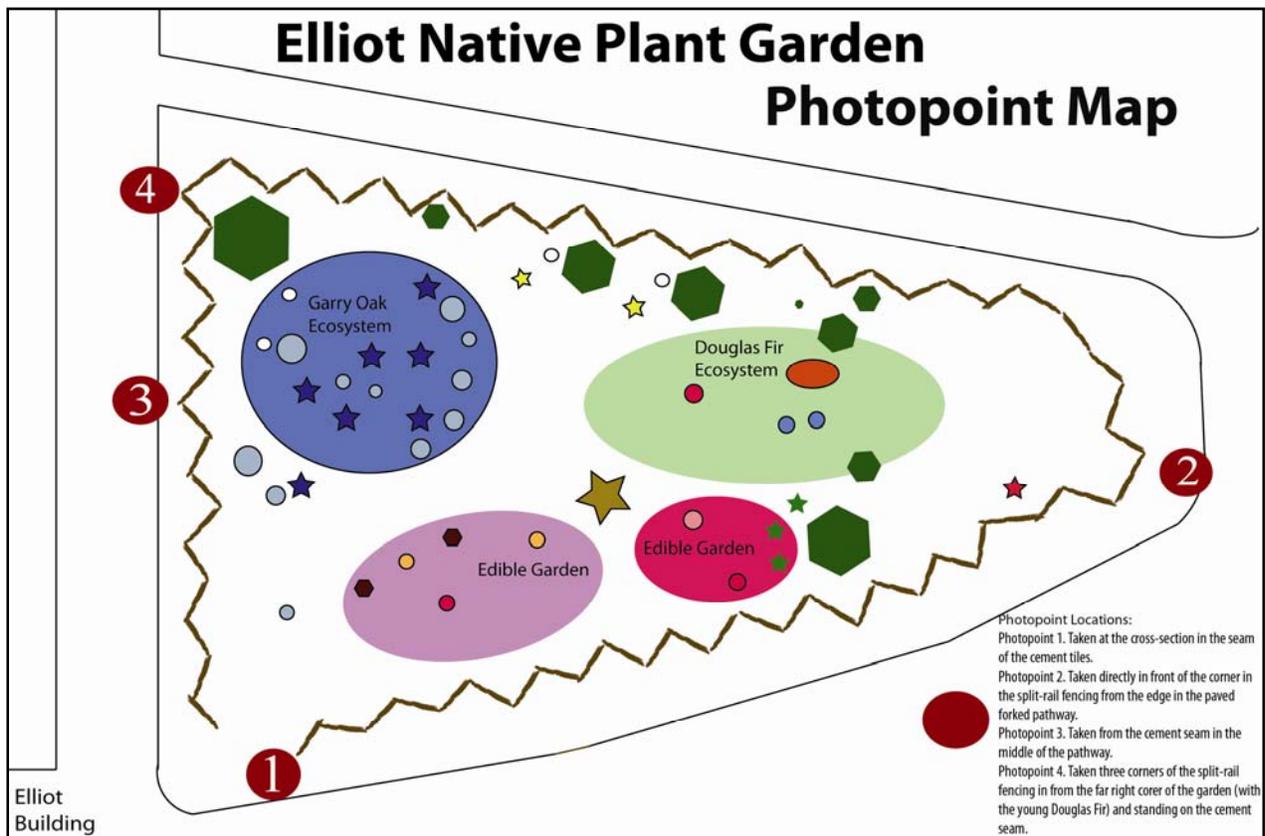
| <b>Rank</b> | <b>Description</b>   |
|-------------|--|
| 0           | No apparent negative impact or disturbance by humans                           |
| 1           | Human disturbance present but not overly detrimental or damaging to vegetation |
| 2           | Obvious damage to system by humans   |

### **7.3.7. Photopoints**

- The photopoint protocol should be carried out for both spring and summer seasons. Spring photographs should be taken between March 15<sup>th</sup> and March 30<sup>th</sup> while summer photographs should be done between August 15<sup>th</sup> and August 30<sup>th</sup> each year.
- All photographs are to be taken at the height of 5ft with vertical and horizontal shots taken for maximum reporting of all vegetation layers. The zoom is not to be used for any of the shots to maximize consistency; in addition, the camera is to be set to 'auto' to select the appropriate aperture for the light conditions. All photographs should be taken in the highest resolution possible.
- In conventional procedures for Photopoint monitoring, Photopoints are marked with a permanent stake; however, due to the urban nature of the garden there were enough exterior landmarks to serve as markers and therefore descriptions of the points are listed below.
- General view photos can also be taken to provide additional information at the discretion of the surveyor.
- After photographs have been taken, they should be saved to disk as high quality JPEG images.
- Comparison of each Photopoint photograph should then be compared to previous Photopoint photographs from the same location to examine the site for changes occurring overtime. Baseline photographs taken for Spring 2009 are attached in Appendix E, also serving as a template for the standard information (camera, date, time, weather) to be included with the Photopoint monitoring information. These baseline photos are also found on the accompanying CD-ROM.

## Photopoint Locations

- ✓ **Photopoint 1.** Taken at the cross-section in the seam of the cement tiles.
- ✓ **Photopoint 2.** Taken directly in front of the corner in the split-rail fencing from the edge in the paved forked pathway.
- ✓ **Photopoint 3.** Taken from the cement seam in the middle of the pathway.
- ✓ **Photopoint 4.** Taken three corners of the split-rail fencing in from the far right corner of the garden (with the young Douglas Fir) and standing on the cement seam.



## **8. The Future of the Elliott Native Plant Garden**

### **8.1. Restoration Challenges for the Elliott Garden**

The greatest challenge facing the Elliott Garden is our lack of knowledge regarding the current conditions of the site. The initial planting of the Elliott Garden took place in November 2007. Since that time, there has been no ongoing monitoring or upkeep of the site. As our project was undertaken in winter, it was impossible for us to accurately judge how many of the original plant species, if any, were still alive. It is highly likely replanting will be necessary in the future.

Once the plants have grown or blossomed in the spring, it will be necessary to inventory the site to determine what will need to be replanted. Once the plants can be identified, the three ecosystem themed sections of the garden and the path through them should be demarcated with small stones. This will serve several purposes; it will allow quick identification of each ecosystem, show where the individual gardens are in the winter, and make it appear like an inviting garden instead of a decorative space that should not be entered.

The second challenge facing the site is that posed by the ever hungry resident rabbits and occasional deer. As keeping the rabbit fence up is mandatory, the garden would be best served by having a gate at one entrance. Having a fence, even one low enough to step over, creates an immediate sense for most people that an area is off limits. A gate with an attractive sign naming the garden overcomes this issue.

### **8.2. Suggestions for Future Restoration**

Despite the time that was spent on creating bird boxes in 2007 none can be observed in the garden today and it appears as though none were installed. To enhance the biodiversity of the garden site bird boxes would be a welcome addition. A further sign could be added to educate people on the different native birds that flourish in the unique Gary Oak and Douglas Fir Ecosystems, and which of those birds can be spotted on campus today. Bird boxes would also provide additional educational and research opportunities for the University.

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<http://www.invasive.org/weeds/starthistle/chapter3.html>.

## 10. Appendix

### Appendix A. Previous Project Goals and Objectives

The class performing the initial restoration project split into three teams to create the garden, a planning team, a plant collection team, and an implementation team. The planning team laid out a set of clearly defined goals for their project:

- I. To restore a degraded and ignored area to create a diverse habitat that would remain a “green” protected area on campus, providing an aesthetically pleasing atmosphere.
- II. To create three “themes” in the garden: an edible garden, a Garry Oak meadow ecosystem and a Douglas Fir forest ecosystem, all of which exist on Vancouver Island and are thus truly native.
- III. To increase the diversity of flora and fauna on the UVic landscape, and to increase student knowledge of them.
- IV. To create a self-sustaining ecosystem.
- V. To reconnect natural and cultural systems.
- VI. To reduce costs and to build a sense of community through focal practices, UVic students were to be the primary drivers behind the project.

Their specific objectives to achieve these goals were:

- I. Removal of exotic grasses.
- II. Rabbit control via a fence and repellent plants.
- III. Fulfillment of the species “wish-list”.
- IV. Introduce garden art.
- V. Increase diversity of wildlife.

## **Appendix B. Previous Project's Process of Creating the Garden**

The creation of the garden involved much more than simply digging up the site and planting some new plants, and this section will outline the process the ES 341 class went through to complete it. Dates are provided where available.

September 24<sup>th</sup>, 2007.

1. Initial planning.
2. Walk-about and site analysis.
  - creation of strategic planting diagram
  - creation of a list of potential flora and fauna

September 27<sup>th</sup>, 2007.

3. Class consultation.
  - development of a "wish-list"
4. Decision of goals and objectives.
5. Decision on the three ecosystem themes.
6. Site design planning.
7. Salvage and acquisition of plants and seeds.
  - In total, 507 plants, seeds and bulbs were collected by students on campus and from donations by individuals and businesses.

October 4<sup>th</sup>, 2007.

7. Preparation of the site by facilities management.
  - rototilling
  - exotic grass removal
  - addition of mulch and soil

October 25<sup>th</sup>, 2007.

8. Class planting.

November 5<sup>th</sup>, 2007.

9. Commemoration ceremony.

**Appendix C. Species List**

Species list of those originally planted in the Elliott Garden site, and those species still present upon visual survey of the site during the month of March.

|                          | <b>Species Planted in Fall 2007</b> | <b>Species Present in March 2009</b> |
|--------------------------|-------------------------------------|--------------------------------------|
| <b>Douglas Fir</b>       | Red osier dogwood                   | ✓                                    |
|                          | Snowberry                           | ✓                                    |
|                          | Indian plum                         |                                      |
|                          | Bunchberries                        |                                      |
|                          | Nootka rose                         | ✓                                    |
|                          | Black twinberry                     |                                      |
|                          | Ocean spray                         | ✓                                    |
|                          | Kinnikinnik                         |                                      |
|                          | Salal (Heath Family)                |                                      |
|                          | Oregon grape                        |                                      |
|                          | Sword Fern                          |                                      |
|                          | Lady fern                           |                                      |
|                          | Piggyback plant                     |                                      |
|                          | Bracken fern                        |                                      |
| <b>Garry Oak</b>         | Davidson penstemon                  |                                      |
|                          | Fringecup                           |                                      |
|                          | Yellow monkey flower                |                                      |
|                          | Red osier dogwood                   | ✓                                    |
|                          | Nodding onion                       |                                      |
|                          | Garry oak                           | ✓                                    |
|                          | Idaho fescue                        |                                      |
|                          | Black cottonwood                    |                                      |
|                          | Licorice fern                       |                                      |
|                          | Alpine strawberries                 |                                      |
|                          | False lily-of-the-valley            |                                      |
|                          | Maidenhair fern                     |                                      |
|                          | Fawn lily                           |                                      |
|                          | Common camas                        | ✓                                    |
|                          | White fawn lily                     |                                      |
|                          | Hooker's onion                      |                                      |
|                          | Western buttercup                   |                                      |
| Indian consumption plant |                                     |                                      |
| Yellow-twig dogwood      |                                     |                                      |
| <b>Edible Gardens</b>    | Red flowering currant               | ✓                                    |
|                          | Salmonberry                         |                                      |
|                          | Honeysuckle                         |                                      |
|                          | Red elderberry                      |                                      |
|                          | Pacific willow                      |                                      |
|                          | Thimbleberry                        |                                      |
|                          | Alpine strawberry                   |                                      |
|                          | Evergreen huckleberry               |                                      |
|                          | Mock orange                         |                                      |
|                          | Red osier dogwood                   |                                      |
|                          | Black twinberry                     |                                      |
|                          | Sword fern                          |                                      |
| Red huckleberry          |                                     |                                      |

## Appendix D. Calculation Tables

**Table D1. Tree Density, Coverage and Condition Assessment Calculations**  
(See Monitoring Section 7.3.1.4)

| Assessment                        | Description  | Calculation  |
|-----------------------------------|--|--|
| Abundance                         | total number of individuals in each species                                      | $A = \text{sum of count for all individuals of a species}$   |
| Individual Tree Basal Area        | cross section area of stems calculated from DBH                                  | $\text{Individual Tree BA} = \pi (\text{DBH} \div 2)^2$  |
| Total Basal Area for each species | sum of Basal Areas for all individuals of a species                              | $\text{TBA} = \text{sum of BA for all individuals of a species}$   |
| Density                           | number of individuals of a species per m <sup>2</sup>                            | $D = \frac{\text{Number of individuals}}{\text{total area of the site}}$   |
| Relative Density                  | density of one species relative to all species                                   | $\text{RD} = \frac{\text{Number of individuals of a species}}{\text{total number of individuals of all species in site}} \times 100$ |
| Dominance                         | area a occupied by a species relative to the area of the site                    | $\text{Dom} = \frac{\text{Basal area of each species (m}^2\text{)}}{\text{total area of the site (m}^2\text{)}}$                     |
| Relative Dominance                | area occupied by a species as a percentage of total area occupied by all species | $\text{RDom} = \frac{\text{Basal area of a species (m}^2\text{)}}{\text{total basal area of all species (m}^2\text{)}} \times 100$   |
| Relative Frequency                | frequency of a species relative to all species in the sample                     | $\text{RF} = \frac{\text{frequency of species}}{\text{total frequency of all species in site}} \times 100$                           |

**Table D2. Physical Soil Structure Calculations**  
(See Monitoring Section 7.3.4.3)

| Assessment                                    | Calculation  |
|---|--|
| Soil Water Content (g/g)                      | $\text{SWC} = \frac{(\text{weight of moist soil} - \text{weight of dry soil})}{\text{weight of dry soil}}$ |
| Soil Bulk Density (g/cm <sup>3</sup> )        | $\text{SBD} = \frac{(\text{weight of dry soil})}{\text{volume of soil}}$                                   |
| Volumetric Water Content (g/cm <sup>3</sup> ) | soil water content $\times$ bulk density   |
| Soil Water-filled pore space (%)              | $\text{WPS} = \frac{(\text{volumetric water content of soil} \times 100)}{\text{soil porosity}}$           |
| Soil Porosity (%)                             | $\text{SP} = \frac{1 - (\text{soil bulk density})}{2.65}$  |

**Appendix E. Photopoint Photos from March 2009.**

**Notes on the Photopoints:**

**Camera:** FujiFilm FinePix S7000 Digital Camera.

**Time:** 1100hr to 1130hr on March 21, 2009,

**Weather:** High winds altered the cloud cover quickly, which is why some photos have strong shadows and others do not.

**Photopoint 1, Photograph 1. March 21, 2009. 11:00am**

Taken at the cross-section in the seam of the cement tiles.



**Photopoint 1, Photograph 2. March 21, 2009. 11:00am**  
Taken at the cross-section in the seam of the cement tiles.



**Photopoint 2, Photograph 1. March 21, 2009. 11:00am**

Taken directly in front of the corner in the split-rail fencing from the edge in the paved forked pathway.



**Photopoint 2, Photograph 2. March 21, 2009. 11:00am**

Taken directly in front of the corner in the split-rail fencing from the edge in the paved forked pathway.



**Photopoint 3, Photograph 1. March 21, 2009. 11:00am**  
Taken from the cement seam in the middle of the pathway.



**Photopoint 3, Photograph 2. March 21, 2009. 11:00am**  
Taken from the cement seam in the middle of the pathway.



**Photopoint 4, Photograph 1. March 21, 2009. 11:00am**

Taken three corners of the split-rail fencing in from the far right corner of the garden (with the young Douglas Fir) and standing on the cement seam.



**Photopoint 4, Photograph 2. March 21, 2009. 11:00am**

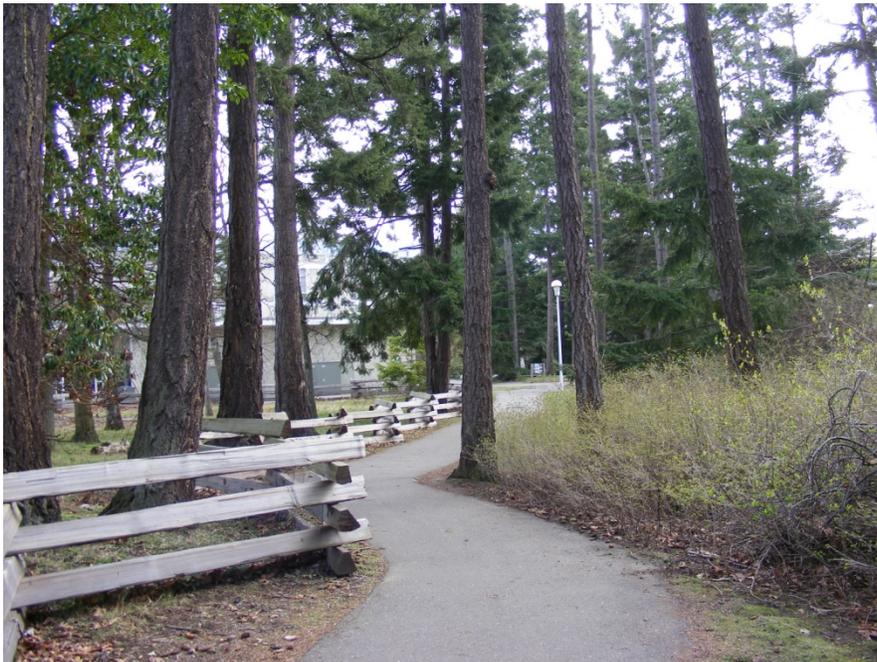
Taken three corners of the split-rail fencing in from the far right corner of the garden (with the young Douglas Fir) and standing on the cement seam.



## Additional Views of the Elliott Native Plant Garden



This is the Cunningham side entrance of the garden site, which we propose should be fenced in.



The adjacent forested area is thick with snowberry.

**Appendix F. Monitoring and Assessment Summary Chart**

Selected ecological attributes, respective metrics and general rating criteria for assessment and monitoring of the Elliot Native Plant Garden.

|                                     | Assessment Category     | Ecological Attribute   | Assessment Metric   | Definition  | Timescale                       | Rating Criteria  |                                       |                     |
|-------------------------------------|-------------------------|--|---|---|---------------------------------|--|---------------------------------------|---------------------|
|                                     |                         |  |   |   |                                 | Excellent  | Fair                                  | Poor                |
| <b>BIOTIC CONDITION</b>             | Trees                   | Overall Tree Density   | Species Counts  | Overall density of trees in the system measured in the number of individuals/m <sup>2</sup>   | Every 3 years                   | These measurements will be relative to baseline assessments, and valuable more so for an evaluation of changes over time |                                       |                     |
|                                     |                         | Relative Species Density   |   | Density of each species relative to all other tree species measured in the number of individuals/m <sup>2</sup>                                   |                                 |  |                                       |                     |
|                                     |                         | Tree Coverage (Area)   | Diameter at Breast Height (DBH)   | Cross sectional area of stems for all species   | Every 3 Years                   |  |                                       |                     |
|                                     |                         | Tree Species Dominance   |   | Dominance of each tree species measured as the area occupied by each species in m <sup>2</sup> relative to the area of the site in m <sup>2</sup> |                                 |  |                                       |                     |
|                                     | Tree Condition          | Qualitative assessment   | Relative ranking of the condition of individual trees and species based on nine predefined categories | Annual  | Mostly Alive Standing (AS)      | Mostly Alive but damaged (AB, AL, AF)  | Mostly Dead Category (DS, DB, DL, DF) |                     |
|                                     | Small Plants and Shrubs | Shrub Community Species Abundance  | Species Counts  | Overall density of shrubs in the system measured in the number of individuals/m <sup>2</sup>  | Annual                          | These measurements will be relative to baseline assessments, and valuable more so for an evaluation of changes over time |                                       |                     |
| Shrub Community Species Composition |                         | Density of each species relative to all other shrub species measured in the number of individuals/m <sup>2</sup> |   |   |                                 |  |                                       |                     |
| Plant Exotics                       | Non-Native:Native Ratio | Species Counts   | Number of non-native species relative to native species expressed as a percentage                     | Annual  | 85-100% cover of native species | 50-85% cover of native species   | <50% cover of native species          |                     |
| <b>ABIOTIC CONDITION</b>            | Soil                    | Soil Compaction  | Horizon Bulk Density  | Degree of compaction of soil horizons measured as the bulk density ratio of the mass/volume of the soil   | Every 3 years                   | <0.5g/mL   | 0.5-2.0g/mL                           | >2.0g/mL            |
|                                     |                         | Soil Acidity   | pH  | Measure of acidity to determine ease of nutrient absorbability  | Annual                          | pH 6-7   | pH 5.5-6                              | pH <5.5 or pH > 7.8 |
|                                     |                         | Soil Chemistry   | Nitrogen Phosphorus Potassium   | Chemical assessment of soil to examine balance and relative levels of elements of particular importance for healthy plant growth and development. | Annual                          | As per Soil Test Kit Instructions  |                                       |                     |
| <b>SYSTEM INTEGRITY</b>             | Disturbance             | Human Disturbance  | Qualitative assessment  | Observation of site for evidence of foot traffic, litter, ecosystem abuse   | Annual                          | Rank 0   | Rank 1                                | Rank 2              |
|                                     |                         | Rabbit Damage  | Qualitative assessment  | Observation of site for evidence of rabbit presences, especially chewing of vegetation  | Annual                          | Rank 0-1   | Rank 2-3                              | Rank 4-5            |