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ER390 Selected Project
For Dr. Val Schaefer
April 24th, 2019

Removing invasive plant species from Highrock Park in Esquimalt, British Columbia: Helping preserve and restore unique ecosystems through community participation

Executive Summary

This report examines the presence of exotic and invasive plant species in a small urban park in Esquimalt, British Columbia. Highrock Park is a remnant of unique associated ecosystems of Douglas-fir (*Pseudotsuga meziesii*) forest and Garry oak (*Quercus garryana*) meadowland of significant cultural, recreational, and ecological importance to southeastern Vancouver Island. Threatened like many urban greenspaces with ecosystem disturbances caused by human encroachment, the park faces a loss of biodiversity caused by the proliferation of invasive plant species. The focus of this project was to inventory the amount of invasive species present within the selected project area and to remove as many species as possible through volunteer-based community participation. Furthermore, the goal of removing invasive species was made in preparation for future native re-vegetation planned by the municipality for its annual 'Earth Day' event on April 24th, 2019. Large quantities of English ivy (*Hedera helix*), Himalayan blackberry (*Rubus armeniacus*), and Laurel-leaved daphne (*Daphne laureola*) along with several individuals of English holly (*Ilex aquifolium*), Scotch broom (*Cytisus scoparius*), and English hawthorn (*Crataegus laevigata*) were identified in the project area using the Line Intercept Method in conjunction with terrestrial ecosystem mapping based on British Columbia's Field Manual for Describing Terrestrial Ecosystems (2nd ed., 2010). A volunteer 'weed pull' event was organized for April 13th, 2019 that resulted in seven volunteers working a combined thirty volunteer hours to remove significant amounts of invasive plant species from the study area. Ultimately, the project succeeded in bringing together community members to prepare the project area for potential native re-vegetation by municipal staff and grade school volunteers on April 24th, 2019.

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Introduction

Project Location and Reasoning:

Figure 1 - Map of Esquimalt showing location of Highrock Park - BC Map inset (Times Colonist)

Highrock Park is an urban park located in the Township of Esquimalt, British Columbia. It is 7.1 hectares in size and features a unique association of Douglas-fir (*Pseudotsuga menziesii*) forest and sensitive Garry oak (*Quercus garryana*) ecosystems that are native to southeastern Vancouver Island. Its geographical location at 48°26'03.9"N 123°24'23.9"W places the park within the Coastal Douglas-fir moist-maritime (CDFmm) biogeoclimatic (BGC) zone. The present combination of ecosystems in the park reflects the historical influence by local First Nations communities that managed Garry oak ecosystems within the CDFmm zone, where prior to European contact most of the local area contained such environments (Figure 2). As a result, Highrock Park today represents a rare remnant of ecological and historical significance within a densely populated urban landscape. And because of its setting, the park currently faces a myriad of challenges associated with urban encroachment, notably the proliferation of invasive plant species. This project builds upon a previous case study of Highrock Park from April 2018 that was completed as part of the University of Victoria's Restoration of Natural Systems course titled 'Principles and Concepts of Ecological Restoration (ER311, 2018),' where a potential

opportunity for future restoration activity involving invasive plant species removal and native re-vegetation was identified (Appendix D). A meeting with Esquimalt Parks staff was held in November of 2018, where an appropriate site within the park was selected for undertaking a restoration project that focused on addressing the spread of invasive plant species by engaging the local community through educational and volunteer activities, with goals of both restoring native biodiversity and helping maintain unique and culturally significant urban park space.

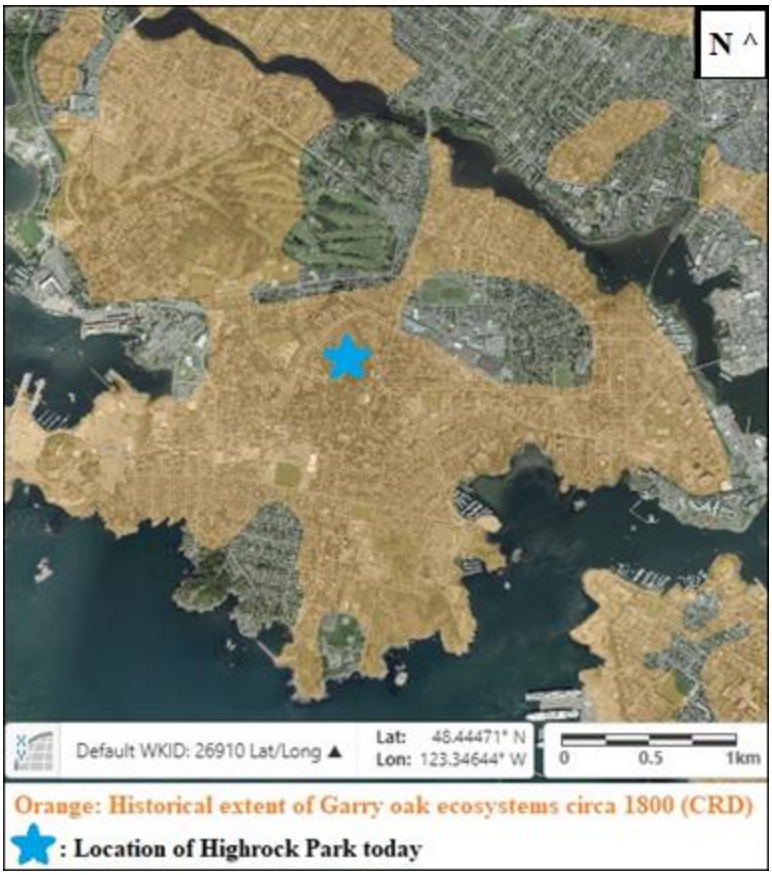

Figure 2 - Aerial photo of Esquimalt area showing pre-European extent of Garry oak ecosystems (CRD Natural Areas Atlas)

Background

Park Background & Environmental Challenges:

Highrock Park is a popular recreation spot for many area residents who enjoy its varied natural features, unique flora and fauna, commanding hilltop views, and convenient dog-walking opportunities. Its central location and easy accessibility from the surrounding residential neighbourhoods mean the park is well-used year-round by people and pets alike. But the park's urban location and ease of access also come with certain ecological impacts that can threaten the health and biodiversity of sensitive ecosystems. City parks regularly face anthropogenic disturbances that can exacerbate the spread and proliferation of introduced plant and animal species, thereby harming the healthy ecological function of

sensitive native ecosystems (Gilbert, 1991). It is important to note, however, that despite the ecological degradation urban parks often face due to such disturbances, their natural features still serve important roles in contributing ecosystem services that mitigate pollution impacts, support wildlife habitat, and provide important gathering spaces for urban communities (Schaefer, Rudd, and Vala, 1999). Highrock Park's importance as both a recreational space and a place of important ecological value means that thoughtful and pro-active park management that includes the implementation of restoration activities are vital to both maintaining and improving the park's biodiversity and supporting community engagement with its natural spaces.

Methods & Materials

Initial Project Site Assessment & Selection:

Initial identification of the project area took place in November of 2018 in conjunction with Esquimalt Parks staff. The area selected for restoration was chosen due to its high concentration of visible invasive plant species, with notable amounts of vertical-growing English ivy (*Hedera helix*), thickets of Himalayan blackberry (*Rubus armeniacus*), and trailside concentrations of toxic Laurel-leaved Daphne (*Daphne laureola*). Furthermore, parks staff indicated that the soil compaction of a previously established trail was resulting in unwanted groundwater runoff creating overly muddy and impassable conditions in the trail's lower elevations (Figure 3). Therefore, the decision to assist in de-activating the old, compacted trail in favour of promoting a new trail running several meters parallel to the north was also included in the initial restoration plans.

Figure 3 - Project area in January 2019 showing soil compaction of old trail and pervasiveness of English ivy mats

A rough project timeline was established that would see primary restoration work completed ahead of the Township's 'Earth Day' celebration at the park on April 24th, 2019 (Table 1). At the same time, a goal was established of having 'Earth Day' celebration participants, comprised mostly of local middle and high school students, build off the restoration project by assisting in further restoration work including invasive species removal and native plant re-vegetation. Furthermore, the Township decided to schedule trail-building activities with the students on April 24th that would address the trail de-activation work initially included in project restoration plans. Overall, the agreed-upon project objective was to help restore native biodiversity within the project area at little to no cost to the Township by promoting community engagement with park restoration through volunteer activity and education. Esquimalt Parks agreed to support the project by assisting with the coordination of restoration activities, loaning of tools and equipment for a planned invasive species removal event, and with off-site disposal of invasive plant debris.

Table 1 - Project Timeline

Project Timeline:	
November 2018	• Meetings with Parks staff to determine site selection and identify preliminary restoration objectives
December 2018	• Create formal restoration proposal and establish rough project timelines
January 2019	• Begin initial project site mapping upon approval of Parks management and UVic restoration program administrator
February-March 2019	• Commence field data collection (plant species inventories and terrestrial ecosystem mapping) and pertinent literature review • Begin planning stages for hosting of invasive species removal event
April 2019	• Compile & finalize field data • Host invasive species removal event based upon appropriate treatment prescriptions • Submit final restoration report to Township of Esquimalt Parks department and present report to community at April 24th 'Earth Day' event

Project Area Mapping:

Materials used:

- Garmin handheld Global Positioning System (GPS) unit
- field notebook
- digital camera
- Capital Regional District (CRD) Natural Areas Atlas
- Google Maps
- Compass
- Shovel
- Clinometer
- 30m measuring tape
- BC Field Manual for Describing Terrestrial Ecosystems, 2nd ed. (2010)

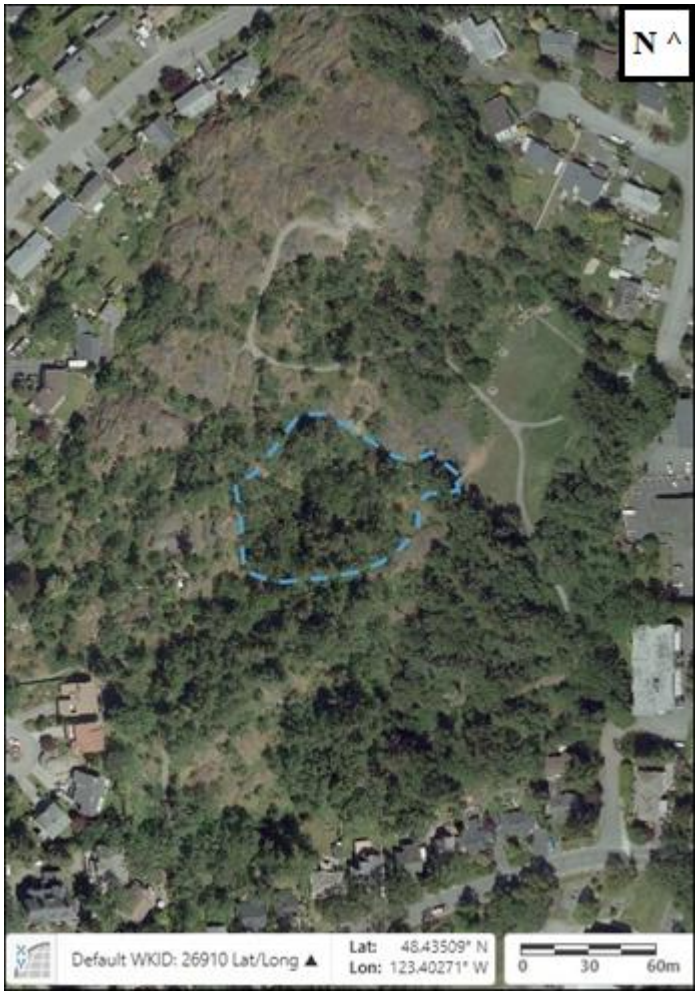

Figure 4 - Aerial image of Highrock Park with project boundary outlined in blue (CRD Natural Areas Atlas)

Methods:

The park itself can be accessed from surrounding neighbourhoods at several points. There is an entrance on the park's eastern edge in the 700 block of Matheson Avenue. The southern park entrance is located at the 700 block of Cairn Road. And the southwestern park entrance is accessible from the 1000 block of Highrock Avenue. Within the park, the project site is centrally located to the south of the main rocky outcrop that rises over 70m (230ft) in height and is marked by a cairn erected in celebration of Queen Elizabeth II's Golden Jubilee (Highrock Park is also sometimes referred to as Cairn Park because of this) (Township of Esquimalt, 2019). The project site also lies west adjacent to the large grassy field used primarily by park users as a dog run and picnic area.

Primary site mapping took place in January 2019, and primary project area boundaries were established using a handheld Garmin GPS unit and the online CRD Natural Areas Atlas. The location of the project site lies between two rocky outcroppings of Garry oak ecosystem. A project site perimeter was established using these outcroppings as natural boundary edges. GPS coordinates were recorded at points along these natural boundaries and inputted into the online CRD Natural Areas to assist in overlaying the boundaries on satellite imagery. Using this data, a perimeter of 291m and an area of 4800m² (0.48ha) was established as the formal restoration project site.

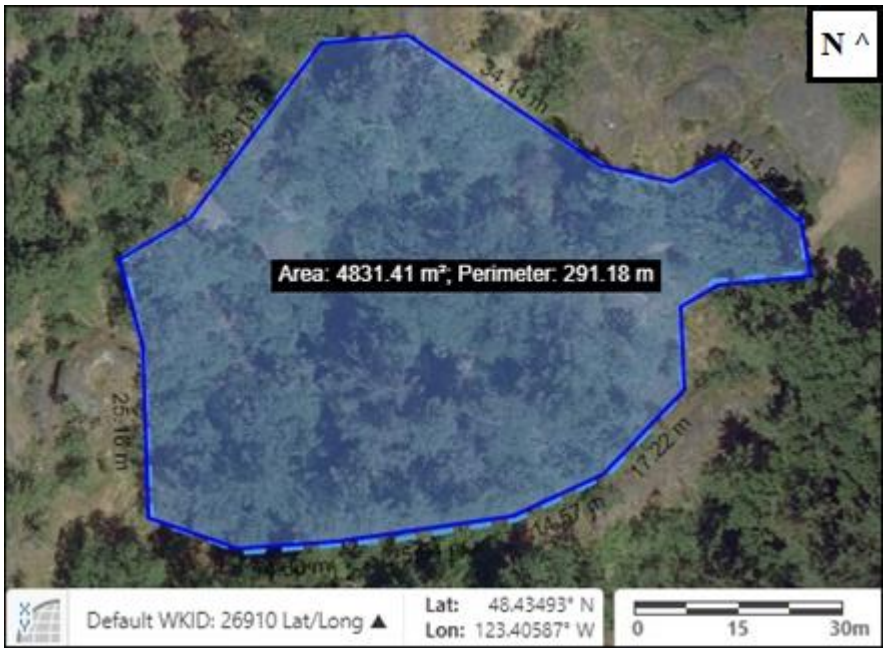

Figure 5 - Aerial image of project area with study site highlighted blue (CRD Natural Areas Atlas)

Terrestrial Ecosystem Mapping (TEM) took place in January 2019 using the British Columbia Field Manual for Describing Terrestrial Ecosystems, 2nd Ed (2010). Using the field manual's Ground Inspection Form, data was collected for the purposes of describing the location, terrain, soil, and ecosystem components within the project site. This was done with the aim of determining soil moisture and soil nutrient regimes (SMR and SNR, respectively) that could be used in selecting appropriate plant species for recommended native re-vegetation. A hole was dug to a depth of 45cm in a representative area of the project site to determine soil texture, moisture, and nutrient attributes. Visual inventories of tree, shrub and herb layers were estimated by percent of area coverage. Slope position, grade and aspect were measured using a compass and clinometer. A rough field sketch of the project area was made for future reference use.

Generating Plant Species Inventories:

Materials Used:

- Field notebook
- 50m surveyor's tape
- Plant identification guides
- Digital camera

Methods:

Plant species inventories were recorded using the Line Intercept Method due to its simplicity and usefulness for sampling forest understory and shrub communities. As described in the University of Idaho's handbook for vegetation sampling, "*The Line Intercept method consists of horizontal, linear measurements of plant intercepts along the course of a line (tape). It is designed for measuring grass or grass-like plants, forbs, shrubs, and trees.*" (Webpages.uidaho.edu, 2019) For this project, a total of ten line intercepts using a 50m surveyor's tape were recorded (Figures 6, 7,8) . The first line was laid out beginning at randomly selected point in the project area's eastern boundary. Each line intercept was spaced approximately 10m apart and ran in a rough north-south direction. The ten lines measured made the total width of the sampled area 100m. Plant species were recorded rounded to the nearest 10cm interval along each line to estimate the total coverage of forest understory and ground-cover vegetation.

Figure 6 - Measuring tape laid over English ivy

Figure 7 - Measuring tape laid over woody debris and yellow moss

Formula for determining percent coverage on a line (Example):

Line intercept length = 12.0m
English ivy coverage on line = 3.6m
3.6/12.0=0.3
0.3x100 = 30% English ivy coverage observed on that line

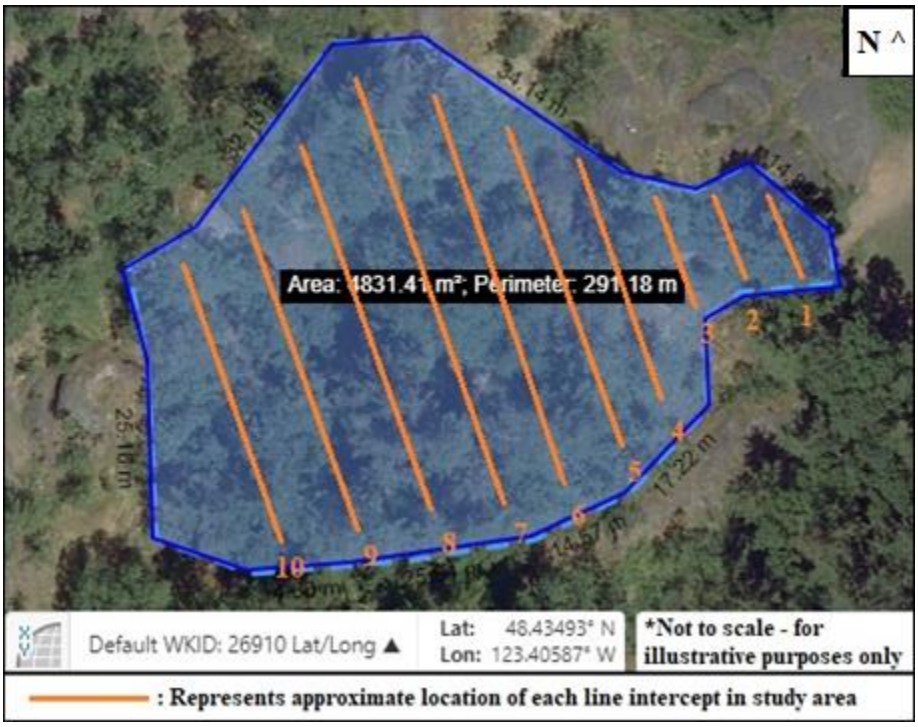

Figure 8 - Study area highlighted blue, line intercepts shown in orange (CRD Natural Areas Atlas)

Establishing a Treatment Prescription:

Materials Used:

- Field data collected from project area mapping and vegetation line intercepts.
- Garry Oak Ecosystem Recovery Team (GOERT) 'Best Practices for Invasive Species Management in Garry Oak and Associated Ecosystems' guide

Methods:

Using the data collected by the line intercepts and project site mapping, target areas for invasive species removal were established based on several factors. Treatment sites were identified where

density of invasive plant species was higher in relation to other sample areas. In addition, treatment sites were also identified in cases where certain species were in close proximity to nature trails or were at higher risk of being spread. Best practices for invasive species removal were established using the GOERT's 'Best Practices for Invasive Species Management in Garry Oak and Associated Ecosystems.' (GOERT, 2011). For the English ivy that was present in the project area, GOERT recommendations of focusing action "areas that can practically be accessed for repeat treatments" was prioritized. In addition, recommendations were to be followed that would target the plant's adult phase, which usually is seen spreading vertically (GOERT, 2011). For the Laurel-leaved daphne, GOERT recommendations of pulling patches of individual stems when the soil is moist and before the plants go to seed was deemed the best course of action in the project area but taking extra care to avoid skin contact with the plant. Finally, the Himalayan blackberry was also targeted based on GOERT's recommendations to remove from accessible areas to first contain its ability to spread. Other invasive species were treated on a case-by-case basis as there were only a handful of individuals present. Wherever possible plants were to be pulled or dug by the root, or cut as low as possible, with extra care taken to minimize soil disturbance and trampling of sensitive plant communities.

Planning and Conducting a Volunteer Invasive Species Removal Event:

Materials Used:

- Website: www.facebook.com for event advertising and communicating with prospective attendees
- 3x Tarps
- 14x Secateurs
- 14x Loppers
- 14x Safety glasses
- 14x work gloves
- Various food & drink items (coffee, water, snack bars, cookies, veggies)
- 3x signage material
- Cooler

Methods:

Initial planning for conducting the invasive species removal event began in March 2019. In coordination with Esquimalt Parks staff, an initial event date of Saturday, April 6th was selected, with a

goal of bringing out ten to twelve volunteers to participate. Plans for a tool loan-out were confirmed with Esquimalt Parks staff, with the department agreeing to lend up to twelve pairs of secateurs, loppers, work gloves, and safety glasses along with several tarps to assist in removing invasive species from the project area. With the goal of bringing together both student restoration practitioners and local community members, the event promotion was shared online to both the UVic Environmental Restoration Network (EVRN) and Esquimalt Community Connection Facebook groups. The event was also shared among staff members of the Forest Improvement and Research Management Branch (FIRM) of Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). A local grocery business was also contacted with an inquiry about discounting or donating food or drink items for the event.

The initial event invitation was distributed on March 10th, 2019. Excerpt: "*I am a diploma student in UVic's Restoration of Natural Systems program. I am undertaking my program's final restoration project in partnership with the Township of Esquimalt's parks department to restore a section of Highrock park. In particular, we're hoping to remove a significant amount of invasive species including English ivy, Himalayan blackberry and Daphne laurel in order to prepare an area for native plant species re-establishment on Earth Day.*

I am seeking 10-12 volunteers to help with the invasive species removal on Saturday, April 6th. Esquimalt Parks has generously offered to lend much of the necessary tools including gloves, tarps, secateurs, eye protection and loppers. And I plan to provide free snacks and drinks to anyone willing to help out!

I would be very grateful for anyone willing to lend a hand for a few hours to help pull some weeds and hopefully have some fun doing it, too! The date for the event is Saturday, April 6th, between the hours of 10am and 4pm. The total time commitment is up to the volunteer, but I am asking for a minimum of 2 hours helping out if you are indeed able to come due to the limited amount of gloves and tools. (Appendix A)"

Due to a wind storm with gusts over 70km/h forecasted for the original event date of April 6th, the decision was made in conjunction with Esquimalt Parks staff to postpone the event due to the potential safety risk posed by falling tree debris in the project site. A new event date for the following

Saturday, April 13th was selected, and prospective volunteers were notified of this change as soon as the weather forecast looked probable on Thursday, April 4th (Appendix A).

On Friday, April 12th tools were collected from the Esquimalt Parks department. The following day, April 13th, the invasive species removal event took place between 10:00am and 4:00pm. Signs were posted at park entrances and project area boundaries to help direct volunteers to the project site. Volunteers were given a site safety orientation and shown the various target species slated for removal. Special attention was paid to ensuring volunteers understood how to safely handle and remove Laurel-leaved daphne, as the sap and vapours produced by the plant is toxic to humans and animals (ISCBC). All volunteers had previously been instructed to dress appropriately for the work at hand, and were provided with appropriate safety equipment, tools, and refreshments (Appendix A). Volunteers were distributed throughout the project area based on need, with some people focused on removing vertical-growing English ivy from tree trunks (Figures 9 & 10), and others tasked with removing toxic Laurel-leaved daphne from trailside areas (Figures 11 & 12). Others directed efforts on removing English ivy mats and English holly from the understory, or Scotch broom and English hawthorn from more open areas. Special care was taken to minimize soil disturbance by treading carefully in sensitive off-path ecosystems and focusing removal activity in easily accessible areas. All plant material was piled on tarps and removed from the project site to a location agreed upon with Parks staff, which would then be removed from the park the following week.

Results and Interpretation

Terrestrial Ecosystem Mapping Results:

Completion of a ground inspection form (Table 2) yielded data that described the forest structure, soil moisture and soil nutrient regimes, soil texture, drainage, slope and aspect, canopy cover, vegetation, and other indicators of the project site's ecological makeup:

Table 2 - Ground Inspection Form (Ministry of Forests and Range, 2010)

Ground Inspection Form – Compiled			
DATE	January 26th, 2019		
SITE	Highrock Park		
Ecosystem Map Unit: Jm6iC	NAME	ER390 Restoration Project Area	
	GPS	48.43404° N, 123.40618° W	
	DESCRIPTION	Mixed stand of Douglas-fir and Garry oak boundary lying in a depression between rocky outcrops, intersected by walking trails and sloping gently east	
	SLOPE	6%	
	ELEVATION	58m	
	ASPECT	ESE	
	VEGETATION	TREES	Douglas-fir, Red alder, Garry oak, Scouler's willow, Pacific crabapple, Western redcedar
		SHRUBS	Himalayan blackberry, Nootka rose, Common snowberry, Dull Oregon-grape, Laurel-leaved daphne, various Rubrus sp.
		HERBS	Licorice fern, Bracken fern, Western fescue, Common camas, Cleavers, various grasses
		MOSSES	Yellow moss, Sphagnum sp.
	SOIL	SMR	4 – Medium
		SNR	D – Rich
		MESO SLOPE	Middle-lower slope
		DRAINAGE	Moderate
		COARSE FRAG	<20%
	TERRAIN	TEXTURE	loam
		SURFICIAL	n/a
		EXPRESSION	n/a
		GEOMORPH	n/a
	ECOSYSTEM	BGC	CDFmm
		ECOSECTION	NAL – Nanaimo Lakes
		SITE SERIES	FdBg – Oregon grape

		SITE MODIFIERS	j – gentle slope, m – medium textured soils, i – irregular canopy, C – coniferous
		STRUCTURAL STAGE	6 – Mature forest
		CROWN CLOSURE	~30%

The TEM data that was recorded during the completion of the ground inspection form indicates the project site is contains loam-textured, rich, and moderately drained soils. The gently sloping site also features a mature forest comprised primarily of conifers (Douglas-fir) with irregular canopy structure. Crown closure over the entire project area was estimated at 30%, with some areas of the site featuring wide open canopy resulting from recent windfalls. A mixture of native and non-native understory vegetation was observed, intersected by criss-crossing walking trails of both compacted soil and bark mulch.

Line Intercept Species Inventory Results:

Plant species inventories and coverage estimates were compiled from ten line intercepts that varied in length from 10.8 to 48.3 metres roughly between the rocky outcrop boundary edges. 25 species of plants were recorded by the line intercepts in significant amounts, and a further 9 species were observed in the study area in insignificant amounts that did not appear on a line, for a total of 34 identified species (Appendix C). The area also contained sizable portions of un-vegetated areas comprised of bare rock, compacted soil and bark mulch trails, and woody debris. The results yielded the following data demonstrating the percentage of area covered by various species, both native and invasive, listed from most prevalent to least:

*Note: As species can overlap within a line intercept, combined percentages of species cover in each line may total greater than 100%

Table 3 - Species Coverages from Line Intercepts

Line #	Species coverage (%)
Line 1 (12m)	• Common camas: 64.3 • No vegetation/Compacted bare soil/bark mulch: 37.5 • Cleavers: 4.1

	• Trumpet daffodil: 2.9
Line 2 (11.5m)	• No vegetation/bark mulch: 53.0 • Common camas: 35.5 • Himalayan blackberry: 8.6 • Nootka rose: 2.6 • Western fescue: 0.8
Line 3 (10.8m)	• Common camas: 39.4 • Common snowberry: 36.1 • No vegetation/Bark mulch: 13.0 • Laurel-leaved daphne: 8.3 • Himalayan blackberry: 6.4 • Licorice fern: 3.7 • Western fescue: 1.8 • Garry oak: 0.9
Line 4 (15.8m)	• English ivy: 20.1 • No vegetation/Bark mulch: 17.0 • Common camas: 13.9 • No vegetation/Bare rock: 11.4 • Common snowberry: 7.9 • Licorice fern: 7.5 • Himalayan blackberry: 5.6 • No vegetation/Coarse woody debris: 5.6 • Douglas-fir: 4.4 • English holly: 3.2 • Miner's lettuce: 3.2 • Garry oak: 2.5 • Laurel-leaved daphne: 2.4 • Trailing blackberry: 1.9 • Western fescue: 0.6
Line 5 (26.2m)	• English ivy: 43.5 • Common snowberry: 16.0 • Himalayan blackberry: 8.1 • No vegetation/bark mulch: 7.6 • No vegetation/Coarse woody debris: 6.1 • Bracken fern: 5.7 • Laurel-leaved daphne: 4.2 • Common camas: 3.4 • No vegetation/compacted soil: 3.1 • Dull Oregon-grape: 2.7 • Douglas-fir: 2.3 • No vegetation/leaf litter: 0.8
Line 6 (27.5m)	• English ivy: 45.5 • Common snowberry: 15.2 • Himalayan blackberry: 8.0

	• No vegetation/Bark mulch: 7.2 • No vegetation/Coarse woody debris: 5.8 • Bracken fern: 5.4 • Laurel-leaved daphne: 4.0 • No vegetation/compacted soil: 2.9 • Dull Oregon-grape: 2.5 • Douglas-fir: 2.2 • Common camas: 0.7 • No vegetation/Leaf litter: 0.7
Line 7 (29.4m)	• Nootka rose: 43.9 • English ivy: 26.2 • No vegetation/Bark mulch: 9.5 • No vegetation/Coarse woody debris: 7.1 • Common snowberry: 5.8 • Unknown grass species: 5.1 • Laurel-leaved daphne: 2.8 • English holly: 2.0 • Pacific crabapple: 1.7 • Douglas-fir: 1.7 • Himalayan blackberry: 1.4 • Scouler's willow: 1.0 • Garry oak: 0.7
Line 8 (35.5m)	• English ivy: 43.6 • No vegetation/Compacted soil: 21.6 • Common snowberry: 19.4 • Laurel-leaved daphne: 12.4 • Nootka rose: 6.2 • No vegetation/Coarse woody debris: 2.3 • Scouler's willow: 1.4 • Unknown grass species: 0.8 • Unknown *Rubus sp.*: 0.8 • Trailing blackberry: 0.2
Line 9 (48.3m)	• English ivy: 68.2 • No vegetation/Bark mulch: 12.4 • Salal: 10.1 • Nootka rose: 9.1 • Common snowberry: 3.3 • Unknown grass species: 2.1 • No vegetation/Compacted soil: 1.9 • Dull Oregon-grape: 1.7 • No vegetation/Coarse woody debris: 1.6 • Douglas-fir: 1.4 • Yellow moss: 1.0 • Trailing blackberry: 0.8

	• English holly: 0.6 • Red alder: 0.4 • Laurel-leaved daphne: 0.4 • Hairy cat's ear: 0.2
Line 10 (26m)	• English ivy: 54.3 • Common snowberry: 18.8 • Salal: 16.5 • No vegetation/Bark mulch: 5.4 • Bracken fern: 3.8 • No vegetation/Rock outcrop: 3.5 • English holly: 3.1 • Unknown *Sphagnum sp.*: 1.5 • Laurel-leaved daphne: 1.2

Throughout the project area and as demonstrated by Table 3, there was a significant amount of non-native invasive plant species present. The most prolific of these invasive species was English ivy, which was seen in large abundance in nearly every transect. English ivy is commonly found in moist forest communities and urban park spaces around Greater Victoria and is notable for its ability to invade and climb throughout the forest structure (Larocque, 1999). Also prevalent in the project area was toxic Laurel-leaved daphne which was noted in eight of ten line intercepts (Table 3). Like English ivy, this species is also common in moist forest areas and is highly adaptable to either sun or shade conditions (ISCBC, 2019). It was noted to be growing in various conditions within the project area, both in amongst the understory and alongside walking trails, and could be seen forming dense patches (Figure 11). Another notable invasive was Himalayan blackberry, which formed unruly thickets in pockets of low-growing vegetation in the forest's rich soil. This species is known for its deep-rooting ability and ability to out-compete native vegetation including Garry oak (ISCBC, 2019). Other invasive plants seen in lesser quantities included English holly, Scotch broom, and English hawthorn (Appendix A). Though not present in significant amounts, these individuals were nonetheless targeted for removal in the project area. If left unchecked, these plants are more than capable of spreading quickly and outcompeting native species.

Invasive Species Removal Event Results:

A total of sixteen people responded to the event listing that was shared to the UVic EVRN and Esquimalt Community Connection groups on Facebook, indicating they were either 'going' or 'interested' in the event. Further interest was shown in the event from community members asking what species we were planning to remove, posting words of support, or sharing the event among their followers. When it came to the event day on April 13th, a total of seven volunteers came out to participate in the invasive species removal. Three individuals reached out expressing their disappointment that they were unable to make it after the postponement but indicated their interest in further events.

Figure 9 - (BEFORE) English ivy growing vertically

Figure 10 - (AFTER) Same area after ivy removal

Of the volunteers that were present on April 13th, their ages ranged from 23 to 67. Prior experience ranged between first-time participants to former restoration program graduates. Participants came out from three local municipalities: Sidney, Saanich, and Esquimalt. Over the course of the day, volunteers successfully removed six different types of invasive plant material (Table 3). In

total, an estimated 30 combined volunteer hours was spent removing several yards (or an estimated 1.5 pickup truckloads) of material from the project site (Appendix D). There was also engagement with several park users who inquired about the event and the reasons for the project. The park users we spoke to were supportive of the efforts and indicated their interest in future events, and kindly offered words of encouragement.

Table 4 - Event Costs

Invasive Species Removal Event Cost:	
Food & Drink for volunteers	$56.81
Cooler for food & drink storage	$38.01
New loppers to replace loaned pair that were lost	$33.59
Total Spending:	$128.41

Figure 11 - (BEFORE) - Dense patch of Laurel-leaved daphne prior to removal

Figure 12 - (AFTER) - The same area after the removal of hundreds of Laurel-leaved daphne plants

Discussion and Recommendations

Native Plant Re-Vegetation Recommendations:

According to site classification tables in the BC Field Guide to Describing Terrestrial Ecosystems 2nd Ed. (2010), the site series is identified as "05 – FdBg – Oregon grape." The corresponding vegetation table lists the following species as native to the project area, and therefore recommended for use in re-vegetation activity:

Table 5 - Native Plant Recommendations (Ministry of Forests and Range, 2010)

Native Plant Recommendations	
Tree Layer	• Douglas-fir (*Pseudotsuga menziesii*) • Bigleaf maple (*Acer macrophyllum*) • Western redcedar (*Thuja plicata*) • Grand fir (*Abies grandis*) • Pacific dogwood (*Cornus nuttalli*)
Shrub Layer	• Salal (*Gaultheria shallon*) • Dull Oregon-grape (*Mahonia nervosa*) • Baldhip rose (*Rosa gymnocarpa*) • Oceanspray (*Holodiscus discolor*)
Herb Layer	• Western swordfern (*Polystichum munitum*) • Vanilla-leaf (*Achlys triphylla*) • Bracken fern (*Pteridium aquilinum*) • Threeleaf foamflower (*Tiarella trifoliata*)
Moss Layer	• Big shaggy-moss (*Rhytidiadelphus triquetrus*) • Oregon beaked-moss (*Kindbergia oregana*) • Glittering woodmoss (*Hylocomium splendens*) • Palm tree moss (*Leucolepis menziesii*)

Furthermore, a list of native plant species that will be available for use at the April 14th 'Earth Day' event was provided by Esquimalt Parks staff, and are also recommended as appropriate for native re-vegetation in the park:

Table 6

Available Native Plants for 'Earth Day' Event	
Species	Quantity
Oceanspray (*Holodiscus discolor*)	35
Nootka rose (*Rosa nutkana*)	25
Common snowberry (*Symphoricarpos albus*)	17
Tall Oregon-grape (*Mahonia aquifolium*)	20
Black hawthorn (*Crataegous douglasii*)	15
Hardhack (*Spiraea douglasii*)	5

Future Monitoring and Final Thoughts:

Future monitoring and maintenance will be key in preventing the further spread of invasive plant species in Highrock Park. The invasive species currently present in the park will require repeated treatments to mitigate their spread or eliminate them from the park entirely. Active participation by community members in events like Esquimalt's annual 'Earth Day' celebration are important in fostering a connection between urban residents and their local greenspaces. Furthermore, educating young people on the importance of environmental responsibility and actively involving them in community restoration initiatives will go a long way to promoting long-term environmental sustainability (Berry, 2016). In the end, urban parks like Highrock face a constant barrage of ecosystem disturbances brought on by human impacts. Urbanization impacts environmental quality by degrading natural habitat and facilitating the introduction and spread of invasive plant species (Niemelä, 2011). However, we must remember that urban parks still hold important ecological value as bastions of biodiversity and providers of important ecosystem services (Schaefer, Rudd, and Vala, 1999). It is important to protect urban biodiversity by facilitating the reduction of invasive species through active management, community engagement, and education. In the case of Highrock park, it is important to consider the uniqueness and significance of the ecosystem it contains as part the cultural identity and natural history of southeastern Vancouver Island. And with active community involvement, urban parks like Highrock can thrive as both cultural and recreational spaces as well as refuges of biodiversity.

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Appendix A – Weed Pull Event Communications

Initial Invitation (March 10th, 2019):

Hi all,

I am a diploma student in UVic's Restoration of Natural Systems program. I am undertaking my program's final restoration project in partnership with the Township of Esquimalt's parks department to restore a section of Highrock park. In particular, we're hoping to remove a significant amount of invasive species including English ivy, Himalayan blackberry and Daphne laurel in order to prepare an area for native plant species re-establishment on Earth Day.

I am seeking 10-12 volunteers to help with the invasive species removal on Saturday, April 6th. Esquimalt Parks has generously offered to lend much of the necessary tools including gloves, tarps, secateurs, eye protection and loppers. And I plan to provide free snacks and drinks to anyone willing to help out!

I would be very grateful for anyone willing to lend a hand for a few hours to help pull some weeds and hopefully have some fun doing it, too! The date for the event is Saturday, April 6th, between the hours of 10am and 4pm. The total time commitment is up to the volunteer, but I am asking for a minimum of 2 hours helping out if you are indeed able to come due to the limited amount of gloves and tools.

Please contact me if you have any questions and I'll be sure to do my best to answer and provide more details. This is my first go at hosting a weed pull, so I'm a total newbie at this. Please RSVP if you're able to make it out!

Thanks!
Tyler

Postponement update (April 4th, 2019):

UPDATE:

In consultation with Esquimalt Parks staff, we have made the decision to change the date of the weed pull event to Saturday, April 13th in lieu of the rain and high winds that are forecasted for April 6th. This decision had to be made due primarily to safety concerns about invasive species removal in the Douglas-fir forest during periods of high wind due to risk of falling debris.

Apologies to those who had their heart set on attending this Saturday, however we hope any who are still interested can attend next Saturday the 13th under better weather conditions! I will be posting another update around the middle of next week with final details and information for prospective attendees. In the meantime please feel free to contact me if you have any further questions.

Thanks

Final pre-event update (April 12th, 2019):

Hi folks, we're looking forward to tomorrow's event! I just thought I'd provide a quick update so anybody who's interested in attending knows where to meet and what to expect. If you plan on coming out tomorrow, please read the following:

-WEATHER: Tomorrow's forecast is currently calling for some light rain in the morning, so for those attending I'd advise on bringing some rain gear if you've got it. And hopefully it clears off a bit for us in the afternoon! And keep in mind much of the invasives removal is happening under tree cover so hopefully we can stay drier that way, too.

-TOOLS: Esquimalt Parks is generously providing tools including gloves, tarps, secateurs, eye protection and loppers for up to 12 people. If you have your own tools and would prefer to use those, please feel free to bring them along, but please make sure they're marked somehow so they don't end up going missing or getting mixed up with other materials at the end of the day.

-CLOTHING: I recommend wearing warm work clothes with long plants and long sleeves, and sturdy work boots or gum boots.

-FOOD: There will be light snacks and refreshments provided, but for those of you planning on coming out for the whole day I recommend bringing a bag lunch. And please bring your own re-usable mug and/or water bottle if you've got one.

-SAFETY: **Important** Please check-in and introduce yourself before commencing any weed pull work. I'll be going over safe and proper removal techniques based on the Garry Oak Ecosystem Recovery Team's best practice guidelines. One of the species we'll be removing (Daphne laureola) is toxic and requires special care when removing.

-MEETING POINT: Finally, our work area is right in the centre of the park, just west of the big grassy field/dog run. I will have signage directing volunteers to the work area, and you'll able to pick me out by my bright blue Hi-Vis cruiser vest. We'll be there from 10am until around 4pm, so please feel free to drop by for a couple hours and help out! It'll be a great way to connect with the community and help do some good in our local parks.

We're looking forward to it and we hope to see you out there tomorrow! If you have any questions please feel free to ask here or message me directly.

Appendix B – Line Intercept Data & Species List

Line Intercept 1 (12.0m)		
Measurement (m)	Common name (*Scientific name*)	Species Coverage on this line (%)
0.0–2.8	Common camas (*Cammasia quamash*)	Common camas: 64.3% Trumpet daffodil: 2.9% No vegetation/Compacted bare soil/bark mulch: 37.5% Cleavers: 4.1%
2.8–2.9	Trumpet daffodil (*Narcissus*)	
2.9–3.8	Common camas (*Cammasia quamash*)	
3.8–6.5	No vegetation/Compacted bare soil and bark mulch	
6.5–6.8	No vegetation/Compacted bare soil	
6.8–8.9	Common camas (*Cammasia quamash*)	
7.3–7.5	Trumpet daffodil (*Narcissus*)	
8.9–10.4	No vegetation/Compacted bare soil	
10.4–10.9	Cleavers (*Galium aparine*)	
10.4–12.0	Common camas (*Cammasia quamash*)	

Line Intercept 2 (11.5m)		
Measurement (m)	Common name (*Scientific name*)	Species Coverage on this line (%)
0.0–1.7	Common camas (*Cammasia quamash*)	Common camas: 35.5 Nootka rose: 2.6 Himalayan blackberry: 8.6 Western fescue: 0.8 No vegetation/bark mulch: 53.0
1.7–2.0	Nootka rose (*Rosa nutkana*)	
2.0–2.1	Himalayan blackberry (*Rubus armeniacus*)	
2.1–2.2	Common camas (*Cammasia quamash*)	
2.2–2.3	Western fescue (*Festuca occidentalis*)	
2.3–3.1	Himalayan blackberry (*Rubus armeniacus*)	
3.1–9.2	No vegetation/Bark mulch	
9.2–11.5	Common camas (*Cammasia quamash*)	
11.1–11.2	Himalayan blackberry (*Rubus armeniacus*)	

Line Intercept 3 (10.8m)		
Measurement (m)	Common name (*Scientific name*)	Species Coverage on this line (%)
0.0–0.4	Licorice fern (*Polypodium glycyrrhiza*)	Licorice fern: 3.7 Common camas: 39.4 Western fescue: 1.8 Garry oak: 0.9 Himalayan blackberry: 6.4
0.2–1.2	Common camas (*Cammasia quamash*)	
1.2–1.4	Western fescue (*Festuca occidentalis*)	
1.4–1.5	Garry oak (*Quercus garryana*)	
1.5–2.5	Common camas (*Cammasia quamash*)	
2.5–2.6	Himalayan blackberry (*Rubus armeniacus*)	
2.6–4.0	No vegetation/Bark mulch	
4.0–6.0	Common camas (*Cammasia quamash*)	
5.1–6.0	Laurel-leaved daphne (*Daphne laureola*)	
6.0–8.5	Common snowberry (*Symphoricarpos albus*)	

8.5-9.1	Himalayan blackberry (*Rubus armeniacus*)	No vegetation/Bark mulch: 13.0 Laurel-leaved daphne: 8.3 Common snowberry: 36.1
9.1-9.4	Common camas (*Cammasia quamash*)	
9.4-10.8	Common snowberry (*Symphoricarpos albus*)	

Line Intercept 4 (15.8m)		
Measurement (m)	Common name (*Scientific name*)	Species coverage on this line (%)
0.0-0.4	Garry oak (*Quercus garryana*)	Garry oak: 2.5 Common camas: 13.9 Western fescue: 0.6 No vegetation/Bare rock: 11.4 English ivy: 20.1 Laurel-leaved daphne: 2.4 Himalayan blackberry: 5.6 Common snowberry: 7.9 Licorice fern: 7.5 Trailing blackberry: 1.9 No vegetation/Coarse woody debris: 5.6 No vegetation/Bark mulch: 17.0 Douglas-fir: 4.4 English holly: 3.2 Miner's lettuce: 3.2
0.4-1.8	Common camas (*Cammasia quamash*)	
1.7-1.8	Western fescue (*Festuca occidentalis*)	
1.8-3.6	No vegetation/Bare rock outcrop	
3.6-4.0	Common camas (*Cammasia quamash*)	
4.0-4.2	English ivy (*Hedera helix*)	
4.2-4.4	Laurel-leaved daphne (*Daphne laureola*)	
4.4-4.8	Common camas (*Cammasia quamash*)	
4.8-5.5	Himalayan blackberry (*Rubus armeniacus*)	
5.5-5.6	English ivy (*Hedera helix*)	
5.6-5.8	Common snowberry (*Symphoricarpos albus*)	
5.8-7.0	Licorice fern (*Polypodium glycyrrhiza*)	
7.0-7.3	Trailing blackberry (*Rubus ursinus*)	
7.3-8.0	No vegetation/Coarse woody debris	
8.0-9.2	No vegetation/Bark mulch	
9.2-9.4	English ivy (*Hedera helix*)	
9.4-9.5	Common snowberry (*Symphoricarpos albus*)	
9.5-11.0	No vegetation/Bark mulch	
11.0-11.2	Laurel-leaved daphne (*Daphne laureola*)	
11.0-11.9	Common snowberry (*Symphoricarpos albus*)	
11.9-13.3	English ivy (*Hedera helix*)	
13.3-13.5	No vegetation/Coarse woody debris	
13.5-14.8	English ivy (*Hedera helix*)	
13.9-14.1	Himalayan blackberry (*Rubus armeniacus*)	
14.1-14.8	Douglas-fir (*Pseudotsuga menziesii*)	
14.8-15.3	English holly (*Ilex aquifolium*)	
15.3-15.8	Miner's lettuce (*Claytonia perfoliata*)	

Line Intercept 5 (26.2m)		
Measurement (m)	Common name (*Scientific name*)	Species coverage on this line (%)
0.0-0.9	Laurel-leaved daphne (*Daphne laureola*)	Laurel-leaved daphne: 4.2
0.9-1.1	Himalayan blackberry (*Rubus armeniacus*)	

0.9–1.2	English ivy (*Hedera helix*)	Himalayan blackberry: 8.1 English ivy: 43.5 Common snowberry: 16.0 Bracken fern: 5.7 Common camas: 3.4 Dull Oregon-grape: 2.7 No vegetation/Coarse woody debris: 6.1 Douglas-fir: 2.3 No vegetation/compacted soil: 3.1 No vegetation/bark mulch: 7.6 No vegetation/leaf litter: 0.8
1.2–3.1	Himalayan blackberry (*Rubus armeniacus*)	
3.1–5.3	Common snowberry (*Symphoricarpos albus*)	
5.3–6.3	Bracken fern (*Pteridium aquilinum*)	
6.3–7.2	Common camas (*Cammasia quamash*)	
6.5–7.2	Dull Oregon-grape (*Mahonia aquifolium*)	
7.2–8.5	No vegetation/Coarse woody debris	
8.5–9.1	Douglas-fir (*Pseudotsuga menziesii*)	
9.1–12.8	English ivy (*Hedera helix*)	
12.8–13.6	No vegetation/Compacted soil	
13.6–13.9	No vegetation/Coarse woody debris	
13.9–14.4	Bracken fern (*Pteridium aquilinum*)	
14.4–14.6	Laurel-leaved daphne (*Daphne laureola*)	
14.6–15.6	English ivy (*Hedera helix*)	
15.6–17.6	Common snowberry (*Symphoricarpos albus*)	
17.6–19.6	No vegetation/Bark mulch	
19.6–19.8	English ivy (*Hedera helix*)	
19.8–20.0	No vegetation/Leaf litter	
20.0–26.2	English ivy (*Hedera helix*)	

Line Intercept 6 (27.5m)		
Measurement (m)	Common name (*Scientific name*)	Species coverage on this line (%)
0.0–0.9	Laurel-leaved daphne (*Daphne laureola*)	Laurel-leaved daphne: 4.0 Himalayan blackberry: 8.0 English ivy: 45.5 Common snowberry: 15.2 Bracken fern: 5.4 Common camas: 0.7 Dull Oregon-grape: 2.5 No vegetation/Coarse woody debris: 5.8 Douglas-fir: 2.2
0.9–3.1	Himalayan blackberry (*Rubus armeniacus*)	
1.1–1.2	English ivy (*Hedera helix*)	
3.1–5.3	Common snowberry (*Symphoricarpos albus*)	
5.3–6.3	Bracken fern (*Pteridium aquilinum*)	
6.3–6.5	Common camas (*Cammasia quamash*)	
6.5–7.2	Dull Oregon-grape (*Mahonia aquifolium*)	
7.2–8.5	No vegetation/Coarse woody debris	
8.5–9.1	Douglas-fir (*Pseudotsuga menziesii*)	
9.1–12.8	English ivy (*Hedera helix*)	
12.8–13.6	No vegetation/Compacted soil	
13.6–13.9	No vegetation/Coarse woody debris	
13.9–14.4	Bracken fern (*Pteridium aquilinum*)	
14.4–14.6	Laurel-leaved daphne (*Daphne laureola*)	
14.6–15.6	English ivy (*Hedera helix*)	
15.6–17.6	Common snowberry (*Symphoricarpos albus*)	
17.6–19.6	No vegetation/Bark mulch	
19.6–19.8	English ivy (*Hedera helix*)	

19.8–20.0	No vegetation/Leaf litter	No vegetation/compacted soil: 2.9 No vegetation/Bark mulch: 7.2 No vegetation/Leaf litter: 0.7
20.0–27.5	English ivy (*Hedera helix*)	

Line Intercept 7 (29.4m)		
Measurement (m)	Common name (*Scientific name*)	Species coverage on this line (%)
0.0–0.7	English ivy (*Hedera helix*)	English ivy: 26.2 Laurel-leaved daphne: 2.8 English holly: 2.0 Pacific crabapple: 1.7 Douglas-fir: 1.7 Common snowberry: 5.8 Unknown grass species: 5.1 Garry oak: 0.7 Scouler's willow: 1.0 No vegetation/Coarse woody debris: 7.1 No vegetation/Bark mulch: 9.5 Nootka rose: 43.9 Himalayan blackberry: 1.4
0.7–1.1	Laurel-leaved daphne (*Daphne laureola*)	
1.1–1.4	English holly (*Ilex aquifolium*)	
1.4–1.9	Pacific crabapple (*Malus fusca*)	
1.9–2.4	Douglas-fir (*Pseudotsuga menziesii*)	
2.4–6.5	English ivy (*Hedera helix*)	
5.5–7.2	Common snowberry (*Symphoricarpos albus*)	
7.2–7.3	Unknown grass species	
7.3–7.5	Garry oak (*Quercus garryana*)	
7.5–8.9	Unknown grass species	
8.9–11.6	English ivy (*Hedera helix*)	
9.1–9.4	Scouler's willow (*Salix scouleriana*)	
11.6–13.1	No vegetation/Coarse woody debris	
13.1–15.9	No vegetation/Bark mulch	
15.9–25.9	Nootka rose (*Rosa nutkana*)	
22.5–22.7	English ivy (*Hedera helix*)	
23.5–23.9	Laure-leaved daphne (*Daphne laureola*)	
24.2–24.5	English holly (*Ilex aquifolium*)	
24.5–24.9	Himalayan blackberry (*Rubus armeniacus*)	
25.9–26.5	No vegetation/Coarse woody debris	
26.5–29.4	Nootka rose (*Rosa nutkana*)	

Line Intercept 8 (35.5m)		
Measurement (m)	Common name (*Scientific name*)	Species coverage on this line (%)
0.0–5.2	No vegetation/Compacted soil	No vegetation/Compacted soil: 21.6 English ivy: 43.6
5.2–10.4	English ivy (*Hedera helix*)	
6.0–6.1	Trailing blackberry (*Rubus ursinus*)	
10.4–10.7	Unknown grass species	

10.7–15.1	Laurel-leaved daphne (*Daphne laureola*)	Trailing blackberry: 0.2 Unknown grass species: 0.8 Laurel-leaved daphne: 12.4 Scouler's willow: 1.4 Nootka rose: 6.2 Common snowberry: 19.4 No vegetation/Coarse woody debris: 2.3 Unknown *Rubus sp.*: 0.8
15.1–15.5	Scouler's willow (*Salix scouleriana*)	
15.5–19.1	English ivy (*Hedera helix*)	
19.1–21.6	No vegetation/Compacted soil	
21.6–23.9	English ivy (*Hedera helix*)	
22.2–24.4	Nootka rose (*Rosa nutkana*)	
23.4–30.3	Common snowberry (*Symphoricarpos albus*)	
30.3–31.1	No vegetation/Coarse woody debris	
31.1–35.5	English ivy (*Hedera helix*)	
34.5–34.8	Unknown shrub – possibly *Rubus sp.*	

Line Intercept 9 (48.3m)		
Measurement (m)	Common name (*Scientific name*)	Species coverage on this line (%)
0.0–0.1	No vegetation/Coarse woody debris	No vegetation/Coarse woody debris: 1.6 English ivy: 68.2 Salal: 10.1 Red alder: 0.4 Trailing blackberry: 0.8 No vegetation/Bark mulch: 12.4 Common snowberry: 3.3 Douglas-fir: 1.4 Yellow moss: 1.0 Unknown grass species: 2.1 Hairy cat's ear: 0.2
0.1–0.2	English ivy (*Hedera helix*)	
0.2–3.6	Salal (*Gaultheria shallon*)	
3.6–3.8	Red alder (*Alnus rubra*)	
3.8–4.2	English ivy (*Hedera helix*)	
4.0–4.2	Trailing blackberry (*Rubus ursinus*)	
4.2–4.5	No vegetation/Coarse woody debris	
4.5–6.0	Salal (*Gaultheria shallon*)	
6.0–9.3	No vegetation/Bark mulch	
9.3–10.9	Common snowberry (*Symphoricarpos albus*)	
10.9–11.1	Douglas-fir (*Pseudotsuga menziesii*)	
11.1–11.6	Yellow moss (*Homalothecium fulgescens*)	
11.6–12.1	Douglas-fir (*Pseudotsuga menziesii*)	
12.1–14.8	No vegetation/Bark mulch	
12.8–13.8	Unknown grass species	
13.5–13.6	Hairy cat's ear (*Hypochaeris radicata*)	
13.6–13.8	Trailing blackberry (*Rubus ursinus*)	
13.8–15.8	English ivy (*Hedera helix*)	
15.8–16.7	No vegetation/Compacted soil	
16.7–17.5	Dull Oregon-grape (*Mahonia aquifolium*)	
16.7–44.4	English ivy (*Hedera helix*)	
27.5–27.8	English holly (*Ilex aquifolium*)	
33.3–33.5	Laurel-leaved daphne (*Daphne laureola*)	

40.0-44.4	Nootka rose (*Rosa nutkana*)	No vegetation/Compacted soil: 1.9 Dull Oregon-grape: 1.7 English holly: 0.6 Laurel-leaved daphne: 0.4 Nootka rose: 9.1
44.4-44.8	No vegetation/Coarse woody debris	
44.8-48.0	English ivy (*Hedera helix*)	
48.0-48.3	Common camas (*Cammasia quamash*)	

Line Intercept 10 (26m)		
Measurement (m)	Common name (*Scientific name*)	Species coverage this line (%)
0.0-4.3	Salal (*Gaultheria shallon*)	Salal: 16.5 No vegetation/Bark mulch: 5.4 English ivy: 54.3 Bracken fern: 3.8 No vegetation/Rock outcrop: 3.5 Unknown *Sphagnum sp.*: 1.5 English holly: 3.1 Common snowberry: 18.8 Laurel-leaved daphne: 1.2
4.3-5.7	No vegetation/Bark mulch	
5.7-14.2	English ivy (*Hedera helix*)	
13.2-14.2	Bracken fern (*Pteridium aquilinum*)	
14.2-14.8	No vegetation/Rock outcrop	
14.8-15.2	Unknown moss species – possibly *Sphagnum sp.*	
15.2-15.5	No vegetation/Rock outcrop	
15.5-19.5	English ivy (*Hedera helix*)	
18.2-19.0	English holly (*Ilex aquifolium*)	
19.5-24.4	Common snowberry (*Symphoricarpos albus*)	
22.2-22.5	Laurel-leaved daphne (*Daphne laureola*)	
24.4-26.0	English ivy (*Hedera helix*)	

Appendix C – Species List

List of all species observed in line lintercepts:

- English ivy (*Hedera helix*)
- Common snowberry (Symphoricarpos albus)
- Laurel-leaved daphne (Daphne laureola)
- English holly (Ilex aquifolium)
- Bracken fern (Pteridium aquilinium)
- Salal (Gaultheria shallon)
- Common camas (Cammasia quamash)
- Nootka rose (Rosa nutkana)
- Dull Oregon-grape (Mahonia aquifolium)
- Trailing blackberry (Rubus ursinus)
- Himalayan blackberry (Rubus armeniacus)
- Hairy cat's ear (*Hypochaeris radicata*)
- Yellow moss (*Homalothecium fulgescens*)
- Douglas-fir (Pseudotsuga menziesii)
- Red alder (Alnus rubra)
- Unidentified Rubus sp.
- Unidentified Sphagnum sp.
- Scouler's willow (*Salix scouleriana*)
- Garry oak (*Quercus garryana*)
- Miner's lettuce (*Claytonia perfoliata*)
- Licorice fern (*Polypodium glycyrrhiza*)
- Western fescue (*Festuca occidentalis*)
- Trumpet daffodil (*Narcissus*)
- Cleavers (*Galium aparine*)
- Unidentified grass species

List of all species observed in study area but not recorded by intercepts:

- Nodding onion (*Allium cernuum*) – One individual
- White fawn lily (*Erythronium albidum*) – Several individuals
- Scotch broom (*Cytisus scoparius*) – Several individuals
- English hawthorne (*Crataegus laevigata)* – One individual
- Hardhack (*Spiraea tomentosa)* – One individual
- Western redcedar (*Thuja plicata*) – One individual
- Common bluebell (*Hyacinthoides non-scripta*)
- Western buttercup (*Ranunculus occidentalis*)
- Indian plum (*Oemleria cerasiformis*)

Appendix D – Weed Pull Event Photos

Appendix E – ER311 Case Study Excerpts

"There is a need for more in-depth study to be undertaken to gain a better understanding of the invasive species problems at the park. Further research and recommendations on removal strategies and native species re-establishment goals (for example, discussions with experts and stakeholders on what types of species may be best suited to the variety of ecological settings within the park) is required to begin to piece together a restoration strategy at Highrock. In the end, I believe increased public awareness of the issues at Highrock Park is a good starting point to begin addressing these problems, and the Township of Esquimalt's Earth Day celebration scheduled for April 25th, 2018 will include invasive species removal and native species planting work (Esquimalt.ca, 2018)." (Esplen, 2018)