MECHANICAL REMOVAL OF HIMALAYAN BLACKBERRY (RUBUS ARMENIACUS) IN DERBY REACH REGIONAL PARK, LANGLEY, BC

Prepared for ER 390 – Restoration of Natural Systems Program

Abstract

The long-term goals for Derby Reach Park are key in our Invasive removal strategy of Rubus armeniacus integrating the pillars of sustainability and the social, economic and environmental impacts the Park has to the region. Additionally, our ultimate intention is to create adequate pollinator habitat as well as overwintering bird habitat, providing a buffer between the mixed-use spaces in the park.

Sierra Harvey

November 2019

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Alison and I would like to thank Janice Jarvis from Metro Vancouver Regional District and the staff of Derby Reach Regional Park for being a source of support and interest for this project. We would also like to thank and wish Val Schaefer, who has since retired from the RNS department, for being an enthusiastic supervisor – always keen to do a bird survey!

And lastly, I would like to thank my local Cowichan Valley organizations for being a source of information and support.

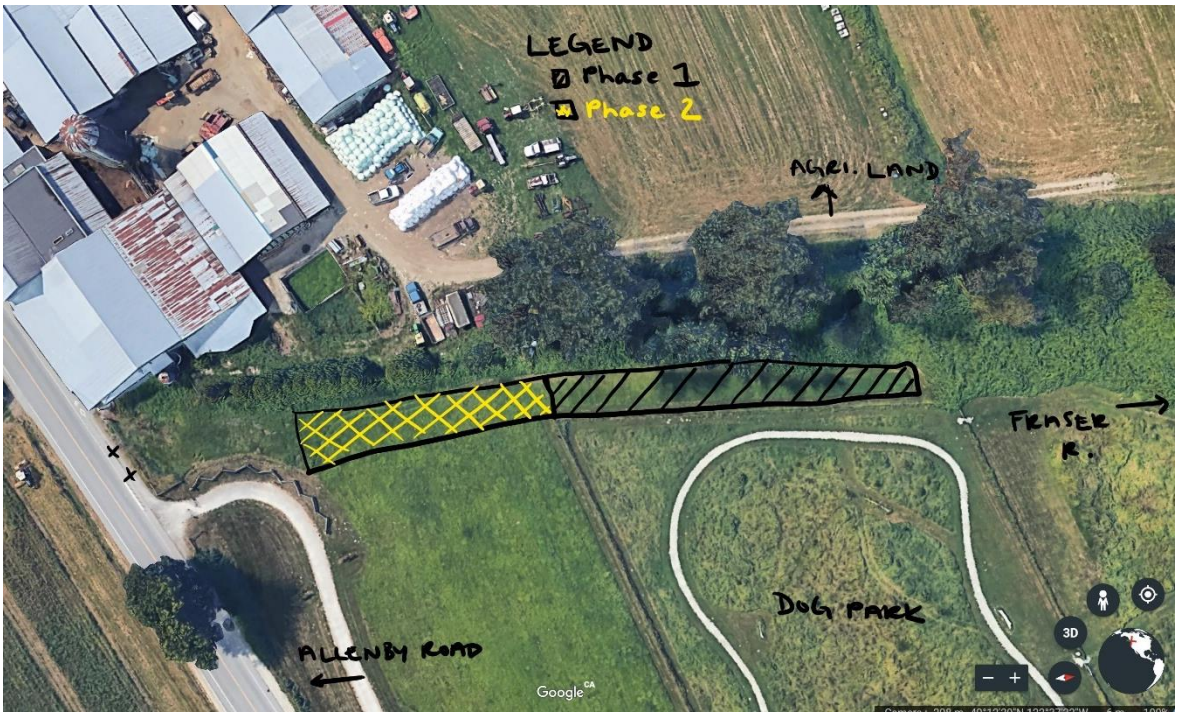
1.0 INTRODUCTION

Himalayan blackberry *Rubus armeniacus*, English ivy *Hedera Helix*, and Yellow Lamium *Lamium galeobdolo* are substantially more abundant than any other species in the Metro Vancouver area. According to a study prepared for the Coquitlam municipality, Himalayan blackberry accounted for more than half (54%) of all invasive plants measured in the inventory (Page & Lilley, 2008). Himalayan blackberry has proven to be a serious invasive species in the lower mainland of British Columbia. This project and subsequent restoration plan have suggested no different. The plot of interest is a large monotypic thicket of Himalayan blackberry, in a non-forested, grassy, disturbed area of Derby Reach Regional park. There is considerable community interest in this area of parkland as it is situated just (South) of the Fraser River - an important ecological riparian zone, and recreation spot for many residents of the Metropolitan Vancouver area. In 2017 Metro Vancouver data revealed that it had over 817,000 annual visitors at Derby Reach Regional Park, tipping the park to be the third most visited in the region (Vancouver, 2017).

Anthropogenically, Derby Reach Regional Park is a serene park which offers visitors riverfront trails, picnic areas, camping, picturesque mountain and forest views (Derby Reach, British Columbia, 2019). Derby Reach is located in the Coastal Western Hemlock range and is situated in a key flood zone along the Fraser River; this area is dominated by the annual snowmelt freshet and the sediment that was collected from along the river from Pleistocene Valley fills (Church, 2017). In the Pleistocene era, advancement and retreat of glaciers carved out the pre-existing valleys and deposited the material that had accumulated in the glacier by the melting of either the glacial outwash or the melting of the ice that composed the glacier itself. This process has resulted in one of the world's greatest salmon habitats, the Fraser River. The gradient declines near the sea, dumping a rich gravel load and creating a wandering-braided channel that supports salmon, as well as any other aquatic species (Church, 2017). This zone has a cool mesothermal climate and is characterized by cool summers and wet winters. Persistent human development and activity has degraded some of the natural processes. Regular dredging for navigation has decreased natural flood cycles, resulting in a loss of sand recruitment to the delta front. Natural history and human development are intertwined in complex ways along the lower course of this river, severely changing the operation of how this region and how Derby Reach Park operates.

Alison Martin, a fellow RNS student and my partner in this project, is an employee at Metro Vancouver Regional District (MVRD) and is familiar with the operations of the park. This was helpful when deciding on our methods and discussing our project with Janice Jervis, our community partner with Metro Vancouver. The rich history of Derby Reach and its ongoing significance to the community were foundational in our decision to choose this park.

FIGURE 1 GOOGLE EARTH IMAGE OF THE SITE AS SEEN FROM ABOVE.



1.1 The History of Derby Reach

Our project area is located within the traditional territory of the Kwikwetlem First Nation. Kwikwetlem are Coast Salish people, have used this area since time immemorial (Kwikwetlem First Nation, 2019). Archaeological findings have confirmed the continuous occupation of the Kwikwetlem traditional territory for at least 9,000 years, since the last ice age. Kwikwetlem people, xʷəltɑməyə', to forever live in and rule over the waters of the Coquitlam River, the people have unbreakable ties to the sockeye that run up the Fraser River. Even the name, kʷikʷəƛ̓əm (Kwikwetlem, which later was colonized

to Coquitlam), refers to a small red fish – “Red Fish Up the River.” The red fish represent an early sockeye salmon that once ran in great numbers in the Coquitlam River and spawned in Coquitlam Lake; some elders claimed it was so strong you could walk across the water on the backs of the salmon (Roundtable, 2019).

Lands along the Lower Fraser River, including Derby Reach Regional Park were among the first area upstream of the Fraser delta to be settled by non-indigenous Canadians in what was a wave of immigration that began in the mid-1800s (Roundtable, 2019). The first European fort in Coast Salish territory was constructed by the Hudson’s Bay Company (HBC) within the park in 1827 (Society, 2019). This impact significantly changed the indigenous dependence on the river and surrounding flora as European provisions were introduced. The post moved downstream in 1839 due to its vulnerability to flooding and the long distance from nearby farmland. The township name Derby is believed to be derived from that of the British Prime Minister in 1858, Edward Geoffrey Smith-Stanley, 14th Earl of Derby providing further context of the history of the Fort (Derby Reach, British Columbia, 2019).

Derby, located where the old HBC fort was, resulted in the re-settlement of the local First Nations, increasing their dependency on European goods as access to the local resources diminished into the 20th century. As outlined in the Derby Reach management plan, protecting and maintaining the cultural heritage, especially of First Nations sites, the site of Fort Langley and the Houston Pioneer Farm, are key goals for park planning (Vancouver, Derby Reach Managment Plan , 1999). Among maintaining the historic goals of the park, we are focused on the value of the species within the park.

1.2 Himalayan Blackberry in Southern British Columbia

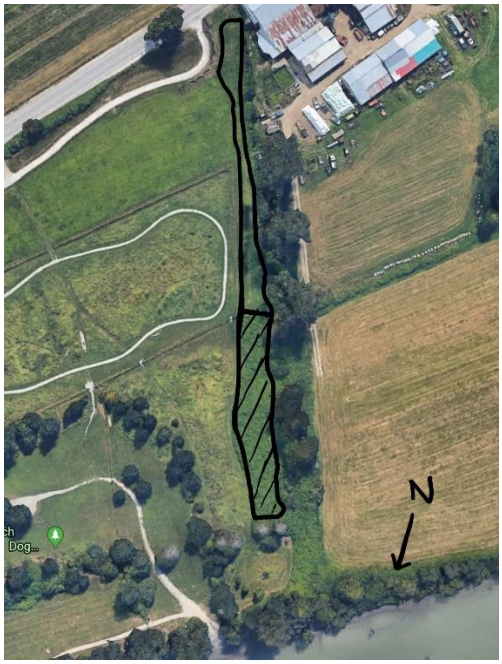
Our section of Derby Reach Park is 179m long x 19 m wide at the north end / 8m wide at the south end and is located on the south end of the park, furthest from the Fraser River, and closest to the roadway. The predominate problem with this area is its infestation of invasive Himalayan blackberry. When invasive and problematic plants infiltrate ecosystem webs, they become a major disruption to ecosystem services. Invaders have severe effects on fire regimes, water and nutrient cycling, and the pollination of native flowers (Shelby & Peterson, 2014).

Research has proven that “showy” long-blooming plant species that are resource rich, such as Rubus Americanus (Himalayan blackberry) are significant threats to sensitive and rare local species and have illustrated how the most conspicuous plants have proven highly disruptive for native species. Below is

an image illustrating the extent to which Rubus Armeniacus has been found in British Columbia. The plant is primarily dispersed by small mammals and birds which eat the seeds and expel them. In British Columbia humans have also resulted in the spread of Himalayan blackberry by planting the canes to harvest the fruit in the summer ((ISCB), 2019). Originating in Eurasia this species has long been colonizing North America, having been introduced by Luther Burbank in the early 1900's (Service, 2014). Himalayan blackberry is now found globally.

FIGURE 2 EXTENT OF RUBUS AMERICANUS IN SOUTHERN BRITISH COLUMBIA

FIGURE 3 SITE MAP IN RELATION TO ROADWAY, FARM, DOG PARK AND FRASER RIVER



1.3 CURRENT SITE

Derby Reach Regional Park is directly situated on the Fraser River. The location of Derby Reach is within the township of Langley and is surrounded by rural industry most notably the Cranberry Farm located across the road. Derby Reach Park is one of Metro Vancouver's regional parks, protecting diverse ecosystems including both second and old growth forests, lowland marsh, and riparian sites (Vancouver, Derby Reach Managment Plan , 1999).

The park is found within the Coastal Western Hemlock (CWH) biogeoclimactic zone. This zone has a cool mesothermal climate and is characterized by cool summers and wet winters. The topography of the park is the product of two highly influential natural forces, glaciation and the potent force of the Fraser River (Township of Langley (TOL), 2017). Located in the Fraser Lowland, the soil is made up of rich alluvial material and is quite fertile, as the Fraser River deposits sediment from its headwaters in the Rocky Mountains.

Human use and invasive plant species have greatly impacted the natural areas within the park. The study area, located between the dog off-leash area of the park and a farmer's field, has been infested with Himalayan blackberry *Rubus armeniacus*. The purpose of the project will be to re-establish habitat

for overwintering birds and pollinators by removing the blackberry and creating a buffer between the dog off-leash area and the park boundary.

1.4 Community Partners

Derby Reach is cared for by the Metro Vancouver Regional District, formerly known as the Greater Vancouver Regional District (GVRD) from 1968 to 2017. Furthermore, it was known as the Regional District of Fraser–Burrard for nearly one year upon incorporating in 1967.

The MVRD is under the direction of 23 local authorities; it delivers regional services, sets policy and acts as a political forum. The MVRD is our community partner as defined by the RNS 390 guidelines. Alison and I have worked extensively with Janice Jervis within the Natural Resource sector of MVRD. Janice is one of the chief decision-makers for Derby Reach Regional Park.

When creating this project, I felt it was imperative to consider the historical goals, as our site is situated on top of known and documented First Nations archaeological sites. Janice communicated this information to Alison and me during our site visit in January 2019. With this knowledge, I chose to consider and conduct the restoration prescription in a specific way, keeping in mind the long history and context of the site.

1.5 Standards and Regulations

Unfortunately, we are now well past utilizing any mechanisms to prevent the invasive blackberry and are focused on rapid detection and elimination of current growth. The majority of the blackberry is growing within the fence line that divides our project site and the dog park. Repeated mowing of the entire site by park staff in early spring, has ensured that the plant exhausts its food supply as the flowers are beginning to bloom (Species, 2019).

1.6 Safety

Proper personal protective equipment and training is a number one priority for volunteers helping with the project. Once the restoration is complete, proper cleaning of the equipment and disposal of the blackberry is necessary to reduce the spread of the invasive species.

During the hand removal, volunteers need to be equipped with closed toed shoes, leather pants and gloves. These tools will be partly supplied by Metro Vancouver and partly supplied by the individual.

1.7 Regulatory Standards

The project will follow *Best Management Practices for Himalayan Blackberry in the Metro Vancouver Region*. Section 2(1)(b)(iii) of the "Community Charter Spheres of Concurrent Jurisdiction - Environment and Wildlife Regulation" states that "municipalities may regulate, prohibit and impose requirements in relation to control and eradication of alien invasive species", which includes Himalayan blackberry. The guidelines document different restoration methods for the removal of blackberry in Metro Vancouver regional parks, including both chemical and physical methods; both methods will be presented in the projects outlined by Alison and myself.

If herbicide is used, then a pesticide license is required. The federal and provincial governments have safety standards and regulations regarding the use, storage and disposal of pesticides. There are several key goals in our project proposal: the most important being to adopt an Integrated Pest Management approach and utilize herbicides only when the benefits outweigh the costs and risks.

2.0 The Site

Our site is currently made up of predominately Himalayan blackberry, but it is also partly interspersed with the species listed in Table 2. Table 1 illustrates the plant inventory we collected during our visit on June 15th, 2019. The site had been routinely mowed and the blackberry was not visible at this time. The site is dominated by a variety of grasses and a dense herb layer.

TABLE 1 PLANT INVENTORY FROM JUNE 15TH, 2019

Latin Name	Common Name	Vegetation Layer	Percent Cover (%)
Poa palustris	Fowl bluegrass	Herb	15
Poa pratensis	Kentucky bluegrass	Herb	30
Festuca occidentalis	Western fescue	Herb	25
Cynosurus echinatus	Hedgehog dogtail	Herb	40
Phleum pratense	Timothy-grass	Herb	5

Ranunculus repens	Creeping buttercup	Herb	5
Rubus armeniacus	Himalayan blackberry	Herb	2

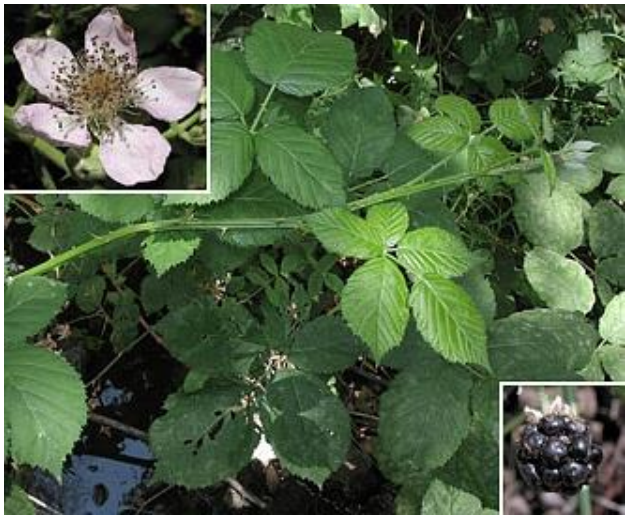
2.1 Site Goals

Goal 1: Eliminate Himalayan blackberry from the Project Site by December 2020.
Objective 1.1: Entirely remove the Himalayan blackberry through mechanized removal at the site by Fall 2020.
Objective 1.2: Maintain the treated area to monitor new growth over the winter of 2020/2021.
Objective 1.3: Plan a volunteer work party for Spring 2021.
Goal 2: Improve habitat for pollinators and overwintering birds by Spring 2021.
Objective 2.1: Create native plant beds and plant native species such as snowberry (S*ymphoricarpos*), oceanspray (*Holodiscus discolor*) and salal (*Gaultheria shallon*) by May 2021, planted with the proper amendments.
Objective 2.2: Cover any exposed soil between the native plant beds with mulch and a native grass seed mix by May 2021
Objective 2.3: Continuous monitoring of bird and pollinator populations for at least five years following restoration treatment.
Goal 3: Monitor and mitigate growth of Himalayan blackberry for at least five years.
Objective 3.1: Continuous maintenance of project site to mitigate re-establishment of Himalayan blackberry for at least five years.
Objective 3.2: Develop community engagement programs that involve invasive species removal to maintain the project site for at least five years.

2.2 Invasive Plant Species Populations

Himalayan blackberry is a biennial plant growing predominantly in disturbed areas. The site is in a particularly disturbed section of Derby Reach Regional Park and is therefore perfect for the growth of the blackberry. The blooms of this plant are small, delicate white flowers with 5 petals along robust, hexagonal stems, a contrast from the trailing native blackberry which are thin and circular ((ISCB), 2019).

FIGURE 4 HIMALAYAN BLACKBERRY FLOWER, LEAF AND BERRY (SEARCH, N.D.)



The increasing temperatures resulting from climate change have resulted in many species and their general range shifting north. This will result in a longer growing season for Himalayan blackberry and a greater competition for native plants (Chow, 2018). Once it becomes well established, this species of blackberry outcompetes low stature native vegetation and can prevent establishment of shade intolerant trees (such as Douglas fir, ponderosa pine etc.), leading to the formation of permanent blackberry thickets with few other species present. Additionally, this species can easily grow in low water moisture and low nutrient available soils. This, in combination with its ability to thrive in high light conditions, allows *R.americanus* to easily occur in anthropogenically disturbed habitats (Caplan & Yeakley, 2006). Larger mammals often have trouble moving through these thickets, resulting in a fragmented habitat that does not replace a diverse understory of plants. As a result, *R.americanus* can be highly disruptive to native species.

2.3 SOILS

The soil is a hummus type of moder and is a loam sandy texture. The relative soil moisture regime is 5^2. Blackberry and herbaceous grasses such as *Cynosurus echinatus, Festuca occidentalis* are the predominate species which are often found in grasslands as well as openings in dry forests bordering non-shaded sites. *Rubus Armeniacus* thrives in moist but not true wetland soils, and tolerates a wide range of soil moisture regimes (Soll, Controlling Himalayan Blackberry (Rubus armeniacus [R. discolor, R. procerus]) in the Pacific Northwest, 2002). The Fraser lowland is made up of rich alluvial material and is quite fertile, as the Fraser River deposits sediment from its headwaters in the Rocky Mountains, this soil

will be good for growing a range of native plants, as illustrated by the proportion of agriculture focused there (District F. V., 2017).

2.4 Bird and Pollinator inventory

There was no significant pollinator activity noted in our assessments on January or June of 2019. Prior to initiating the restoration objectives, we recommend completing an additional survey and inventory as a point-in-time measurement to determine pollinator population and habitat. Upon completion of the restoration objectives, a follow-up monitoring survey will help to understand how the new flora is impacting the species and evaluate the numbers, abundance, distribution and reproductive success as indicators of success. Repeated observations will be key in determining this success.

TABLE 2 LOCATION AND HABITAT CHARACTERISTICS OF 3 SITES SAMPLED DURING JUNE SURVEY

	Habitat Description	Anthropogenic Influences	Cover
Far East Corner	Mixed vegetation mostly trees along the back NE corner.	People walking and enjoying the park. Development along the river.	Fairly open but more surrounding cover. This is the most protected region of our restoration area.
Near Road	Grass	Roadway is moderately busy. There are industrial operations across the street (cranberry farm).	Quite open. Only protection is from the barrier between restoration area and farmer's field on the north end.
Midway Near Dog Park	Grasses and shrubs, the large trees remain on the outskirts of the area.	Dogs present a large barrier for landing birds. There are also few large standing trees in this area. The south side (where the dog park is) has mostly shrubs.	Fairly open. Few standing structures in dog park (all the trees are quite low).

TABLE 3 POLLINATOR SURVEY

Type of Pollinators	Description
Bumble Bees	• Social (queens and workers) • Ground-nesters, need existing holes • Spring, summer, early fall
Sweat Bees	• Solitary to semi-social • Ground-nesters • Spring and summer
Hair-Belly Bees	• Solitary • Cavity or ground-nesters • In spring, use mud • In summer, use leaves
Mining Bees	• Solitary • Ground-nesters • Mostly spring
Honeybees	• Highly social • Non-native, managed bees
Others	• Flies, wasps, butterflies and beetles

We completed two bird point surveys, each around the same time of day. The first visit was on January 31st and we observed an American robin *Turdus migratorius*. During our second site visit on June 15th, we conducted a bird survey and observed a Black-headed grosbeak *Pheucticus melanocephalus* and a Willow flycatcher *Empidonax trailii*. As we did not observe many birds during our visits, we compiled a list of species that have been observed within the park from the website *ebird*. This website allows birdwatchers to upload the data of their bird sightings and is useful to get a general sense of their typical habitat. Table 2 demonstrates the birds that are most frequently observed and are most likely to be found in the project site.

TABLE 4 BIRD OBSERVATION AT DERBY REACH REGIONAL PARK FROM EBIRD AND HABITAT DATA FROM ALL ABOUT BIRDS

Common name	Scientific name	Habitat Description
Northern flicker	*Colaptes auratus*	Open habitat near trees (woodlands, parks)
Black-capped chickadee	*Pocile atricapillus*	Mixed forests, open woods, parks
Chestbut-backed chickadee	*Poecile rufescens*	Mainly in coniferous forest but also found in urban areas when trees and shrubs are present
Red-breasted nuthatch	*Sitta canadensi*	Mainly in coniferous forest and will use habitat in parks in winter
Pacific wren	*Troglodytes pacificus*	Lives in forested habitats with a thick understory of mosses and ferns
American robin	*Turdus migratorius*	Found almost everywhere but will move to woods with berry-producing shrubs in winter
Varied thrush	*Ixoreus naevius*	Mainly in dark, wet forests but will migrate to parks in winter if berries are abundant
Cedar Waxwing	*Bombycillia cedrorum*	Found in forest but are most abundant around fruiting plants in parks during winter
Spotted towhee	*Pipilo maculatus*	Found along forest edges and places with dense shrub cover and leaf litter
Purple finch	*Haemorhous purpureus*	Found in evergreen forests but can be found in shrubby areas and weedy fields in winter
House finch	*Haemorhouse mexicanus*	Found in human-created habitats, including small conifers and urban centres
American goldfinch	*Spinus tristis*	Found in weedy fields and common in parks
Steller's jay	*Cyanocitta stelleri*	Common in forest wilderness but also parklands
Rufous hummingbird	*Selasphorus rufus*	Mainly in open or shrubby areas (parks, yards)
White-crowned sparrow	*Zonotrichia leucophrys*	During winter, these birds frequent thickets, weedy fields, backyards, parks
Dark-eyed junco	*Junco hyemalis*	During winter, they use a wide variety of habitat that include open woodlands, fields, parks

2.5 POLLINATORS SURVEY

Table 2 lists the species of pollinators that are native to the site and a description of their behaviour. We did not conduct a formal survey but instead utilized the information from a citizen science website, *Border Free Bees & Environmental Youth Alliance.*

TABLE 5 POLLINATORS AND THEIR DESCRIPTION

Common Name	Scientific Name	Description
Bumble Bees	*Apidae Bombus*	They are social with queens and workers that are ground-nesters who find existing holes to nest in. They are active in the spring, summer and early fall.
Hover Fly	*Syrphidae*	These flies look like bees but have four wings. They are good pollinators of open-faced flowers and dominate pollination in high altitudes.
Hair-Belly Bees	*Megachilidae*	These bees' nest in tunnel-shaped cavities and re-purpose materials from nature. Mason bees, leafcutter bees, and resin bees are all part of this category.
Mining Bees	*Andrenidae, Halictidae, Colletidae*	Includes all ground-nesting bees (miners, sweat bees, and plasterer bees). They are solitary and are active mostly in the spring.
Honey-Bees	*Apis mellifera*	Plays an important role in the economics of agricultural crop pollination and the only bee in North America that makes honey for winter food source.
Butterfly	*Lepidoptera*	Only a handful are common in urban centres and tend to thrive in grassland and coastal meadows in BC. They typically pollinate and feed on nectar from daytime blooming flowers.
Wasp	*Vespidae*	Vespid wasps are the most common family in BC and feed on nectar, which pollinates the plants in the process.

3.0 RELATE - METHODS

Large swaths of Himalayan blackberry reduce ecological values and are challenging to remove. Methods of removal like cutting, tilling and burning are generally not effective ((ISCB), 2019). Broad-scale techniques such as mowing, tilling, mulching and herbicide use can be resource and time intensive (Page & Lilley, 2008). Instead, this project will focus on mechanized removal through excavation to

remove the blackberry from the site and the subsequent process that will follow, including planting native species, tilling and monitoring.

3.1 Mechanized Removal

Using a mechanized approach to remove vegetation is typically a non-selective process, in that all vegetation within a given proximity is affected (Soll, Controlling Himalayan Blackberry in the Pacific Northwest, 2004). In this case, mechanized removal is favorable as the patch of land has a lack of vital, native flora and an overabundance of blackberry. Once collected, the removed materials will be stored on site in the park's yard waste materials site and then disposed of by incineration as it is the cheapest method of removal as outlined by the Invasive Species Council of BC. There is a risk of seeds spreading; therefore, it is important the compost is taken off site or burned accordingly (Species, 2019).

The roots are at risk of re-sprouting if left on the ground and must be taken off site. A compost pile will be identified as part of the restoration field plan to ensure that all of the blackberry cuttings are discarded properly (Soll, Controlling Himalayan Blackberry in the Pacific Northwest, 2004). Through tilling and excavation, the soil and roots can be broken and removed, keeping in mind that root ball removal is challenging and best done either individually with a pulaski, or by machine. To prevent unwanted plant growth and to retain moisture, we will add a surface covering, such as mulch, in the garden beds. Lastly, if we notice there is an issue and need for biological control, such as the introduction of herbivorous insects or fungal pathogens, an herbicide application would be considered as a final defense. (Page & Lilley, 2008)

I chose to model my approach after the work of *Somenos Marsh Conservation Society* in the Cowichan Valley, whom has had success with mechanized removal of Himalayan blackberry. Somenos Marsh is the oldest conservation society in the Valley and has completed many successful restoration sites. In an interview with previous consulting biologist David Preikshot, he explained how he utilized an excavator to remove the blackberry root balls, turning the soil and creating a mounded terrain. David Preikshot, he explained how he utilized an excavator to remove the blackberry root balls, turning the soil and creating a mounded terrain. As the project concluded, it was evident that the mounded terrain worked well to limit the colonization of blackberry and provided dynamic terrain for both plants and animal species (Preikshot, 2019). In addition, the turning of the soil released native seeds that had been buried below, allowing them to be

the initial colonizers (Preikshot, 2019) This method is colloquially coined the "*rough and loose*" method. Local Cowichan Valley expert, David Polster examines this method and suggests that it can be successful to help mimic and increase ecological succession stages (Polster, 2015). Considerably more research needs to be done on this method, as it has been challenging to find reputable sources. However, as per conversations with groups that are practicing in the field, I believe this method will work well for our site, given the conditions.

Once the beds have been created, there are four main methods of re-introduction that we will utilize: natural colonization, re-seeding of a native grass blend, planting potted native plants and the planting of live cuttings/staking. Each of these methods comes with a varied level of time and resources. We will predominantly be relying on replanting container grown trees and shrubs and spreading native seed to ensure they have a chance to outcompete non-native colonizing plants. Natural colonization or succession (including introducing physical features to promote succession) and the seeding of desirable grasses, forbs, or trees is necessary to outcompete blackberry seeds, which can remain viable in the soil for several years (Species, 2019). Native seeds will be spread once the potted plants are mulched and planted in the soil (Cheri Ayers, 2019). Live staking has been proven to be effective to plant early succession trees such as willow, alder, and poplar (Polster, 2015). These trees will be staked with the help of volunteers.

3.2 SLOPE

Most mechanical equipment is not safe to operate on slopes over 30 percent (Soll & Lipinski, Controlling Himalayan Blackberry in the Pacific Northwest, 2004). It is also of limited use where soils are highly susceptible to compaction or erosion, or where soils are very wet (Coquitlam, 2008). The slope of the plot is <30 degrees and therefore mechanized machine removal will not be an issue. Based on our June assessment, the soil structure will allow for machine operation during the dry season.

3.3 ARCHEOLOGY

As outlined in the Derby Reach management plan, protecting and maintaining the cultural heritage, especially of identified Indigenous sites, the site of Fort Langley and the Houston Pioneer Farm is a key goal for the park (Vancouver, Derby Reach Managment Plan , 1999). When conducting this

project, I felt it was imperative to recognize this goal, as our site is situated on top of First Nations archaeological sites, communicated to Alison and I by Janice on our first visit to the park, in January 2019. With this knowledge in mind, I chose to consider and conduct the plan in a specific way, ensuring that within my report we included the hiring of a local First Nations archeologist or a contracted archeologist hired and trusted by the local nation of Kwikwetlem. This process is an important step in reconciliation, and I do not think it should be skipped if we are to ensure we are upholding the management goals of the park, written in 1999. Unfortunately, I had a challenging time contacting the appropriate person to budget out an archaeological dig at this site. The numbers I have estimated for the budget were compiled from a project on Vancouver Island, by Quantum Murray Environmental Services, who work with Malahat First Nations with regular archeological digs. See Appendix C.

Below is the approximate schedule we will follow:

- **Early Fall –** Mechanically remove the blackberry, excavate root balls, remove the blackberry from the site, dispose of it in the park waste containers. The waste will either decompose in a contained space or be incinerated. The site will be tilled and mounded.
- **Winter -** Purchase native species while planning a volunteer planting event to take place early spring.
- **Early Spring –** Plant the area with native species
    - Continue to maintain restored area
    - Remove any blackberry sprouts and weeds as soon as they emerge
    - Water native vegetation for 1.5 years after restoration
    - Incinerate the remaining root balls and seeds
    - Plan a volunteer planting day

3.4 BUDGET

See Appendix C for estimated budget table based on current pricing for similar projects.

4.0 INTERPRET

The site is in a historically significant area for the Kwikwetlem First Nation. As this is part of the restoration plan, excavation requires additional steps, including hiring a member of the nation to be present during excavation, to ensure the proper care is taken to recognize the cultural significance of this area. Archeology sites fall within the legislation of the Province and are regulated under the Heritage Conservation Act (District C. R., 2018). The Conservation Act is the overarching legislature that governs how these sites are looked at; however, municipalities have some freedom in how they reference the Act and care for the sites under provincial management. In the case of Derby Reach, if we were to grub and mechanically mix the soil, removing the blackberry, it would be imperative to have an

archeological dig conducted by a member of the First Nation. The cost and price of the dig has been budgeted into this restoration program. To move forward with this plan, we would hire a local archeologist hired by the Kwikwetlem First Nation.

4.1 Restoring the natural vegetation and planting

A few native and ornamental alternatives to plant include Nootka Rose, Thimbleberry, Marionberry or Boysenberry, Red Raspberry and Black Huckleberry ((ISCB), 2019). These plants will provide excellent habitat for a series of desired birds and pollinators. It is key to note that these native plants are chosen for their resistance to invasive species, heartiness and that they will grow to shade out the encroaching blackberry from the Northeast side (BC, 2019).

Plant beds will be used to encourage clustered growing and resistance against other non-native species, limiting fragmentation. The plant beds will also be useful in creating a visual barrier for onlookers in the dog park. Because we are using a mechanized approach to remove the blackberry, the soil will already be turned and ready for planting. To ensure success, we will encourage the use of amendments, such as a mix of compost and bone-meal. Compost and bone-meal will be to each hole dug and the mulch will be used to retain moisture and deter weeds. The bone-meal is used to promote root growth and add nutrient value to the depleted soil, in the form of marine derived nutrients. In past projects, I have used bone-meal as a successful amendment for coastal plants to mimic the cycle of salmon brought to the forest floor by predators.

Upon review of the *Metro Vancouver's Best Practice and Simon Fraser University's Pollinators of BC* pamphlet, we chose the above native vegetation to be planted on the site to increase pollinator habitat. Please refer to Table 6.

Native vegetation is not typically available in the quantities that are required for such a project; thus, they may need to be special ordered from a nursery, potentially adding to the timeline of the project. Most of the beds should have about 72 inches between them to allow for routine maintenance by the park's operation staff (this parameter was outlined by Derby Reach Park staff). Figure 5 demonstrates the layout of the native plant beds. The placement of plants can be decided onsite once the soil beds are prepared and the plants have arrived. The beds must be large enough to comfortably fit trees and shrubs with approximately 2m between one another. Trees need a larger circumference, while shrubs can be planted closer, ~ 1m (Ayers, 2019).

TABLE 6 VALUE ADDED PLANTS

Common Name	Scientific Name	Type of Bloom	Type	Berries
Thimbleberry	*Rubus parviflorus*	May-July	Shrub	n/a
Nootka rose	*Rosa nutkana*	May-July	Shrub	n/a
Red flowering currant	*Ribes sanguineum*	February-April	Shrub	Ripens July to September
Snowberry	*Symphoricarpos*	May-August	Shrub	Ripens in early fall and persists over winter
Tall Oregon grape	*Mahonia aquifolium*	March-May	Shrub	Ripens August to September
Oceanspray	*Holodiscus discolor*	June-August	Shrub	Ripens September to October and persists over winter
Douglas-fir	*Pseudotsuga menziesii*	n/a	Tree	Ripens September to October
Red alder	*Alnus rubra*	n/a	Tree	Ripens late summer
Arctic lupine	*Lupinus arcticus*	June-July	Herb	Ripens September
Fireweed	*Chamaenerion angustifolium*	June-September	Herb	Ripens late summer
Salal	*Gaultheria shallon*	May-July	Herb	n/a
Black twinberry	*Lonicera involucrata*	April-August	Shrub	n/a
Red Osier dogwood	*Cornus sericea*	May-July	Shrub	Ripens July to September
Hard Hack	Spiraea douglasii	June - September	Shrub	n/a
Maple Tree	Acer macrophyllum	n/a	Tree	n/a

FIGURE 5 PLANTING PLAN

By fully removing the Himalayan blackberry through excavation there is a greater probability that it will not return and outcompete native colonizers. Cutting the blackberry is a timely process, and unless done regularly, is not effective. As part of a three-prong approach, we will remove the blackberry mechanically, turn the dirt while shaping it into large mounds, ~ 2m x 2m, and lastly planting native vegetation and grass seed. With this approach, routine maintenance will be minimal for park staff.

5.0 Monitoring and Volunteer Hours

In 2014 Derby Reach became a focus park for Metro Vancouver and volunteer efforts began to increase exponentially. The Geocaching Association, Catching the Spirit Youth Society, and the Derby Reach Bray Island Park Association, all contribute to different projects such as an invasive removal, nest box program, and wildlife monitoring (Roy Teo, 2015). With an already established park coordinator, we are confident in achieving strong volunteer attendance during key field days. Competition and prizes could help incentivize this endeavor. A reporting model would be highly effective in this area due to the proximity of the dog park, and routine number of walkers. A plant-reporting model would be a good way to engage visitors in the importance of being aware of invasive species and to have them help us monitor the site. Volunteers need to be accurately prepared for removing predominantly invasive

blackberry, ensuring that everyone has sturdy boots, workpants and thick leather gloves; this is key to avoiding injuries and keeping up volunteer morale.

I plan to conduct a bird surveying day where we invite an expert birder to come facilitate a survey with volunteers. This type of event is routinely offered as a citizen science program at the Cowichan Estuary Nature Centre, located in Cowichan Bay on Vancouver Island, and has proven to be an effective method for engaging volunteers while compiling citizen science data (Volunteer Manual, 2019). Some challenges I foresee in using birds as a key indicator for restoration success is the proximity to the dog park. Some of our surveys would need to be completed during times of fewer dog walkers. Due to the complexity of bird surveys, Alison and I found it challenging to accurately identify the species by ear. By inviting an expert, we would get a better understanding of the species in the region and of the success of the restoration project. I believe a survey should be done pre-restoration in fall and post-restoration during the same time of year. Our budget includes utilizing a bird expert one to two times per year. We will refer to "Fraser Valley Birding" as a resource to identify which birds are native to Derby Reach Park and to assist us in identifying them and publishing successful bird reports.

Lee Beavington, a local educator and biologist, coordinates interpretive walks in the park. Lee has been creating content for the past three years, guiding participants through the park and leading groups through Derby Reach and into the magnificent coastal rainforest (Beavington, 2019). There is an opportunity here for collaborating with Lee, to inspire and teach park visitors about the ecosystem and incorporating restoration techniques.

Interpretive signage has been very successful in other restoration projects, and initial data from a published pilot study, *Designing for Interpretive Signage: Best Practices for Increasing Attraction Power*, suggests that it positively affects people's views on environmentally sensitive design (Carter, 2013). The mounded terrain that will result in this project will stimulate curiosity and would be well received with a sign, mural, or installation. Interpretive signage has become increasingly necessary as new types of infrastructure are introduced to the landscape. The signage is an important element of passive outdoor education for those without formal education or knowledge (Carter, 2013).

(Polster, 2015)

5.1 Conclusion

As the ecosystem continues to change it is important to be dynamic in our approach to restoring this section of Derby Reach. The site has been highly influenced by anthropogenic impacts, challenging the natural state and potential outcomes of this prescription. With its influence from dogs, regular visitors and industrial impacts, the goal of increasing bird and pollinator populations is imperative for a thriving environment. Restoration work aimed at controlling the spread of Himalayan blackberry will increase biodiversity and have a significant impact on the area.

FIGURE 6 ALISON AND I CONDUCTING SITE ASSESSMENTS, JAN 2019

Appendix A

Bird Survey notes

Title: Bird Survey 1
Date: June 13th, 2019
Time: Morning, Approx. 110am
Location: 49.206764, -122.621220 / 49 12” 24.4’ N 122 37” 16.4’ W
Surveyors: Alison Martin and Sierra Harvey
Weather conditions: Gray, overcast (over 70% cloud), cool, air temperature = ~ 15 degrees
Objective: to complete a bird count and estimate the bird community composition and relative abundance
Equipment: Field book and pencil to record data as well as the bird surveys methods sheets from 312B Field Notebook, Brian Eaton, Pg. 29 with Val Schaefer.
Methodology: Point counts were done by proceeding to a given point and listening for 5 minutes. Listening in combination with looking was helpful to identify the various bird species in the area. This is not an exact science but by recording the sounds and reviewing, along with identifying photos we were able to roughly estimate which birds were present. We recorded species that were seen and heard in each habitat, as well as the number of individuals seen and heard, noting which species were flying overhead or that were visibly utilizing the habitat.

Appendix B

Budget Table based on Estimates

Excavator	The cost of renting an excavator is ~ $250-$500 per acre depending on the situation (Soll, Controlling Himalayan Blackberry in the Pacific Northwest, 2004).
Mulch:	~ $200 (quoted by Chemainus, BC company - Jemco) at $12/yard
Compost	25 bags x 20lb bag @ $7/bag = $140
Archeologist	Archeologist Tech: estimate based Enviro Consulting Company, Quantum Murray, and their work with Malahat Nation ~ $30/hr. The project will stop if things are found as this is an intact site, which can potentially delay the project and cost more.
Plants	Streamside Plant Nursery, Bowser, BC. Evergreen Shrubs ~$5.50 each for 1-gallon x 300 Deciduous Trees ~ $9.75 for 2 gallon x 100 =~$2625
Amendments	Bone meal: 3 large bags ~$300
Volunteers	$200 (food, gear, etc.)
TOTAL	$3465 + additional costs for excavator+ archeologist

Appendix C

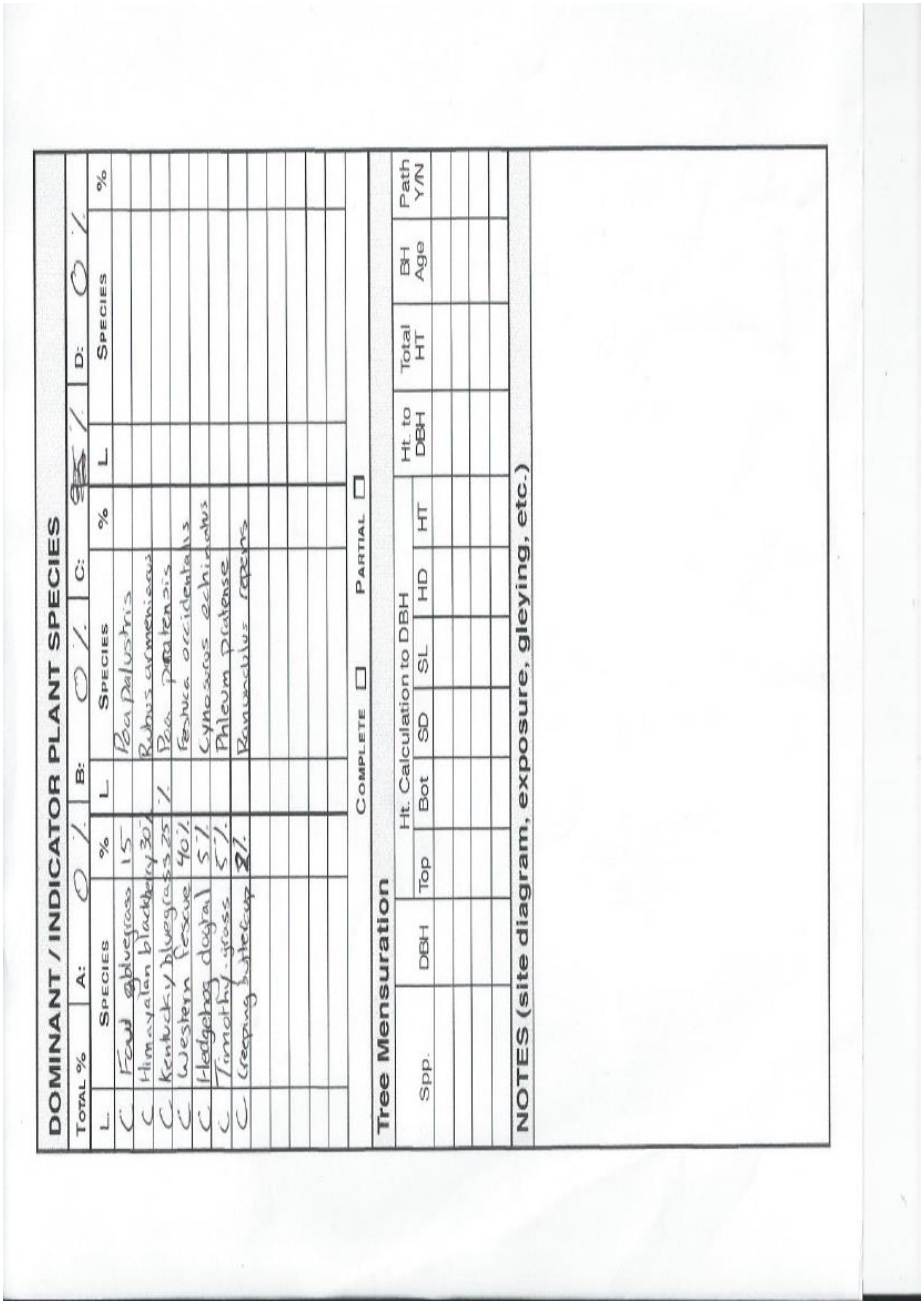
Terrain Classification System Legend and Site Series

Terrain Texture		
Code	**Name**	**Description**
s	**sand**	**Particle size between 0.062-2**
Surficial Materials		
F	**fluvial**	**River deposits**
Surface Expression		
m	**rolling**	**Unidirectional surface; up to 3^{o}**
Geological Processes		
I	**Irregular channel**	**A single, clearly defined main channel displaying irregular turns and bends**

Site Series		
Code	**Ecosystem Units**	**Definitions**
RR	**Rural**	**Any area in which residences and other human development are scattered and intermingled with forest, range, farmland, and native vegetation or cultivated crops.**

Appendix D

Plant Inventory



DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	A: 0 %	B: 0 %	C: 0 %	D: 0 %
L	SPECIES %	L	SPECIES %	L	SPECIES %	L	SPECIES %
C	Fowl bluegrass 15		Poa palustris				
C	Himalayan blackberry 30		Rubus armeniacus				
C	Kentucky bluegrass 25	/	Poa pratensis				
C	Western fescue 40		Festuca occidentalis				
C	Hedgehog dogtail 5		Cynosurus echinatus				
C	Timothy grass 5		Phleum pratense				
C	Creeping buttercup 2		Ranunculus repens				

COMPLETE ☐ PARTIAL ☐

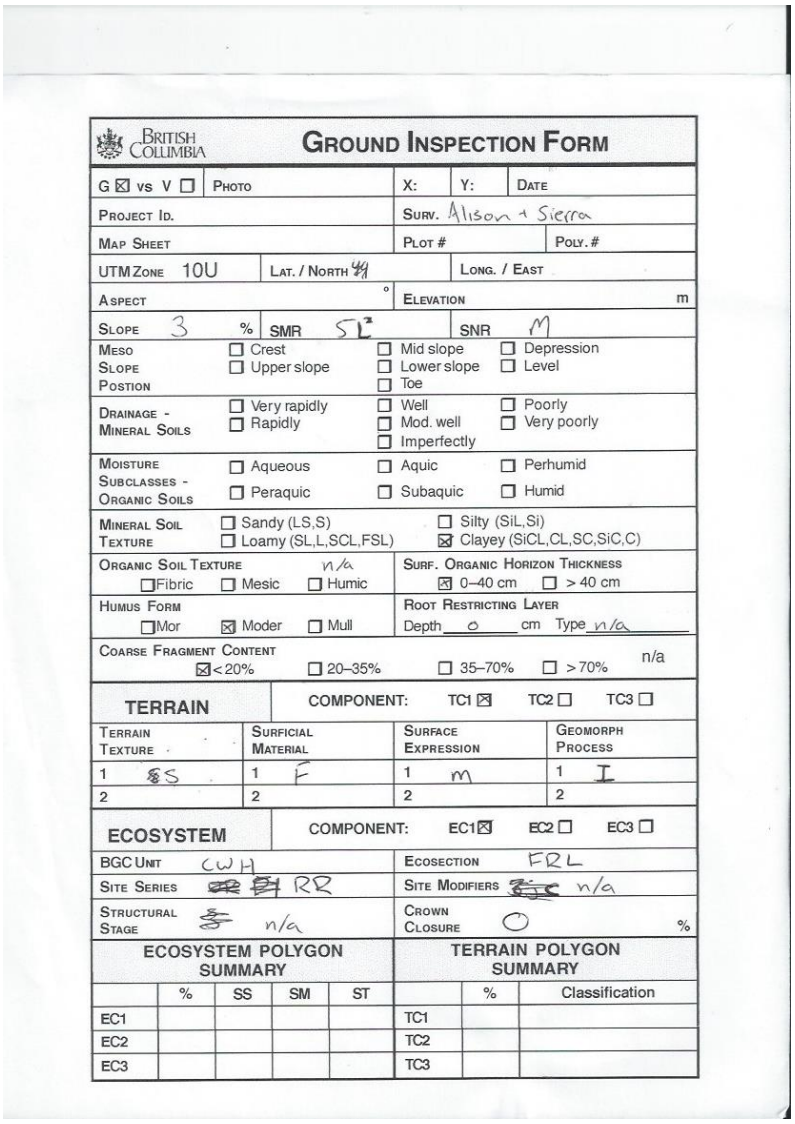
Tree Mensuration

Spp.	DBH	Ht. Calculation to DBH: Top	Bot	SD	SL	HD	HT	Ht. to DBH	Total HT	BH Age	Path Y/N

NOTES (site diagram, exposure, gleying, etc.)

Appendices E

Ground Inspection Form (GIF)



BRITISH COLUMBIA

GROUND INSPECTION FORM

G ☒ VS V ☐ PHOTO		X:	Y:	DATE
PROJECT ID.		SURV. Alison + Sierra		
MAP SHEET		PLOT #		POLY. #
UTM ZONE 10U	LAT. / NORTH 49	LONG. / EAST		
ASPECT °		ELEVATION m		
SLOPE 3 %	SMR 52	SNR M		

MESO SLOPE POSTION	☐ Crest ☐ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☐ Depression ☐ Level	
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☐ Very poorly	
MOISTURE SUBCLASSES - ORGANIC SOILS	☐ Aqueous ☐ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid	
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☒ Clayey (SiCL,CL,SC,SiC,C)		
ORGANIC SOIL TEXTURE n/a ☐ Fibric ☐ Mesic ☐ Humic		SURF. ORGANIC HORIZON THICKNESS ☒ 0–40 cm ☐ > 40 cm		
HUMUS FORM ☐ Mor ☒ Moder ☐ Mull		ROOT RESTRICTING LAYER Depth 0 cm Type n/a		
COARSE FRAGMENT CONTENT ☒ < 20% ☐ 20–35% ☐ 35–70% ☐ > 70% n/a				

TERRAIN

COMPONENT: TC1 ☒ TC2 ☐ TC3 ☐

TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1 ~~S~~	1 F	1 M	1 I
2	2	2	2

ECOSYSTEM

COMPONENT: EC1 ☒ EC2 ☐ EC3 ☐

BGC UNIT CWH		ECOSECTION FRL	
SITE SERIES ~~02~~ ~~04~~ RR		SITE MODIFIERS ~~S~~ n/a	
STRUCTURAL STAGE ~~5~~ n/a		CROWN CLOSURE ○ %	

ECOSYSTEM POLYGON SUMMARY					TERRAIN POLYGON SUMMARY		
	%	SS	SM	ST		%	Classification
EC1					TC1		
EC2					TC2		
EC3					TC3		

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