Invasive Species Restoration Project and Management Recommendations

for *Reynoutria japonica* at Neilson Regional Park

Figure 1: Neilson Regional Park and Hatzic Lake

By Nicole Mulligan
University of Victoria
ER 390 Project
Supervisor: Nancy Shackelford

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Executive Summary

The Invasive Species Restoration Project at Neilson Regional Park, in partnership with the Fraser Valley Regional District (FVRD), aims to restore the salmon habitat at Draper Creek by targeting the bank stability and developing a long-term invasive management plan along the creek bank. Draper Creek and Hatzic Lake are critical fish habitats, with salmon traveling up the creek from the Fraser River to their traditional spawning sites. However, invasive vegetation has been making this journey challenging for spawning fish. The restoration project focused on reducing invasive plants in riparian slopes by removing them and planting native slope stabilization species. This project focused on three distinct sites: site A1, site A2, and site B, totalling 330 m^2.

The removal of three main invasive species included *Phalaris arundinacea* (reed canarygrass), *Rubus armeniacus* (Himalayan blackberry), and *Impatiens glandulifera* (Himalayan balsam). Volunteers contributed 60 hours to remove 465 kg of invasive biomass from the three project sites. A group of students spent an additional 50 hours planting 42 native species. *Reynoutria japonica* (Japanese knotweed) was also identified as a significant invasive species. However, a comprehensive management plan is necessary due to its extensive rhizome system and environmental impact. The success of the native plantings relies on a long-term management plan, including ongoing monitoring and removal of invasive species and nurturing the establishment of native plants.

To ensure the project's success, the FVRD staff will continue to monitor and maintain the restoration sites for five years after the initial project in 2022. By planting carefully selected native species and actively managing invasive species, the project enhances ecosystem resilience and promotes biodiversity in critical natural habitats. Continued monitoring and commitment to long-term management will be essential to preserving the ecological balance and native species diversity for future generations.

Introduction

In partnership with the FVRD, the invasive species restoration project and management recommendations for Neilson Regional Park's goal is to enhance salmon habitat in Draper Creek by creating a more complex ecosystem. To create a more complex creek ecosystem, we are stabilizing the creek banks by removing invasive species and planting native slope stabilization species in their place. The native species will also provide shade to the creek keeping the creek cool for the salmon. Unstable slopes in creeks will erode, depositing vegetation and soil into the creek. The increase of sediment in the creek can create piles of sediment, making it difficult for the salmon to traverse. The second way we enhance the salmon habitat is by monitoring the *R. japonica* in the creek. *R. japonica,* which inhabits Draper Creek, makes salmon movement difficult by creating vegetation islands in the creek.

These sediment piles and vegetation islands reduce the number of riffles and pools in the creek. Riffles and pools are essential creek features for the salmon as they use pools to hide from predators, while riffles add oxygen to the water and contain a lot of aquatic invertebrates that parr (juvenile salmon) eat. Vegetation islands in creeks bring more terrestrial invertebrates into the creek, which does not benefit the salmon since the parr only eats aquatic invertebrates. Ultimately, this project aims to create a complex salmon habitat by stabilizing Draper Creek's slopes and creating a 5-year management plan to map and monitor the invasive *R. japonica* found in Neilson Regional Park.

Neilson Regional Park (Figure 1) is one of ten FVRD regional parks. It is a ten hectares park on Mission's east side; it provides green space and access to the western side of Hatzic Lake (FVRD, 2023). Hatzic Lake is an oxbow lake that drains into the Fraser River and is located north of it. The Fraser River Draper Creek runs for roughly 3.5 km with an elevation gain of 99 m and feeds into Hatzic Lake (MapCarta, 2022). Draper Creek and Hatzic Lake are critical fish habitats. Salmon travel from the Fraser River into Hatzic Lake and up Draper Creek to look for their traditional spawning sites. It is a part of the Fraser Valley Lowlands (FVL) Ecosection (Demarchi, 2011) and part of the Coastal Western Hemlock dry maritime (CWHdm) biogeoclimatic zone (BEC). The CWH is one of the rainiest BEC zones in BC, and the Western hemlock is usually the most common species in the forest cover (Meidinger & Pojar,1991). However, since the research site has been disturbed and cultivated over the years, it does not follow the typical forest composition of the CWHdm BEC zone.

Since time immemorial, First Nation people have used the Fraser River and its surrounding areas, including what is now known as Neilson Regional Park. Neilson Regional Park was an area of interest to 21 First Nations groups and organizations: Stó:lō Nation; Stó:lō Tribal Council; Soowahlie First Nation; Seabird Island Band; Shxw'ōwhámél First Nation; Skawahlook First Nation; Kwantlen First Nation; Matsqui First Nation; People of the River Referrals Office; Peters First Nation; Popkum First Nation; Sumas First Nation; Hul'qumi'num Treaty Group; Stz'uminus First Nation; Cowichan Tribes; Halalt First Nation; Lake Cowichan First Nation; Lyackson First Nation; Penelakut Tribe; Semiahmoo First Nation; and Leq'a:mel First Nation (British Columbia, 2023).

The Neilson family owned the FVRD park property from 1941 until the sale of it in 1976 (Morris, 2015). The Neilson family sold the park to the Dewdney-Alouette Regional District (DARD) in conjunction with the province of BC (Gord, Haber, and Company, 1976). Therefore, the DARD acquired the ten-hectare park 1976 from Hilda Neilson (Gord, Haber, and Company, 1976). When the Neilson family owned the property, there had already been ecological changes and uses at the site around Hatzic Lake, such as fruit trees at the bottom of the northern field (Morris, 2015), and a few are still present today. For the duration of the Neilson Family's property ownership, they had several agricultural processes. For example, during World War II, the Jack family ploughed and planted tulips on the southern field (Morris, 2015). The Neilson family also leased the lands to the Woron family until the late 1970s for grazing cattle (Morris, 2015).

After selling the park property to the regional district, Neilson Regional Park officially opened on June 23, 1979. Between 1977 and 1979, most site improvement projects focused on the foreshore and Hatzic Lake access (Morris, 2015). In 1995, DARD and two other regional districts: Fraser-Cheam Regional District and Central Fraser, amalgamated to form what is now known as the FVRD (FVRD, 2023).

The project area spans two distinct sites, site A and site B, totalling 330 m^2 in size (Figure 2). Both sites are on the north side of Draper Creek, near its confluence with Hatzic Lake. Site A further divides into two subsections, A1 and A2, due to their ecological disparities despite their proximity. Site A1 occupies the upper slope, while site A2 lies within a depression. With the historical and ecological context of Neilson Regional Park and Draper Creek in mind, the invasive species restoration project strives to restore the delicate balance of this vital ecosystem and foster a sustainable environment for salmon.

Figure 2: Shows a map of the three restoration sites at Neilson Regional Park: A1, A2, and B. The blue dotted line is Draper Creek.

Methods

Ground Inspection Forms

Ground Inspection forms collect important information to determine the best suitable stabilizing native flora species for the restoration sites. The two potential planting sites had three ground inspection forms completed. Site A had two distinctive ecological systems due to the quick change in the slope. Appendix A has an overview of species at each restoration site. The location data on the ground inspection forms were collected using smartphone GPS locating devices to determine the sites' UTM, aspect, and elevation. A clinometer measured the slope of the sites. To measure the slope with the clinometer, one person stands at the top of the slope and points the clinometer at a target object at the bottom. To determine the soil components, a 0.6 m hole was dug at the center of each, using the soil keys from the BC’s Land Management Handbook No. 25 to determine the soil's characteristics.

Preparing the Restoration Sites

All three sites had an abundance of invasive species (Table 1 and Figure 3A and 3B). Several months before the native planting could occur, the sites needed to be prepared by removing the invasive vegetation that expedites bank erosion. Hand pulling was the primary method used to remove the invasive species. Volunteers met at Neilson Regional Park on August 27, 2022, to help prevent the spread of *I. glandulifera.* Ten volunteers used hand pruners to cut the flowering seed heads off the *I. glandulifera* plants and placed them in garbage bags before hand-pulling out the stalks for 30 hours. All the biomass was gathered and disposed of at a green waste facility (Figure 4C).

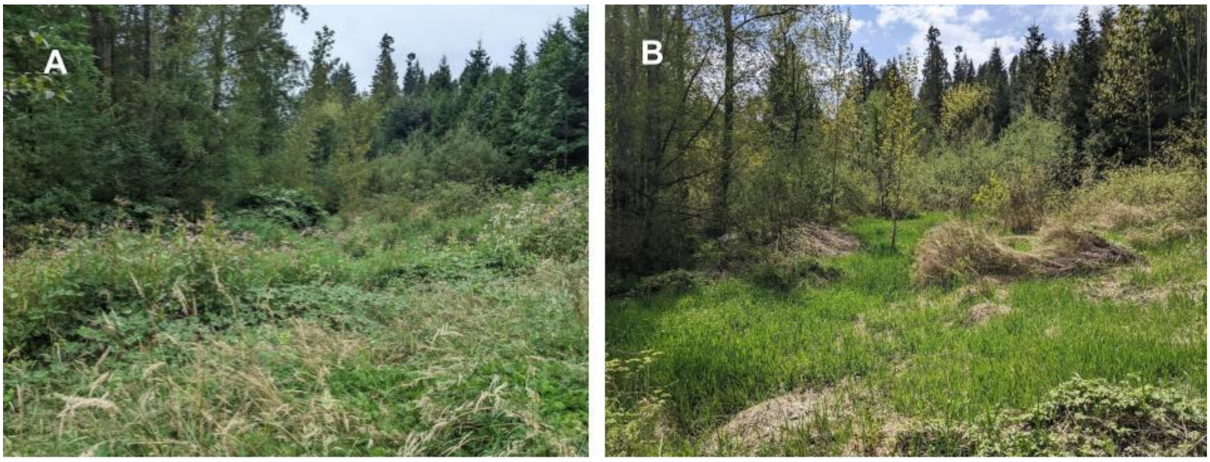


Figure 3: Shows restoration sites A1 (3A) and A2 (3B) before any of the restoration work.

Scenifictic Name	Common Name	Sites
Rubus armeniacus	Himalayan blackberry	A1 and B
Impatiens glandulifera	Himalayan balsam	A1, A2, and B
Phalaris arundinacea	Reedcanary grass	A2

Table 1: Invasive Species found at Restoration Sites

After the volunteer event, several FVRD staff prepared sites A and B for the native planting scheduled for the early fall over 30 hours. The FVRD staff mulched and removed *R. armeniacus* thickets by using a mulching blade on a line trimmer. This allowed the FVRD staff to come back a second day to dig out the *R. armeniacus* root balls with shovels and pickaxes to prevent its spread. Site A only required one day of prep work, where the *P. arundinacea* was trimmed low to the ground using a line trimmer. FVRD park staff will continue to keep the *P. arundinacea* low by trimming the area twice in a growing season to allow the native species to eventually shade out the invasive grass (Tu, 2004).

Native Species Plantings

On November 4, 2022, 20 students from the local elementary school helped plant native species at all three sites for 50 hours (Figure 4D). Eight different native species and 42 plants were planted throughout the three sites. Students brought their own gloves and gardening spades. The students received a demonstration on how to plant the native flora by FVRD staff. The students worked in groups to loosen the dirt and dig holes with their gardening spades. Once they had holes, the depth required for the nursery plant's root system, they added mulch to the bottom of the hole, removed the native plants from their nursery pots, loosened the nursery soil and the plant's root system before placing the plant in the hole. Once the plant was in the hole, mulch and dirt from the site were used to backfill the holes, then they gently pressed the soil around the roots to ensure good soil-to-root contact. After the roots were covered, FVRD staff provided cardboard to lay around the stems of the native plants; finally, mulch was added on top, ensuring there was space left around the stem to prevent rot. Adding the mulch and cardboard helps the new plantings retain moisture, suppress weeds and improve the soil's health.

Figure 4: 4C shows all the invasive plant material that volunteers removed from the restoration sites. 4D shows student volunteers planting native species at site B.

The native species' plantings happened in the fall; watering was unnecessary. Neilson Regional Park is in the Coastal Western Hemlock (CWH) Biogeoclimatic Ecosystem Classification (BEC) zone, which has high precipitation levels during the fall, winter and spring (BC Government, 2023). The plantings were watered during their first summer in 2023 and will require additional watering for the next two years; after that, they should be established on the site and not require additional watering. Additionally, the FVRD staff will continue to monitor the sites for invasive species, and the invasive species will need to be removed from sites A and B to ensure the native plantings succeed. Sites A and B already experienced regrowth from *R. armeniacus* and *I. glandulifera* in the spring and summer of 2023. Lastly, the *P. arundinacea* is being monitored and continually mowed low during the spring and summer.

Eight different native species were planted at the three restoration sites. They were selected at the end of the growing season from a local native plant nursery with available stock. All the plants chosen are native to the area and thrive in riparian ecosystems similar to those found along Draper Creek. Three deciduous trees were picked for the sites, and the 39 other native plants are shrubs.

*Crataegu*s *douglasii* (black hawthorn) preferred growing conditions are similar to the ecology found at site A1. *C. douglasii* is found on streamsides, with well-draining soil, at low to mid-elevations (Pojar & Mackinnon, 2004). The location of A1 is at the upper meso-slope; we planted all the *Cornus sericea* (red osier dogwood) and half of the *Physocarpus capitatus* (Pacific ninebark), where they will thrive in the upper streambank of Draper Creek with the full sun, rich and moist soils. Finally, three plants of *Rubus parviflorus* (thimbleberry) and *Rubus spectabilis* (salmonberry) were planted at this site. *R. parviflorus* and *R. spectabilis* grow near each other and in similar site conditions (British Columbia, Ministry of Agriculture, 2012). They are more hardy than some of the other species chosen and would grow successfully at all three sites.

The ideal conditions for *Alnus rubra* (red adler) include floodplains, streambanks with full sun or partly shaded conditions at low elevations (Pojar & Mackinnon, 2004). These conditions most closely fit the ecology found at site A2. On the planting day, the site was coming out of a prolonged drought and had recently received 18 mm of precipitation the day before; by the end of the planting day, an additional 40 mm had fallen (weatherstats, 2023). Since site A2 soil is composed mostly of clay, resulting in the soil having poor drainage, all the first few holes dug quickly filled with water. The conditions of the planting day meant that it was unrealistic to continue planting in site A2 during the current wet conditions.Therefore, we moved all of the additional species to sites A1 and B, where the soil drainage was better, making it easier to secure the native species in the ground successfully. The poor drainage and the precipitation resulted in site A2 getting fewer native species planted than initially planned.

They planted *Acer macrophyllum* (big leaf maple) at site B; here, it will be in its ideal conditions at a dry to moist soil site at a low elevation (Pojar & Mackinnon, 2004). *A. macrophyllum* can also tolerate temporary flooding (Corneau et al., 2002), which is possible at this location. The location of site B is on the mid-slope (Figure 5E); therefore, removing the invasive species that can contribute to slope and bank erosion was important (Figure 5F). P. capitatus, *R. parviflorus* and *R. spectabilis* all have stabilizing root systems that will benefit the mid-slope of the site (British Columbia, Ministry of Agriculture, 2012). Due to the steepness of the slope, it was essential to add back native species to secure the slope (Figure 5G). All the *Gaultheria shallon* (salal) was planted at this site to create a wall along the site's southern edge where additional invasive species are still growing. *G. shallon* is a hearty evergreen shrub that can be slow to establish but once it does it aggressively develops into large patches of rich foliage (Native Plants PNW, 2015).

Figure 5: This figure shows site B before any restoration was done (5E), after the invasive species have been removed (5G), and after the native planting (5F).

Reynoutria japonica Management

Due to its extensive rhizome system, the recommended way to treat *Reynoutria* spp is with herbicides; however, there are additional challenges with treating *R. japonica* at

Neilson Regional Park. The location of the *R. japonica* is inside and outside the Pesticide-Free Zone (PFZ). The *R. japonica* outside the PFZ does receive chemical treatments annually and it will continue to receive treatments until it is eradicated. The eradication of *Reynoutria* spp takes at minimum three years (Metro Vancouver, 2021). However, since there is untreated *R. japonica* in Draper Creek, it will likely grow outside the PFZ until all the *R. japonica* in Draper Creek has herbicide treatments. Nevertheless, the *R. japonica* inside the PFZ cannot obtain treatment without an herbicide permit, per the BC Integrated Pest Management Act and Regulation (2023). Since waterways fall under provincial ownership, the FVRD cannot obtain this permit, and the provincial government must make the request; reducing *R. japonica* is not currently feasible in Draper Creek.

Mechanically removing the *R. japonica* from Draper Creek would involve digging out the root systems; they can be up to 3 m deep and 20 m wide (Green, 2022). This process would destroy the creek bed and negatively affect the fish and spawning salmon in Draper Creek; therefore, this is not a reasonable option to mechanically remove the *R. japonica*. Instead, per advice and guidance from the Fraser Valley Invasive Species Society, the best action is to map and record the *R. japonica* and submit our findings to the Provincial Invasive Alien Plant Program IAPP, 2005 - 2023, now InvasivesBC database (Green, 2022). Morrow Bioscience is contracted to treat *R. japonica* outside the PFZ and will assit in mapping Draper Creek along with FVRD park staff.

Results

Ground Inspection Forms

The results from the ground inspection are in Appendix A. Sites A1 and B are both part of the Act-Red osier dogwood site series; therefore, they had the most similarities; however, all three of the sites have soils that were either plentiful or have abundant nutrients. They have minimum coarse soil fragments present, and there was no organic soil layer. Site A1 and B have a slope of 45 degrees which means this slope is prone to erosion with the slope stabilization vegetation present, whereas site A2's site series is Fm-middle bench flood class and is on a depression; therefore, it has no slope. A2’s Fm-middle bench flood class means that the area gets standing water during freshet and other periods with abundant rain (Province of British Columbia, 1998). The *P. arundinacea* at site A2 also clogs up the flood zone with a matted root system that slows water seepage causing the area to hold standing water longer (Anderson, 2012). This changes the original function of the ecosystem. All the sites are at a low elevation, ranging between 2 m to 9 m. The soil moisture regime (SMR) was the item that varied the most between the three sites. Site A1 SMR is subxeric, where the water drains rapidly from the loamy-slit soil; site A2 SMR is hygric, where the water drains slowly, and the clayey soil stays wet for most of the growing season; and finally, site B is submesic, where the water drains out of the silty-clay soil in moderately short periods after precipitation (Luttmerding et al., 1990).

Invasive Removal

At the end of August 2022, the ten volunteers spent three hours each assisting with the *I. glandulifera* removal in the three restoration sites; they collectively gathered 230 kg of invasive biomass. The volunteers did remove all the *I. glandulifera* from the three sites;

however, there was still *P. arundinacea* present in site A2 and *R. armeniacus* present on sites A1 and B. Several FVRD staff members removed these other two invasive species from the restoration sites in early fall; they removed an additional 235 kg of *R. armeniacus* and trimmed 189 m^2 of *P. arundinacea* low to the ground. Over the course of this project over 465 kg of invasive plant material was removed from the three restoration sites.

Native Species Planting

Eight different native species and 42 native plants were used throughout the three sites (Table 2). Each of the three sites received a tree to plant, and the majority of the shrubs were in sites A1 and B, with A2 only getting two other shrubs and a total of 3 native species.

Scenifictic Name	Common Name	Site A1	Site A2	Site B	Total planted
Acer *macrophyllum*	Big leaf maple	0	0	1	1
Alnus rubra	Red alder	0	1	0	1
Crataegus douglasii	Black hawthorn	1	0	0	1
Cornus sericea	Red osier dogwood	3	0	0	3
Gaultheria shallon	Salal	0	0	8	8
Physocarpus capitatus	Pacific ninebark	4	0	4	8
Rubus parviflorus	Thimbleberry	3	1	6	10
Rubus spectabilis	Salmonberry	3	1	6	10

Table 2: Native Species Planted on Restoration Sites

Site A1

C. douglasii was the tree in site A1 along with the three *Cornus sericea*, 4 of the *Physocarpus capitatus,* and 3 of both the *R. parviflorus* and *R. spectabilis,* making a total of 14 native species.

Site A2

A. rubra was the only tree and one of three native species planted in site A2 along with one *R. parviflorus* and *R. spectabilis*. Due to extremely wet weather many of the species planned for this area were moved into the other two sites.

Site B

A. macrophyllum got planted where the slope steepness had leveled out at site B. All 8 *Gaultheria shallon* plants were planted at the south edge of the plot to create a barrier between site B and the rest of the uncleared *R. armeniacus* along the slope. The remaining *P. capitatus*, *R. parviflorus*, and *R. spectabilis* were randomly planted on the slope for 25 plants on site B.

Discussion

The majority of the flora species found on the three sites are invasive; understanding the ecological systems at each site helped determine which native species would be beneficial to add to the sites. The ground inspection surveys provided insight into what native vegetation would thrive on these restoration sites. The three sites had many similarities in soil richness and a minimal difference in elevation; however, they are all located on different parts of a slope and show a variety in their vegetation despite the prevalence of invasive species at each site. Site A1 was located at the upper slope and had the least invasives present; this site was mostly *Poa pratensis* (Kentucky bluegrass), with a few *R. armeniacus* located towards the southern and eastern outside edges and the downward slope. The *I. glandulifera* is present throughout the tall grasses and steep sections of the downward slope. The location of site A2 is in a depression where there was a thick covering of the tall *P. arundinacea*; however, this site had the most native species present on the site with some sparsely placed *Spiraea douglasii* (hardhack) and *Athyrium filix-femina* (lady fern). Finally, site B is found on the middle slope and was a thicket of *R. armeniacus* with *I. glandulifera* growing throughout the openings in the thicket and along the edges where sunlight was present.

Native Species

In the spring in 2023, all three tree species and 92 percent of the shrubs got new growth. Only three of the shrubs did not make it through the harsh winter. Many different garden weeds came up around the new native species in site B. A lot of bare soil had been left between the plantings. The bare soil makes weeding the area easier but provides a large space for them to spread. Planting more native shrubs at each site and packing them closer together may have shaded out the new garden weeds that appeared. This was not the case for site A1 because it had a lot of *P. pratensis* present around the planting that was not removed. Wet conditions on the site A2 planting day, meant that many plants were migrated to sites A1 and B. Site A2 looks similar to the way it did after the site preparation with the *P. arundinacea* cut low to the ground.

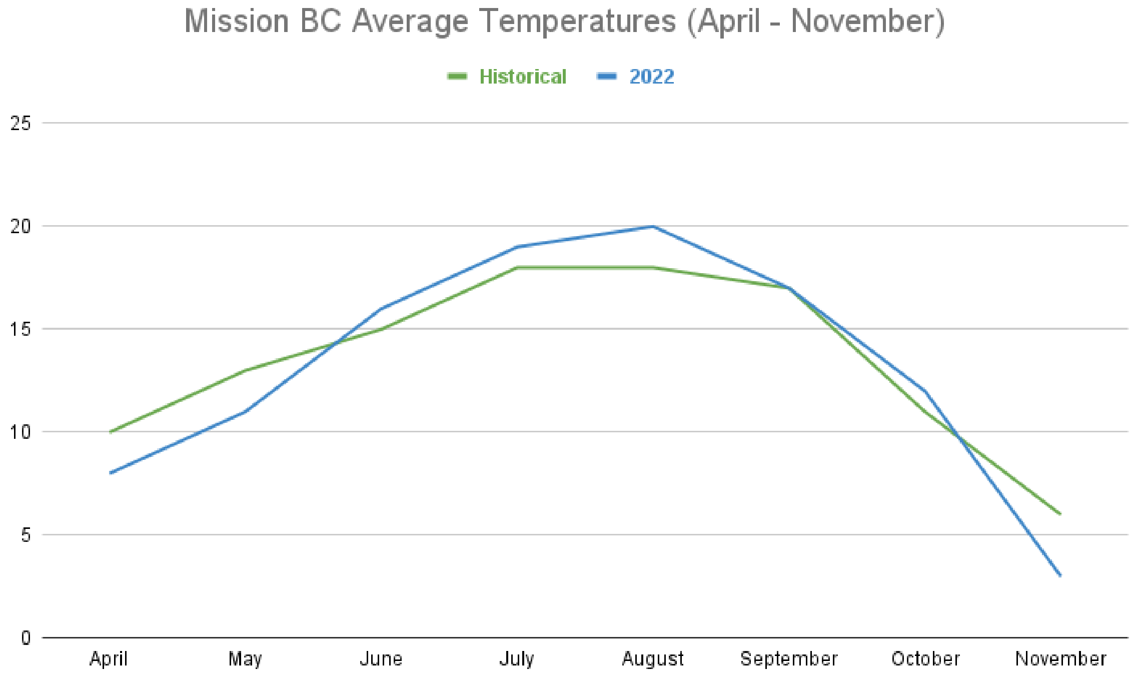
Each invasive species mentioned in this paper negatively affects the native salmon habitat. They alter creek and stream ecosystems by depositing an abundance of sediment into the creek and reducing the essential creek features that salmon and other aquatic species utilize to thrive in their habitat. Since many invasive species are quick and aggressive invaders, they alter the creek’s functions before any native aquatic species can adapt, resulting in dwindling populations and local extinction. Salmon is a keystone species because they support over 130 other species in British Columbia, including humans (Pacific Salmon Foundation, 2023). They are an essential part of the ecosystems and culture in the Fraser Valley. The loss of keystone species like salmon would forever change their ecosystems and negatively affect many other species.

For example, bald eagles capture the returning spawning salmon, where they lay their eggs and eat and dispose of their body around nearby forested ecosystems (Pacific Salmon Foundation, 2023). The leftover salmon carcasses deposit nitrogen into the soil, a nutrient the vegetation requires to grow (Pacific Salmon Foundation, 2023). If salmon are displaced from one of their traditional spawning sites, like Draper Creek, the forested areas around the spawning site would lose out on maintaining nitrogen-rich soil. It could also decrease or displace bald eagles and other salmon predator populations.

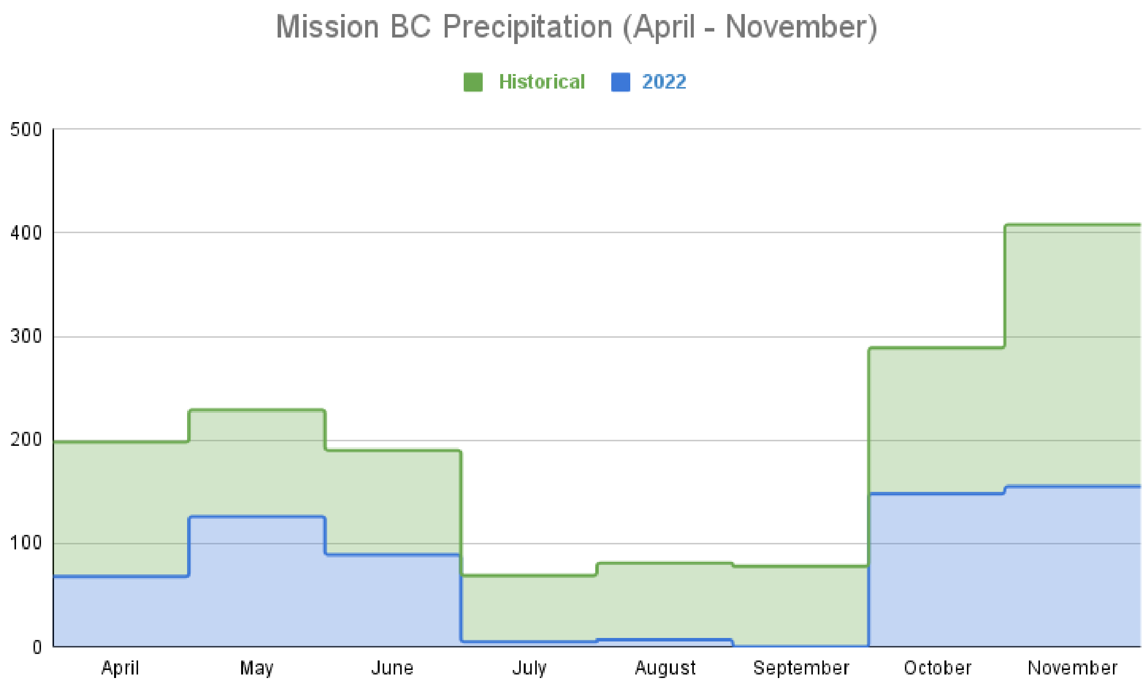
Weather

The project took place from April to November of 2022. The weather was abnormal for the region, adding additional challenges to the project. The Fraser Valley experienced a cold spring that continued into the start of July (Graph 1); this affected the growing season. The *I. glandulifera* located in the park usually starts flowering from late June and early July. However, in 2022 the flowering was delayed due to the cold spring. It is important for the flowers to start blooming to make it easy for volunteers to correctly identify them for removal; therefore, the volunteering event got pushed into August.

The Fraser Valley region was in drought, which extended the wildfire season well into October (Graph 2), causing poor air quality. The goal of planting the native species in the fall was to eliminate the need for watering, as they would get moisture from the rainy fall days as they lay dormant until the next growing season. Alternatively, if the native species were planted in the spring, they would have required weekly watering over the spring and summer months to help them get established. High temperatures and poor air quality from wildfires burning late in the year made it unsuitable for the students to plant the native species until the air quality improved and the region was experiencing consistent precipitation. By the middle of October the weather started to cool down (weatherstats, 2023). As the effects of climate change continue to alter long-term weather patterns in all regions, steps need to be taken to adapt to these changing work conditions.



Graph 1: Mission, BC Comparing the Average Temperature from April to November in 2022 and Historical.



Graph 2: Mission, BC Comparing the Average Precipitation from April to November in 2022 and Historical.

Invasive Species

Phalaris arundinacea

P. arundinacea is an aggressive invader, perennial grass that forms a sod layer, which contributes to an increase of bank sediment and is known to alter stream flow which can degrade riparian areas through flooding and constricting waterways (Lavergne & Molofsky, 2004). Like other invasive species at Neilson Regional Park, the grass creates a monoculture that suppresses the growth native deep-rooting species by pushing chemicals out of its root system (Jonsson, 2023). Its creeping rhizomes systems exclude other plants by reducing oxygen levels as it biodegrades, decreasing native flora species, which can increase in water temperatures and decrease in oxygenation (Metro Van, 2021). Deoxygenation has negative effects on all aquatic species, including salmon (Jonsson, 2023). *P. arundinacea* tends to be abundant between emergent plant communities; this is the case at site A2, where it is dominant.

It is a challenging area to work in and makes it hard to remove *P. arundinacea* from an ecosystem without using a pesticide or completely digging out the invasive grass. The only other way to decrease its presence is to create a closed canopy, blocking the sunlight from reaching *P. arundinacea*; therefore, planting fast-growing shrubs and trees will shade out the *P. arundinacea* to reduce its dominance on-site (Tu, 2004). We are attempting the shade out approach; however, due to the wet conditions on the planting day very few native species were added to site A2. Ultimately without a dense ground cover of quick growing native shrubs the *P. arundinacea* will continue to dominate the site and cause harm to the Draper Creek salmon habitat.

Rubus armeniacus

R. armeniacus are abundant around the Fraser Valley; they are naturalized in BC, meaning they are established non-native species in our environment. They are especially prevalent in Mission, BC; they grow in full sun and create large amounts of shade, out competing other native riparian species (FVISS, 2023); hence blackberries are found in ditches, undeveloped land, and riparian banks, which is the case at Neilson Regional Park. There are large thickets of blackberries on the slopes around the park and on the banks of Draper Creek. Similarly to the other invasive species found on the riparian banks, it provides minimal stream bank protection with its shallow nodular root system that can contribute to streambank and slope erosion (ISCMV, 2023).

When a streambank erodes into a stream, it has the potential to cause much harm to that ecosystem. The potential harm includes loss of wildlife habitat, higher levels of nutrients in the stream, clouding of the stream, vegetation falling into the stream blocking the waterway and the loss of canopy cover over the water (Xenophon, et al., 2022). Fish and other aquatic benthic organisms are susceptible to the slightest changes in their environments. An increase in nutrients in the water and the loss of canopy cover over a stream can quickly increase a shallow stream's water temperatures (Xenophon, et al., 2022). Any of these changes can cause a decrease in salmon reproduction and a loss of food sources in the aquatic ecosystem. It is essential to remove invasive species that compromise the stability of a slope and replant deep-rooting native shrubs in their place.

Impatiens glandulifera

I. glandulifera is an invasive annual plant present around the banks of Draper Creek because it is known to overtake areas with moist soils. It is native to the Himalayas in Northern India and was introduced to North America in the early 1800s as a hitchhiker in ships' ballast water and as an ornamental plant (Ammer et al., 2011)**.** The ripe seed pods erupt at the slightest pressure or disturbance and have the potential to travel up to 7 m away (Lehmann, 2013). Each plant can produce up to 800 viable seeds for two years and are able to germinate underwater (Lehmann, 2013). Their unique seed dispersal helps them spread quickly and create monocultures in riparian areas. *I. glandulifera* have very shallow roots, which contribute to bank erosion in riparian areas, destabilize slopes and cause slope erosion (Greenwood, et al., 2018).

They are easy to remove by hand pulling because of their shallow roots, but this removal method is only successful before the seed pods have formed. Once the seed pods are on the flowering plant, any disturbance, such as removal, will result in the pods bursting and releasing their seeds for the following year. Since *I. glandulifera* is an annual plant that grows from a new seed each year (Lehmann, 2013), cutting off the flowers before the seed pods form would provide similar results to removing the whole plant. The benefit of removing all the plant material from a site would be to plant native species in their place; the latter was chosen at the three restoration sites. The bright pink flowers have a hooded shape and grow in clusters of five to ten. These plants are easy to identify with their unique hexagonal stocks and bright pink flowers, making them an easy target for volunteers to remove.

Reynoutria japonica Management

Four different invasive *Reynoutria* spp were introduced to BC in 1908 as cultivated horticultural specimens (Barney, 2006); they are now considered noxious under BC's Weed

Control Act and are on the International Union of Conservation of Nature's list of the 100 worst invasive species (Lowe et al., 2000). All *Reynoutria* spp are tolerant to multiple soil types and have aggressive rhizomes that can successfully propagate with only 0.7 g of root or stem material in the soil (Beerling et al., 1994). *Reynoutria* spp can also successfully reproduce from viable seeds dispersed from contaminated soil and equipment, improper disposal of removed plant matter, wind, wildlife, cutting or mowing, and flooding events (Metro Van, 2019). It is present in riparian areas where *Reynoutria* spp can erode the banks because their roots lack true root hairs that bind to the soil (Metro Van, 2019).

Reynoutria spp *has* extremely negative ecological, social and economic impacts. Ecologically, *Reynoutria spp* creates monocultures threatening native species, biodiversity, and ecosystem functions. At Neilson Regional Park, *R. japonica* monocultures starting from Draper Creek are growing outwards along the banks. As the *R. japonica* grows along the banks, it will erode due to the lack of true root hairs on *Reynoutria* spp rhizomes, creating unstable slopes (ISC, 2017). When it’s present in the creek, it creates bottlenecking, making it more challenging for the salmon to navigate back to their spawning sites. The additional sediment in the water decreases the amount of aquatic invertebrates for the parr to eat. The social impacts of *Reynoutria* spp include being a nuisance to aquatic recreation as it impedes across to the water bodies (FVISS, 2023). If it has not already started, this will likely happen once the knotweed spreads from Draper Creek into Hatzic Lake. *Reynoutria sp* rhizomes and stems can grow through asphalt, building foundations, concrete retaining walls and drains, which can affect homeowners and municipalities economically when *Reynoutria* spp causes damage to existing infrastructure (FVISS, 2023)

Reynoutria spp goes dormant over winter and grows over the spring and summer months. The green stems, also known as canes, are hollow, and their thickness varies depending on the age of the plant (ISC, 2017). Mature plants grow together in dense thickets. The flowers come out in the mid to late summer and are small white and green flowers that grow in plume-like clusters along the leaf axils before they go to seed (ISC, 2017). The leaves are bright green with a heart to triangular shape, and the leaves are in an alternating zigzag pattern on the stem (ISC, 2017). Their characteristics make them easy to spot.

R. japonica was not present at any of the restoration sites; however, it is all along Draper Creek. Since Draper Creek extends outside the park boundaries, treating *R. japonica* without treating all connecting waterways would not be productive. *R. japonica* propagates readily from broken stems and rhizomes; and can easily travel downstream when located in moving bodies of water (e.g., Draper Creek into Hatzic Lake) (Metro Van, 2019). Mapping the *R. japonica* was the best way to monitor the invasive until a better removal method can be used in a PFZ.

Unfortunately, the *R. japonica* will continue to grow and spread in Draper Creek. The FVRD staff will use an internal mapping program to monitor the growth and spread of the *R. japonica* throughout the site. The internal mapping will show the changes in the *R. japonica* over the next five years. It would be ideal to compare this data with the Province of BC through their invasive species database. However, the Province of BC's previous invasive species database, IAPP (Invasive Alien Plant Program), was used from 2005-2023 and is no longer available. There is a new invasive species database called InvasiveBC (2023); the new invasive database is still in its beta stages, and the map viewer is not available to the public yet.

Long-Term Management Plan

In November 2021, the Fraser Valley had a significant flooding event, and the project site was underwater for several weeks. Additional debris came into Draper Creek, completely blocking an area of Draper Creek, the course of Draper Creek changed in Neilson Regional Park, and the flooding event could bring additional invasive species into areas they did not previously exist. It will take two years to know if any different invasive species are present on new sites (Green, 2023). Therefore, when monitoring the three restoration sites it will be important to look for additional invaders and returning invasives in the upcoming years.

The native species planting at the three sites were successful (figure 6H and 6I); however, if they are left unattended, the same invasive species may come back from the plot edges out-competing the native plantings. Hence all restoration sites need a long-term management plan after the initial work. The FVRD park staff will monitor and maintain the three sites for five years. Years two to five will require the removal of invasive species that creep back into all three sites. The *P. arundinacea* at site A2 will be line-trimmed two to three times a growing season to prevent it from shading out the native species. As the years continue, the native species will become more established, allowing them to shade out the *P. arundinacea*. After five years the park staff will reevaluate the restoration site to see if additional monitoring will be required.

Figure 6: Shows the completed native species plantings for site A1 (6H) and site B (6I).

Overall, the Draper Creek restoration project is a valuable example for other riparian areas facing similar ecological challenges. With a goal of enhancing the habitat of keystone species, like salmon, many other native species and ecosystems benefit from the restoration work. Therefore, planting carefully selected native species, actively managing invasive species, and adapting to changing weather patterns due to climate change, can enhance ecosystem resilience and promote biodiversity in these critical natural habitats. Continued monitoring and commitment to long-term management will be essential to enhancing the salmon habitat at Draper Creek and ensuring that the ecological balance and native species diversity are preserved for generations to come.

Citations

Ammer, C., Schall, P., Wördehoff, R., Lamatsch, K., & Bachmann, M. (2011). Does tree seedling growth and survival require weeding of Himalayan balsam (Impatiens glandulifera). European Journal of Forest Research, 130(1), 107–116. https://doi.org/10.1007/s10342-010-0413-0

Anderson, H. (2012). Invasive Reed Canary Grass (Phalaris arundinacea subsp. arundinacea) Best Management Practices in Ontario. Ontario Invasive Plant Council, Peterborough, ON. Retrieved from https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/06/OIPC_BMP_ReedCanaryGrass.pdf

Barney, J.N. (2006). North American history of two invasive plant species: phytogeographic distribution, dispersal vectors, and multiple introductions. Biological Invasions 8: 703-717.
BC Government. (2023). Biogeoclimatic Zones of British Columbia. Retrieved from https://www.for.gov.bc.ca/hfd/library/documents/treebook/biogeo/biogeo.htm

BC Laws. (2023). BC Integrated Pest Management Act and Regulation. Retrieved from https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/604_2004
British Columbia. (2023). InvasivesBC database and mobile application. Retrieved from https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species/invasivesbc

Beerling, D.J., J.P. Bailey, and A.P. Conolly. (1994). Biological flora of the British Isles: Fallopia japonica (Houtt.) Ronse Decraene. Journal of Ecology 82: 959-979
City of Mission. (2023). Webmap. Retrieved from https://map.mission.ca/Html5Viewer/?viewer=External#

British Columbia. (2023). First Nations Consultative Areas Database. Retrieved September from http://webmaps.gov.bc.ca/imfx/imf.jsp?session=1106701612&sessionName=Consultative Areas Database Public&theme-path=Corporate+Applications%2FConsultative_Areas_Database_Public.ssn

British Columbia, Ministry of Agriculture, (2012). Riparian factsheet - No. 4 in series. Selecting plants for agricultural riparian plantings. 810.210-4. Retrieved from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/riparian/810210-4_selecting_plants_for_agric_riparian_plantings.pdf

Corneau, P., and Boateng, J., (2002). Operational summary for big leaf maple complex. Forest Renewal BC. Retrieved from https://www.for.gov.bc.ca/hfp/publications/00041/bigleaf_maple.pdf

Demarchi, D.S. (2011). An introduction to the eroregions of British Columbia, third edition. Ecosystem Information Section Ministry of Environment, Victoria, British Columbia. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/ecosystems/broad-ecosystem/an_introduction_to_the_ecoregions_of_british_columbia.pdf

FVISS, Fraser Valley Invasive Species Society. (2023). Himalayan blackberries. Retrieved from https://fviss.ca/invasive-plant/himalayan-blackberry

FVISS, Fraser Valley Invasive Species Society. (2023). Knotweed Species. Retrieved from https://fviss.ca/invasive-plant/knotweed-species

FVRD, Fraser Valley Regional District. (2023). Neilson Regional Park. Retrieved from https://www.fvrd.ca/EN/main/parks-recreation/parks-trails/neilson-regional-park.html

FVRD, Fraser Valley Regional District. (2023). What is the FVRD? Retrieved from https://www.fvrd.ca/EN/main/about-the-fvrd/what-is-the-fvrd.html

Gordy, Haber and Company (1976). April 26, 1976 letter to DARD confirming sale of property. Mission, BC: document on file at Fraser Valley Regional District, Chilliwack, BC.
Green, Kathy Ma. (2022). Telephone Conversation. Fraser Valley Invasive Species Society Executive Director.

Green, Kathy Ma. (2023). Fraser Valley Invasive Species Society Presentation. Fraser Valley Invasive Species Society Executive Director.

Green, R. N., Klinka, K., & Green, R. N. (1994). A field guide to site identification and interpretation for the Vancouver Forest Region. Research Branch, Ministry of Forests. - Appendix A

Greenwood, P., Bauman, P., Pulley, S. et al. (2018). The invasive alien plant, Impatiens glandulifera (Himalayan Balsam), and increased soil erosion: causation or association? Case studies from a river system in Switzerland and the UK. J Soils Sediments 18, 3463–3477 (2018). https://doi.org/10.1007/s11368-018-2041-0

ISC, BC. (2017). Knotweed Factsheet. Retrieved from https://bcinvasives.ca/wp-content/uploads/2021/01/ISCBC-Factsheet-Knotweeds-180216-WEB.pdf

ISCMV, (2023). Himalayan Blackberry. Retrieved from https://iscmv.ca/invasives/detail/himalayan-blackberry

Jonsson, A. (2023). Describes the invasive reed canary grass and how it impacts native plants and fish. Video Retrieved from https://rivershed.com/blog/reed-canary-grass/

Lavergne, S., & Molofsky, J. (2004). Reed Canary Grass (Phalaris arundinacea) as a Biological Model in the Study of Plant Invasions, Critical Reviews in Plant Sciences, 23:5, 415-429, DOI: 10.1080/07352680490505934

Lehmann, S. (2013). Himalayan balsam. Retrieved from http://biodiversity.sk.ca/Docs/InvasiveSpeciesCouncilFactSheets/Himalayan%20Balsam.pdf

Lowe, S.J., M. Browne, and S. Boudjelas. (2000). 100 of the World's Worst Invasive Alien Species: A Selection from the Global Invasive Species Database. IUCN/SSC Invasive Species Specialist Group. http://www.issg.org/pdf/ publications/worst_100/english_100_worst.pdf.

MapCarta. (2022). Draper Creek. Retrieved from https://mapcarta.com/24230720

Meidinger, D., & Pojar, J. (1991). Ecosystems of British Columbia. Special Report Series 6, Victoria, BC: B.C. Ministry of Forests and Range Research Branch. Retrieved from https://www.for.gov.bc.ca/hfd/pubs/docs/srs/srs06.htm

Metro Vancov\uver. (2021). Metro Vancouver and the Invasive Species Council of Metro Vancouver, 2021. Best Management Practices for Reed Canarygrass in the Metro Vancouver Region. Retrieved from https://metrovancouver.org/services/regional-planning/Documents/reed-canarygrass-best-management-practices.pdf#search=reed%20canarygrass

Metro Vancouver. (2019). Metro Vancouver and the Invasive Species Council of Metro Vancouver, 2019. Best Management Practices for Knotweed Species in the Metro Vancouver Region. Retrieved from
http://www.metrovancouver.org/services/regional-planning/PlanningPublications/KnotweedsBMP.pdf

Morris, J. (2016). Archaeological overview assessment of maintenance project in Neilson Regional Park. Internal document for Fraser Valley Regional District.

Native Plants PNW. (2015). Salal, Gaultheria shallon. Retrieved from
http://nativeplantspnw.com/salal-gaultheria-shallon/

Pacific Salmon Foundation. (2023). Salmon are keystone species. Retrieved from
https://psf.ca/work/watershed/restoration/

Pojar, R. A., MacKinnon, et al. (2004). *Plants of coastal British Columbia, including Washington, Oregon & Alaska* (Revised edition.). Lone Pine Pub.

Province of BC. (2023). InvasiceBC database and mobile application. Retrieved from
https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species/invasivesbc#getting-access

Province of British Columbia. (1998). Land management handbook, ISSN 0229-1622 ; 25)
Co-published by B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks.
ISBN 0-7726-3604-4

Stewardship Centre for BC. (2002). Hatzic Valley watercourse inventory. Retrieved from
https://stewardshipcentrebc.ca/scbc-case-studies/hatzic-valley-watercourse-inventory/

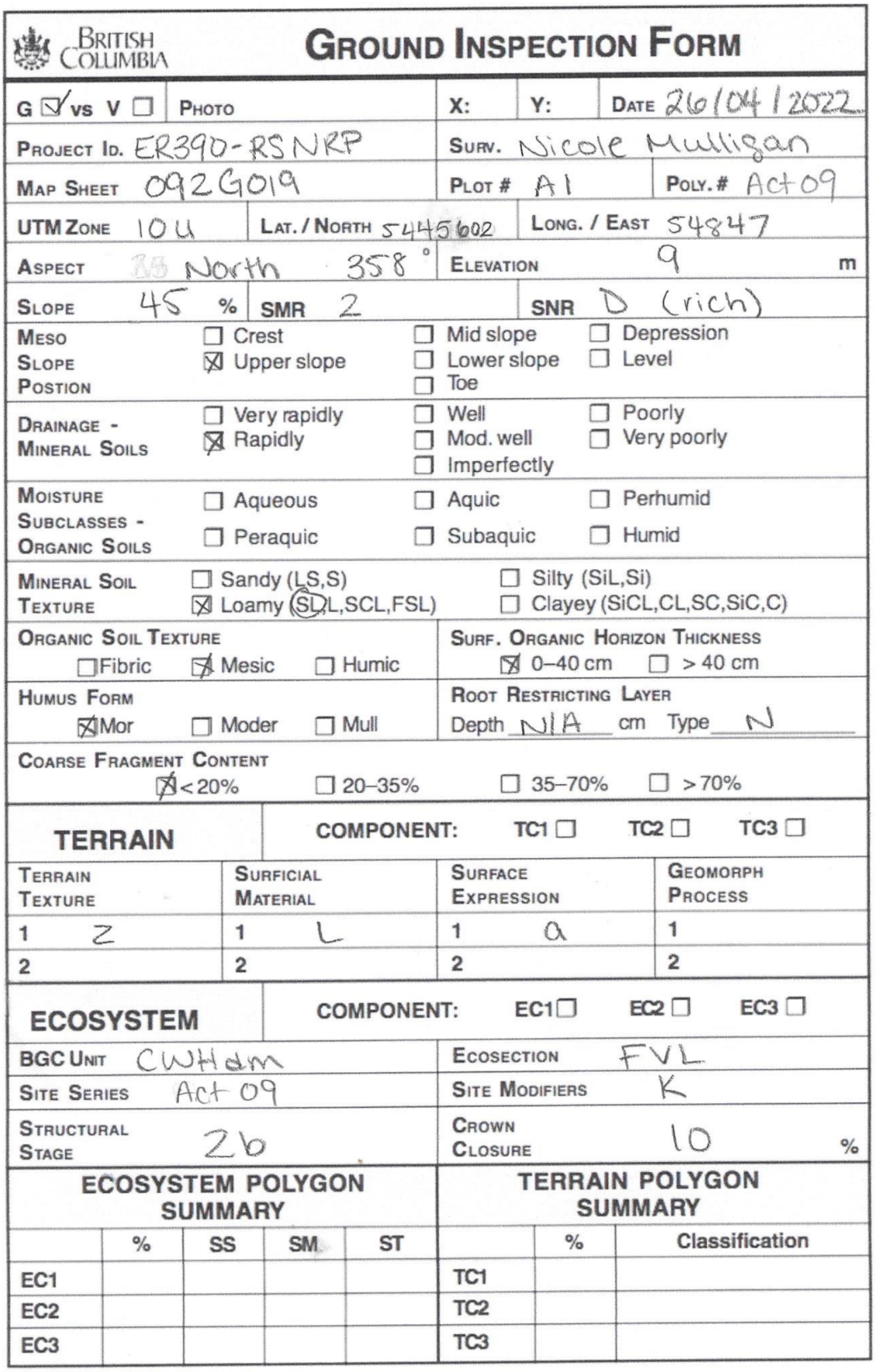
Tu, M. (2004). Reed Canarygrass (Phalaris arundinacea L.) Control & Management in the Pacific Northwest. The Nature Conservancy's Wildlife Invasive Species Team. The Nature Conservancy, Oregon Field Office. Retrieved from https://www.invasive.org/gist/moredocs/phaaru01.pdf

Weather Stats. (2023). Weather Dashboard for Abbotsford. Retrieved from
https://abbotsford.weatherstats.ca/

Xenophon, S.K., Kock, K., and Fetter, J.R. (2022). A deathly stream has stream bank cover. Retrieved from https://extension.psu.edu/a-healthy-stream-has-stream-bank-cover

Figures and Graphs
Figure 1: Created by Author using imagery from City of Mission. (2023). Webmap. Retrieved from
https://map.mission.ca/Html5Viewer/?viewer=External#
Figures 2-5: Created by Author using photos taken by Author
Graph 1 and 2: Created by Author using data from:
Weather Stats. (2023). Weather Dashboard for Abbotsford. Retrieved from
https://abbotsford.weatherstats.ca/
Eldorado Weather. (2023). Mission, British Columbia Canada Climate Data
Mission Average Monthly Climate Data & Extremes. Retrieved from
https://www.eldoradoweather.com/canada/climate2/Mission.html

Appendix A: Ground Inspection Forms for sites A1, A2, and B.



BRITISH COLUMBIA

GROUND INSPECTION FORM

G ☑ vs V ☐ | PHOTO | X: | Y: | DATE 26/04/2022

PROJECT ID. ER390-RSNRP

SURV. Nicole Mulligan

MAP SHEET 092G019

PLOT # A1

POLY. # Act09

UTM ZONE 10U

LAT. / NORTH 5445602

LONG. / EAST 54847

ASPECT North 358 °

ELEVATION 9 m

SLOPE 45 %

SMR 2

SNR D (rich)

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: ☐ Fibric ☒ Mesic ☐ Humic

SURF. ORGANIC HORIZON THICKNESS: ☒ 0–40 cm ☐ > 40 cm

HUMUS FORM: ☒ Mor ☐ Moder ☐ Mull

ROOT RESTRICTING LAYER: Depth N/A cm Type N

COARSE FRAGMENT CONTENT: ☒ < 20% ☐ 20–35% ☐ 35–70% ☐ > 70%

TERRAIN

COMPONENT: TC1 ☐ TC2 ☐ TC3 ☐

TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1 z	1 L	1 a	1
2	2	2	2

ECOSYSTEM

COMPONENT: EC1 ☐ EC2 ☐ EC3 ☐

BGC UNIT CWHdm

ECOSECTION FVL

SITE SERIES Act 09

SITE MODIFIERS K

STRUCTURAL STAGE 2b

CROWN CLOSURE 10 %

ECOSYSTEM POLYGON SUMMARY

	%	SS	SM	ST
EC1				
EC2				
EC3				

TERRAIN POLYGON SUMMARY

	%	Classification
TC1		
TC2		
TC3		

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	A: 2	B: 8	C: 90	D:

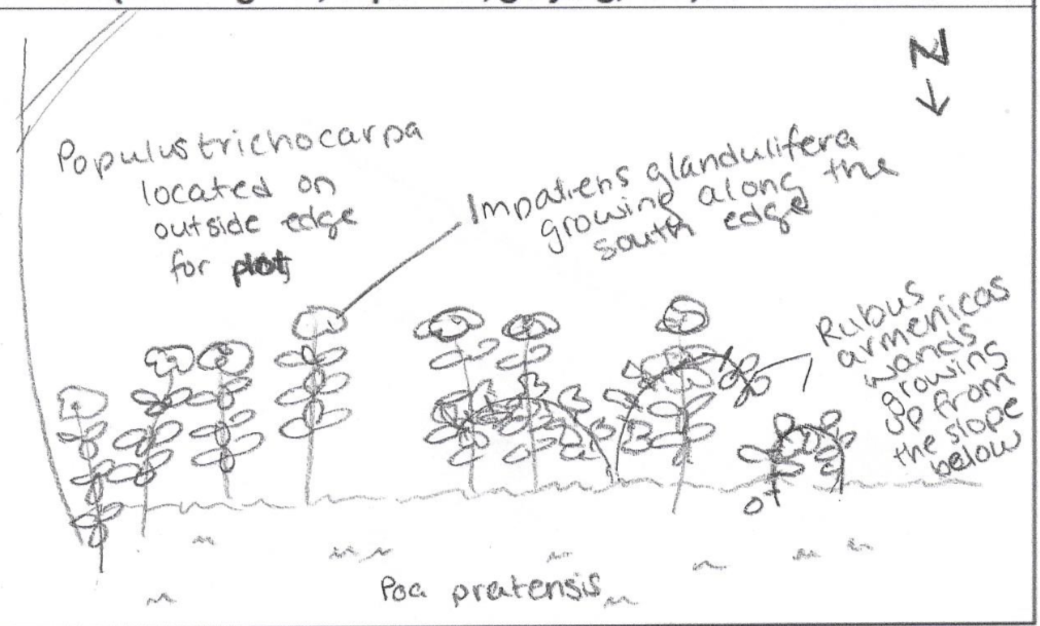
L.	SPECIES	%	L.	SPECIES	%	L.	SPECIES	%
A	Populus trichocarpa	2						
B	Impatiens glandulifera	6						
B	Rubus armeniacus	2						
C	Poa pratensis	90						

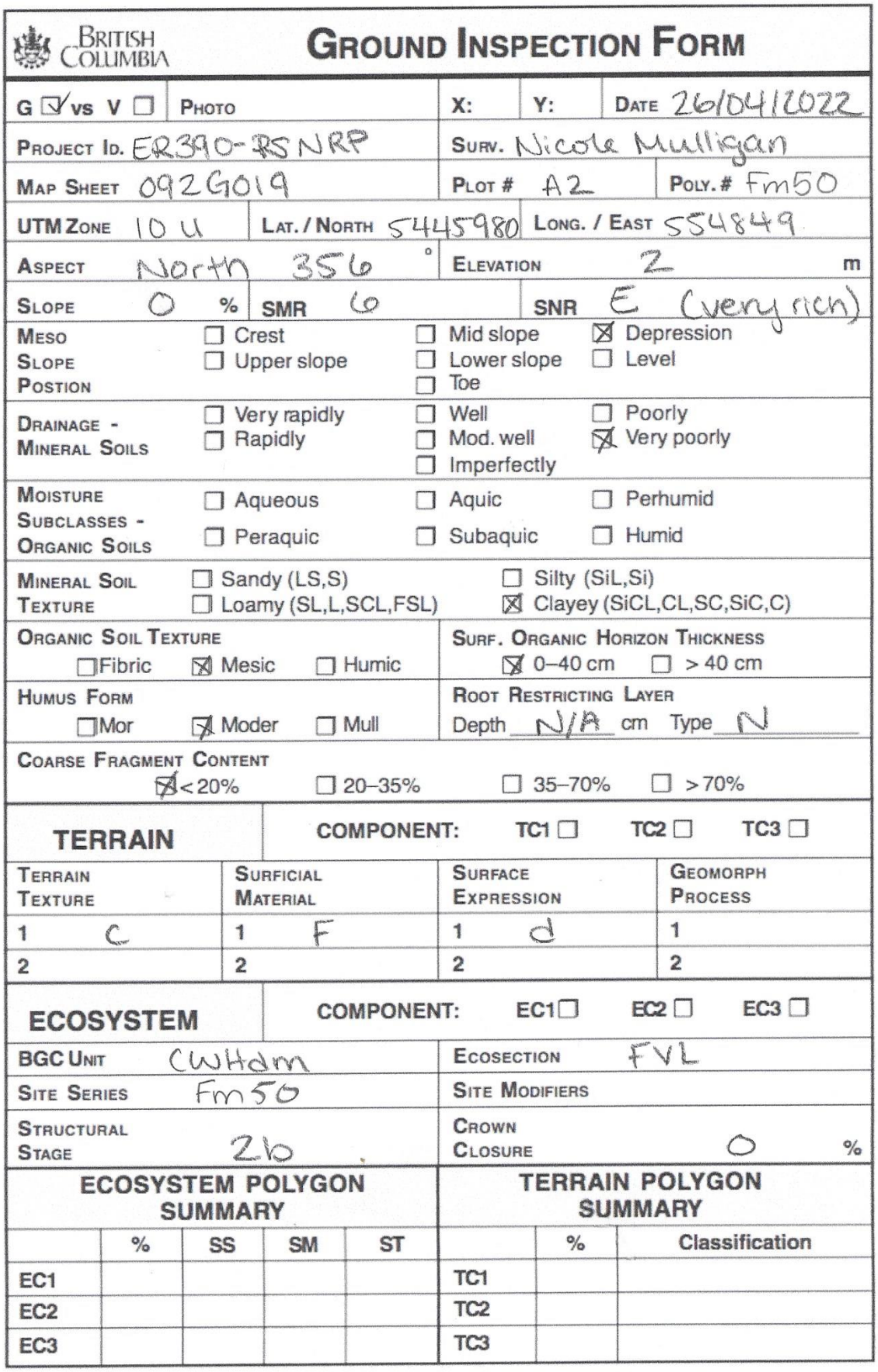
COMPLETE ☑ PARTIAL ☐

Tree Mensuration

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

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





BRITISH COLUMBIA

GROUND INSPECTION FORM

G ☑ vs V ☐ | PHOTO | X: | Y: | DATE 26/04/2022

PROJECT ID. ER390-RSNRP

SURV. Nicole Mulligan

MAP SHEET 092G019

PLOT # A2

POLY. # Fm50

UTM ZONE 10 U

LAT. / NORTH 5445980

LONG. / EAST 554849

ASPECT North 356 °

ELEVATION 2 m

SLOPE 0 %

SMR 6

SNR E (very rich)

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
- ☐ Fibric
- ☒ Mesic
- ☐ Humic

SURF. ORGANIC HORIZON THICKNESS
- ☒ 0–40 cm
- ☐ > 40 cm

HUMUS FORM
- ☐ Mor
- ☒ Moder
- ☐ Mull

ROOT RESTRICTING LAYER

Depth N/A cm Type N

COARSE FRAGMENT CONTENT
- ☒ < 20%
- ☐ 20–35%
- ☐ 35–70%
- ☐ > 70%

TERRAIN

COMPONENT: TC1 ☐ TC2 ☐ TC3 ☐

TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1 c	1 F	1 d	1
2	2	2	2

ECOSYSTEM

COMPONENT: EC1 ☐ EC2 ☐ EC3 ☐

BGC UNIT CWHdm

ECOSECTION FVL

SITE SERIES Fm50

SITE MODIFIERS

STRUCTURAL STAGE 2b

CROWN CLOSURE 0 %

ECOSYSTEM POLYGON SUMMARY

	%	SS	SM	ST
EC1				
EC2				
EC3				

TERRAIN POLYGON SUMMARY

	%	Classification
TC1		
TC2		
TC3		

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	A: 8	B: 2	C: 90	D:

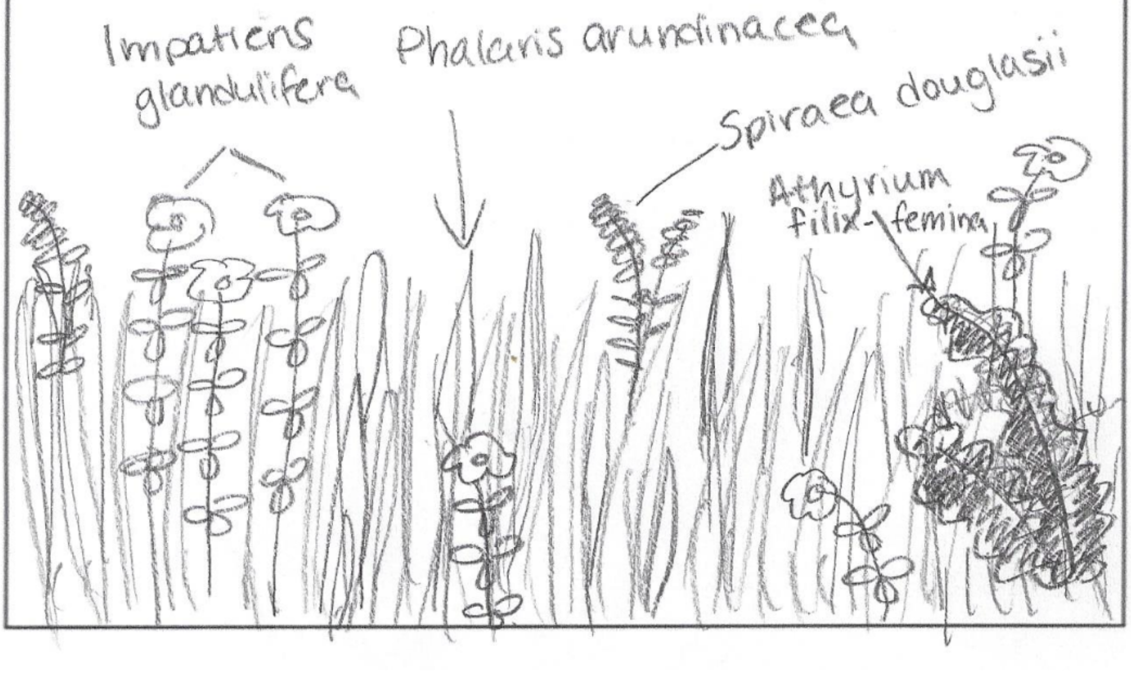
L.	SPECIES	%	L.	SPECIES	%	L.	SPECIES	%
A	Spiraea douglasii	2.5						
A	Impatiens glandulifera	5.5						
B	Athyrium filix-femina	2						
C	Phalaris arundinacea	90						

COMPLETE ☑ PARTIAL ☐

Tree Mensuration

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

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



BRITISH COLUMBIA

GROUND INSPECTION FORM

G ☑ vs V ☐ PHOTO X: Y: DATE 26/04/2022

PROJECT ID. ER390-RSNRP SURV. Nicole Mulligan

MAP SHEET 092G019 PLOT # B POLY. # Act09

UTM ZONE 10U LAT. / NORTH 5445602 LONG. / EAST 554870

ASPECT North 349 ° ELEVATION 6 m

SLOPE 45 % SMR 3 SNR D (rich)

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 ☐ Fibric ☒ Mesic ☐ Humic

SURF. ORGANIC HORIZON THICKNESS ☒ 0–40 cm ☐ > 40 cm

HUMUS FORM ☒ Mor ☐ Moder ☐ Mull

ROOT RESTRICTING LAYER Depth N/A cm Type N

COARSE FRAGMENT CONTENT ☒ < 20% ☐ 20–35% ☐ 35–70% ☐ > 70%

TERRAIN

COMPONENT: TC1 ☐ TC2 ☐ TC3 ☐

TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1 m	1 L	1 a	1
2	2	2	2

ECOSYSTEM

COMPONENT: EC1 ☐ EC2 ☐ EC3 ☐

BGC UNIT CwHdm ECOSECTION FVL

SITE SERIES Act 09 SITE MODIFIERS k

STRUCTURAL STAGE 3a CROWN CLOSURE 5 %

ECOSYSTEM POLYGON SUMMARY

	%	SS	SM	ST
EC1				
EC2				
EC3				

TERRAIN POLYGON SUMMARY

	%	Classification
TC1		
TC2		
TC3		

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	A: 5		B: 95		C:		D:	
L.	**SPECIES**	**%**	**L.**	**SPECIES**	**%**	**L.**	**SPECIES**	**%**
A	Alus rubra	5						
B	Rubus	65						
	armeniacus							
B	Impatiens	30						
	glandulifera							

COMPLETE ☐ PARTIAL ☐

Tree Mensuration

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

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