ECOLOGICAL RESTORATION

Galiano Conservancy Association

DEMONSTRATION NATIVE GARDEN and FOREST RESTORATION

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University of Victoria and the Galiano Conservancy Association

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ER 390
Restoration of Natural Systems

Galiano Conservancy Association

University of Victoria

Thank you to Adam Huggins from the GCA whose coordination wizardry and collborative spirit helped ferry this restoration project to completion.

I'd also like to express my gratitude to the remarkable ability of native plants to restore ecosystems and the waters of the Salish Seas Many peaceful and stormy commutes from Saltspring Island to Galiano Island were experienced during this restoration effort.

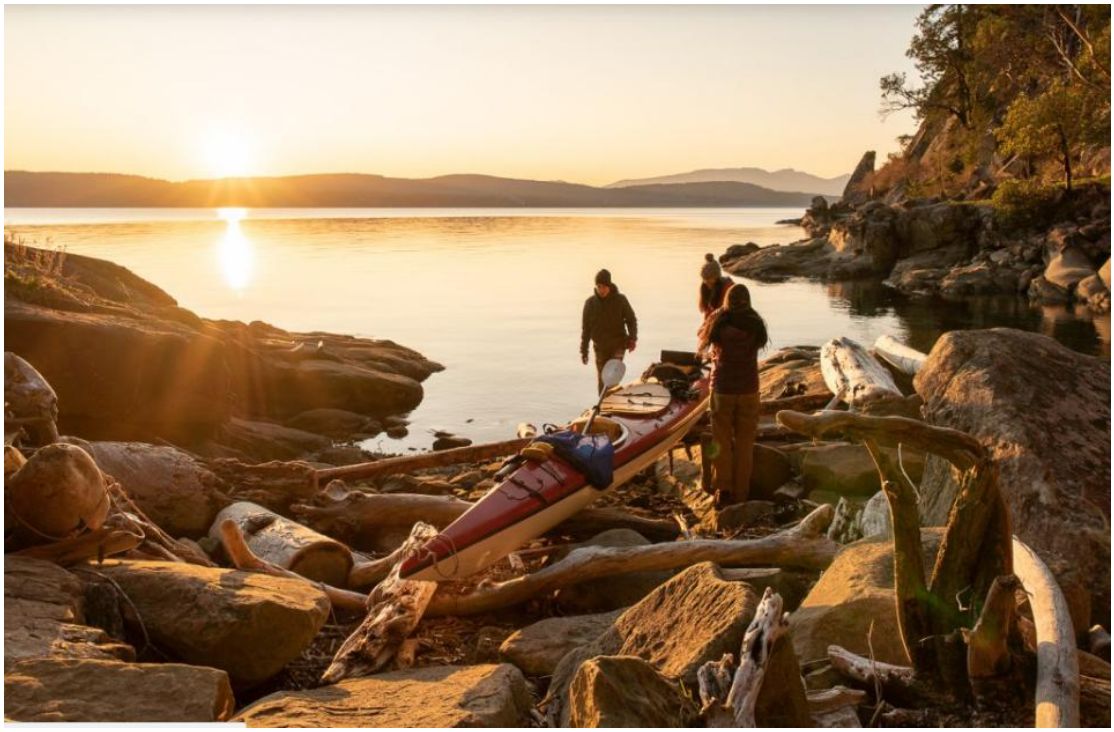


Table of Contents

1.0 Executive summary

As one of BC's first community-based land trusts, the Galiano Conservancy Association (GCA) has coordinated exemplary restoration projects that demonstrate a variety of approaches to ecological restoration including classic forest restoration, a native plant forage forest, and a permaculture food forest. In November 2019 the construction of the GCA Project Centre, located at the entrance to the Galiano Conservancy Association's District Lot 57, was completed. The GCA Project Centre houses staff offices and serves as a main access point for visitors. The recent construction disturbance and historical logging of the land surrounding and adjacent to the GCA Project Centre combined with it being the visitor gateway to the GCA made it a candidate site for a restoration project.

The restoration process for the GCA Project Centre site took approximately 1.5 years and was realized with the outstanding collaborative efforts of many GCA staff and student interns, especially restoration coordinator Adam Huggins. My involvement began in the conceptual stages in August 2018 as part of a final project for the Galiano Field School (ER412). I formally began collaborating with the GCA to restore the Project Centre Site in January 2019. In March 2019, the GCA was a successful recipient of an EcoAction grant which provided funding and responsibility for implementing restoration. All surveying of the site took place between February 2019 to June 2019 followed by site design (July 2019 to September 2019) and the initial implementation phase (July 2019 to March 2020). This final report presents my contributions from the assessment to implementation phases which helped successfully carry out the restoration project.

This restoration project is centered on four goals: 1) Produce a comprehensive baseline survey of the site 2)Restore degraded Site A in a way that addresses both the ecological and social values of the site 3)Restore ecological integrity for the logged and degraded Site B consistent with the Coastal Douglas-fir biogeoclimatic zone 4) Engage the GCA, GCA interns, GCA visitors, and the Galiano community in the restoration process and 5) Monitor site, report results, and adapt management accordingly.

2.0 Background and Site Description

2.1 Background

Galiano Island

Galiano island is one of the Southern Gulf Islands that lies in the Georgia straight between Vancouver Island and the lower mainland of BC and is part of unceded Hul'qumi'num territory. It comprises 5787 hectares and is defined by the Salish sea waters of the Trinchomali channel to the west, Active pass to the south, and Porlier pass to the north. A small, vibrant, and community oriented population of just over a thousand people live on Galiano Island. Although the population of Galiano is small, pressures to develop and change the natural landscape are tremendous (Islands Trust Conservancy 2019). Summer tourism is one of the economic backbones of Galiano and visitors from the nearby urban centers of Vancouver and Victoria help service this industry.

Galiano Conservancy Association

The Galiano Conservancy Association was founded in 1989. The GCA's primary mission is "To preserve, protect and enhance the quality of the human and natural environment" on Galiano Island" (GCA, 2020). The GCA approaches this mission as a grassroots democratic organization and has been devoted to land and marine conservation, stewardship and restoration, and environmental education and public awareness since its creation. In total, the GCA has acquired 185.6 hectares of land for conservation purposes and holds conservation covenants on an additional 217.32 hectares (GCA, 2016).

The Ken and Linda Millard Learning Centre

One of the more recent community-based land acquisitions has been DL57, a 76-hectare parcel of land that is held for conservation purposes protecting the longest stretch of undeveloped coastline in the Southern Gulf Islands and 35 hectares of mature and old growth forest. Additionally, it is where the Galiano Learning Centre is located which is a building that hosts educational and outreach programs for students and workshops. DL57 also produces medicinals and edibles for the community through cultivation of the Native Forage Forest restoration project and the Food Forest permaculture project. These ongoing projects demonstrate how the GCA is accomplishing its 6 principle goals of 1)practicing ecological stewardship 2)creating opportunities and providing facilities for learning, research and innovation 3)contributing to local food security 4)contributing to local economic development 5)providing public access and 6) creating opportunities for recreation. DL57 has since been renamed the Ken and Linda Millard Learning Centre and is also where the Project Centre restoration site is located (Figure 2.1.1)

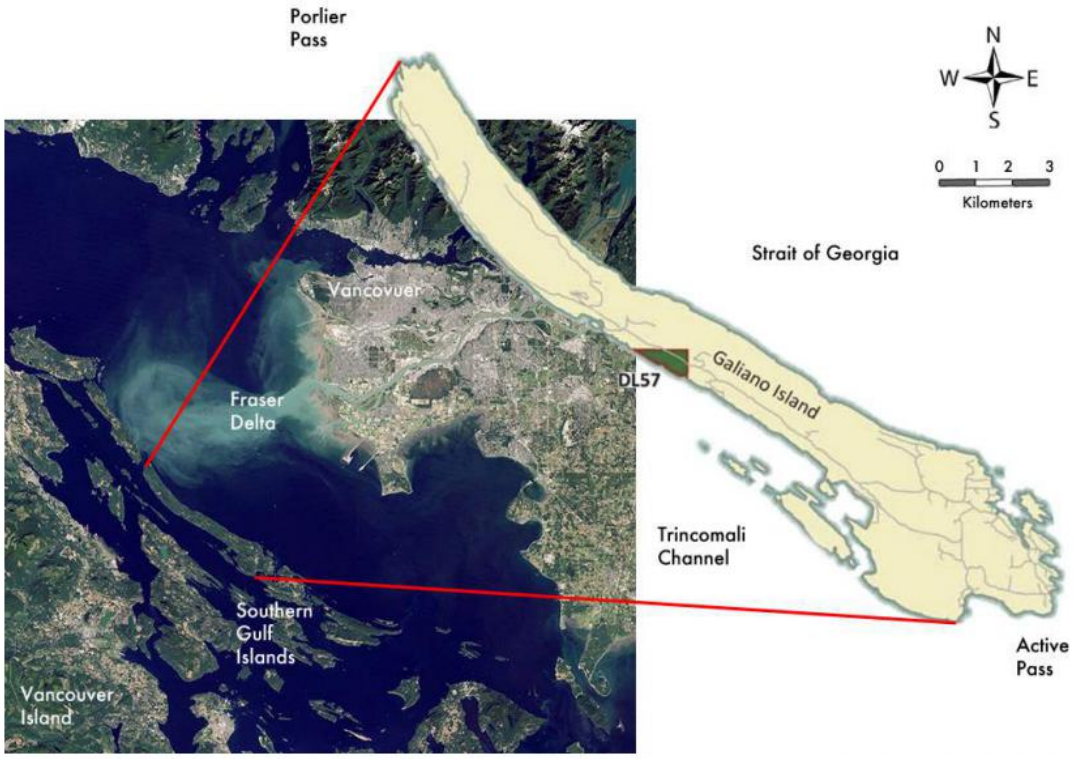


Figure 2.1.:1 Map contextualizing the region of Galiano Island and the location of DL57 (Taken from Huggins, 2017).

Ecological context

The restoration site falls within the Coastal Douglas-fir biogeoclimatic zone, which is a unique and endangered ecosystem characterized by a Mediterranean-like climate of dry summers and mild, wet, winters (CPAWS, 2004). Former vegetation cover on the site would have been forested area dominated by Western red cedar and some Douglas-fir trees. Other less common tree species found on or directly adjacent to the site include bitter cherry, bigleaf maple and arbutus. A more detailed description of the current vegetation cover is described in Section 2.2.

Overabundance of deer populations far exceeding historical densities on the Southern Gulf Islands, including Galiano, are a significant factor in current plant composition and structure. Heavy grazing by deer has simplified plant communities and decreased sapling recruitment. Deer present one of the main constraining factors to restoration efforts on Galiano (Arcese et al., 2014).

Looking into the future, regional climate change models that include the Southern Gulf Islands and Galiano island predict a precipitation pattern change involving drier summers and wetter winters; more extreme weather events such as heavy rainfall, flooding, and drought period; and an increase of 2-4 degrees in average summer and winter temperatures (Lemmen and Warren, 2016; Aubie et al., 2017).

Geologic context and soils

Galiano Island lies within the Nanaimo basin in a large depression at the southern end of the Georgia Strait. The bedrock strata of the island form a

homocline that dips northeast. The bedrock is part of the Nanaimo group known as the Gabriola formation which dates back to the Upper Cretaceous (65-100 million years ago) and forms a stratigraphic layer over 500m deep of mostly arkosix arenite sandstone. The Gabriola formation occupies 75% of Galiano Island including the Project Centre restoration site (Islands Trust, 2013).

The soil of the Project Centre is of the Saturna type. Saturna soils are well-drained loam to sandy loam that developed on shallow deposits from colluvial and glacial drift materials over sandstone bedrock. They form no deeper than 100cm of the surface (Green et al., 1989).

2.2 Project Site and Description

Located along the front driveway of 10825 Porlier Pass Road on Galiano Island, the restoration site is part of the Coastal Douglas-fir moist maritime subzone and of the Southern Gulf Islands subsection (Figure 2.2.1). It is approximately 0.3 hectares and is divided into two main areas: 1)Site A is an area adjacent to the Project Centre building and 2)Site B is part of a logged area on the southwest side of the dirt road.

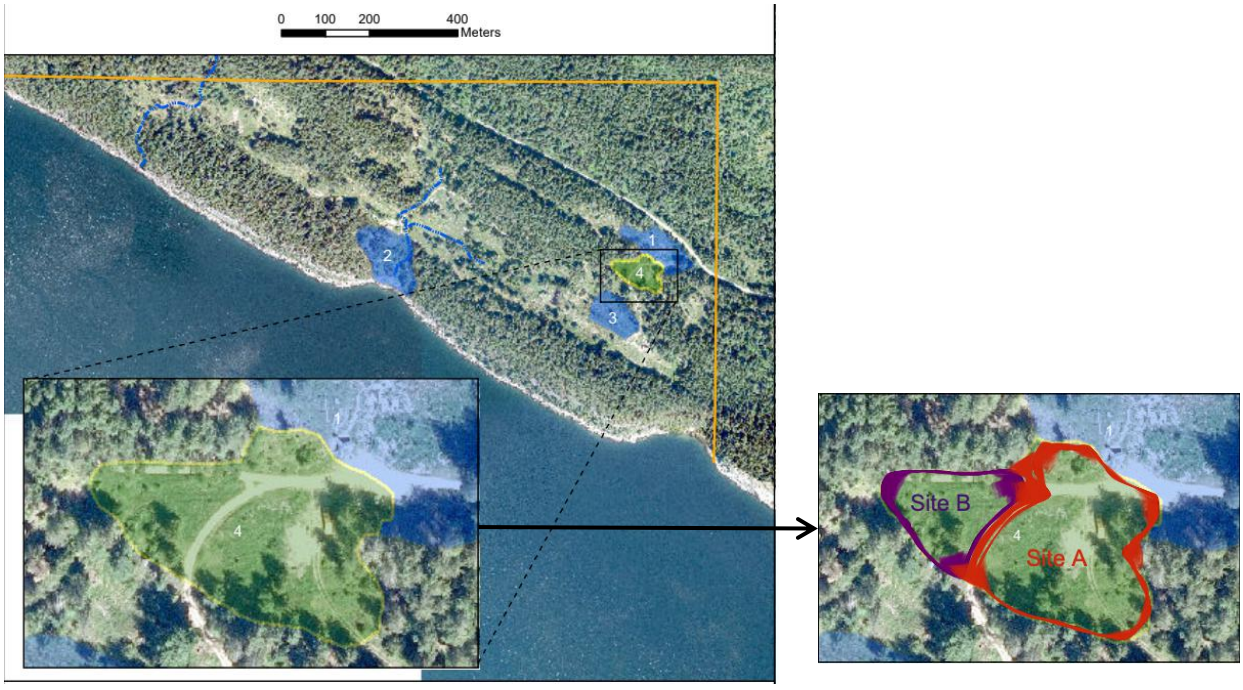


Figure 2.2.1: Map of Project Centre restoration site with Site A and Site B outlined

Restoration Site A comprises a total area of approximately 0.2 acres and consists mostly of a sloped area with a southwest aspect on the west side of the Project Centre. It also includes areas immediately adjacent to the Project Centre building (a few garden beds and a parking lot), and the solar panel area. The site is bounded by

a dirt road on its northwest and west sides and coniferous forest dominated by Western redcedar (*Thuja plicata*) on its south side. Currently, the dominant vegetation colonizing the previously logged site consists of a variety of early succession native and non-native herbaceous species and introduced agronomic grasses (see section 4.0 for more details). A wooden post in the northeast corner of the site is located at UTM 0465748, 5419767.

The excavation of the Project Centre area began in the fall of 2018 and resulted in the removal of top layers of soil that were deposited as a single large pile on the site. Next to this soil pile a pile of coarse woody debris was left (Figure 2.1.3, August 2018). Other disturbance features caused by large machinery include compacted soil and linear features where utility lines for the GCA facilities are buried. Together these disturbances resulted in increased soil compaction in some areas and mixed soils in others. The Project Centre was completed in November 2019 and currently houses staff offices and includes basic bathroom and kitchen facilities for staff use. The location of the area is within one of the multi-use facility zones as defined by the GCA's management plan and lies adjacent to a parking area and across the dirt road from the restored mill site.

Figure 2.1.3: View of Restoration Site A from the solar panel site (courtesy of Lauren Goforth and Christophe Boyer's repeat photography project from ER412, 2018)

There were two early considerations in the restoration of Site A. One was the nearby proximity of the solar panel module, which is located directly west across the dirt road from the site, and which could not be shaded. The other was a bigleaf maple (*Acer macrophyllum*) sapling that grows near the Project Centre deck. This maple was purposefully left untouched by the excavator who died of a heart attack in the GCA parking lot shortly after finishing excavation work (per Keith Erickson). Due to the maple's sentimental value, the GCA had requested that the tree be incorporated into the restoration plans.

Restoration Site B is part of the larger surrounding area southwest of the Project Centre site. It is triangular in shape and is bordered by the two main dirt roads to its north and east sides. Its west side is marked by a ridge that extends to the south and the bottom of a hill that extends to the north. Former tree cover was primarily Western redcedar with some douglas-fir - stumps in the furthest southwest area of

the site attest to this ecological legacy (Figure 2.1.4, April 2019). It was historically disturbed due to the previous owner's (Bill Campbell) logging and milling activities, which resulted in forest clearings and soil compaction. One of the main areas of compaction is a linear old road feature that leads down to well water infrastructure and is dominated by *Juncus effucus*. Other notable infrastructure is a water culvert that passes under the northeast road. Site vegetation consists of a mixture of early-to-mid succession native herbaceous and shrubby species, introduced agronomic grasses, and invasive herbaceous and shrubby species

Figure 2.1.4: View of Restoration Site B from the southwest stump plateau (April 14th, 2019)

3.0 Goals and Objectives

Taking into account the GCA's mission and the Society for Ecological Restoration's 8 principles underpinning ecological restoration (Gann et al., 2019) , five overarching goals guided this restoration project. These overarching goals are supported by primary goals which provide direction for action. Site A was more of a priority than Site B as it was the area included in the EcoAction grant and also receives more visibility and visitation. As a result, goals for Site A are more developed than Site B.

1) Produce a comprehensive baseline survey of the site

a. Use TEM to identify ecological, geologic, and hydrologic characteristics of site
b. Use GPS surveying to produce GIS maps of the site
c. Identify barriers to recovery

2) Restore degraded Site A in a way that addresses both the ecological and social values of the site

d. Develop and implement a restoration prescription that inspires visitors to engage in home restoration projects and support restoration efforts
e. Design and implement a detailed native garden planting scheme

3) Restore ecological integrity for the logged and degraded Site B consistent with the Coastal Douglas-fir biogeoclimatic zone

f. Develop restoration recommendations that improves ecological composition, function and structure

4) Engage the GCA, GCA interns, GCA visitors, and the Galiano community in the restoration process

g. Collaborate with GCA staff to receive guidance and permission for restoration actions
h. Involve GCA interns in restoration design and implementation efforts
i. Engage GCA visitors and students for voluntary help in the implementation phases of restoration

5) Monitor site, report results, and adapt management accordingly.

j. Develop a monitoring plan
k. Adjust management and design based on feedback from monitoring results
l. Engage university and college students to continue research on site and report results

4.0 Site assessment

4.1 Methods

Most of the site assessment was conducted on March 30th, 2019; weather was partially cloudy and the average daily temperature was 11°C. The remaining site assessment was conducted on April 14th, 2019; weather was sunny and the average daily temperature was 15°C. The site was delineated into six distinct polygons based on topography, road barriers, and existing plant communities. Eight soil pits were dug (three for polygon 2) to the depth of 1m or bedrock (see Appendix A) so that soils could be classified. A portable GPS Garmin was used to survey locations of soil pits, polygon delineations, infrastructure (water lines, culverts, roads), and other landscape features (stumps, notable vegetation). This survey information helped produce GIS maps for restoration design (Figure 4.1.1). Slope and aspect were determined using a hand held compass and clinometer. Vegetation was recorded and species coverage estimated by visual assessment during the two first survey visits (Tables 5.1.2-5.1.8). Subsequent visits to the site were made in May, June, September, and October to make observations about hydrology in dry and wet conditions and to note any other previously cryptic plant species.

Observations were made following the *Standards for Terrestrial Ecosystem Mapping in British Columbia* (1998), and site series were identified using *A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region* (Green & Klinka, 1994). Soils were classified using the *Terrain Classification System for British Columbia* (Howes & Kenk, 1988).

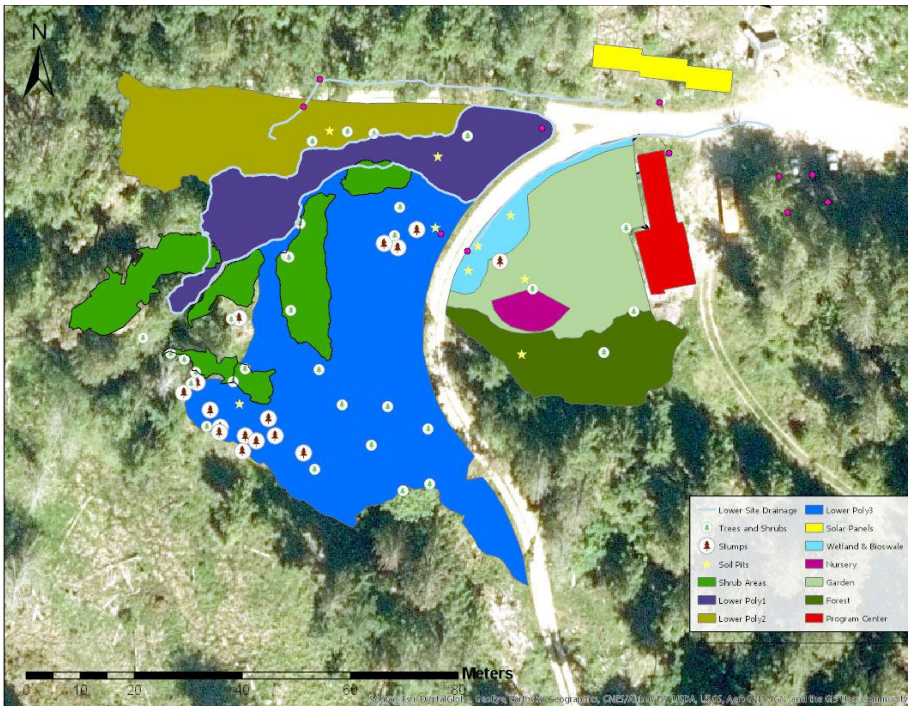


Figure 4.1.1: GIS mapped area of restoration site with terrain and vegetation features marked

5.0 Results

5.1 Results

The two different site series that occur across the surveyed area are Fd - Salal and CwFd - Kindbergia (Figure 5.1.1 and Table 5.1.2). Site A contains Polygons #1-3 fall while contains polygons #4-6 fall within Site B. Site series were consistent with existing and previous forest cover and species assemblages. The following table (Table 5.1.1) summarizes ecological and terrain characteristics of each of the 6 polygons and describes them as they were surveyed in March and April 2019.

Table 5.1.1: Descriptions of the ecological and terrain characteristics of Polygon #1-6

Polygon	Description
1	As the eastern slope edge of Site A this polygon is bordered by second growth forest which makes it the most shaded polygon of Site A. A rock outcrop is visible for the southern half of the polygon. Dominant vegetation is sword fern, salal, and dull oregon grape root. Several Douglas-fir and Western red cedar stumps are present.
2	Continuously sloped with a southwest orientation, this largest polygon of Site A is also the most disturbed (~60% of ground cover) with recent construction activity and historical logging in the 2000s. A large mixed soil pile and a coarse woody debris pile have been deposited in the middle of the polygon. There is moderate soil compaction from machine work across the whole polygon. It is dominated by introduced grammanoid species, small-flowered bulrush, and other native and non-native weedy species.
3	This polygon is comprised of a trough that follows the road bordering the northeast part of Site A. This trough eventually pools out on the lowest slope area of Site A where water sometimes sits or drains imperfectly. A culvert drains this water across the road into Site B. Vegetation is dominated by grammanoid species and small-flowering bulrush.
4	This polygon in Site B features an old road that leads down to a well infrastructure and eventually the native forage forest. It is indicated by heavy soil compaction and dominated by grammanoids and small-flowering bulrush, which give it a strongly mounded microtopography. Surface water is funneled into and drains down the compacted road.
5	Logged in the early 2000s there are varied features in this central polygon of Site B. The upper portion of the polygon contains exposed steep bedrock and a small flat area where a few solar panels are housed. The lower portion features a stumped terrace that illustrates the historical legacy of a mature forest of Western red cedar and Douglas-firwhich. It ends abruptly with a southwest cliff edge. A couple of coarse woody debris piles lie on the terrace in partially decomposed state. Most of the polygon is in an early succession state with island patches of salal. The area contains many signs of deer usage including trails, beds, and heavy browsing (most notably on young oceanspray). Songbirds, thrushes, and woodpeckers were present at each site visit for habitat and forage use of regenerating shrub and forest. Two wildlife alder trees are present (<50cm in diameter, decaying, bark peeling, no branches)
6	Slope bordered by the road where a recent culvert installation has created disturbance and bare ground that is currently being colonized by nettle and Canada thistle. At the bottom of the slope is a small patch remnant of mature Western red cedar

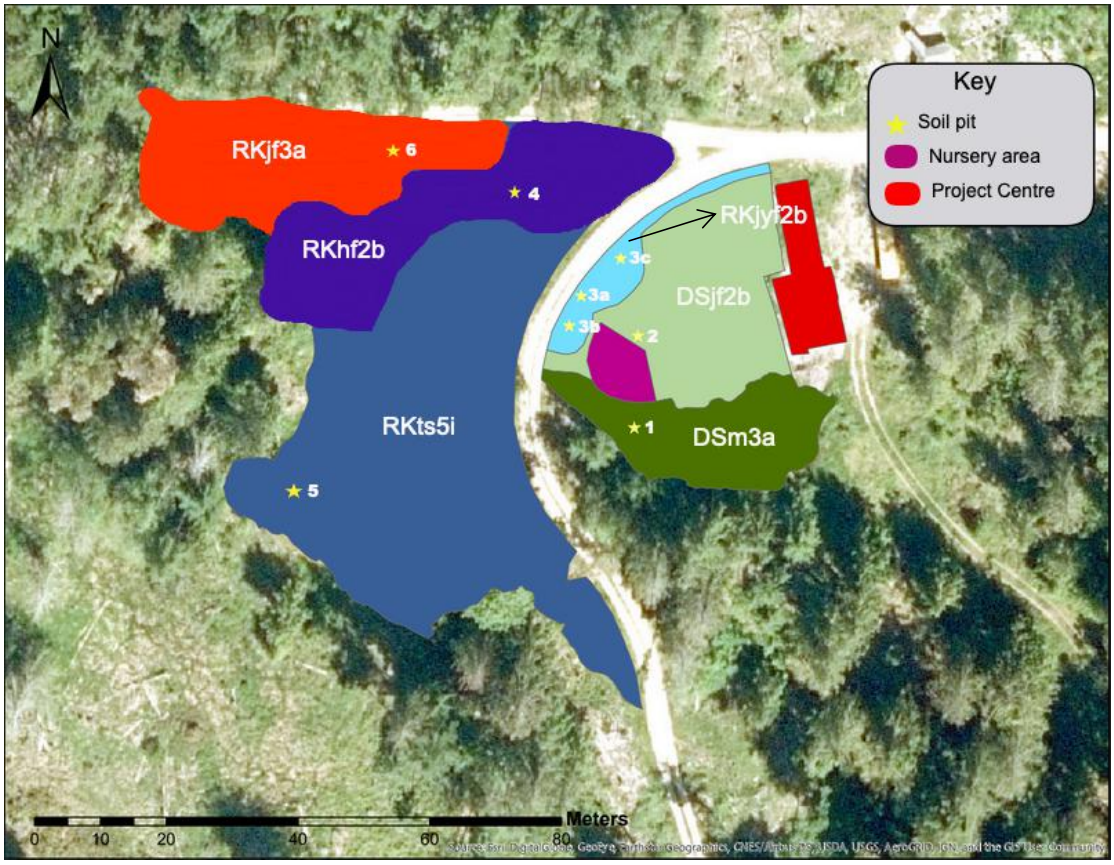


Figure 5.1.1: TEM map of surveyed restoration area with polygon site series, soil pits, and infrastructure sites

Table 5.1.2. Summary of the TEM ground inspection forms for Polygon #1-6

Polygon	Site series	Structural stage	Mapped modifiers	Slope	Aspect
1	**01** Fd-Salal	3a - Shrub/herb	m	3°	260°
2	**01** Fd-Salal	2b - Grammanoid	j, f	3°	282°
3	**05** CwFd - Kindbergia	2b - Grammanoid	j, y, f	2.5°	210°
4	**05** CwFd - Kindbergia	2b - Grammanoid	h, f	4°	270°
5	**05** CwFd - Kindbergia	5i Young forest	t, s	2°	265°
6	**05** CwFd - Kindbergia	3a - Shrub/herb	j, f	1°	260°

Vegetation

There were a total of 39 species found at the site (4 tree species, 12, shrub species, and 26 herbaceous species) as summarized in Table 5.1.4. Table 5.1.5 - Table 5.1.10 summarizes the plant species found and coverage estimates of each one for polygons #1-6. The polygon with the greatest coverage of woody debris, grammanoids, and bare ground was Polygon #2. In polygon #5 the greatest diversity of plant species (n=23) was found (3 trees, 6 shrubs, and 14 herbaceous species). Polygon #5 also had the most diversity of introduced species (n=8) and coverage by introduced species at 45%. Categories for the vegetation layers recorded are described in Table 5.1.3.

Table 5.1.3: Vegetation layers used for the plant survey in polygons #1-6

Code	Layer	Description
A	Trees	>10m
B	Shrubs	Woody<10m
C	Herbs	All non-woody plants

Table 5.1.4: Project Centre site plant species checklist (Status N=native and I=introduced)

Layer	Latin name	Common name	Status
Trees (A)	Alnus rubra	Red alder	N
	Prunus emarginata	Bitter cherry	N
	Thuja plicata	Western red cedar	N
	Pseudotsuga menziesii	Douglas-fir	N
Shrubs (B)	Cirsium vulgare	Canada thsitle	I
	Cytisus scoparius	Scotch broom	I
	Gaultheria shallon	Salal	N
	Holodiscus discolor	Oceanspray	N
	Ilex aquifolium	English holly	I
	Lonicera ciliosa	Trumpet honeysuckle	N
	Mahonia aquifolium	Tall oregon grape	N
	Rosa gymnocarpa	Baldhip rose	N
	Rosa nootkana	Nootka Rose	N
	Rubus armeniacas	Himalayan blackberry	I
	Rubus spectabalis	Salmonberry	N
Herbs (C)	Cardamine occidentalis	Western bitter cress	N
	Cirsium vulgare	Canada thistle	I
	Cytisus scoparius	Scotch broom	I
	Digitalis vulgare	Foxglove	N
	Geranium bicknelli	Bicknell's geranium	N
	Hypericum perforlatum	St. John's wort	I
	Hypochaeris radicata	Hairy cat's ear	N
	Leucanthemum vulgare	Oxeye daisy	I
	Linaria purpurea	Purple toadflax	I
	Lonicera ciliosa	Trumpet honeysuckle	N
	Mahonia nervosa	Dull oregon grape root	N
	Medicago lupulina	Black medic	I
	Myosotis laxa	Small flowered forget-me-not	N
	Phalaris arundinacea	Reed canarygrass	I
	Polystichum munitum	Sword fern	N
	Pteridium aquilinum	Bracken fern	N
	Ranunculus repens	Creeping buttercup	
	Rubus ursinus	Trailing blackberry	N
	Scirpus microcarpus	Panicled bulrsuh	N
	Spp. ?	Grammanoids	I
	Trientalis latifolia	Northern starflower	N
	Urtica dioica	Stinging nettle	N
	Vicia americana	American vetch	N

Table 5.1.5: Vegetation survey for Polygon #1

Layer	Latin name	Coverage (%)
Trees	Alnus rubra	1
	Pseudotsuga menziesii	5
	Thuja plicata	7
Shrubs	Gaultheria shallon	25
	Lonicera ciliosa	<1
	Rosa gymnocarpa	<1
Herbs	Mahonia nervosa	7
	Polystichum munitum	25
	Spp. ?	25
	TOTAL	95
	Woody debris	5
	Bare soil	0

Geranium bicknelli	<1
Hypochaeris radicata	<1
Leucanthemum vulgare	<1
Medicago lupulina	<1
Myosotis laxa	<1
Pteridium aquilinum	2
Ranunculus repens	<1
Scirpus microcarpus	7
Spp. ?	25
Urtica dioica	2
Vicia americana	<1
TOTAL	44
Woody debris	11
Disturbed ground	45

Table 5.1.7: Vegetation survey for Polygon #3

Layer	Latin name	Coverage (%)
Trees	Pseudotsuga menziesii	1
Shrubs	Cirsium vulgare	7
Herbs	Cardamine occidentalis	<1
	Scirpus microcarpus	20
	Grammanoid spp. ?	70
	Urtica dioica	<1
	TOTAL	98
	Woody Debris	0
	Bare ground	2

Table 5.1.6: Vegetation survey for Polygon #2

Latin name	Coverage (%)
Pseudotsuga menziesii	2
Gaultheria shallon	1
Rubus armeniacas	2
Cardamine occidentalis	<1
Cirsium	1
Digitalis	2

Table 5.1.8: Vegetation survey for Polygon #4

Latin name	Coverage (%)
Thuja plicata	3
Gaultheria shallon	7
Rosa nootkana	<1
Rubus armeniacas	<1
Grammanoid spp.?	60
Cirsium vulgare	<1
Cytisus scoparius	<1
Digitalis	<1
Polystichum munitum	1
Pteridium aquilinum	1
Rubus ursinus	<1
Scirpus microcarpus	25
Urtica dioica	<1
TOTAL	97
Woody Debris	3
Bare ground	0

Table 5.1.9: Vegetation survey for Polygon #5

Latin name	Coverage (%)
Alnus rubra	2
Pseudotsuga menziesii	2
Thuja plicata	5
Cytisus scoparius	<1
Gaultheria shallon	20
Holodiscus discolor	2
Ilex aquifolium	1
Mahonia aquifolium	<1
Rubus discolor	3
?	40
Cirsium vulgare	3
Digitalis	2
Hypericum perforlatum	<1
Leucanthemum vulgare	1
Linaria purpurea	<1
Lonicera ciliosa	<1
Myosotis laxa	<1
Polystichum munitum	5
Ranunculus repens	<1
Scirpus microcarpus	7
Trientalis latifolia	<1
Urtica dioica	2
Vicia americana	<1
TOTAL	95
Woody debris	5

Table 5.1.10: Vegetation survey for Polygon #6

Latin name	Coverage (%)
Alnus rubra	1
Prunus emarginata	1
Thuja plicata	1
Gaultheria shallon	15
Rosa nootkana	1
Rubus discolor	2
Rubus spectabalis	7
Cirsium vulgare	15
Digitalis	1
Phalaris arundinacea	2
Polystichum munitum	1
Scirpus microcarpus	3
spp.	35
Urtica dioica	3
TOTAL	88
Woody debris	5
Bare ground	7

Soil

Soil pits reflected the different slope positions across the site (which consistently sloped with a southwest oriented drainage), presence of bedrock, and varying hydrology (influenced by the presence of culverts and microtopography). Table 5.1.11 summarizes the information gathered from the soil pits. Most of the soil pits were consistent with the Saturna grouping (sandy loam <100cm). The exceptions were soil pits 3a and 3c, which contained more clayley soils and were dug in water drainage locations located at Polygon #3 . Three soil pits were dug for Polygon #3 to assess the differences in soil at, above, and below the culvert drainage (soil pits 3a, 3b, and 3c respectively). The results of clayley soils above and loamy soils below is consistent with how particles would deposit given the hydrologic features of Polygon #3.

Table 5.1.11: Summary of soil pits for polygon 1-3 of proposed native garden

Soil pit	Drainage (mineral soil)	Moisture subclass (organic soil)	Mineral soil texture	Organic soil texture	Surface organic horizon thickness	Humus form	Root restricting layer	Coarse fragment content
1	well	humid	sandy	mesic	>40cm	moder		35-70%
2	well	humid	loamy	mesic	0-40cm	mesic	10.25"; clay	<20% Charcoal present
3a	Imperfectly	aquic	clayley	humic	0-40cm	mull	7.5"; clay	<20%
3b (downstream)	Well	aquic	loamy	fibric	0-40cm	moder	7";	40%
3c (upstream)	well	aquic	clayley	mesic	0-40cm	moder	8"	<20%
4	Well	Aquic	Loamy	Mesic	0-40cm	Moder	17.5"	20-35% (CWD 10%)
5	Moderately well	humid	Clayley (grey/brown)	Mesic	0-40cm (medium brown)	Moder	15"; bedrock	<20%
6	Moderately well	humid	Clayley (mottled orange/grey)	Humic	0-40cm (light grey)	Moder		<20%

6.0 Discussion & Recommendations

The Project Centre restoration area is a complex site due to the varying degrees of disturbance, infrastructure, and different human goals for the site. The GCA has prioritized site A because it is an ideal location for visitor educational opportunities and is also the main area which received the GCA EcoAction grant for demonstrative water conservation systems. Site B would not naturally receive lots of visitor traffic and is less of a priority for the GCA. With these GCA priorities in mind, different restoration approaches should be applied to site A and site B. Site A should be designed as a demonstration native garden and bioswale site that emphasizes the use of native plant landscaping whereas site B could employ more traditional forest restoration practices.

The plant surveys demonstrate the significant presence of introduced species in the restoration area. Dense clusters of introduced species were marked during the GIS survey and should be manually removed when human resources allow. Otherwise, introduced species can be tolerated in site B as natural succession processes will shade out current herbaceous species. In site A, most of the introduced species are currently present due to large areas of disturbed and exposed soil. However, once site A is planted as a native garden and tended there will be less bare soil and less opportunity for introduced species to establish or grow. Restoration plantings will be key to the success of this restoration project. The GCA nursery is an excellent option for providing most of these plants.

Excessive mule deer browsing is a barrier to restoration and must be removed before any restoration planting efforts. For Site A where the demonstration native garden will be created, it is necessary that a 6 foot fence be built around the perimeter to serve as an effective exclosure area to deer. For Site B, any restoration plantings will need to be individually caged until the plant becomes tall enough to withstand browsing pressure. Already established native shrubs and herbs could also be caged to encourage their establishment.

The soil pits in Polygon #3 reveal that this area is a relatively moist area. The clay deposits soil pit 3a confirm that water has a natural tendency to sit and stay seasonally in the depression . This area could be augmented in size and depth and be made impermeable by creating a demonstration liner wetland pond.

Other important considerations for the restoration prescription of site A should include:

- On-site water collection systems to help maintain plantings
- redistribution of the large coarse woody debris and mixed soil piles which will require machine work.

7.0 Restoration Process for Site A

The restoration process was a collaborative effort between the GCA, GCA interns, University of Victoria students, and myself. My main responsibility was designing and implementing the restoration planting schemes for the demonstration native garden. What follows is a documentation of the design to implementation phases for site A of the Project Centre. Included are references to the work done by others that helped complete the restoration process.

7.1 Native Garden (Site A): Goals

The restoration vision for site A was to create a demonstration wetland and native garden that inspires visitors to engage in home restoration projects and to support restoration efforts. The goals of this site were established with GCA and are as follows:

- To showcase a demonstration bioswale and liner wetland pond.
- To demonstrate water conservation through hydrologic design and native plant landscaping.
- To increase native plant diversity and illustrate how to landscape with them in a range of conditions and habitat types.
- To promote nursery sales by encouraging visitors to check out the nursery annex.
- To provide an attractive space for visitors to enjoy, relax, and learn in.
- To increase habitat value by attracting birds and pollinators.

7.2 Native garden (Site A): Design

A thematic approach to planting the site made ecological and aesthetic sense. Each garden bed was organized by a plant community theme which helped determine plant selection based on species sharing similar habitat and site condition needs. Species lists, quantities recommended, and costs for seven different garden beds were suggested to the GCA(Appendix A): wetland, wet meadow, dry meadow, edible shrubs, deer & drought resistant, forest edge, and solar panel. The diverse array of garden beds aims to showcase restoration possibilities of native plant landscaping and hopefully inspire visitors to enact their own restoration efforts.

The native garden will need to be maintained at a shrub successional stage in order to avoid compensating the neighbouring solar panels (see Yip, 2018). To ensure this successional goal, no tall trees were planted in the native garden and small trees currently growing on site were removed. As well, the species selected should grow no higher than 20m in height. One of the restoration goals of this project is to promote nursery sales through the nursery annex located in the native garden. To aid

this goal, the native garden features species which are already available at the GCA nursery or will likely become available in the future due to their propagative potential and restoration value.

Based on a site walk through on October 6th, 2019 a general layout was designed for the native plant garden site (Figure 7.2.1). In my site walkthrough I observed that the upper one-third of the slope (10-14 meters SW of the project centre) is relatively flat and if kept this way would be suitable for the dry meadow plant community. After this point the slope becomes pronounced at a 3° decline until it reaches the lower quarter of the slope. Conceptual contour lines were drawn to give a sense of the approximate topography of the site.

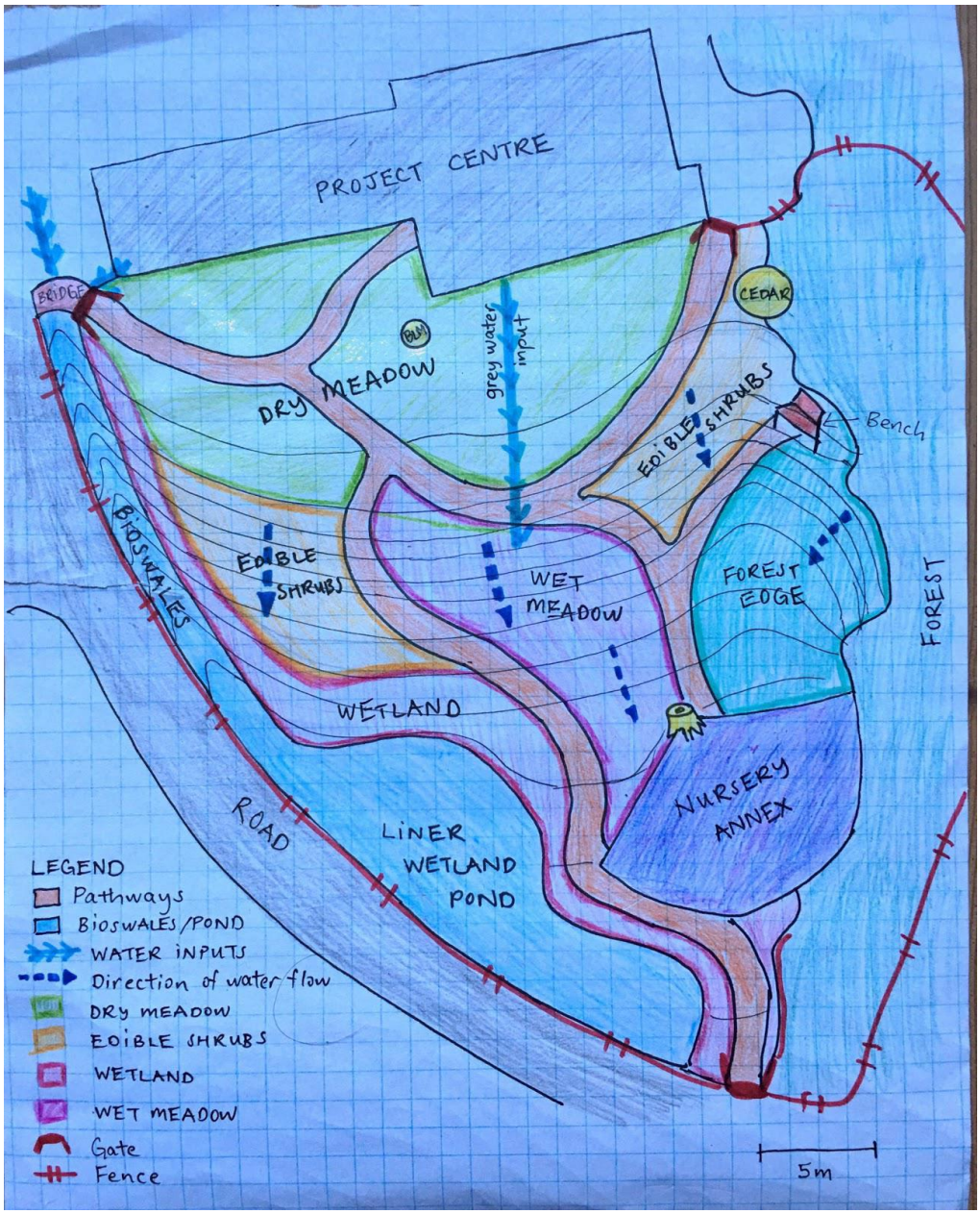


Figure 7.3: Native garden draft design for Site A showing thematic garden bed and pathway placements

Here are a few things to note in the design:

- The gray water line output ends when the slope begins and at the top and center of the wet meadow garden.
- There are three gated entryways to the native garden.
- A bridge of some sort brings visitors from near the Project Center into the native garden.
- The fence adjacent to the road is located on the outside edge of the bioswales and then crosses over the inside edge of the liner wetland pond.
- The pathways are at least 1.2 meters wide made from a three inch layer of cedar wood chips.

Location of different garden beds

The location of different garden beds are based on a combination of site hydrology and topography, sun/shade conditions, delineation by garden pathways, and social function. Below is a summary of the reasoning behind the location of each type of garden bed:

Dry meadow: This garden bed is in the driest part of the site due to its upper slope position and fairly level topography. The area is in mostly full sun conditions with a part of the south end in partial shade conditions. With its proximity to the Project centre and its level topography, the dry meadow could serve as a gathering area for visitors and its design should encourage this use. For example, a small stone foot pathway could lead to a planted garry oak tree that would provide future dappled shade for a seated area.

Wet meadow: This garden bed is in one of the wetter sites due to it receiving the gray water output and being in the receiving position on the slope. Swales against contour could be installed to retain moisture for this area. The area will mostly receive full sun with some part shade southern areas. The contour variety will provide different moisture regimes which should support different wet meadow plants.

Wetland: This garden bed is a mini riparian edge that runs along the bioswales and liner wetland pond. Due to it being adjacent to the site's largest water sources it will be appropriate for wetland plants to become established here. The upper half of this garden bed will be in full sun conditions while the lower third will be in partial shade conditions.

Edible shrubs: There are two locations for this garden bed - one in full sun conditions and the other in partial shade conditions. The two different exposures will allow for different plants to thrive. Both areas will be fairly dry due to not receiving any water inputs and being on the slope. The shrubs planted in this area will provide soil stabilization on the slope and be low maintenance.

Forest edge: This area is mostly in shady conditions and has not been disturbed by construction. Natural regeneration in the direction of a Douglas-fir and cedar forest are already occurring here. As such, this garden bed will require little to no maintenance but could be host a shaded seated area to admire the native garden from or get reprieve from the summer sun.

Pathways

On October 14th pathways were marked with string and rocks and then walk tested to see if the layout was practical and desirable (Figure 7.2.1). Pathways were laid out to purposefully direct pedestrian flow to different areas of the site for different reasons:

- The main artery of the pathway leads from the top gate through the nursery annex and down to the bottom gate so that the GCA can promote nursery sales and for nursery annex functions
- A pathway from the deck to the native garden allows staff and visitors easy access to the native garden
- The pathways wind through the different areas so that visitors can experience different plant communities

Figure 7.2.1: String marks the pathway layout near the Project Centre deck, October 2019

7.3 Site Preparation

Due to all of the construction disturbance for building the Project Centre and in order to create the bioswale, recontouring the land was required to prepare the site for the demonstration native garden. An excavator was booked for two days of machine work in late October, 2019 (Figure 7.3.1 - 7.3.4). One of the major discoveries during machine work was that the area designated to become a liner wetland pond was unsuitable due to a shallow bedrock. As a result, the liner wetland pond plan had to

be abandoned for Site A. The site, however, still suited the bioswale plans. I was unable to be present for these days but provided the following input to GCA staff in preparation of and during the machine work days.

Preparation for Machine Work

The following areas need to be measured and demarcated with stakes, rebar, or spray paint in order to guide the machine work day(s):

- Nursery annex. The stump with the Douglas-fir sapling marks the north corner of the annex (Area: 64m2, Radius: 7m; See Judith's nursery annex design)
- Bioswales. The recommended width of the bioswales is 1.5m. Depth is to be determined.
- Gray water pipe installation. The gray water pipe should be installed to a length that allows it to reach the point where the downslope begins. The idea behind this is to be able to have water input for the wet meadow plant community.
- Demarcate pathways where possible (ex. dry meadow area; near nursery annex)

Figure 7.3.1: Marked perimeter and terraces of the bioswale on Site A before machine work day

Recontouring the land

During machine work there will be an opportunity to recontour the land to some extent in order to support site functions and to create the physical topography of the garden. The earth for recontouring will be gained from two main sources: the excavation of the liner wetland pond and bioswales, and the existing large soil pile on the site. The excess earth will need to be prioritized towards the following areas:

- Filling in the ditch dug out for the grey water line.

- Creating level ground for the nursery annex.
- Recontouring the steeper middle section of the slope with a focus on the middle section where paths may be located.
- Creating more level ground at the bottom of the slope.

Figure 7.2.2 and 7.2.3: Excavator levels out the top of site A (left); Excavator digs out and places large rocks in the bioswale trench (right)

Ordering machine operations

Starting from the top of the slope with priority needs and moving to the bottom of the slope makes gravitational sense in terms of moving large amounts of soil. Below is a suggested order of operations:

- Excavate the bioswale ditch from the top and place removed soil adjacent to the bioswale ditch on the south side. This soil can be used to recontour the nearby slope.
- Excavate the liner wetland pond. Soil should first be deposited on the nursery annex area until there is enough to make the area level. If there is excess soil it could be used to either recontour the middle section of the slope or level out the bottom half of the slope.
- Fill in the gray water ditch so that it is level with the neighbouring ground using soil lying adjacent to the ditch.
- Recontour the middle slope to a 1-2° gradient with a focus on areas where pathways will be laid. Soil should first be used from the remaining amounts excavated from the liner wetland pond excavation before sourcing from the large soil pile and bioswale excavation piles.
- Redistribute coarse woody debris (CWD) pile in the following places:
  - 1-2 longer logs at the edge of the liner wetland pond (to be positioned in the pond later).
  - 1-2 stumps at the edge of the liner wetland pond.
  - Logs across contour at different points at the mid slope where the wet meadow and edible shrub areas are.
  - Aesthetic CWD scattered into the dry meadow area.

Figure 7.2.4: After machine work is completed Site A is recontoured and coarse woody debris is redistributed

7.3 Implementation

There were a few different infrastructure components involved in the implementation phase of Site A, which involved the design minds of GCA interns and the coordinating wizardry of GCA restoration coordinator Adam Huggins. These efforts are summarized and photo-documented below:

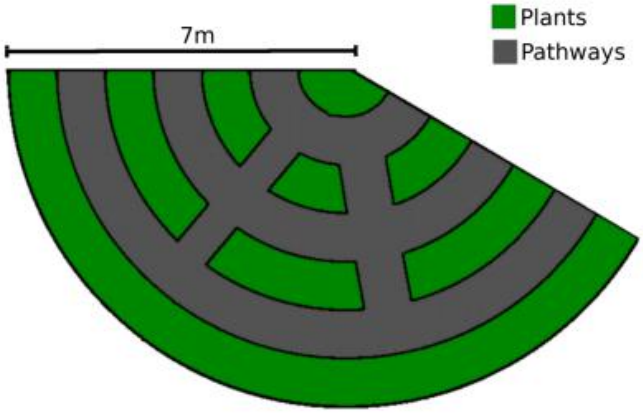
Fencing

An 8 foot high wire fence with metal posting was erected at the perimeter of Site A by GCA intern Sadie and GCA restoration coordinator Adam Huggins (Figure 7.3.1).

Figure 7.3.1: Fencing is laid out along the road to be erected onto metal poles at Site A

Nursery Annex

GCA intern Judith calculated the dimensions and materials required to build a pallet based nursery annex that would house 500 nursery plants (Figure 7.3.2). The nursery annex was placed in the shadiest part of the site to provide the best conditions for young plant sales.



There are 27.39 m² total area for plants.

If we assume, that one pallet has an area of 1.20m² and we imagine, that we can fill this space with usual pallets, we could use 22.83 pallets. If 20 plants fit one one pallet, there is room for about 456 plants.

Total area	Area pallet	# pallets	# plants
27.39m²	1.20 m²	22.83	456.5

Figure 7.3.2: Nursery annex design by Judith

Water conservation systems

Adam Huggins coordinated the design and implementation of all of the water conservation systems on Site A, which include a demonstration bioswale, rooftop water collection system, and greywater system. The bioswale was designed by University of Victoria students Adam Dewar and Liam Baron-Preston for their ER 412 project, which outlined hydrologic design recommendations. Dewar and Baron-Preston's planting recommendations were considered in the recommended planting scheme for the bioswale area (Appendix A). Installation of the bioswale involved surveying and marking the bioswale dimensions, digging out the trough, lining the bioswale with gravel fill, and re-vegetating the site (Figure 7.3.3). The rooftop water collection system was installed by directing rainwater gathered on the rooftop into a cistern and placing a pipe system that transferred overflow into the garden. The greywater system collects laundry and shower water from the Project Centre and directs it through a branched piping system to a garden bed in Site A (Figure 7.3.4).

Figure 7.3.3: Creation of the bioswale from recontouring to planting. Water is collected from part of the roof and run-off from the above parking lot (top left). Excavator recontours bioswale by digging out a trench and placing large stones to create bioswale tiers (top right). GCA intern Sadie checks out the gravel filled bioswale (bottom left). Volunteers plant willow to stabilize the bioswale bank and place burlap sacks over planted areas (bottom right).

Figure 7.3.4: Creation of the branched greywater system to the greywater garden bed. Piping is connected to the Project Centre greywater outlet (top left). Trenches dug allot branched greywatersystem to water fruit tree mounds (top right). Volunteer crew stands proudly by their work (bottom right)

Pathways

Pathways were manually contoured to follow the pathway design. Long pieces of coarse woody debris and large rocks were used to mark the edges of pathways. The width of pathways was determined based on type of usage - the main pathway is ~2m wide to allow for wheelbarrow passage while the other pathways are ~1m wide for foot traffic. Paths were finalized with layer of burlap sack on top followed by a 10cm cedar mulch layer.

Planting

A total of 685 plants were planted in Site A including 3 trees, 190 shrubs, and 492 herbs. Most of these were purchased from the GCA nursery for a total cost of $4960.00 for 547 plants. The remaining plants were gathered by salvage. Volunteers were essential for the planting effort, which mostly took place over two different weekends. The first planting date was for the weekend of November 16th and 17th, 2020 and involved a seven person volunteer crew from Victoria's INLAND project. The date had been chosen to take advantage of the winter rains so that plants coud have better success establishing. Unfortunately, that weekend a sudden, heavy frost made it impossible to dig into the soil. However, plants were placed in appropriate microsites based on moisture regime, exposure, and garden bed theme (Figure 7.3.5).

Figure 7.3.5: Potted plants are placed during the first weekend of restoration planting at site A

The second planting weekend took place on February 8th 2020 with the help of 50 volunteers from a UBC ecological restoration class (Figure 7.3.6). The entire first phase of planting was completed inside the fenced area and underneath the solar panels in 2.5 hours. Extra time enabled the planting and caging of plants of on Site B.

Figure 7.3.6: UBC class hard at work to get site A planted

7.4 Reflection

The initial implementation phase of restoring Site A was accomplished with the help of many hands totaling 110 volunteers and 661 volunteer hours. Implementation took place piecemeal dependent on seasonal considerations, order of project infrastructure development, and volunteer ability. A key part of the implementation success was the GCA nursery which provided all of the plants for restoration. Adaptation to on site conditions as they were discovered was very important to ensure that restoration efforts would be effective. For example, the excavator revealed shallow bedrock in the area were the liner wetland pond was destined and this restoration component had to be adjusted. Weather and seasonal variation also played a role in determining the timeline of restoration efforts. For instance, a heavy December frost delayed planting until February. An assessment of the restoration

goals of this project at the time that this final report was written are summarized below:

✓ Produce a comprehensive baseline survey of the site
- A TEM map and GIS map was produced
- Barriers to recovery were identified

✓ Restore degraded Site A in a way that addresses both the ecological and social values of the site
- Barriers to recovery were removed by erecting fencing, creating on site watering systems, and removing dense patches of introduced species.
- A demonstration native garden was planted, which displays native species for educational purposes consistent with the CDFmm biogeoclimatic zone.
- Visitors can see and learn about different systems of water conservation with a functioning bioswale, greywater bed, and rooftop cachement system.
- Visitors can access the nursery annex to start home restoration projects by purchasing native plants.

× Restore ecological integrity for the logged and degraded Site B consistent with the Coastal Douglas-fir biogeoclimatic zone
- Barriers to recovery were identified in the site survey.
- Select patches of introduced species were removed, native shrubs were individually caged, and an initial phase of planting was implemented

Recommendations: A more detailed prescription for Site B is needed. Recommended treatment priorities would be: 1) decompaction and replanting of the old road 2) a diverse planting scheme to improve structure and function of the stump area.

✓ Engage the GCA, GCA interns, GCA visitors, and the Galiano community in the restoration process
- Coordination with the GCA through restoration coordinator Adam Huggins was maintained throughout the project design and implementation phases
- The minds and hands of GCA interns and visiting university classes were engaged in the design and implementation of the restoration process
- GCA visitors and the Galiano community can see and learn about different systems of water conservation with a functioning bioswale, greywater bed, and rooftop cachement system.

× Monitor site, report results, and adapt management accordingly.
- An assessment scheme has been developed for Site A (see section below)

Appendix A

All suggested species, except for one, are native to Galiano Island as verified through checking the 2018 Galiano inaturalist plant list obtained through Andrew Simmons. The one exception to this selection criteria is Myrica (Sweet gale), whose selection is justified in the wetland garden bed description. Species were selected based on considering several criteria (letter abbreviations will be used in the plant list tables):

- **Ecological function** (EF). The species increases habitat value, hydrological function, or soil conditions.
- **Medicinal/Edible value** (M/E). The species is appealing because it is edible or can be used for medicine.
- **Cultural value** (C). The species is culturally significant to the Hul'qumi'num Treaty group.
- **Aesthetic value** (A). The species is aesthetically appealing.
- **Low maintenance** (LM). The species, once established, should require little to no maintenance.
- **Rarity** (R). The species is threatened or endangered (R)or uncommon (R).
- **Attracts pollinators** (P). Attracts hummingbirds, other birds, bees, or insects.

The following thematic garden bed plant lists summarizes each selected species latin name, common name, exposure, moisture regime, height, ease of establishment, and justification for selection. Information for these plant lists was gathered from E-flora of BC, Indicator Plants of Coastal British Columbia and through the King County Native Plant Guide. (https://green2/kingcounty.gov/gonative/Plant.aspx?Act=find) Below is a legend for some of the categories found in the plant lists.

Legend for Plant Lists (taken from King County Native Plant Guide)

EASE (how difficult are the plants to grow)
High - large margin of error on growing conditions. Tough to kill!
Medium - easy to grow if all the specific growing conditions are met
Low - specific or uncommon requirements for survival that make plant challenging to grow even when conditions are met.

EXPOSURE
Sunny conditions - Areas receiving at least 6 hours of sun including afternoon sun.
Part shade - 2-6 hours of sun.
Shade - less than two hours of sun.

MOISTURE
Dry - quick drying, well draining soils

Moist - damp much of the year, but may dry out completely during late summer drought. Not standing water. Some may be wetlands, others not.
Wet - very rarely or never dries out. Soils may be saturated for long periods of the year. Would classify as wetlands.

Wetland garden

The wetland garden bed borders the demonstration wetland, which consists of the bioswale and liner wetland. Dewar and Baron-Preston (2019) address the conceptual design for the bioswale and liner wetland and also provide well thought out functional and structural plant community recommendations. Their plant suggestions can be found in their report "Building a Bioswale and Designer Wetland" on pages 12-15 and

Type	Latin name	Common name	Exposure	Moisture	Height	Ease	Justification
Shrub	*Myrica gale*	sweet gale	sun - part shade	moist - wet	1.5 m	M	EF*, M/E, A
Shrub	*Salix scouleriana*	Scouler's willow	sun	moist-dry	2-12m	H	EF, LM
Shrub	*Spiraea douglasii*	spiraea; hardhack	sun - part shade	moist - wet	2 m	H	EF, A, LM, P
Groundcover	*Athyrium filix-femina*	lady fern	sun - shade	moist - wet	2 m	H	R, A
Grass-like	*Carex hendersonii*	Henderson's sedge	shade tolerant/intolerant	moist - wet	50-100cm	?	EF, LM
Grass-like	*Carex opnupta*	slough sedge	sun - part shade	wet	60-150 cm	H	EF, LM
Grass-like	*Juncus bolanderi*	Bolander's rush	sun	moist-wet	15-60 cm	M	EF, LM
Grass-like	*Juncus effuses*	Common rush	shade intolerant	moist - wet	25-130 cm	?	EF, LM
Grass-like	*Luzula subsessilis*	Short-stalked wood-rush	?	dry	10 - 35 cm	?	EF, LM
Grass-like	*Scirpus microcarpus*	small-fruited bulrush	sun - part shade	wet	1.5 m	H	EF, LM
Aquatic	*Lysichiton americanus*	swamp lantern	part shade - shade	wet	30 - 150 cm	M	EF, A, P

*Myrica gale justification: Myrica gale is endemic to the CDFmm. Its closest distributions are shown below on maps from E-flora BC and iNaturalist. It is a nitrogen fixing species that could help species selected for the wetland bed thrive because many are nitrophytic. Myrica gale is often associated with Spirarea douglasii.

Below is a conceptual illustration and descriptive text of the wetland garden beds around the demonstration wetland taken from Dewar and Baron-Preston (2019). Original text is in black while additional commentary is in blue.

Vegetative communities of the designed bioswale and wetland system. Light green represents the bioswale communities, dark green represents the wetland community, and orange represents auxiliary plants. There are three bioswale communities differentiated by edge colour. The first and second bioswale communities (red and yellow respectively) will both be made up of rush species (*Luzula subsessilis, Juncus effusus, Juncus bolanderi*) and sedge species (*Carex obnupta, Carex hendersonii, Scirpus microcarpus*) with the first (red) being more rush dominant and the second (yellow) being more sedge dominant. The third community will be made up of Panicled Bulrush (*Scirpus microcarpus*) and Swamp Lantern (*Lysichiton americanus*). The wetland community will be made up of Panicled Bulrush (*Scirpus microcarpus*), Broadleaf Cattail (*Typha latifolia*) and Scouler's Willow (*Salix scouleriana*). While *Typha latifolia* is a representative wetland species on GCA grounds, this species has a growth tendency to eventually choke out small ponds and is recommended to not be planted around the liner wetland if an open pond is the desirable long-term state. Some debate over the use of Scouler's willow is also warranted as this species can grow to a small tree height and could easily dominate other species. Two more ideal candidate species that could form the wetland community framed around the liner wetland are sweet gale (Myrica gale) and hardhack (*Spiraea douglasii*), which often grow together. It would also be interesting to experiment with planting lady fern (*Athyrium filix-femina*) along the wetland. The orange dot beside the office represents an Oceanspray bush (*Holodiscus discolor*). The orange bars between the wetland and the garden represent Salmonberry bushes (*Rubus spectabilis*). This orange bar area is discussed as the wet meadow garden bed in this prescription. The orange dot on the bottom right represents a Bigleaf Maple tree (*Acer macrophyllum*). Another candidate species that would provide shade for the wetland more quickly than Bigleaf Maple is Scouler's willow.

Wet Meadow garden

The plant species selected in the wet meadow garden beds require higher moisture regimes. The best location for the wet meadow area is directly downstream of where the greywater line is released and can extend downhill to the liner wetland. The plant list below recommends taking advantage of the high year-round moisture conditions this area may present in order to showcase water loving species. The different shrub species can be used to create borders to define different garden beds or to provide shade for groundcover. There is uncertainty regarding which plants will successfully

establish in this garden bed due to unknowns about how much moisture will be available from the greywater system.

Type	Latin name	Common name	Exposure	Moisture	Height	Ease	Availability	Justification
Shrub	***Cornus stolenifera***	Red osier-dogwood	sun-part shade	moist	1 - 6 m	H	GCA	EF, A, LM
Shrub	***Ribes divaracatum***	wild gooseberry	sun - shade	moist - wet	5	M	GCA	M/E
Shrub	***Rubus spectabalis***	salmonberry	sun - shade	moist - wet	4 m	H	GCA	EF, M/E
Shrub	***Sambucus racemosa***	red elderberry	part shade - shade	moist - set	3 - 6 m	H	GCA	A, P
Shrub	***Viburnum edule***	highbush cranberry	sun - part shade	moist - wet	6 m	M	GCA	M/E
Groundcover	***Aquilegia formosa***	red columbine	sun - part shade	moist	1 m	M	GCA	R, A, P
Groundcover	***Epilobium densiflorum***	Dense-spike primrose	sun	moist - dry	0.5-3	?	GCA	R
Groundcover	***Heracleum lanatum***	cow-parsnip	sun - shade	moist - wet	1 - 3 m	M	GCA	R, A, M/E, P
Groundcover	***Lilium columbianum***	Columbia lily	Sun - part shade	Moist	40-120 cm	?	GCA?	R, A
Groundcover	***Maianthemum dilatatum***	false lily-of-the-valley	sun - shade	moist - wet	1	H	GCA	R, A

Groundcover	***Mimulus (Erythranthe) guttatus***	seep monkeyflower	sun - shade	moist-wet	10 - 80 cm	M	GCA	R, A
Groundcover	***Petasites frigidus var. palmatus***	palmate coltsfoot	shade intolerant	moist - wet	10 - 50 cm	H	GCA	M/E
Groundcover	***Tellima grandifolia***	fringecups	Sun-part shade	moist-wet	40 - 80 cm	M	GCA	A
Groundcover	***Trifolium wormskjoldii***	Spring clover	Sun	Moist	10-80		GCA?	C, M/E

Dry meadow

The dry meadow garden bed features native grass species interspersed with perennial forbs which are drought-tolerant and should require no water maintenance once established. The garden bed should be located on the western side of the site which receives the most sun exposure and the least moisture.

Type	Latin name	Common name	Exposure	Moisture	Height (cm)	Ease	Justification
Grass-like	*Danthonia californica*	California oat-grass	sun - part shade	Dry - moist	30-130	?	LM, A
Grass-like	*Elymus glaucus*	Blue wildrye	Sun - part shade	Dry -moist slopes	30-180	?	LM, A
Grass-like	*Festuca roemerii*	Roemer's fescue (bunch grass)	sun	dry - well drained	30-90	?	LM, A
Grass-like	*Koeleria macrantha*	Prairie junegrass	Sun	Dry	30-60	?	LM, A
Grass-like	*Melica subulata*	Alaska oniongrass	Partial shade -	Dry - moist (prefers	30-80	?	

			shade	moist soils)			
Grass-like	*Sisyrinchium idahoense*	blue-eyed grass	Sun	moist	10-42	H	A
Groundcover	*Brodiaea coronaria*	crown brodiaea	sun	dry	30 cm	?	R, A
Groundcover	*Camassia leichtlinii*	Great camas	Sun	Dry - moist	20-100	M	C, M/E
Groundcover (annual)	*Clarkia amoena var. caurina*	Farewell to spring	sun	Dry, Garry oak meadows	10 - 100	?	R, A
Groundcover	*Dodecatheon hendersonii*	Henderson's shooting star	sun to part shade	mesic - dry	5 -50	?	R, A, P
Groundcover	*Eriophyllum lanatum*	oregon sunshine	Sun	Dry	10-60	?	A, P
Groundcover	*Fragaria vesca*	Woodland strawberry	Sun - part shade	Dry - moist	25	H	M/E
Groundcover	*Lomatium nudicaule*	barestem biscuitroot	Sun	Dry	20-90	?	C, M/E
Groundcover	*Sannicula bipinnatifida*	Purple sanicle	sun-shade	dry	5 - 50 cm	?	R (BC red-listed, COSEIWC threatened), M/E
Groundcover	*Triteleia howelli*	Howell's triteleia	Part shade	dry - mesic	20 - 50 cm	?	R

Edible Shrubs

Type	Latin name	Common name	Exposure	Moisture	Height	Ease	Justification
shrub	***Amelanchier alnifolia***	saskatoon berry	sun - shade	dry - moist	10 m	H	M/E
Shrub	***Ribes sanguineum***	red flowering currant	sun - part shade	dry - moist	1 -3 m	M	M/E, P
Shrub	***Rosa gymnocarpa***	baldhip rose	sun - shade	dry- wet	2 m	H	M/E,
Shrub	***Rosa nootkana***	nootka rose	sun	dry - moist	0.5 - 3 m	H	M/E, P
Shrub	***Rubus leucodermis***	black cap raspberry	sun - shade	dry - wet	3.5 m	H	M/E

Deer and drought resistant

Type	Latin name	Common name	Exposure	Moisture	Height	Ease	Justification
Fern	***Polystichum munitum***	Sword fern	part shade - shade	dry - moist	1.5 m	H	LM
Fern	***Pteridium aquilinum***	Bracken fern	sun - shade	dry - moist	2.5 m	H	LM
Shrub	***Berberis aquilifolium***	Tall oregon grape	sun - shade	dry - wet	4 m	H	LM, P
Shrub	***Berberis nervosa***	Dull oregon grape	sun-shade				
Groundcover	***Achillea millefolium***	Yarrow	sun	dry - moist	30 - 100 cm	H	LM, P
Groundcover	***Eriophyllum lanatum***	oregon sunshine	Sun	Dry	30-60	?	A, P
Ground cover	***Mianthemum dilatatum***	False-lily--f-the-valley	Shade	Moist			
Ground cover	***Achlys triphylla***	Vanilla leaf	Shade	Moist			

Sourcing and buying plants

Table 3.1 Wetland garden availability and pricing

Latin name	Common name	Availability	Size	Cost	Quantity	Total Cost
Myrica gale	sweet gale					
Salix scouleriana	Scouler's willow	SNP GCA?	3 gal	$35		
Spiraea douglasii	spiraea; hardhack	SNP GCA?	1 gal/ 2 gal	$10/$15		
Athyrium filix-femina	lady fern	SNP GCA?	1 gal	$10		
Carex hendersonii	Henderson's sedge	SNP (SOLD OUT)	10 cm	$4		
Carex opnupta	slough sedge	SNP GCA?	10 cm	$4		
Juncus bolanderi	Bolander's rush	SNP	1 gal	$7		
Juncus effuses	Common rush	GCA?				
Luzula subsessilis	Short-stalked wood-rush					
Scirpus microcarpus	small-fruited bulrush	GCA?				

Lysichiton americanus	swamp lantern	SNP (SOLD OUT)	1 gal	$10		

table 3.2 Wet Meadow Garden Availability and pricing

Latin name	Common name	Availability	Size	Cost	Quantity	Total Cost
Cornus stolenifera	Red osier-dogwood	GCA	1 gal/2 gal	$10/$20		
Ribes divaracatum	wild gooseberry	GCA	4 in/1 gal/2 gal	$5/$10/$20		
Rubus spectabalis	salmonberry	GCA	1 gal	$10		
Aquilegia formosa	red columbine	GCA	4 in/1 gal	$5/$10		
Epilobium densiflorum	Dense-spike primrose	GCA	4 in	$5		
Heracleum lanatum	cow-parsnip	GCA	4 in	$5		
Lilium columbianum	Columbia lily	GCA?				
Maianthemum dilatatum	false lily-of-the-valle	SNP	10 cm	$5		

	y					
Mimulus (Erythranthe) guttatus	seep monkeyflower	GCA	4 in/1 gal	$5/$10		
Petasites frigidus var. palmatus	palmate coltsfoot	GCA	1 gal/2 gal/5 gal	$10/$20/$35		
Tellima grandifolia	fringecups	GCA	4 in/1 gal/2 gal	$5/$10/$20		
Trifolium wormskjoldii	Spring clover	SNP GCA?	10cm	$4		
Sambucus racemosa	red elderberry	GCA	1 gal/5 gal	$10/$35		
Viburnum edule	highbush cranberry	GCA	1 gal/2 gal	$10/$20		

table 3.3 Dry meadow availabiltiy and pricing

Latin name	Common name	Availability	Size	Cost	Quantity	Total Cost
Danthonia californica	California oat-grass	SNP	10 cm	$4		

Elymus glaucus	Blue wildrye	SNP	1 gal	$6		
Festuca roemerii	Roemer's fescue (bunch grass)	GCA	4 in/1 gal/2 gal	$5/$10/$20		
Koeleria macrantha	Prairie junegrass	SNP	10 cm	$4		
Melica subulata	Alaska oniongrass	SNP	10 cm	$4		
Sisyrinchium idahoense	blue-eyed grass	GCA	4 in/1 gal	$5/$10		
Brodiaea coronaria	crown brodiaea	GCA?				
Camassia leichtlinii	Great camas	GCA	4 in/1 gal	$5/$10		
Clarkia amoena var. caurina	Farewell to spring		10 cm	$3.50		
Dodecatheon hendersonii	Henderson's shooting star	SNP GCA?	10 cm/1 gal	$4/$7		
Eriophyllum lanatum	oregon sunshine	GCA	1 gal	$10		
Fragaria vesca	Woodland strawberry	GCA	4 in/1 gal	$5/$10		
Lomatium nudicaule	barestem biscuitroot	GCA	4 in/1 gal	$5/$10		

Sannicula bipinnatifida	Purple sanicle					
Triteleia howelli	Howell's triteleia					

table 3.4 edible shrubs availability and pricing

Latin name	Common name	Availability	Size	Cost	Quantity	Total Cost
Amelanchier alnifolia	saskatoon berry	GCA	4 in	$5		
Ribes sanguineum	red flowering currant	GCA	2 gal/5 gal	$20/$35		
Rosa gymnocarpa	baldhip rose	GCA	1 gal/2 gal	$10/$20		
Rosa nootkana	nootka rose	GCA	1 gal/2 gal/5 gal	$10/$20/$35		
Rubus leucodermis	black cap raspberry	GCA	2 gal	$10		

Table 3.5 Deer and drought resistant

Latin name	Common name	Availability	Size	Cost	Quantity	Total Cost

Polystichum munitum	Sword fern	GCA	1 gal/2 gal/5 gal	$10/$20/$35		
Pteridium aquilinum	Bracken fern	GCA?	4 in/1 gal	$5/$10		
Berberis aquilifolium	Tall oregon grape	GCA	1 gal/2 gal	$10/$20		
Achillea millefolium	Yarrow	GCA	4 in/1 gal	$5/$10		
Eriophyllum lanatum	oregon sunshine	GCA	1 gal	$10		

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