

Pollinator Conservation Plan for the Berggren Demonstration Farm

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**A Plan Compiled by the University of Oregon's
ELP Sustainable Farms Team
June 10, 2012**

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1.0 Executive Summary

The Sustainable Farms Team, as a part of the University of Oregon's Environmental Leadership Program (ELP), created this Pollinator Conservation Plan to provide the Berggren Demonstration Farm with a comprehensive guide to managing its property for pollinators. Its intent is to direct the Berggren Demonstration Farm (Demo Farm) in creating and implementing bee friendly habitat and farm management practices to promote increased pollination services. The plan includes management techniques and methods to conserve pollinators by providing recommendations for both nesting habitat and a food source.

By accommodating aspects of bee life cycles, the farm will have pollinator services that are both cost effective and ecologically viable. The Pollinator Conservation Plan outlines the current use and history of the Demo Farm and the management practices used. In the past the farm was equestrian with hay pasture, the property is currently going to be changed into a farm with crop production year round. After the overview of the farm, the plan highlights the conservation tasks and goals. A pollinator hedgerow design was created using native plants. The hedgerow will act as a pollen and nectar source along with providing protection against soil nutrient leaching. The increase of pollen and nectar habitat will be supplemented by the addition of a Pollinator Garden. The Plan has a comprehensive plan for a garden of both native and non-native plants. The garden is an educational tool used to demonstrate the importance of conservation of pollinators.

The Plan recommends other nectar habitat, such as: cover crops, interplantings, and the use of the escarpment between the upper and lower terrace for nesting habitat. All actions increase the diversity of plants available attracting more pollinators while providing nesting habitat. The nesting Habitat recommendations make accommodation for the many native bee types, including solitary ground nesting bees. To guarantee the success of the recommendations, the Plan incorporates other management practices on the farm to increase pollination success. These practices include no to reduce tilling, with off limit areas along with no use of insecticide to using organic herbicide. To track the success of the project baseline monitoring of the future hedgerow site. All recommendations in this plan were made to increase and conserve both native and non-native pollinators to ensure the future success of the farm

2.0 Introduction and Background

2.1 Introduction

The Berggren Demonstration Farm (Demo Farm) is a 30-acre management zone within the Berggren Watershed Conservation Area (BWCA) located along the north side of the McKenzie River near Springfield, Oregon. McKenzie River Trust owns the BWCA and has partnered with Cascade Pacific Resource Conservation & Development to manage the Demo Farm. These organizations, as well as other partners, envision the Demo Farm as a hub for sustainable agriculture, community education, and innovative farm management practices.

Each year, the University of Oregon's Environmental Studies Program gives undergraduate students the opportunity to become part of a local service-learning program known as the Environmental Leadership Program (ELP). The ELP's Sustainable Farms team worked in coordination with the Demo Farm managers to create a pollinator conservation plan for the Demo Farm. At the forefront of this plan was the need to attract native pollinators and create long-term native pollinator habitats. Native pollinators provide crucial pollinator services that increase the health and abundance of plants within an area. This report presents the Sustainable Farms team's work, and is intended to recommend designs that can be put into operation at the Demo Farm.

The Pollinator Garden and the Pollinator Hedgerow plans are focused on increasing native pollinator foraging habitat at the Demo Farm. Alongside these design elements, this plan offers a set of future management strategies for the farm to help it increase its native pollinator services. Our suggestions are designed to implement the farm's core values of sustainable agriculture, providing educational opportunities, and serving as an example for potential practices to be implemented at other local farms.

2.2 Project Need

Over the past two decades, the populations of native pollinator species in the United States have been on a steady decline³. We recommend enhancing the farm area with plant species that would attract and support native pollinators by installing a pollinator garden and hedgerow. Our design for the Pollinator Garden includes more than twenty flowers, shrubs, and herbs that encourage pollination services from a variety of bumblebees, butterflies, and hummingbirds. In addition to providing habitat for native pollinators, the Pollinator Garden will serve as an attractive educational garden for students and other community members visiting the farm.

We also designed a Pollinator Hedgerow to be located on the lower terrace of the farm. The 342 m (984 ft) Pollinator Hedgerow will attract native pollinators and provide crucial

nesting habitat, in addition to providing a buffer between the riparian zone and the farm. Because of their close proximity to water, the plants and shrubs in the Hedgerow were chosen based on their strength and ability to withstand flooding and moist soil.

3.0 Site Description

3.1 Site Location and Existing Conditions

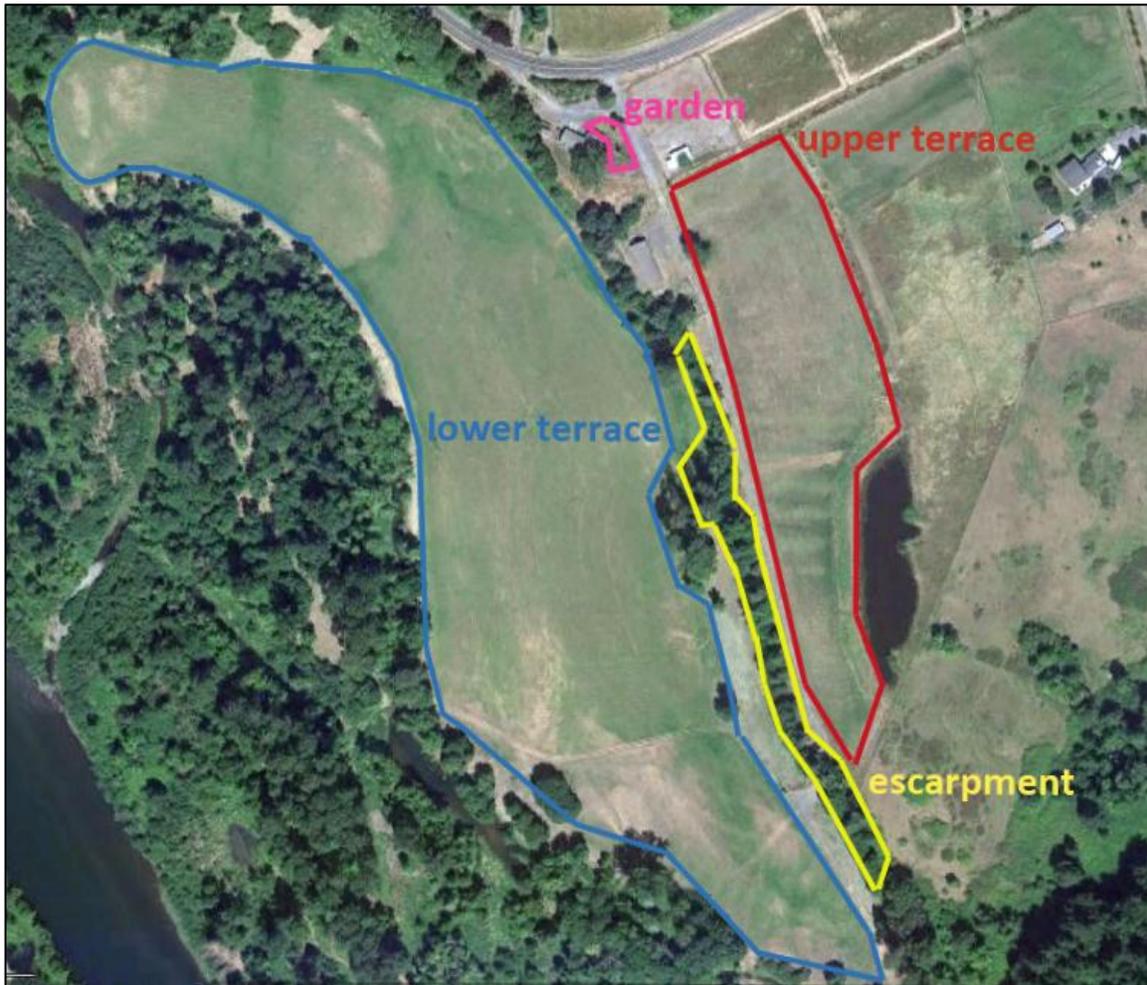


Figure 1. Aerial photo of Demo Farm displaying the two terraces, garden, and escarpment.

3.1.1 Physical Characteristics

The two terraces will be used for agricultural purposes. The lower terrace is much larger, and will be used as the incubator farm for beginning farmers. The lower terrace is at an elevation of 156m (512 ft) while the upper terrace is at 167m (548 ft). Because the lower terrace is so close to the McKenzie River, it floods during times of high river discharge.

This needs to be taken into account when choosing crops and pollinator hedgerow plants; the hedgerow species need to be able to withstand seasonal flooding.

The soil in the lower terrace is Newberg Sandy Loam¹⁰. This soil is found on floodplains, and is typically moist, but very well drained, and is often dry from depths of 20 to 61 cm¹¹. The United States Department of Agriculture states that this soil is best used as pasture, and for growing vegetables and fruits.

The soil in the upper terrace consists of Pengra Silt Loam¹⁰. This soil is typically poorly drained, and often saturated. Because of this, it is not as well suited for agricultural purposes as the lower terrace, although it can be used for hay and pasture¹⁴.

3.1.2 Biological Characteristics

The property's biological characteristics currently consist of riparian zones near the river and grass fields on the terraces (Figure 1 previous page). In the past, the upper terrace was used for feeding and keeping horses, and this has led to severe soil compaction. The lower terrace has been historically used to grow rye grasses¹⁶. Just above the slope on the east side of the upper terrace there is a 0.8-acre pond. The buffer zone between the terraces, and the area nearest the river do contain some invasive plant species, but work is being done to contain and eradicate them from the property. It is important that pithy, woody plants are present for bees⁹. These plants can be utilized near the pond on the upper terrace, or in the buffer zone, because the main pollinator hedgerow will be along the lower terrace's border.

3.2 Site Management

3.2.1 Site History

A private farmer owned the land before it became the Berggren Watershed Conservation Area/Berggren Demonstration Farm. The previous owner used the farm for hay production and raising horses, which lasted for 10 years leading up to the change in ownership¹⁶. Throughout this time, tilling was the most disruptive practice in terms of pollinator management. There was an array of pesticides used in the past and we have records of glyphosate being used to try and eradicate the blackberries.

Current management practices are minimal because Cascade Pacific and their partners are still solidifying the Demo Farm plans. However, on the upper terrace there are two rectangular sections about 30ft x60ft, which are being solarized to kill dormant weed and grass seeds. These two locations are the potential sites for future greenhouses. Near the farmhouse a large number of shrubs have also been removed to prepare the site for the future pollinator garden. On the west side of the upper terrace is a sloping meadow that

contains the pond, which was established in 2005¹⁰. There are three existing structures: the farm house (2,300ft²), the shop (2,240ft²), and the barn (864ft²)¹⁷.

Beginning in 2011 and into 2012, the McKenzie Watershed Council has conducted riparian restoration and enhancement activities. These activities include but are not limited to the removal of invasive species and planting of native trees and shrubs.

3.2.2 Future Management

The upper terrace or Learning Farm (15 acres) will be an educational site for students, community members, and local farmers. Due to poorly draining soil, crop choices for the upper terrace will need to be well thought out in order to conserve time and resources¹⁰. The Demo Farm plans to incorporate greenhouses to grow starts and extend the production season and produce up to one acre of vegetable rows emphasizing “Oregon Harvest of the Month” crops. Oregon Harvest of the Month is a statewide approach to informing school kids about the connection between the foods they eat and where it comes from.

The Demo Farm also plans to incorporate animals into the system, which may include a demonstration apiary, segmented pastures for sheep or goats, chickens, ducks, and perhaps llamas and pigs. This will assist in the reduction of outside costs such as manure and compost as well as demonstrating methods to close various energy loops. The existing barn will be the site of this small-scale livestock production.

The 2,240ft² shop will become a storage location for both McKenzie River Trust and Demo Farm tools and equipment. Cascade Pacific intends to build educational infrastructure adjacent to the farmhouse. Inside it will contain a small workshop and a resource or library space. The structure will include a classroom, an amphitheatre, restrooms, and a produce washing and storage facility. This site will be the central hub for events, visiting schools, meetings, and educational classes.

There will be various test plots for plants like beans and grains and up to four acres will be reserved for filbert/truffle orchards¹⁷. The pond will be host to wildlife studies performed by partnering schools and science classes. The prairie savannah will be actively restored and may eventually have a trail with a viewpoint to overlook the entire Demo Farm.

Along the southwestern edge of the Learning Farm, we proposed a bioswale consisting of native forbs and sedges. A bioswale is a shallow, wide, gentle sloping ditch designed to retain surface water, which helps filter pollutants and silt before making its way to the bottom terrace. This would run parallel to the existing access road.

The lower terrace (16 acres) will become an Incubator Farm for beginning farmers to rent land in plots between 0.5-2 acres. It will be a communal setting where tools are shared, land is leased at or below market value, and trainings and information will be available to

help farmers improve farming practices¹⁷. We have designed a hedgerow (see section 4.1.1) that will be planted 342m (1122ft) long and 3m (9.8ft) wide along the entire length of the lower terrace as a riparian buffer, but will primarily provide habitat and foraging resources for native pollinators. The McKenzie River Trust is currently restoring a 30m (100ft.) riparian buffer of native tree and shrub plantings along the lower terrace on the west side of the field. The combination of the riparian buffer and hedgerow should create a natural gradation, reducing flood damage and filtering constituents that may drain into the fields.

As of now, there is a three-year plan for the upper and lower terraces. A combination of light tilling, disking, and cover cropping will be performed on the production fields for the first couple of seasons in order to transition from pasture to food production. This will help establish the soil but tilling and disking will likely be discontinued to provide more suitable habitat for ground dwelling pollinators¹⁷.

The first year plan for the upper terrace consists mainly of applying for USDA grants, Natural Resource Conservation Service (NRCS) equipment grants, improving irrigation, planning and implementing vegetable and fruit rows, and partnering with schools to coordinate field trips to the farm¹⁷. The lower terrace will be in preparation (tilling, liming, cover cropping) for crops the following year.

The second year will be focused on sustaining the 2012 projects and hiring two farm apprentices. The farm manager will continue coordination with BWCA restoration projects on the lower terrace as well as beginning the implementation of the Incubator program. The third year plan will continue and expand upon previous projects and perhaps add additional Incubator Farm projects.

All projects are designed to provide examples of ways to help increase the economic viability of small-scale organic farming while practicing watershed friendly methods.

4.0 Conservation Goals and Tasks

4.1 Pollinator Habitat

4.1.1 Pollinator Hedgerow

A pollinator hedgerow is a permanent linear planting of woody plants with the specific purpose of attracting pollinators. Ideally, a pollinator hedgerow will not only provide pollinators with adequate nectar and pollen with which they can feed themselves, but also provide pollinators with a habitat in which they can nest and thrive. Hopefully, such an environment will be a host to pollinator activity throughout the year, and provide farms with a reliable native pollinator population that can pollinate their crops. If a healthy native pollinator population is achieved, a farm could reduce its management costs by not

having to rent expensive honeybee hives. Pollinator hedgerows are not only ecologically beneficial, but also economically valuable; they are designed to make the farmer's management easier and their crops more productive.

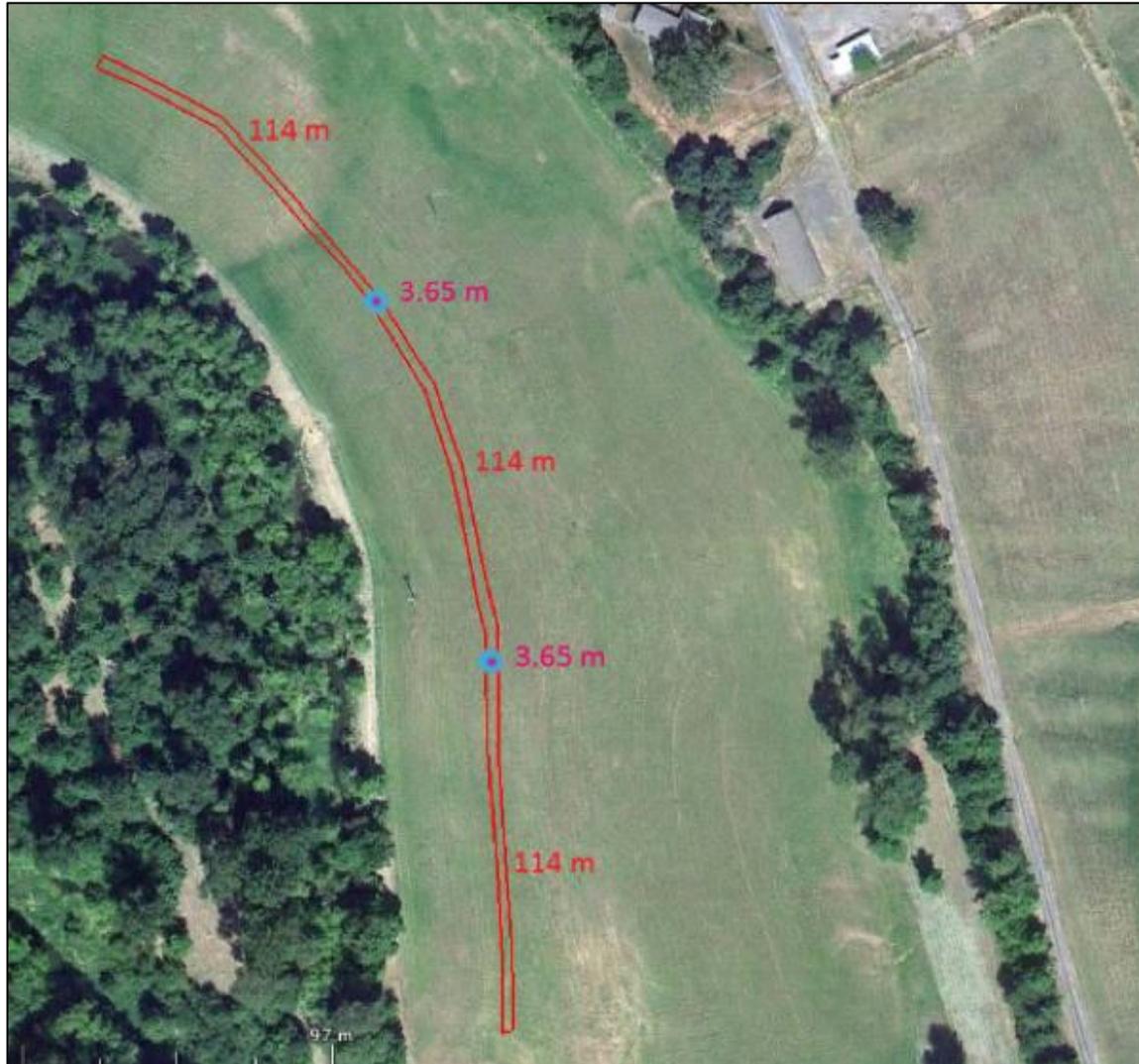


Figure 2. Aerial photo showing the location of the hedgerow along with the size of each section.

The pollinator hedgerow will be located on the farm's lower terrace (Figure 2). The lower terrace is located between the farm's upper terrace to the east and the McKenzie River to the west. The hedgerow will act as a buffer between the food crops of the farm and the riparian zone of the McKenzie River. Besides attracting pollinators, such a buffer could help reduce field erosion during winter floods¹⁹.

The pollinator hedgerow will be 342m long (1,122 ft) and 3m wide (9.8 ft). Essentially, it will look like a long strip of plants that will start from the southwestern edge of the lower terrace and extend north. This long area will then be divided into three sections that will

be separated by two 3.65m (12 ft) pathways (represented by the blue dots in the aerial photo). These pathways will connect the area east of the hedgerow to the proposed access road that will run along the hedgerow's western edge. These pathways were designed to be about 3.65m (12 ft) across in order to be wide enough to allow cars or other farm equipment to drive through them without damaging the hedgerow plants. The three sections that result from the splitting of the hedgerow will each be 114m long (374 ft).

Design

In our hedgerow design, we created three options for sections that could be used to populate the hedgerow with plants and flowers. The options are labeled A, B, and C. This was done to create an easy-to-implement design that would ultimately give the farm managers the freedom to choose which plants/options would work best for them. For example, if a plant species is determined to not be ideal for the hedgerow by the farm managers, it can be replaced with any number of the other plants that have been suggested.

The options were designed to ensure that the entire hedgerow has an equal amount of flowers in bloom throughout the entire growing season. Each option has flowers that roughly correspond to a specific bloom period (early, middle, and late). Early flowers bloom between March and May, middle flowers bloom between May and July, and late flowers bloom from July to September. For example, Option C consists of three plants: Tall Oregon Grape, Nootka Rose, and Douglas Spiraea. Tall Oregon Grape blooms early, Nootka Rose blooms in the middle, and Douglas Spirea blooms late. Every option follows this model while at the same time using different plant species. Therefore, when these options are used in succession, they provide the best overall bloom-coverage for the entire growing season. The timeline above shows the bloom succession for the suggested hedgerow plants.

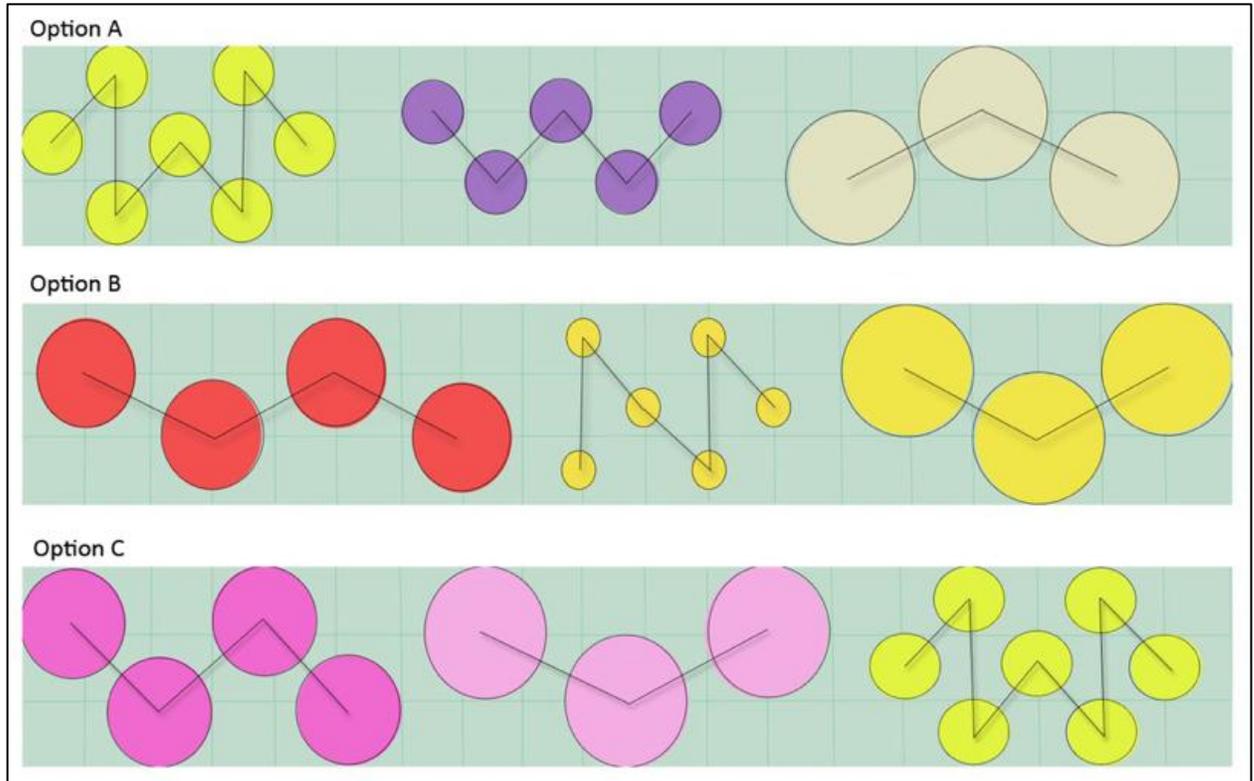


Figure 3. Hedgerow Options A, B

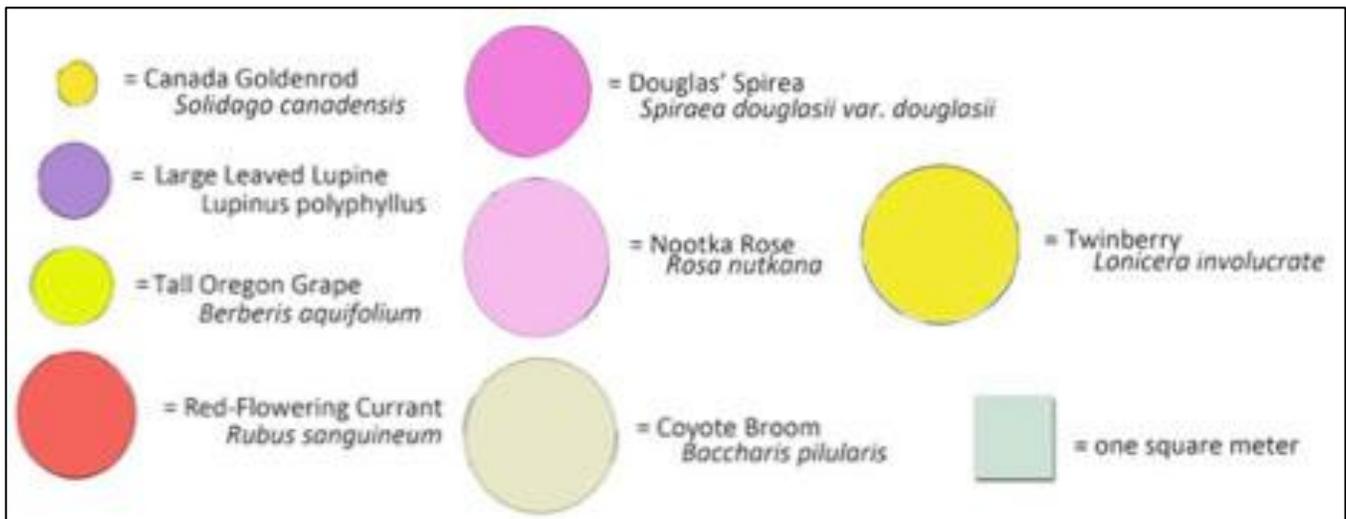


Figure 4. Hedgerow Design Key.

Each design option for the hedgerow is stacked together in the pattern “ABCABC” within each 114-m section of the hedgerow. By repeating this pattern throughout the entire hedgerow, the whole area will be in constant bloom for most, if not all, of the growing season.

As for the specific plants that we decided to include in our design, each plant attracts either local pollinators creates pollinator habitat, or performs both services. All of the plants that we picked for the hedgerow should do well in both the climate and soil conditions of the lower terrace.

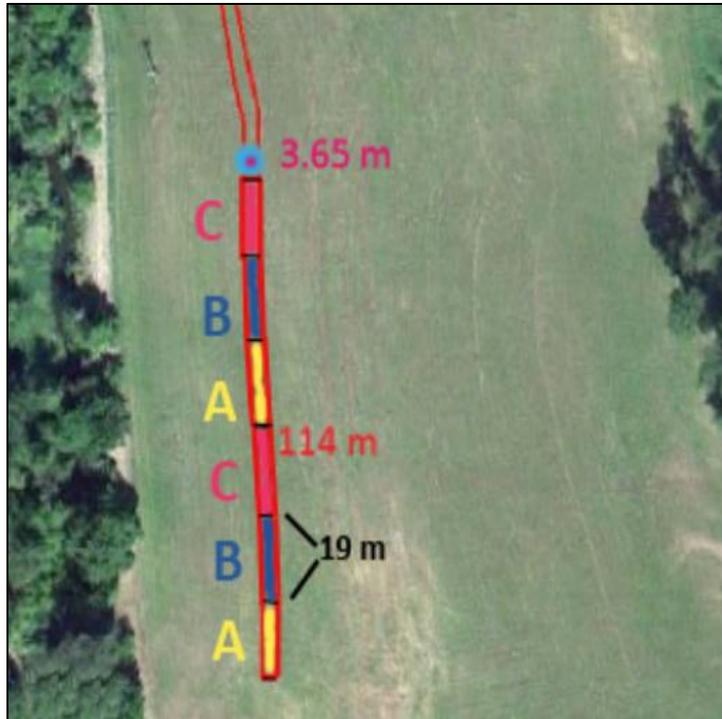


Figure 6. Aerial photo of segment of the pollinator hedgerow showing recommended section order

We chose plants with relatively low maintenance requirements. Irrigation should not be necessary; since all of the plants that we have picked are native to the Willamette Valley, they should do very well by using just the natural rainfall alone. Many of our plants are also both resistant to droughts and floods. It should be noted, however, that irrigation during the first year following planting increases survival. Additional irrigation may also extend the bloom time of certain plant species (e.g. the lupine) Furthermore, if rain is more scarce than usual during a certain year, irrigation may be required. In addition, due to the seasonal flooding of the lower terrace, many of the plants that we have chosen are also resistant to floods (as well as droughts). Overall, the plants we have chosen are ideal for the overarching conditions of the site (e.g. hydrology, sun exposure, and soils). For more specific on the hedgerow plants, refer to Appendix B.

4.1.2 Pollinator Garden

Introduction

This garden was designed to attract different species of native and non-native pollinators as well as educate visitors about beneficial pollinator plants for home use, as well as being aesthetically pleasing. There are three main educational examples of plants within the garden: native plants, non-native kitchen herbs, and drought resistant pollinator plants. A mix of shrubs and forbs along with successive bloom windows will provide habitat and foraging resource for native bees, butterflies, hummingbirds, and other beneficial garden insects. See Appendix A for a garden bloom timeline, as well as images of the garden during different bloom windows.

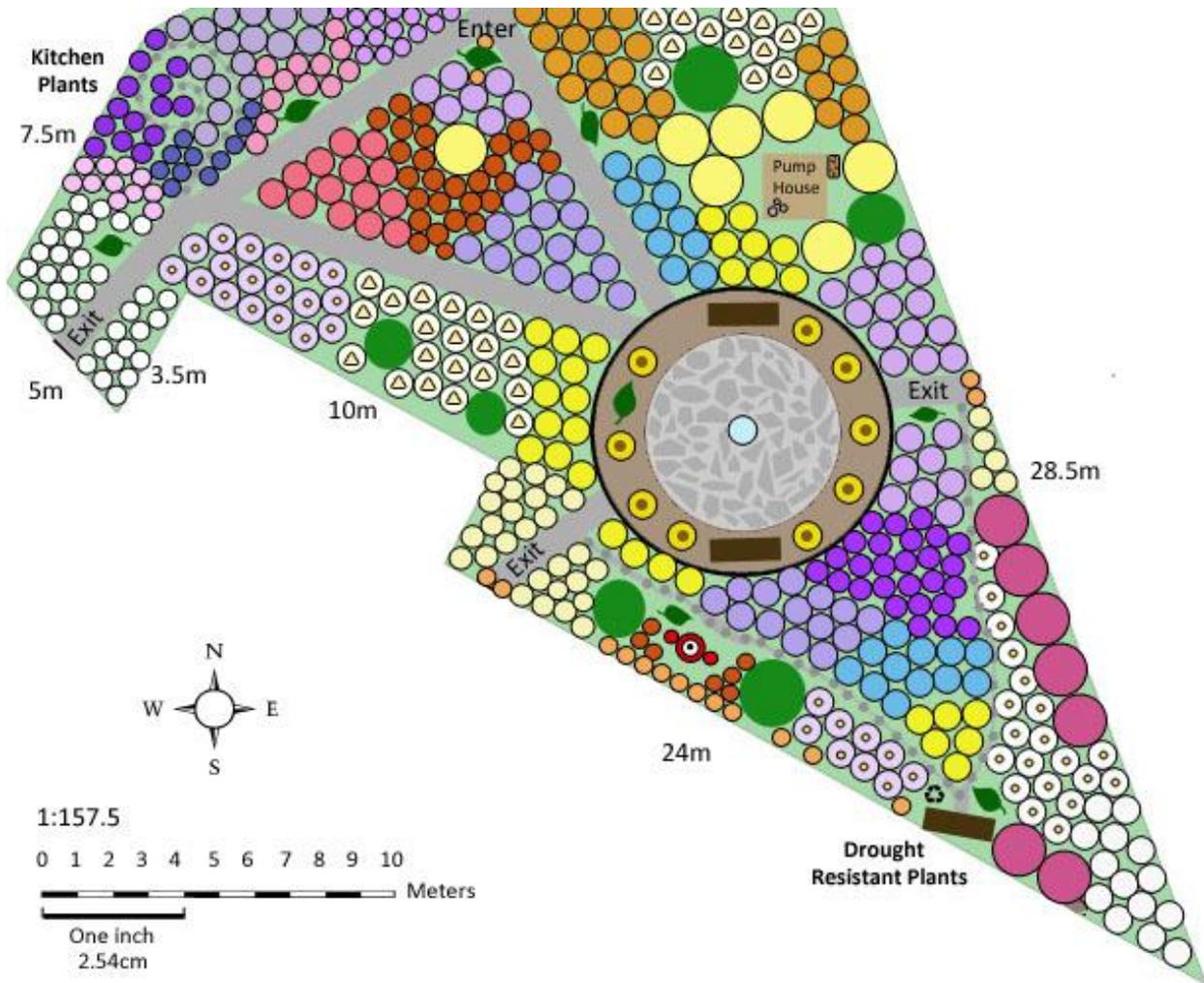


Figure 8: Proposed Pollinator Garden Design for the Berggren Conservation Farm

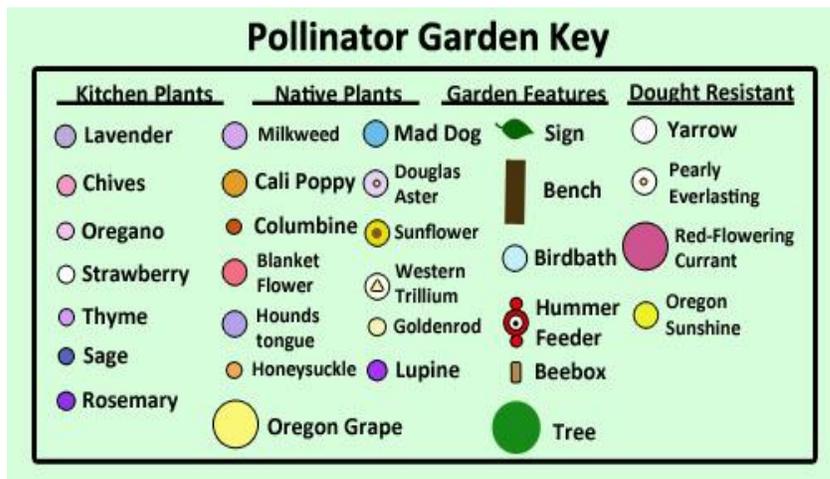


Figure 9. Garden Design Key

Inside The Garden

The main visitor entrance is located on the north end of the garden. A sign will be posted at the head of the entrance fork to provide information about the garden. A fork at the entrance will spark children's curiosity by allowing them to decide which path to explore first. Along the left edge within the spiral path is the non-native kitchen herb section of the garden. At the opposite corner in the bottom right of the screen are the drought tolerant plants. Native pollinator plants are dispersed throughout the garden.

The grey lines indicate main pathways made of pebbles, wood chips or stone slabs (depending on preference and available resources). The thinner grey lines with dispersed dark grey dots are narrower side paths made of small stepping-stones so walkers feel they are amongst the flowers. They also act as ways for caretakers to get into deeper sections of the flower patches to do any necessary maintenance. The six large green circles are existing trees and the green square is the pump house. A wind chime will hang on the corner of the pump house facing the gathering circle for soothing noise. Along another edge of the pump house is a mason bee block to provide a direct home for native mason bees. The circular section in the center is a gathering location to give small talks or to sit and relax. A bird feeder is represented by a small blue circle in the center of the map. The three brown oblong ovals within the center circle are small benches and the brown rectangle in the bottom right of the map is also a bench. There are four entrances/exits at each side of the garden for easy navigation.

4.1.3 Other Pollinator Habitat

While the pollinator hedgerow and garden are intended to be the main foraging habitat for pollinators, there is also opportunity to create additional habitat in other areas of the farm. Having dispersed pollinator habitat will attract pollinators to crops, and it ensures a food supply for bees and other pollinators with smaller flight ranges. This habitat could include cover crops, interplantings, and a bee pasture. The preservation of other natural areas within and adjacent to the farm would also support these beneficial insects⁸.

Cover Crops

Cover crops are intended to increase the fertility of soil, reduce erosion, manage pests and weeds, and improve soil tilth. They are grown for a short period of time while a farm's production crops are not in season. Choosing the right cover crops can provide additional foraging habitat for native pollinators. This is especially beneficial as it provides nectar and pollen when there are fewer plants flowering.

For the Demo Farm, it would be best to plant early-blooming cover crops for the crops later in the season, as they will be tilled before they bloom. Fava beans would be a good choice for this reason. If later blooming plants are to be included in the cover crop, Buckwheat (*Faopyrum esculentum*) is also a beneficial plant for pollinators.

Another option would be to implement a crop rotation system, where a portion of the farm would not be used for crop production purposes for a year. During this time, instead of leaving the field fallow, the area could serve as a temporary pollinator meadow. In addition, this cover crop would present fewer seasonal limitations, allowing more flexibility when choosing plants.

Interplantings

Interplanting is the process of maximizing farm space by planting certain crops with another. This usually involves the combination of plants with different harvest times and sizes. Interspersing a variety of small pollinator plants between the different sections of the farm would be very beneficial for both pollinators and fruit and vegetable production. It would provide additional crucial habitat, while attracting the bees to the farm's crops.

These areas could conceivably be viewed as diminutive crops. Possible plants could include kitchen herbs, such as Oregano, Chives, Rosemary, Lavender, Thyme, and Basil, and other edible plants like Woods Strawberry. Small native flowering plants also work well, but avoid some species of mint and mustard, as they tend to be weedy⁸. This especially applies to Spearmint and Peppermint. It is also essential to plant perennial and annual interplantings with their respective crops, as it is less difficult to manage.

If there will be an orchard on the farm, adding understory plantings that include pollinator-friendly plants would provide foraging habitat for the bees when the trees are not in bloom. Possible plants for this understory include clover, short-statured yarrow, and flax⁸. These plants are low to the ground, flower profusely, and would provide bee habitat without disrupting crops⁸.

Bee Pasture

A bee pasture would be a permanent small plot of wildflowers, intended to serve as vital habitat for pollinators. There is abundant land available for this purpose at the Berggren Demonstration Farm. This pasture could be located in a few different locations around the farm, including near the grazing areas and the sloped hillside adjacent to the pond. Some of the land above the pond could also become restored upland prairie.

Bee pastures can contain a variety of plants, but native plants are a good choice because they have co-evolved with local, native pollinators and meet their needs well⁸. They also have low maintenance requirements. In addition, it is important to have a variety of plants flowering throughout the growing season in order to better support a native pollinator population²². Many native flowers are drought tolerant, making them easier to manage in the summer⁸. *Prunella vulgaris* (a perennial), *Clarkia amoena* (an annual) are two exemplary, low-cost options. Some of the Garden plants could also be included in the pasture, including: Western Goldenrod, Lupine, Yarrow, and Oregon Sunshine. However, the location of the meadow is essential when choosing plants, as conditions vary throughout the farm.

Escarpment

The escarpment is the sloped area between the two terraces, and with new management practices it could provide excellent pollinator habitat. Blackberry plants should be removed and the area could then be planted with a variety of flowering plants to provide foraging habitat. In addition, adding a diverse group of shrubs would be advantageous to attract a wide variety of pollinators throughout the growing season, and provide valuable the valuable pithy wood needed by some pollinators in their life cycles. This could include: Baldhip Rose, Twinberry, Salmonberry, Osoberry, and Red Elderberry¹². Smaller shrubs would be effective if placed near the base of the escarpment on the lower terrace and could include: Oregon grape, Nootka Rose, and Mock-orange¹².

Other Natural Areas

There is abundant land throughout the farm that could also serve as potential foraging habitat. This includes the riparian buffer zones separating the western edge farm from the McKenzie River, the willows around the pond on the upper terrace, and the adjacent Vickery Park. The presence of natural habitat itself is beneficial to the pollinators, as it provides space for them to breed and forage⁸.

4.2 Nesting areas

Nesting sites for native bees are integral to the pollination, and thus success, of farm crops. The most prevalent type of native bees globally are solitary, ground-nesting bees, accounting for about 70% of bee diversity⁹. Ground-nesting bees typically nest in well-drained, bare sandy or sandy-loam soils with occasional patchy vegetation⁹. These areas include roadsides, ditch banks, and other marginal areas⁹. Ground-nesting bees burrow their nests 6 to 36 inches into the soil forming small chambers, in which their larva grow²¹. Solitary wood and cavity nesting bees, which make up about 30% of the native bee population, build nests inside hollow tunnels, twigs, snags, or artificial structures^{9,21}. Other potential nesting sites include bunch grass, rodent burrows, and brush piles⁹. Social bumblebees construct nests in small cavities including, rodent nests or brush piles²¹.

Considering the life cycles of native bees and their habitat requirements, we recommend that areas of the Demo Farm be set aside for potential nesting sites. There should be areas of bare and well-drained soil where farmers do not till or use pesticides²². Nesting areas should also include dead tree branches and grassy thickets^{9,21}. We recommend that several sites within the farm be enhanced as well as creating new nesting sites. These improvements include: nesting blocks for mason bees, bare soil areas near the hedgerow, nest sites in the escarpment, and keeping broken branches and snags around in the nearby riparian zone¹⁸.

Nesting blocks, used by native mason bees, can be placed in the pollinator garden to be used as an educational tool to display the lifecycle of mason bees. The blocks can be created by drilling 3-5 inch deep holes, with a diameter of 3/32 inches to 3/8 inches into a piece of wood^{18,22}. Nesting blocks sites should be sheltered from weather; a roof can be

added for this purpose, with the entrance facing east to get the morning sun^{18,22}. The holes should be cleaned out to reduce the spread of diseases²². We recommend that paper straws be used to line the holes, making cleaning the nesting blocks simple and effective²².

Nesting sites containing logs and snags can be implemented in the escarpment between the upper and lower terrace. Cavity and wood nesting bees would benefit greatly from this addition by increasing nesting area on this site¹⁸. This area could further be enhanced if the non-native blackberry is removed and replaced with other plants that contain similar pithy twigs, like elderberry⁹. Management for this area should allow for the creation of snags and dead material that can be used as nests, thus broken branches should not be removed.

We also recommend that the area between to road and the escarpment on the upper terrace be left bare. This bare soil is a nesting site for ground-nesting bees¹⁸, and should be void of tilling and pesticide use. This means that the weeds that develop in that area need to be manually removed²². The riparian zone, next to the hedgerow, should be managed to allow for dead branches and snags to persist, as they can be used for nesting sites²¹.

4.3 Recommended Management Practices

There are various methods of management that will promote pollinators visiting and establishing nests on farm property. According to the Xerces Society for Conservation⁹, best management practices include not using pesticides and avoiding tilling.

If tilling is a necessary aspect of the farm, try to create nesting bee habitat in other areas. If tilling can be avoided, then this is best for retaining ground-nesting bee habitat, as tilling heavily disturbs these habitat areas. There are also other methods of drilling to plant seeds that do not pull up and disturb nesting habitat like traditional tilling.

Reducing pesticide use is an integral management practice for the success of pollinators on the property. Ideally, the farm's management plan would not include pesticide use, but if it's necessary, then it is important to focus on minimizing usage as much as possible. Additionally, if pesticides are used, it is best to spray at night when pollinators are not foraging. Of all pesticides, insecticides are the most damaging to pollinators; even organic insecticides can harm or kill pollinators that are desired on the farm. Many organic herbicides are less harmful and can be used on the crops. Organic Materials Review institute can also help in finding these organic herbicides. Careful consideration of when spraying happens should be made. If pesticides are used, spraying at night, after pollinator's are done for the day, is important for pollinator management.

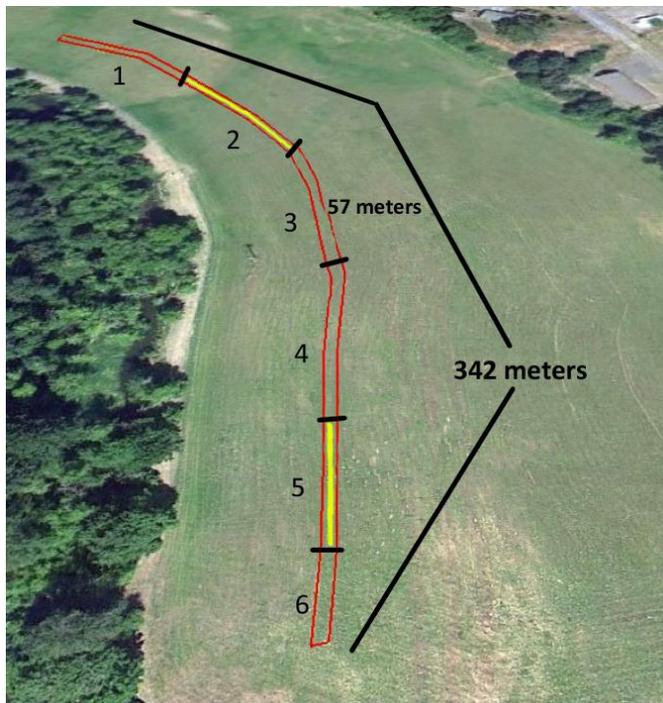
Finding alternatives to herbicides is also an important pollinator management practices. It is important to know the area, and experiment on small scales before implementing something on the entire property. First off, managing the weed seed bank in the soil is

important. Nipping these seeds from the beginning will make weed control easier in the future. It is important to place fertilizer in strategic places. Put these fertilizers in rows where they will most successfully be used by the crops, not the weeds⁶. Cover crops are also important for weed control in that they compete with the weeds.

There are other methods to control pests on the farm. Swallow and kestrel nesting boxes, and bat boxes can be used to encourage natural pest control. Having these animals on the property can enhance the natural control of pests. Bats in particular can consume great quantities of problematic insects on a farm⁷. Kestrels can help in the control of small mammals (such as voles) that can cause extensive damage.

5.0 Monitoring

The goal of conducting this survey was to see how many pollinators were in the area before the recommended hedgerow is implemented. Baseline monitoring is used to establish how many pollinators are currently present along the projected hedgerow. Implementing these monitoring techniques now will help others in the future evaluate pollinator activity and habitats and maintain monitoring consistency over multiple seasons. This monitoring was conducted at the Berggren Farm on May 4, 2012 at 1:00 PM. The hedgerow is approximately 342 m (1124 ft) long that runs along the west side of the lower terrace. The majority of the terrace currently contains grasses and a few forbs. We divided the hedgerow into six transects that were approximately 57 m (187 ft) long. By using a simple random sample we chose transects two and five to walk along the hedgerow. Transect two started at 507952.36 Easting, 4879285.90 Northing and ended at 508008.46 Easting, 4879253.76 Northing. There were 114 m (374 ft) between transect two and transect five. The starting coordinates for transect five began at 508032.62 Easting, 4879146.05 Northing and ended at 508048.71 Easting, 4879087.20 Northing.



After plotting these transects, we used the methodology from Ullmann et al.²⁰ to collect data for our baseline monitoring. For this survey we walked two 60 m transects each taking 20 minutes. While walking along this transect line, we were looking for pollinators such as bumblebees, honeybees or bee flies that were present on the lower terrace. The goal of conducting this survey was to see how many pollinators were in the area before the recommended hedgerow is implemented.

Figure 10. Aerial photo of pollinator hedgerow showing the two transects observed during baseline monitoring.

The data was collected in overcast weather conditions. The temperature was 17.3 degrees Celsius with a wind speed of 0.3 m/s at the start of the pollinator survey. There was no sun during the allotted time of the pollinator survey. Therefore, there were limited sightings of pollinators flying around on the lower terrace. Transect two recorded a single pollinator and categorized it as “other”, describing it as a small white moth. Transect five recorded a single fly pollinator but was found during the time it was raining, so no pollinating was occurring. At the end of the survey, 20 minutes later, the weather had changed to a temperature of 14.2 degrees Celsius and a wind speed of 0.5 m/s. We assumed that the low presence of pollinators in the lower terrace was due to poor weather conditions and the lack of plants that attract native pollinators.

6.0 Conclusion

The Berggren Watershed Conservation Area is an example of coordinated habitat conservation, restoration, and agricultural practices on a single 92-acre site between several community partners. The combination of conservation education and implementation alongside organic farming will help in protecting the quality of the McKenzie River. The ELP’s role within the Demo Farm is to design a plan that provides native pollinator habitat and foraging resources to increase the presence of native pollinators (bumblebees, hummingbirds, butterflies, and other pollinating insects). An increase in local pollinators will lead to more productive crops and larger yields. The integration of the native wildflowers and shrubs will not only attract pollinators but also predatory insects, which protect crops against pests like aphids and mites. This conservation biological control will hopefully be enough to prevent any future spraying of pesticides or insecticides commonly used for pest management. The pollinator garden and hedgerow will provide examples of plants and planting styles for those (home or farm use) looking for more holistic methods of increasing yield while maintaining biological integrity.

7.0 Acknowledgments

The ELP Sustainable Farms Team could not have completed this project without the assistance of a large number of people. Our thanks go out to the Katherine Bisbee II Fund of the Oregon Community Foundation and the UO Environmental Studies Program for their generous support and for funding our work. We’d also like to thank the McKenzie River Trust, the landowners and stewards of the Berggren Watershed Conservation Area on which the Demo Farm is located. We could not have completed our work without the continual support of Jared Pruch and Rosie Sweetman who manage the farm for Cascade Pacific Resource Conservation and Development. We’d also like to give many thanks to our technical advisers, Eric Mader of The Xerces Society for Invertebrate Conservation; and Bruce Newhouse of Salix Associates. Peg Boulay and Katie Lynch provided invaluable guidance and advice to our entire team during our project, for which we are extremely thankful. Finally, we’d like to thank Raj Vable our project advisor. Without his unwavering support and encouragement throughout the course of our project, we would not be where we are today.

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Appendix A: Bloom Time Lines

Botanical Name	Common Name	March	April	May	June	July	August	September	October	November	December
<i>Berberis (Mahonia) aquifolium</i>	Tall Oregon Grape	■	■	■	■						
<i>Rubus sanguineum</i>	Red Flowering Currant		■	■	■						
<i>Lonicera involucrata</i>	Twinberry		■	■	■	■	■				
<i>Lupinus polyphyllus</i>	Many-Leaved Lupine			■	■	■	■				
<i>Rosa nutkana</i>	Nootka Rose			■	■	■	■				
<i>Spiraea douglassi</i> var. <i>douglassi</i>	Douglas' Spirea					■	■	■	■		
<i>Solidago lepida</i> var. <i>salebrosa</i>	Western Goldenrod					■	■	■	■	■	
<i>Baccharis pilularis</i>	Coyote Broom						■	■	■	■	■

Figure A1. Hedgerow Bloom Timeline¹²

Botanical Name	Common Name	March	April	May	June	July	August	September
<i>Fragaria vesca</i> var. <i>bracteata</i>	Woods Strawberry	0	0	0	0	0	0	0
<i>Berberis (Mahonia) aquifolium</i>	Tall Oregon Grape	■	■	■	■			
<i>Ribes sanguineum</i>	Red-Flowering Currant		■	■	■			
<i>Cynoglossum grande</i>	Pacific Houndstongue		■	■	■	■		
<i>Trillium ovatum</i> ssp. <i>ovatum</i>	Western Trillium		0	0	0	0	0	0
<i>Rosmarinus officinalis</i>	Rosemary		■	■	■	■		
<i>Aquilegia formosa</i>	Red & Yellow Columbine			■	■	■	■	■
<i>Salvia officinalis</i> 'Tricolor'	Tri-Color Sage			■	■	■	■	■
<i>Lonicera ciliosa</i>	Orange-flowered Honesysuckle				■	■	■	
<i>Lupinus polyphyllus</i>	Large-Leaved Lupine				■	■	■	■
<i>Eriophyllum lanatum</i>	Oregon Sunshine				■	■	■	■
<i>Asclepias speciosa</i>	Showy Milkweed				■	■	■	
<i>Achillea millefolium</i> var. <i>occidentalis</i>	Yarrow						0	0
<i>Anaphalis margaritaea</i>	Pearly Everlasting						0	0
<i>Lavender angustifolia</i>	English Lavender					■	■	■
<i>Gaillardia grandiflora</i>	Blanket Flower					■	■	■
<i>Scutellaria lateriflora</i>	Mad-Dog Skullcap					■	■	■
<i>Eschscholzia californica</i>	California Poppy					■	■	■
<i>Solidago lepida</i> var. <i>salebrosa</i>	Western Goldenrod						■	■
<i>Helianthus annuus</i>	Sunflower						■	■
<i>Symphotrichum subspicatum</i>	Douglas Aster						■	■

Figure A2. Garden Bloom Timeline^{1x2}

Appendix B: Pollinator Garden Plant Profiles



(Photo Credit: www.fs.fed.us)

Red and Yellow Columbine

Aquilegia formosa

Red and Yellow Columbine is a perennial forb that prefers average soil moisture to grow in²⁴. It can live in either full sun or part sun²⁴. This plant grows approximately 5' tall²⁴ and about 2' wide¹⁸. It attracts humming birds, butterflies, and native bees with its nectar²⁴.



(Photo Credit: www.vfthomas.com)

Large-Leaved Lupine

Lupinus polyphyllus var. polyphyllus

Large-leaved Lupine is a perennial forb that prefers damp soil²⁴ and full sun²⁴. It grows approximately 1.2m (4ft) tall and 1.2m (4ft) wide²⁸. It attracts humming birds²⁸, butterflies, and native bees with its nectar²⁴. It is also a valuable host for butterflies²⁴.



(Photo Credit: spokanerosesociety.org)

Orange-Flowered Honeysuckle

Lonicera ciliosa

Orange-flowered Honeysuckle is a perennial forb that can survive in average soil types and prefers full sun or part shade²⁴. This plant is a climber and will do well on a fence, trellis, archway or tall shrub so it can grow upwards and sideways²⁶. Its nectar strongly attracts humming birds, as well as butterflies, and native bees²⁴.



(Photo Credit: www.fs.fed.us)

Western Trillium

Trillium ovatum ssp. ovatum

Western Trillium is a perennial forb that can survive in average soil types and with part or full shade²⁴. This plant grows approximately 1m (3ft) tall²⁴ and about .2m (5ft) wide²⁹. It attracts native bees with its nectar²⁴.



(Photo Credit: swbiodiversity.org)

Yarrow

Achillea millefolium

Yarrow is a perennial forb that can live in average soil types and in full sun²⁴. This plant grows approximately 1m (3ft) tall²⁴. It attracts butterflies and native bees with its nectar²⁴.



Western Goldenrod

Solidago lepida var. salebrosa

Western Goldenrod is a perennial plant that is commonly found in meadows and prairies¹². It grows well in direct sunlight and moderate to well-drained soil²⁴, and is drought tolerant. The plant typically grows to a height of 1-2 m (3-6.5 ft) tall. Western Goldenrod produces nectar for butterflies, and provides other pollinators with habitat and foraging grounds.



(Photo Credit: www.wildflower.org)

Oregon Sunshine

Eriophyllum lanatum

Oregon Sunshine is a perennial forb that prefers dry soil and sun. It grows up to 1m (3ft) tall. It attracts butterflies as well as some bees. Very showy and great for landscape use²⁴ and is drought resistant²⁴.



(Photo Credit: www.wildflower.org)

Pearly Everlasting

Anaphalis margaritacea

Pearly Everlasting is a perennial forb that prefers dry, sandy or gravelly soil²⁴. It requires part shade as well as sun and grows up to 1m (3ft) tall. It attracts only butterflies, has a long bloom time and is easy to care for²⁴.



(Photo Credit: green.kingcounty.gov)

Douglas Aster

Symphyotrichum subspicatum

Douglas Aster is a perennial forb that requires moist soil and full sun. It grows up to 1m (3ft) tall. It attracts native pollinators and butterflies and is a host plant for certain butterflies. It has a late bloom time with showy violet-colored flowers¹⁸.



(Photo Credit: newlifeonahomestead.com)

Rosemary

Rosmarinus officinalis

Rosemary is a perennial forb that grows 1.5m (5ft) tall in a semi-erect shape. It is very drought tolerant, using little water²⁸. It has large purple flowers that are especially attractive to bees, and honeybees in particular.



(Photo Credit: smilinggreenmom.com)

English Lavender

Lavender angustifolia

English Lavender is an annual forb that prefers light soil in an open, sunny location²⁴. At its tallest, English Lavender can grow up to 1m (3ft) tall. It is fragrant and very attractive to various bee species.



(Photo Credit: ag.arizona.edu)

Blanket Flower

Gaillardia grandiflora

Blanket Flower is a hybridized perennial that grows 2-3' tall. It attracts birds and butterflies and has a long bloom period²⁴. It is showy, needs full sun, and well-drained soil. It is also low-maintenance³⁰.



(Photo Credit: www.wildflower.org)

Common Sunflower

Helianthus annuus

Common Sunflower grows 1.5-8' and needs medium amount water, lots of sun and soil consisting of dry clay or heavy sand. Its seeds attract many types of birds³⁴. Sunflowers have also been recognized by pollination ecologists as attracting large numbers of native bees³⁴.



(Photo Credit:
www.wildflower.org)

California poppy

Eschscholzia californica

California Poppy is a perennial that grows up to 1 foot in height. It needs lots of sun and dry soil to do well. It attracts many types of bees, but mainly bumblebees³³.



(Photo Credit: www.wildflower.org)

Showy Milkweed

Asclepias speciosa

Showy Milkweed is a perennial, growing 1.5-3' tall. It needs sun and moist soil. Milkweed attracts hummingbirds and butterflies²⁴, and is most notable for being a Monarch Butterfly, host plant.



(Photo Credit: www.illinoiswildflowers.info)

Mad Dog Skull Cap

Scutellaria lateriflora

Mad Dog Skull Cap is a perennial, growing to about 1-2.5' tall²⁴. It prefers light shade to full sun as well as wet to moist conditions⁹.



(Photo Credit: www.wildflower.org)

Red-Flowering Currant

Ribes sanguineum

Red-Flowering Currant is a shrub that grows 6-12' tall. It can live in sun or shade, but requires moist to drier soil. It attracts hummingbirds, butterflies and bees²⁴.



(Photo Credit: www.kingcounty.gov)

Pacific Hound's tongue

Cynoglossum grande

Pacific Hound's tongue is a perennial growing 1-2.5 ft tall. It prefers small clearings with some sun but is shade tolerant and needs moist soil²⁴. It blooms in the spring, and attracts early native bees.



(Photo Credit: green.kingcounty.gov)

Tall Oregon Grape

Mahonia (Berberis) aquifolium

Tall Oregon Grape grows up to 8' tall and can live in dry or wet areas as well as in shade or sun as is drought resistant. It attracts bees, birds and butterflies. It has slightly prickly leaves.



(Photo Credit: www.mountainvalleygrowers.com)=

Tri-Color Sage

Salvia officinalis var. tricolor

Tri-color Sage is a perennial growing up to 3' tall. It needs full sun.



(Photo Credit: www.wildflower.org)

Woods Strawberry

Fragaria vesca ssp. bracteata

Woods Strawberry is a perennial herb that does best in partial shade and average soils. The fruit is edible, and the plant also attracts native pollinators. It is a host plant for certain butterfly species.



(Photo Credit: [http://usesofherbs.com/wp-content/uploads/2011/12/Oregano_Flower.j](http://usesofherbs.com/wp-content/uploads/2011/12/Oregano_Flower.jpg)
pg

Oregano

Origanum vulgare

Oregano is a perennial growing 1 to 2 ft tall. It needs lots of sun and dry to well-drained soil to flourish³⁶. It is an important kitchen herb.



Chives

Allium schoenoprasum

The Chive is a perennial herb that does best in partial shade and average soils. It grows to be 1-2 ft tall. It is most commonly used as a kitchen herb, but it also attracts various pollinators³⁶.



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Thyme

Thymus mongolicus

Thyme is a perennial herb that does best in partial shade and average soil. It grows to less than 1 ft tall and has culinary and pollinator value³⁶.

(Photo Credit: westernwildflower.com)



out/

Appendix C: Hedgerow Plant Profiles

(Photo Credit: www.dereila.ca)



(Photo Credit: wildflower.org)

Twinberry

Lonicera involucrata

Twinberry is a shrub that likes full sun and prefers soil with average to wet moisture levels²⁴. Twinberry's flowers are yellow with reddish bracts at the base. This shrub can grow up to 1-2 m (3.2-6.4 ft) tall, and is very low maintenance¹⁹. This is an important shrub for the hedgerow because it will be resilient to the conditions on the lower terrace, and it attracts hummingbirds, butterflies, and holds value to bumblebees²⁴.

Nootka Rose

Rosa nutkana

Nootka Rose is a large, perennial shrub that prefers moisture and full sun⁸. The plant blooms from the beginning of May through the end of June⁸, and will grow between 1.5 and 3 m (5-10 ft) tall. This shrub requires some maintenance, as the underground rhizomes tend to spread and require removal. Nootka Rose is bright pink, and has a strong, sweet fragrance⁸. This is a good addition to the pollinator hedgerow because it attracts hummingbirds and bumblebees, and it is suitable for the conditions of the lower terrace⁸. Nootka Rose requires some maintenance, as it has underground rhizomes that spread.

Coyote Broom

Baccharis pilularis

Coyote Broom is a perennial flowering shrub native that has expanded its range from the Coast inland to the Willamette Valley. It will do well on the lower terrace because it likes full sun and can survive in a wide range of soil conditions²⁵. This shrub grows to a height of 2-3 m (6.5-10 ft). Coyote Broom also has a high drought tolerance, grows rapidly, and needs little maintenance³⁷. This shrub grows well in hedgerow form³⁹. The Xerces Society has categorized it as a good plant to attract native pollinators and beneficial predatory insects³⁹.



(Photo Credit: wildflower.org)

Douglas Spiraea

Spiraea douglasii var. *douglasii*

Douglas Spiraea is a shrub native to the Willamette Valley. This plant does well in direct sun and in average to wet soil^{24, 31, 36}, making it a good fit for the conditions on the lower terrace. Any flooding that may occur will not deter its growth; it is a plant that is often used in riparian zones^{25, 36, 40}. This spiraea usually grows 1-1.5m tall. The Xerces Society for Invertebrate Conservation has recognized Douglas Spiraea as a good pollinator plant that attracts a large number of native pollinators²⁴. Douglas Spiraea also offers butterfly habitat and develops well in a hedgerow²⁴. Douglas Spiraea equires some maintenance, as it has underground rhizomes that spread.



(Photo Credit: orcawatcher.org)

Tall Oregon Grape

Mahonia (Berberis) aquifolium

Tall Oregon Grape is an evergreen shrub that thrives in moist soils and open spaces²⁵. At full growth, Tall Oregon Grape will reach a height of 2-3.5 m (6.5-11.5 ft)²⁴. This shrub is an excellent candidate for the hedgerow and Pollinator Garden at the Demo Farm because it forms hedges easily, requires very low maintenance⁸, and attracts many native pollinator and bird species²⁴.



(Photo Credit: beachatchers.wsu.edu)

Red-Flowering Currant

Ribes sanguineum

Red-Flowering Currant is a deciduous shrub that blooms a bright fuchsia-pink color in the spring²⁵. This shrub grows well in moist, well-drained soil, and in areas with abundant sunshine and open space²⁵. Red-Flowering currant is fairly low-maintenance, and has an average height of 2-3 m (6.5-10 ft) tall, making it an ideal shrub for a hedgerow¹⁴. This shrub attracts native pollinators, as well as hummingbirds¹⁴, and will likely see a lot of pollination activity.



(Photo Credit:
science.halleyhosting.com)

Many-Leaved Lupine

Lupinus polyphyllus var. *polyphyllus*

Many-leaved Lupine is a perennial plant that grows well in both direct sun and shade, and tolerates moderately dry to moist soil. This plant grows to a height of .5 to 1.2 m (1.5-4 ft). Lupine requires some maintenance, as it has underground rhizomes that spread very quickly. This plant will provide nectar and habitat for butterflies to lay their eggs, and attract other pollinators such as bumblebees²⁴. The Lupine can also improve soil quality; its roots are associated with bacteria that can fix nitrogen to the soil⁴.



(Photo Credit: orcawatcher.org)

Showy Milkweed

Asclepias speciosa

Showy Milkweed is a perennial shrub that grows well in direct sunlight and moist, well-drained soil²⁴. This shrub grows to a height of 1 to 2 m (3-6.5 ft), and, because it is rhizomatous, requires some maintenance. Showy Milkweed is known to attract local butterflies and pollinators; butterflies will drink its nectar and use it as a place to lay its eggs²⁴.



(Photo Credit: paulnoll.com)

Western Goldenrod

Solidago lepida var. *salebrosa*

Western Goldenrod is a perennial plant that is commonly found in meadows and prairies¹². It grows well in direct sunlight and moderate to well-drained soil²⁴, and is drought tolerant. The plant typically grows to a height of 1-2 m (3-6.5 ft) tall. Western Goldenrod produces nectar for butterflies, and provides other pollinators with habitat and foraging grounds.

Appendix D: Bioswale Plant Profiles



(Photo Credit: Naba.org)
Photo Credit: Calflora.net)

Cusicks Checkermallow

Sidalcea cusickii

Cusicks Checkermallow is a perennial forb that needs full sun and average to wet soil moisture to grow²⁴. It attracts both butterflies and native bees²⁴. Dense Sedge is a perennial sedge that can grow in the majority of environments, although it prefers wet soil and full sun²⁴. In bioswales, Dense Sedge is planted on the ground layer, and its rhizomatous roots help thwart soil erosion by forming a thick mass around sediment¹³. This sedge is noted as a butterfly host and provides habitat for other wildlife as well²⁴.

Tufted Hairgrass

Deschampsia cespitosa

Tufted Hairgrass is a perennial cool-season grass that grows best in wet soils and full sun. Like many other bioswale plants, it is often used to decrease erosion in bioswales²⁴. It is a good plant for the bioswale's ground layer or slope²⁴. This grass is also a host for butterflies²⁴.



(Photo Credit: Bluestem.ca)

Common Camas

Camassia quamash ssp. maxima

Common Camas is a perennial forb that needs full sun and average to wet soil moisture to grow²⁴, making it an ideal bioswale candidate along the road between the upper and lower terrace. It is also known for attracting butterflies and native bees with its nectar²⁴.



(Photo Credit: Wnps.org)

Appendix E: Plant Profile Citations

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