WILDLIFE HABITAT ENHANCEMENT PLAN FOR THE PCC ROCK CREEK LEARNING GARDEN

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Introduction

The PCC Rock Creek Learning Garden is a 3.6 acre market garden on the southeast side of Portland Community College's Rock Creek campus (Fig. 1). The garden is north of a pasture where the hoofstock for the college's Veterinary Technology program is grazed. On the north side is a driveway and the Administrative Building while to the west is a fenced gravel lot currently in use by Fortis Construction Management for Bond renovations. On the opposite side of the campus is a 100+ acre wilderness refuge, the Rock Creek Environmental Studies Center, which is habitat for many native plant and animal species. The garden was founded around the idea of sustainability, so balancing the needs of wildlife with the desire to maintain productivity levels is very important.

Fig. 1 – PCC Rock Creek Learning Garden (aerial view). *Photo: Google Earth*

The landscape is mostly level and surrounded by significant amounts of greenspace (Fig. 2). Due to poor soil, most of the growing is done in raised beds rather than tilling the soil, though there is a small section for row crops at the back of the garden. All ground materials are permeable to reduce runoff. Bioswales, rain barrels, and green roofing enhance water conservation. The Learning Garden is built around a courtyard with the nearby community garden easily accessible to student and staff volunteers. Garden plots that support the farmers' market booth and cafeteria are mostly to the southwest, as is the hoophouse and the greenhouses that are shared with Landscape Technology. Blueberries are on the northeast corner of the garden and the orchard is on the east side of the garden.

Fig. 2 – Portland Community College Rock Creek Campus (aerial view). *Photo: Google Earth*

The dominant soil series on the Rock Creek Campus is Helvetia, a mollisol, which means that it is a soft and fertile loam with a rich layer of organic materials in the upper soil horizons; the subsurface layers are silt or clay alluvium from prehistoric flooding events (19B, Fig. 3). Helvetia is moderately well drained with moderately slow permeability. It is considered excellent soil for crops, especially orchards and berries. The climate for this area is maritime with warm, dry summers and cool, rainy weather predominating the other three seasons; there is an average rainfall around 37 inches.

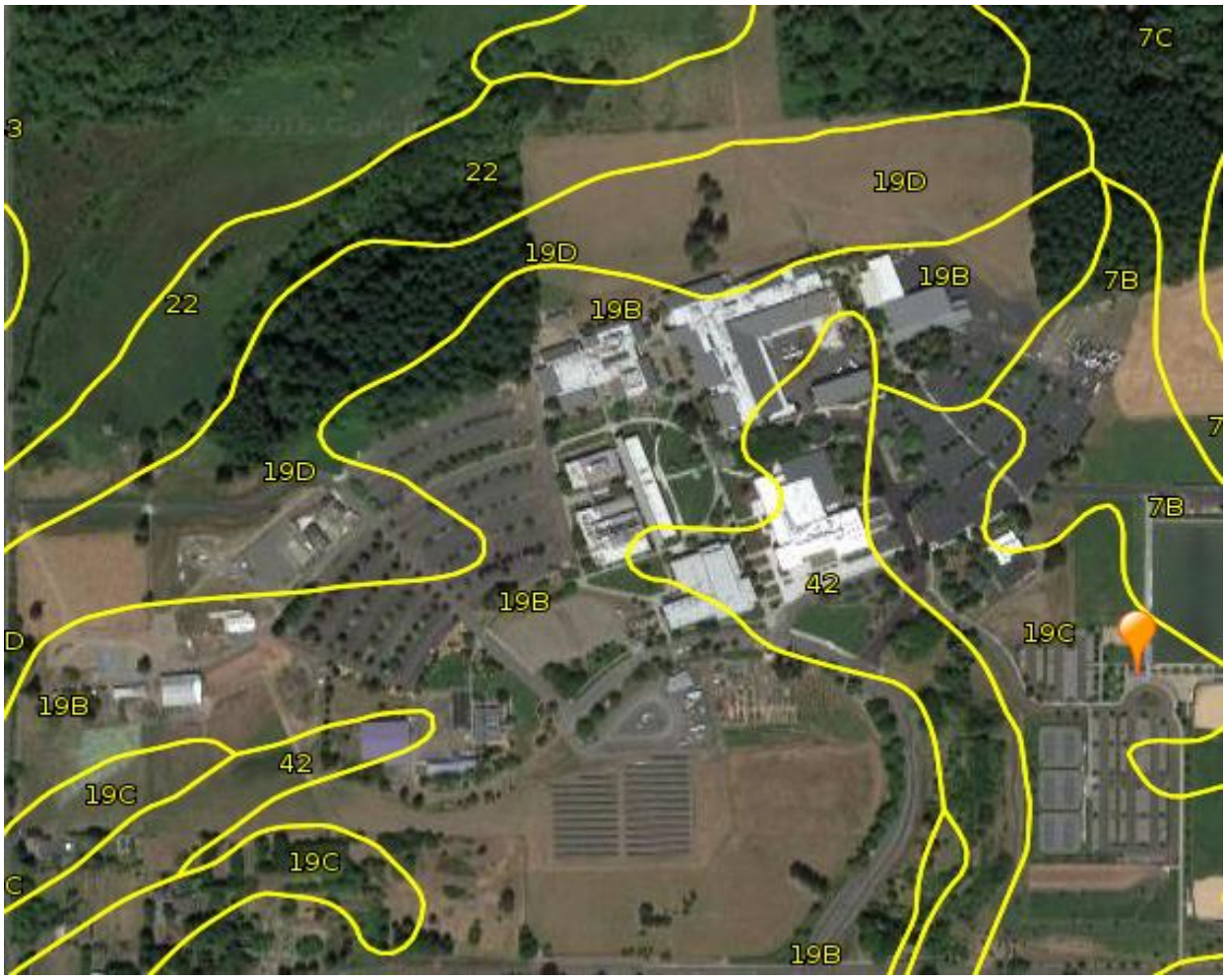

Fig. 3 – Soil map of PCC Rock Creek. *Photo: UCDavis Soilweb*

The habitat around the Learning Garden is diverse. There are pasture lands, developed areas, treatment wetlands and a wilderness refuge with five distinct ecosystems all within a ten minute walk of the garden (Fig. 2). Human impacts such as paving and buildings are obvious to the eye but the campus-wide commitment to sustainability has integrated the greenspaces and anthropocentric spaces fairly smoothly and there are campus-wide plans to continue with ecologically friendly improvements in the long term. The Rock Creek Environmental Studies Center is the most unaffected area on campus. There are soft dirt trails in the forests and a boardwalk into the wetlands. Minimal land management is done in the forests, mostly the removal of fallen trees from pathways after storms and the removal of invasive vegetation; there is a long-term restoration project in the wetlands and wet meadow to remove invasive reed canary grass and replace it with native vegetation. The refuge is home to elk, deer, coyotes, rabbits, bobcats, raccoons, and foxes, as well as a large variety of bird, reptile, and amphibian species.

The current wildlife conservation plan for the garden is largely in its sustainable farming practices and sensitivity to the wildlife that already exists in and around the garden. There are voles, native mice, rats, raccoons, deer, and a variety of songbirds and raptors present in the garden. Last breeding season, a pair of killdeer raised three chicks in the garden and the garden's staff worked around the nesting area until the chicks fledged and left the nest. The Learning Garden is not certified organic, but they do not use herbicides or pesticides in their gardening practices and only practice sustainable gardening techniques. This year the campus was given a Bee Campus USA designation for its bee-friendly practices. There are beehives in the garden maintained by a master beekeeper and the western forest supports several

bumblebee nests each spring and summer. Part of the Bee Campus USA plan is to phase out all use of herbicides campus-wide in 2017 and all pesticide use in 2018. The entire campus is within the Rock Creek watershed and works closely with Clean Water Services to reduce negative impacts on the watershed through the use of permeable paving in the parking lots and a treatment wetland on the east side of campus that connects via groundwater to Rock Creek.

The Learning Garden is a very unique property. Not only is it a market garden, it is a living classroom and social center for the campus. Several classes and academic programs take advantage of the garden for hands-on experience. Students from the Landscape Technology hone their craft in the garden and the greenhouses, Environmental Science students learn about sustainable food by touring or volunteering in the garden, and ESOL students practice their English as they do garden work, using the opportunity to build conversational skills and vocabulary. There is a partnership in place with the Beaverton School District that allows high school students to work in the garden as experiential learning. There are future plans to create a Children's Garden when a childcare program reopens on the campus in the next few years. Not only does the Learning Garden support Portlandia FarmStandia, but also provides fresh produce for catering on the Rock Creek and Sylvania campuses, the student food pantry run by the Women's Resource Center on campus, and the food bank of the St. Juan Diego Catholic Church that sits across the main road from the campus. I am not aware of any conflicts with neighbors over land use.

Historically, the land the campus was built on was a mosaic of agricultural land and wilderness. The idea for the garden began around 2005 when the first sustainable practice coordinator was hired by the college. The coordinator worked in conjunction with a graduate

student who wrote a thesis about the benefits of gardening for older women, which helped secure funding for seeds and irrigation equipment as well as raising the profile of the garden idea. Since then the garden has gained momentum, with greater volunteer numbers, more activities and classes, and a significant reduction in the amount of waste on campus due to the installation of a large vermicomposting station on the farm run by Veterinary Technology as well as the smaller worm nursery in the garden. Crop yields have generally increased from year to year from 2,000 lbs. produced in 2013 to 11,555 lbs. produced in 2015.

The Learning Garden grows a diversity of produce, as shown in the chart below. The greenhouses, hydroponics system, and hoophouse allow for year-round growth of leafy greens, scallions, and cucumbers. Orchard plants and berries are staggered with early-, mid-, and late-season varieties to extend the growing season. The vegetables and flowers in the garden beds and rows are a mix of perennials and annuals to provide greater opportunities for harvest throughout the main market season from April to October, though the Portlandia FarmStandia is open infrequently during the winter if there is produce available.

There is an organic integrated pest management system in place for all crops. Weeds are removed by hand or excluded from growth with landscaping fabric or mulches. Insect pests are hand-picked or treated with non-toxic chemical preparations like soap sprays or hot pepper sprays. Landscape covers are sometimes used to exclude pests like flea beetles. In the hoop house and greenhouses, ladybugs have been released to control aphids. They have also experimented with dither crops to lure insect pests away from market crops. One creative chemical weapon that they use against deer, rodent, and raccoon damage is encouraging the

Veterinary Technology students to walk the program's resident dogs through the garden frequently so that their urine can act as a scent deterrent.

PCC Rock Creek Learning Garden Management Practices	
Area	**Crops & Practices**
Orchard	Apples, pears, persimmons, figs, stone fruits, and more. No tillage. Hand-picking of pests or use of soap sprays, hot pepper spray, or neem oil to treat pests and disease.
Blueberry patch	55 plants of at least five varieties (21 plants unknown variety). No tillage. Hand-picking of pests or use of soap sprays, hot pepper spray, or neem oil to treat pests and disease.
Berry and vine crops	Marionberries, raspberries, grapes, kiwis. No tillage. Hand-picking of pests or use of soap sprays, hot pepper spray, or neem oil to treat pests and disease.
Flower garden	Wide variety of annuals, biennials, and perennials to provide cut flowers for market. No tillage. Hand-picking of pests or use of soap sprays, hot pepper spray, or neem oil to treat pests and disease.
Market/cafeteria garden	Wide variety of vegetables. Dither crops when appropriate. Use of coffee sacks/burlap or mulch to control weeds and disrupt pest life cycles. Hand-picking of pests or use of soap sprays, hot pepper spray, or neem oil to treat pests and disease.
Community garden	Wide variety of flowers and vegetables. No mechanical tillage. Use of landscape fabric or mulch to control weeds and disrupt pest life cycles. Hand-picking of pests or use of soap sprays, hot pepper spray, or neem oil to treat pests and disease.
Hoophouse	Cool weather crops and plant starts. Ladybugs released to control aphids. Hand-picking of pests or use of soap sprays, hot pepper spray, or neem oil to treat pests and disease.
Greenhouses	Seed starting area. Cool weather crops. Dutch bucket and NTF gutter systems. Hand-picking of pests or use of soap sprays, hot pepper spray, or neem oil to treat pests and disease.

Farm Goals

The Sustainability Coordinator and Learning Garden Coordinator have outlined three key goals they would like to achieve to enhance wildlife habitat in The Learning Garden and provide ecosystem services such as increased pollination and natural pest control. They have a secondary goal of these enhancements providing additional opportunities for student and community learning through both the display of the enhancements themselves and the increased presence of wildlife in the garden. They would like to:

1. Attract native bumblebees and solitary bees;
2. Create monarch butterfly seasonal habitat; and
3. Increase the reptile and amphibian populations in the garden.

Conservation and Habitat Enhancements

The Learning Garden provides a rich base upon which to create wildlife habitat enhancements because it has been designed from its inception to minimize negative impacts on wildlife and the environment. There are still plenty of open spaces within the garden that allow for modification to meet the goals outlined by the garden staff.

Native bumblebee and solitary bee enhancements – When most people think of bees they immediately think of the honeybee, which is actually considered a domestic species in America. After that they will likely mention the bumblebee, which is probably the most well-known type of wild bee, but there is actually a tremendous variety of native bees in Oregon. Native bees are highly effective pollinators; many of them outperform honeybees at the task of pollination (Wratten, et al. 2012). Certain crops such as blueberries co-evolved with native bee species and require visits from specific species to let down sufficient pollen to ensure a good crop.

Blueberry flowers hold their pollen very deeply inside and have a let-down reflex that is attuned to the wing vibrations of bumblebees. A honeybee can get small amounts of pollen from a blueberry flower, but crop productivity will suffer without bumblebees. Bumblebees and native solitary bees are increasingly threatened by fragmented foraging habitat and pesticide use (Lee-Mäder, 2011).

A variety of small, cost-effective enhancements to increase food and shelter can be made to attract native bumblebees and solitary bees to the garden; many of which will also enhance monarch butterfly habitat. The first recommendation, one that can be instituted in late winter or early spring of next year, is to provide nesting boxes for orchard mason bees and other solitary bees. Mason bee nests can be purchased at most garden supply centers but are easily made by drilling 5/16" holes at least three inches deep but not all the way through blocks of wood and hanging them in a warm, dry place sheltered from the wind that is near both food sources and a source of mud that the females can use to create their brood chambers in the nest box. Tilting the nest slightly downward or providing it with a tilted roof will prevent water from entering the nest holes and reduce problems with fungal or bacterial growth. A small piece of ¼" hardware cloth secured across the nest holes can prevent bird predation upon the bee larva.

On a larger scale, bee hotels can be made by building a roofed wooden structure enclosed on three sides and filling it with horizontal stacks of berry canes, bamboo, small paper tubes, twigs, logs, and scraps of lumber. On the open side, drilling holes of various depths and diameters into the logs and lumber scraps will provide a variety of nesting spaces for different native bee species such as sweat bees (*Halictidae* sp.) or squash bees (*Lasioglossum* sp.). Bee

hotels and mason bee nests alike will require some seasonal maintenance from garden staff, checking nest holes periodically to make sure that there are no fungus, bacteria, or parasites present and to possibly harvest solitary bee cocoons for overwintering to maximize survival rates.

Encouraging bumblebees (*Bombus* sp.) to nest in a specific area is trickier because bumblebee species vary widely in their nesting habits. The most successful strategy for attracting bumblebees is to provide food sources and a variety of possible nest sites (Lee-Mäder, 2011). Most bumblebee species are ground nesting and will take advantage of abandoned rodent burrows, compost piles, grass tussocks, brush piles, old logs, or loose, soft soils. Some species will inhabit birdhouses or holes in trees. Intentional bumblebee nesting sites should be located in places that are usually undisturbed because bumblebees are loosely social and some species will guard their colonies. There are several burrows from ground-dwelling rodents on site. If clusters of empty rodent burrows can be located in low traffic areas, those would be ideal locations for placing brush piles to attract bumblebees.

Attracting and maintaining native bee populations in the garden relies heavily on providing sources of food and water. A multi-season garden and orchard is fertile ground for bees, but planting border areas and transition zones with areas of nectar-rich flowers that bloom from early spring through late fall will provide food and resting stations for foraging bees. There are seed mixes available to attract beneficial insects or a selection of suitable wildflower and herb seeds can be mixed and sown to suit the area. Adding anise and dill seed to the mix not only provides forage for bees but attracts small predatory wasps that feed on garden pests (Lee-Mäder, 2011).

Another interesting and attractive bee-friendly feature that can be added to the garden is a watering station. A bird bath or elevated shallow dish filled with smooth stones or marbles and then filled with water just until it can be seen between the stones will provide bees and butterflies with a safe place to rehydrate and warm themselves in the sun. Most bees are fairly passive when foraging so long as they aren't threatened, so the bee watering station can also offer garden visitors a chance to view them out in the open and may provide a glimpse of some of the more elusive solitary bees.

Monarch butterfly enhancements – Monarch butterflies have been in the news the past few years because their population is shrinking rapidly. The decline is mostly due to a loss of habitat for the monarch larvae, which are entirely dependent upon milkweed as their food source until metamorphosis. Habitat fragmentation and development has reduced the amount of milkweed available, so reproduction is not occurring at a sustainable rate (Lee-Mäder, 2011).

As stated above, the monarch butterflies will also benefit from some of the modifications made to attract native bees. Watering stations and increased nectar foraging opportunities from flowered border and transition spaces will benefit adult butterflies, but a milkweed patch needs to be planted in order to create nursery space and food for the monarch larvae. In Hillsboro, Oregon, the native milkweeds are narrow-leaved milkweed (*Asclepius fascicularis*) and showy milkweed (*Asclepius speciosa*). Under cultivation, common milkweed (*Asclepius syriaca*) and swamp milkweed (*Asclepius incarnata*) can also grow. The patch needs to be located in a sunny area with some protection from the wind. Milkweed can either be a patch of its own or can be interspersed into the flowered foraging spaces for bees and butterflies. The south edge of the market garden is ideal placement for this enhancement.

Butterflies benefit from sheltered areas to protect them from inclement weather. There are specialty butterfly houses sold on the market but there is no evidence that these attract butterflies and they are very attractive to wasps and hornets, so natural cover is the most effective and least expensive option for offering shelter to butterflies. Brush piles, rock piles, trees, shrubs, and bunched grasses can all provide shelter. A rock pile or smooth stones placed throughout the garden in sunny spots will also provide butterflies with a place to sun themselves.

Reptile & Amphibian Conservation – Reptiles and amphibians may inspire fear in some people but they provide important ecosystem services in the form of natural pest control and can be fascinating subjects for viewing and study. Two snake species, one lizard species, three frog species (one invasive), and five species of newt, salamander, and ensatina have all been recorded in biological surveys on the Rock Creek Campus over the past decade. Garter snakes have been found in the garden already, as have Pacific tree frogs, so there are already elements attracting reptiles and amphibians but they can be enhanced to provide even more habitat.

Reptiles require shelter, warming spaces, access to water, and plentiful food in their habitat. Both local garter snake species, the common garter snake (*Thamnophis sirtalis*) and the Northwest garter snake (*Thamnophis ordinoides*) eat insects, earthworms, slugs, amphibians, and rodents. It is possible that a third local snake species is on the property but has not been recorded due to their secretive nature. Rubber boas (*Charina bottae*) are the northern-most boa species in the world. They are usually found under rocks or fallen logs, so they are rarely seen, but they are an important predator of immature mice, voles, and shrews. They are more sensitive to disturbance than garter snakes but it is possible that with an

increase in shelter areas on the ground, they could be attracted to the garden to reduce rodent populations.

Shelter for snakes can be as simple as a sheet of black plastic, corrugated tin, or landscape fabric on the ground, but more attractive and naturalistic shelters can be created with logs, large bark slabs, pieces of slate, or overturned clay pots with an opening in the side to allow entry. For long-term and significant increases in population, a hibernaculum or denning site could be constructed by digging a pit at least six feet deep and filling it with concrete blocks, stones, and clay roof tiles, allowing snake-sized spaces between the pieces of fill, and then covering the pit with earth and either stones or a log (Toronto Zoo). A few PVC pipes as long as the pit is deep, with holes drilled at intervals along the length can provide entrance points with multi-layer access to the pit; attaching an elbow joint joined with the open end at a horizontal angle will prevent excessive rain from collecting in the hibernaculum. Multiple snakes can use a hibernaculum for shelter from the heat during the summer months and as an estivation shelter during the winter (Huey, et al., 1989). It is important that at least a few feet of the pit be below the frost line to provide insulation and increase winter survival rates. If a hibernaculum is going to be installed, in the years prior to its construction it may be beneficial to do a significant amount of public education to counteract the bad reputation that snakes have in Western culture.

The Northern alligator lizard (*Elgaria spp.*) is the only native lizard in the area. This lizard lives primarily in natural edge habitat between forests and grassy areas, feeding on a variety of insects and snails. Dense shrubs, grass tussocks, logs, bark slabs, and sunning spots will encourage the alligator lizard to populate the garden.

Amphibians need moisture in order to maintain their moist skin and avoid desiccation. Unless a pond is installed in the garden, it is unlikely that the red-legged frog (*Rana aurora*) or any of the salamander, newt, or ensatina species will be found there, but the Pacific tree frog (*Pseudacris regilla*) thrives in the area and habitat can be easily enhanced for them. Tree frogs become nocturnal during the warm season, so holes, crevices, logs, and other hiding places that protect them from the heat will attract them. Tree frog houses can be made by driving lengths of white PVC pipe into the ground with a rubber mallet or setting lengths of concrete pipe on end with rebar inside to prevent tipping. Frogs will use the interior walls of the pipes as shelter. Pipes must be at least three feet in length to deter birds and cats from preying on the frogs. Frogs will also use overturned clay pots or large, broken shards of clay pot or tile as shelter. It is best to place their shelters in heavily planted areas that provide additional cover and moisture for the frogs and attract the insects that they feed on. Decorating tree frog houses is a way to involve the elementary school groups that visit the garden in a hands-on conservation activity.

One major process modification to protect amphibians and reptiles would be to reduce mowing in the area. Lawnmowers are a major cause of mortality for small animals and reducing or eliminating mowing would go a long way toward maintaining healthy reptile and amphibian populations in the garden. There are several grassy edge spaces in the garden, a lawn on the north side, and grass groundcover in the orchard. Interspersing existing grassy areas with a low-growing broadleaf lawn mix rich in clover would require little to no mowing and would provide added benefits such as increased nitrogen fixation and additional food sources for bees and butterflies. If a grass lawn is desired, alternative mowing could be done periodically by either using a rabbit tractor populated with rabbits from the Veterinary

Technology program or borrowing their sheep to graze the orchard a few times a year. The introduction of seasonal livestock grazing would keep grasses down and contribute fertilizer without endangering small animal species.

Fig. 4 – PCC Rock Creek Learning Garden w/proposed modifications. *Photo: Google Earth*

PCC Rock Creek Area Plan			
Land Unit	**Enhancement**	**Size of Area Treated**	**Completion Date**
Orchard/Garden Edges	Install mason bee nest boxes	minimal	Year 1 – late winter/early spring
Orchard	Plant native low-growing lawn mix	1+ acres	Year 1 - spring
North Lawn	Plant native low-growing lawn mix	¼ acre	Year 1 - spring
Throughout Garden	Plant beneficial mix in waste spaces, along building and fences, and around the edges of garden boxes	N/A	Year 1 – spring/early summer
Throughout Garden	Install bee watering station(s)	minimal	Year 1 – spring/early summer

South Side of Orchard	Build bee hotel	12 sq. ft.	Year 2 – late winter/early spring
Orchard	Reseed low-growing lawn mix to fill in	1+ acres	Year 2 - spring
North Lawn	Reseed low-growing lawn mix to fill in	¼ acre	Year 2 – spring
Throughout Garden	Reseed beneficial mix to fill in patches	N/A	Year 2 – spring/early summer
North Side of Orchard	Create brush pile for bumblebee nesting	9 sq. ft.	Year 3 – late winter/early spring
Central Spot in Market Garden/Near Greenhouses	Create brush pile for bumblebee nesting or plant native rose	4-9 sq. ft.	Year 3 – late winter/early spring
Throughout Garden & Orchard	Reseed beneficial mix and low-growing lawn mix if needed	N/A	Year 3 – spring/early summer
South Edge of Market Garden	Plant monarch butterfly patch of mixed milkweed and wildflowers	200 sq. ft.	Year 3 - fall
Flower Bed	Install treefrog houses	N/A	Year 4 – spring/summer
Market Garden	Install treefrog houses	N/A	Year 4 – spring/summer
Throughout Garden	Place large, woody debris to increase reptile/amphibian shelter space	3-6 large pieces placed, size varying	Year 4 – spring
South Side of Orchard	Build hibernaculum	4-6 ft. diameter, at least 6 ft. depth	Year 5 – late winter/early spring

Schedule

The first year of the plan will be focused on enhancing native bee habitat within the garden. Mason bee nests will be purchased or built and installed in the orchard and in sheltered areas at the edge of the garden in later winter or early spring. Once the ground has thawed, a low-growing native lawn mix should be seeded in all areas that are currently grass lawns, including the orchard. A mix rich in clovers would provide forage and habitat connectivity for native bees while enriching the soil. A wildflower mix for beneficial insects

would be planted from spring to summer at the edges of raised beds, in waste spaces, and at the edges of structures to increase forage and cover. The final plan of the first year would be to construct bee watering stations and place them throughout the garden.

The second year's plans also focus around increasing native bee populations in the garden. This year the low-growing lawn mix and beneficial border mix needs to be reseeded in the spring and early summer to fill in any patchy areas. Because most of the flowers are Northwest natives, they will likely reseed themselves, but may occasionally require reseeding to fill in bare spots. The primary focus of this year will be on building two large-scale bee hotels on the south side of the orchard. I estimate that this will have a total approximate footprint of 9-12 sq. ft. depending on the dimensions chosen for each hotel. They will be three-sided, roofed wooden structures filled with a variety of bee nesting materials, including logs with holes drilled in them, lengths of cane and bamboo, twig bundles, and paper tubes in wooden blocks. The bee hotels could be constructed from scrap lumber, either from the Building Construction Technology Program, donated, or sourced through a local rebuilding center to keep costs down. This would be an excellent educational project for students from Landscaping, Building Construction, Environmental Science, or Biology and could include K-12 educational partners both in the building and maintenance of the structure.

In the third year the conservation focus will shift to providing bumblebee habitat in the garden. Bumblebees are loosely social and require larger nesting spaces, usually underground. There is an area near the worm nursery on the north side of the orchard that may be ideal for a brush pile to attract bumblebees, especially if some rodent holes or soft earth can be found in the area. The second site for a bumblebee nest should be in another out-of-the-way area,

either in the market garden to take advantage of the many vole burrows in the area or near the greenhouses. This could be another brush pile if it was near the greenhouses, but a more attractive option if sited in the market garden might be a native rose bush trimmed to a mound to provide shelter and food. As mentioned above, though bumblebees are docile while foraging, they may display some defensive behavior at the nesting site, so location is important. The benefit of bumblebees in the garden is tremendous for pollination services, so at least one nest would be excellent, though two or more would be important from a conservation standpoint since bumblebees have been severely affected by pesticide use. There could also be additional reseeding of lawn mix and beneficials border mix if needed. If the bee hotel was established the year before, seeding the beneficials mix thinly around the structure would enhance forage and cover.

In the fall of the third year, a milkweed patch or patches will be planted in the garden interspersed with wildflowers to attract monarch butterflies. The milkweed is the nursery plant and food source for the caterpillars, while the wildflowers provide nectar for the adults. The best site for a large patch is along the southern edge of the market garden, though smaller patches could certainly be interspersed throughout the landscape. It is likely that these patches will attract other butterfly species as well, so special care may need to be taken with the placement and cultivation of brassicas in the garden due to cabbage white caterpillars.

During the fourth year the focus of conservation efforts shifts to amphibians and the beginnings of reptile habitat in the garden. Tree frog houses made from 4'-5' lengths of PVC pipe and cut at an angle on the lower end should be installed throughout the flowerbeds and market garden, preferably in areas that provide thick vegetative cover around the pipe so that

frogs aren't exposed when they emerge to hunt. It would also be ideal to install some ground-level shelters throughout the garden made of broken clay pots or large pot shards. Installing logs and bark slabs in edge areas during the late spring and early summer will increase habitat for frogs, lizards, and snakes in the garden.

The most ambitious undertaking is scheduled for the fifth year - the creation of a hibernaculum to increase snake habitat in the garden. An abundance of snakes will reduce mouse, shrew, and vole populations without resorting to poisons or lethal traps, which are anathema to the garden's practices. Prior years could be used to launch an educational campaign about the benefits of snakes in the garden as natural rodent and invertebrate controls. The far southeast corner of the orchard is probably the most ideal spot for a hibernaculum because it is the farthest from frequently traveled areas, so minimizes potential snake/human conflicts. This positioning also benefits the snakes with a low traffic area that will make them more inclined to inhabit the structure and enough southern exposure to create a secure basking spot. It is likely that the Building Construction Technology Program would be willing to use their equipment to dig the pit, which should be a minimum of 4' across and 6' deep. Fill such as concrete blocks and broken pieces of concrete, as well as large stones and pavers, could probably be donated by the Building Construction Technology Program or purchased inexpensively through a rebuilding center. Once established, this feature offers a very unique learning opportunity for students and the community, who don't often get chances to intentionally observe snakes in their natural habitat.

Costs

Conservation Enhancement Costs		
Enhancement	**Materials costs**	**Labor costs** - N/A, all work done by volunteers **Costs to Production** - N/A or minimal, all work being done in waste spaces within garden. **Possible Cost-Sharing** - Potential grants from multiple environmental and educational sources for all projects due to garden being both an educational and agricultural resource.
Mason bee nest boxes	Prefabricated nest boxes ($11.95 ea.). Paper tubes ($15.99 per bundle of 50). 4x6 for making homemade nest boxes, Home Depot ($17.27 ea.)	
Plant native low-growing lawn mix	50 lb. bag low growing lawn mix from Silver Falls Seed Company ($383.75)	
Plant beneficials border mix	1 lb. bag honeybee mix from High Country Gardens ($35.95)	
Install bee watering station(s)	Bowls (< $1.00 ea.). Stones (free) or marbles ($1-2 per bag)	
Build bee hotel	Variable. Can be made from scrap wood, so costs should be under $100 for two large hotels.	
Reseed low-growing lawn mix	10 lb. bag low growing lawn mix from Silver Falls Seed Company ($112.00)	
Reseed beneficials mix	½ lb. bag honeybee mix	

	from High Country Gardens ($19.95)	
Create brush pile for bumblebee nesting or plant native rose	Brush can be acquired for free from Landscaping Program. Native rose ($10-30)	
Reseed beneficials mix and low-growing lawn mix	¼ lb. bag honeybee mix - High Country Gardens ($10.95). 5 lb. bag low-growing lawn mix from Silver Falls Seed Company ($80.50)	
Plant monarch butterfly patch of mixed milkweed and wildflowers	Milkweed seeds ($1.95) and 1 oz. Butterfly wildflower mix ($4.95) Nichols Nursery	
Install tree frog houses	Six 2”x5’ lengths PVC pipe with angled ends from Home Depot ($17.37 ea.).	
Place large, woody debris to increase reptile/amphibian shelter space	Free if taken from forest on campus after winter storms.	
Build hibernaculum	Free fill from construction program. Two 4”x5’ lengths of PVC pipe with holes drilled in them ($22.71). Two 4” PVC elbow joints ($4.25 ea.)	

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