Ecological Restoration Plan
for Pathways Retreat in Goshen, Indiana

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Abstract

This plan proposes restoration of a 2.7-acre area of degraded land of Pathways Retreat located at 309 Hackett Road, Goshen, Indiana. Aligned with the mission of Pathways Retreat to provide a place for rest, reflection and renewal, the intention of this plan is to establish a cultural landscape for the co-benefits of spiritual retreat and ecological restoration. This ecological restoration plan provides guidance to transform an existing meadow dominated by tall fescue (*Festuca arundinacea*) and other exotic and invasive species into a prairie with diverse species of native grasses and forbs surrounded by edges of woody vegetation for screening and wildlife habitat. This plan serves five goals: (1) establish a healthy, functioning ecosystem; (2) enhance natural habitat to support biodiversity; (3) provide a space for recreation and spiritual retreat; (4) restore our relationship to the land; (5) provide opportunity for financial support. The first two are ecological, the second two are cultural, and the fifth is economic. This plan describes the site in its natural and historical context; identifies stakeholders, goals, objectives, alternative pathways, and regulations; then provides a reference system and the preferred alternative for restoration with action steps and indicators for success.

Keywords: ecological restoration, prairie, invasive plant species, native plant species.

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This ecological restoration plan is prepared for Pathways Retreat to develop a 2.7-acre area of its land.

Pathways Retreat is a spiritual retreat center for rest, reflection and renewal in Goshen, Indiana. Since 2006 when property was first purchased, Pathways Retreat now uses 17 acres of land as a space for spiritual retreat and is open to all people. Its facilities currently include a retreat house, cottage in the woods, two labyrinths, meditation alcoves, and two miles of trails through woods and meadows.

Aligned with the mission of Pathways Retreat, the intention of this plan is to establish a cultural landscape on this 2.7-acre area for the co-benefits of spiritual retreat and ecological restoration. Now part of the 17 acres of land for Pathways Retreat, the vision of this area of land is a restored naturalistic landscape that renews the land, people, and their relationship to the Earth.

Three goals identified by the Board for the entire 17-acre area of land are to:

1. Restore native plants,
2. Establish wildlife habitat, and
3. Create space for rest, reflection and renewal for people.

In keeping with the mission of Pathways Retreat and these goals, this plan provides guidance to transform the existing meadow dominated by tall fescue (*Festuca arundinacea*) and other exotic and invasive plants into a prairie with diverse species of native grasses and forbs surrounded by edges of woody vegetation for screening and wildlife. This plan seeks to follow the principles and practices of ecological restoration outlined by Gann et al. (2019) based on guidelines of the Society of Ecological Restoration (2005).

Part 1: Site Identification

Site Description

The site for this ecological restoration plan is an area approximately 2.7 acres in size located at 309 1/2 Hackett Rd, Goshen, Indiana 46528 in Section 3, T36N, R6E, Elkhart Township, Elkhart County, Indiana. Its geographic coordinates are 41.603657, -85.826393.

With an elevation of 860 feet, the topography of the area is relatively flat with a gentle slope of approximately 2-3 degrees on the north side of the site. This area is in ecoregion 56b, Elkhart Till Plains, and in hardiness zone 6a with a mean annual air temperature of 47 to 50 degrees F and an annual precipitation of 34 to 40 inches. The site has a frost-free period of 140 to 170 days and is mostly in full sun.

This site area contains no flowing streams or open water. The ground is largely comprised of dry, sandy soils. The soil profile is estimated by Web Soil Survey as 85% Coloma sand with Bristol (5%), Oslo (5%), and Tyner (5%) soils (NRCS 2022). The glaciated landform consists of outwash plains and moraines from sandy outwash parent material. The drainage class of this site is somewhat excessively drained. Depth to restrictive features is greater than 80 inches. Capacity of the most limiting layer to transmit water is high to very high (2.00 to 20.00 inches/hour). Frequency of flooding and ponding is rated as none. Available water capacity is rated as low and depth to water table is more than 80 inches. The Soil pH is estimated be around 6 according to Web Soil Survey. Once frozen ground thaws, soil profile tests can be conducted to determine actual pH.

Primary vegetation, native and exotic (indicated by*), on this site includes:

- Eastern red cedar (*Juniperus virginiana*)
- Eastern white pine (*Pinus strobus*)
- Northern dewberry (*Rubus flagellaris*)
- Privet (*Ligustrum spp.*)*
- Smooth sumac (*Rhus glabra*)
- Tall fescue (*Festuca arundinacea*)*

- American plum (*Prunus americana*)
- Asian bush honey suckle (*Lonicera spp.*)*
- Black cherry (*Prunus serotina*)
- Black oak (*Quercus velutina*)
- Black raspberry (Rubus occidentalis)
- Brome grasses (*Bromus spp.)**
- Eastern black walnut (*Juglans nigra*)

Exotic plant species observed on or around the site:

- Amur honeysuckle (*Lonicera maacki*)
- Asian bittersweet (*Celastrus orbiculatus*)
- Bell's honeysuckle (*Lonicera × bella*)
- Blunt-leaved privet (*Ligustrum obtusifolium*)
- Bull thistle (*Cirsium vulgare*)
- Autumn olive (*Elaeagnus umbellate)*
- Canada thistle (*Cirsium avense*)
- Carolina horsenettle (*Solanum carolinense*)
- Common buckthorn (*Rhamnus cathartica*)
- Crown vetch (*Coronilla varia*)
- Dame's rocket (*Hesperis matronalis*)
- European highbush cranberry (*Viburnum opulus*)
- Field bindweed (*Convolvulus arvensis*)
- Garlic mustard (*Alliaria petiolata*
- Glossy buckthorn (*Frangula alnus*)
- Hairy vetch (Vicia villosa)
- Japanese barberry (*Berberis thunbergii*)
- Japanese honeysuckle (*Lonicera japonica*)
- Lady's thumb (*Persicaria maculosa*)
- Mahaleb cherry (*Prunus mahaleb*)
- Morrow's honeysuckle (*Lonicera morrowii*)
- Multiflora rose (*Rosa multiflora*)
- Musk thistle (*Carduus nutans*
- Norway maple (*Acer platanoides*)
- Periwinkle (*Vinca minor*)
- Poison hemlock (*Conium maculatum*)
- Queen Anne's lace (*Daucus carota*)
- Siberian elm (*Ulmus pumila*)
- Siebold viburnum (*Viburnum sieboldii*)
- Tall fescue (*Festuca arundinacea*)
- Tatarian honeysuckle (*Lonicera tatarica*)
- Tree-of-heaven (*Ailanthus altissima*)
- White mulberry (*Morus alba*)
- Wintercreeper (*Euonymus fortune)*

As these exotic invasive species spread, they displace native plants and pose threats to the environment or our economy (IISC n.d.). In view of this, these need to be removed or controlled (addressed below under management plans). Invasive species like these in a restoration context are a problem in that they (1) dominate a site or its seedbank, (2) may leave behind negative legacies after removal, or (3) could invade the restoration site and co-op the establishment of desired species (Palmer et al. 2016). Consider the example of tall fescue (*Festuca arundinacea*) that dominates the site. While it may appear as a benign grass, research has shown that this exotic invasive grass is not only allelopathic to many plants, but the toxic fungus of its endophyte is harmful to many animal species. As a result, tall fescue diminishes biological diversity of soil organisms, insects, plants, birds, and mammals (USDA/NRCS 2001).

Native plants which can become problematic and need to be controlled on this site include American pokeweed (*Phytolacca americana*), Canada goldenrod (*Solidago canadensis*), Gooseberry (*Ribes spp*.) (as an alternate host to white pine blister rust), and Marestail or horseweed (*Conyza canadensis*).

Invasive terrestrial invertebrates on site include Emerald ash borer (*Agrilus planipennis* Fairmaire) and Gypsy moth (*Lymantria dispar)*. Feral cats have been observed on the site as exotic terrestrial vertebrates.

As for threatened or endangered species, Lincoln's Sparrow and Cerulean Warbler have been spotted on the property of Pathways Retreat. Sandhill crane, broad-winged hawk, sharp-shinned

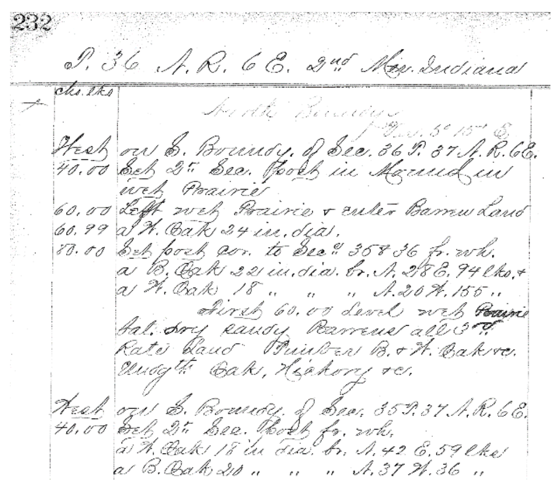
hawk, American woodcock, common nighthawk, black-and-white warbler as species under special concern have also been reported on or over the land (eBird 2022). The monarch butterfly (*Danaus plexippus*), a candidate for an endangered species, has been observed on this site. No endemic species have been observed.

Historical Context

The owner of the site is Pathways Retreat, Inc., a 501(c)(3) not-for-profit spiritual retreat center in Goshen, Indiana with a mission to provide rest, reflection and renewal. The land, recently donated to this center, is now part of the 17-acre property used by the community.

This land is part of an original 138 acres purchased from the United States by James and Elizabeth Pettit in 1834 according to provisions of the 1820 Act of Congress on the sale of public lands (Abstract of Title 1833). No reference is made to Indigenous people (Potawatomi or before them Miami) who inhabited this area before they were violently removed from their land. Other than old wire fencing, no prehistoric or historical anthropogenic features are observed the site. The Abstract refers to a "crop of wheat" growing on this land. Other references are made regarding previous occupants who "cultivated the land" and "raised crops" and "fruit product" (1833). Evidence of exotic pear (*Pyrus spp*.) and apple (*Malus spp*.) trees within 300 yards of the site suggests that fruit may have been raised here. Old, barbed wire fence on adjacent property suggests livestock was also on the land at some point. At least since the 1970s, the center area of this site has been mowed, which has controlled woody species and created the open grassy area. This is what is left of the oak-hickory forest ecosystem that was destroyed for agricultural use.

The 1830 Township Map does not record vegetation type other than the Elkhart Prairie a mile south of this site. However, surveyor notes (1830) of this land mention prairie areas along with oak/hickory forest species (figure 1). Given existing wide, open grown oaks (*Quercus spp*.) on the land over 200 years old on alfisols (forest soils) and the absence of large, fire sensitive species like American beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*) may indicate that more frequent fires were conducted by Potawatomi people to manage this land as prairie or oak savanna (interview with David Bontrager Horst Lehman, February 2, 2022). It is known that Indigenous people managed the prairie a mile south of the site (interview with Luke Gaschow, February 3, 2022). That settlers were raising crops within a year of taking possession of the land suggests that there was savannah landscape or that there were open pocket areas that allow quick cultivation.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chs. lks
West on S. Boundy. of Sec. 36 T. 37 N. R. 6 E.
40.00 Set 2½ Sec. Post in Mound in
60.00 Left
60.99 a W. Oak 24 in. dia.
80.00 Set post cor. to Secs. 35 & 36
a B. Oak 18 " " " N. 20 W. 155 "
Oak, Hickory &c.
West on S. Boundy. of Sec. 35 T. 37 N. R. 6 E.
40.00 Set 2½ Sec. Post
a B. Oak 20 " " " N. 37 W. 36 "

Figure 1. Elkhart Township. (1834). Field Notes

From descriptions in the abstract, areas of land appear to have been cleared of native vegetation for agricultural use around 1833 and farmed until sometime in the middle of the 20th century. After agricultural use was abandoned, most of the site was managed by mowing, except around larger shrubs and trees. At some point the site was

invaded by or planted with tall fescue (*Festuca arundinacea*) and other exotic cool season grasses. Continued practice of mowing maintained this grassy area dominated primarily by tall fescue. Areas on the site that have not been mowed contain numerous exotic invasive species identified above. One brushy island near the center of the site, for example, has a dense patch of Asian honeysuckle (*Lonicera spp.*), Asian bittersweet (*Celastrus orbiculatus*), privet (*Ligustrum spp.*), Mahaleb cherry (*Prunus mahaleb*), tall fescue (*Festuca arundinacea*), white mulberry (*Morus alba*), and wintercreeper (*Euonymus fortune*)—all within less than a 5,500 square feet area (as shown in figure 7).

Preliminary goals for restoration project

Aligned with the mission of Pathways Retreat, the intention of this ecological restoration plan is to renew a 2.7-acre area of land for the co-benefits of spiritual retreat and ecological restoration. The aim is not to restore the former oak-hickory forest ecosystem but to establish and manage for a functioning prairie ecosystem. The vision for this site and its larger context is a naturalistic and cultural landscape that renews the land, people, and their relationship to the Earth.

Three goals identified by the Board for the entire 17-acre area of land it uses are:

1. Restore native plants,
2. Establish wildlife habitat, and
3. Create space for rest, reflection and renewal for people

In keeping with the mission and goals of Pathways Retreat, the intention of this plan is to transform the existing abandoned meadow dominated by tall fescue (*Festuca arundinacea*) and other exotic invasive species into a cultural landscape that emulates a prairie with diverse species of native grasses and forbs surrounded by woody edges of shrubs and trees for screening and wildlife. To this end, this ecological restoration plan has five goals. Two are ecological, two are cultural goals, and one is economic. Goals are to:

1. Establish a functioning savannah prairie ecosystem,
2. Enhance natural habitat to support biodiversity,
3. Provide a space for recreation and spiritual retreat,
4. Offer a demonstration site for ecological integrity.
5. Provide opportunity for financial support.

Anticipated primary environmental benefits include increased biodiversity, wildlife habitat, and food chain support. Anticipated cultural benefits include human recreation, spiritual renewal, and education.

Ecoregion and Watershed

This site is located in larger natural contexts related to bio- or ecoregions and watersheds. Following the ecoregions of North America (EPA 2013), the levels (from I coarse to IV local) of this land area are:

- Level I: Eastern temperate forests (8)
- Level II: Mixed wood plains (8.1)
- Level III: Michigan/N. Indiana Drift Plains (56)
- Level IV: Battle Creek/Elkhart Outwash Plain (56b), also known as the Elkhart Till Plains.

As a glaciated area, the Elkhart Till Plains is nearly level to rolling drift plain with end moraines, glacial outwash landforms, lacustrine flats, and scattered potholes. While oak-hickory

forests and beech maple forests once dominated this region, there were also dry prairies and tamarack swamps. Today, however, corn, soybean, and wheat farming and residential development are more extensive than woodland (EPA 2013). Based on oak and hickory trees over 200 years old in the immediate area, this particular site—especially with dry, sandy soils—originally appears to have been an oak-hickory forest.

This site is located in the St. Joseph River watershed (SJRW) and USGS hydrological region 04050001. The SJRW drains approximately 4,685 square miles of land into Lake Michigan at St. Joseph, Michigan. Approximately 70% of the watershed is used for crop and animal production and more than 50% of historic wetlands in the watershed have been lost (Matousek 2020).

Map and Aerial Photos

Maps and aerial photos below show the site in its surrounding landscape.

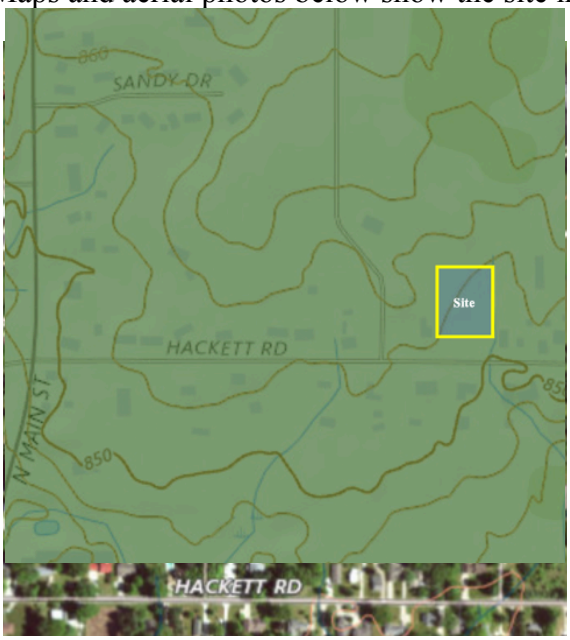

Figure 3
National

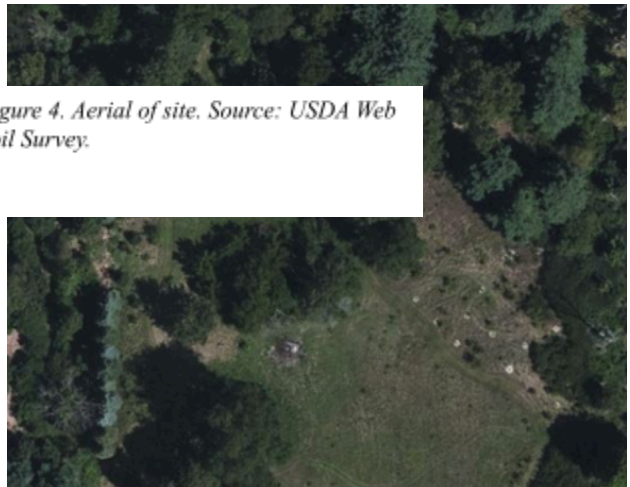

Figure 4. Aerial of site. Source: USDA Web Soil Survey.

Figure 5. Enlarged project site. Source: Google Earth.

On-site Photos

Figure 6. Open area of tall fescue (Festuca arundinacea). Photo credit: Evan Miller.

Figure 7. Brushy island of invasive shrubs and trees surrounded by tall fescue (Festuca arundinacea). Photo credit: Evan Miller.

The problem with non-native, invasive plants

Invasive alien plants threaten native species and habitats by competing for critical and often limited resources like sunlight, water, nutrients, soil and space. They succeed through vigorous growth, prolific reproductive capabilities and by causing changes that favor their growth and spread. Invasive plant species displace and alternative plant communities, impede forest regeneration and natural succession, change soil chemistry, alter hydrologic conditions, alter fire regimes, cause genetic changes in native plant relatives through hybridization and some serve as agents for the transmission of harmful plant pathogens.

In addition to the great loss of biodiversity, habitat degradation and other ecological consequences, invasive species cause huge economic damages valued in billions of dollars annually and some pose a human health threat.

Figure 8. The problem with non-native, invasive plants. Source: Invasive Plant Atlas of the United States (n.d.)

Part 2: Stakeholders, Goals, Options, and Regulations

Stakeholders and partners for this site

Stakeholders and proposed partners for this project may include:

- Pathways Retreat task force, Evan Miller
- Natural Resources Conservation Service (NRCS) / Elkhart County Soil and Water District Conservation, District Conservationist, Wes Krug
- Indiana Department of Natural Resources (IN DNR) district forester, Ben Wilson
- Department of Natural Resources (DNR) Urban Wildlife Biologist, Jessica Merkling
- U.S. Fish and Wildlife Service (FWS), Jared Obrien
- City of Goshen, department of Environmental Resilience, Aaron Kingsley
- Goshen College, department of Environmental Science, Ryan Sensenig
- Owners of surrounding property, Steve Thomas

As owner of the property on which the site is located, the primary stakeholder for this site is Pathways Retreat, Inc. Recognizing that the site is in the city limits of Goshen, it would be good to engage its department of Environmental Resilience for awareness of this project that will benefit the community and its environment and to help promote it in the city. NRCS, DNR, and FWS agencies have interest in ecological restoration and bring technical and cost-share assistance to projects like this. Four of the six individuals identified above have expressed interest in this project. Goshen College may have an interest in this project as a demonstration site for its students in environmental science. Ryan Sensenig, who teaches restoration ecology at Goshen College and specializes in grassland ecosystems, is conducting an ecological project a half mile away from this site. I am also a stakeholder, as Linda (my spouse) and I own 15 acres around this site and are a part of Pathways Retreat.

I relate to a task force of Pathways Retreat that has recently determined that a short grass prairie is desired for the largest area of the site. The task force has also identified features for human use within this setting for rest, reflection and renewal. But no plans for ecological restoration have been made for this site, which is the focus of this plan. Consideration was given to including in the planning process a representative of the Potawatomi people whose ancestors inhabited this area and have a presence in Michigan. But after consulting with Luke Gaschow (personal conversation February 3, 2022), former director of Merry Lea Environmental Center who relates to the Potawatomi, it was decided not to pursue this given the small size of the site and questions about how ready Pathways Retreat is to accommodate Indigenous interests.

Now that Pathways Retreat has determined land use for this site, it's a matter of engaging the other entities identified above in a planning process. Given scheduling challenges of getting these individuals together on site at the same time, they may make individual site visits with Evan Miller (representing Pathways Retreat) and myself to discuss our interests, give feedback on this plan, identify what each may offer, and explore how we can collaborate to bring this project to fruition.

Goals and objectives of restoration project

As described in part 1, the site is seriously degraded as the result of previous agricultural use following settlement in 1833. Fragmentation, cropping and/or grazing, and invasive species have been the key stressors leading to degradation. Currently, the site is dominated by tall fescue (*Festuca arundinacea*) and is populated with many other exotic, invasive plants (listed in part 1). Consequently, ecological functions are severely compromised and biodiversity is diminished.

This is what needs repair. As stewards of this land, Pathways Retreat aims to restore ecological health to this site and enhance its use for the larger community.

In keeping with the mission of Pathways Retreat to provide a place for rest, reflection and renewal, the purpose of this plan is to renew a 2.7-acre area of land for the co-benefits of spiritual retreat and ecological restoration. Given the context of this site and intentions for its use, this plan proposes ecological transformation—that is, a conversion from a previous ecosystem to a different kind of ecosystem within our bioregion (described in part 1). The aim is not to restore the former oak-hickory forest ecosystem but to establish and manage for a functioning prairie ecosystem surrounded by a savannah-like edge. This edge would serve as an ecotone or transition from prairie to woodland. Such an ecosystem would have occurred in patches in and around the former oak-hickory forest in the area. Evidence of land use from abstracts and surveys suggest that such patches were present in the area prior to settlement in the 1830s.

As described in part 1, the vision for this site and its larger context with Pathways Retreat is a naturalistic and cultural landscape that restores the land, people, and their relationship to the Earth. In the faith language of Pathways Retreat, the vision is to restore this piece of creation so that the land once again is a place of abundance, biodiversity, and beauty (Genesis 1-2) aligned with the Creator's intention for shalom on Earth.

Three goals identified by the Board for the entire 17-acre area of land it uses are:

1. Restore native plants,
2. Establish wildlife habitat, and
3. Create space for rest, reflection and renewal for people.

In keeping with its mission and these goals, Pathways Retreat, plans to transform this degraded land—now an abandoned meadow dominated by tall fescue (*Festuca arundinacea*) and other exotic, invasive species—into a healthy, functioning ecosystem. What's envisioned resembles a prairie with a rich diversity of native grasses and forbs surrounded by woody edges of shrubs and trees for screening and wildlife. The savannah-like edge or ecotone will provide a landscape transition from the prairie to the woods on the north side of the site.

Toward this vision, this ecological restoration plan has five goals. The first two are ecological, the second two are cultural, and the fifth is economic. Objectives are stated under each goal.

1. Establish a healthy, functioning ecosystem.
    a. The site consists of a characteristic community of native plants associated with this ecoregion, except for a few non-native species with low invasive potential allowed in cultural landscapes.
    b. Functional plant groups essential for the development and stability of the ecosystem are present.
    c. The physical environment can sustain the intended ecosystem.
    d. The ecosystem is suitably integrated in its larger ecological landscape.
    e. Potential threats to the ecosystem in the surrounding landscape are reduced as much as possible.
    f. The ecosystem is sufficiently resilient to endure normal period stress events in the local environment and is self-sustaining, except for actions that mimic natural disturbances (SER 2004) and actions to control invasives recognizing that this site is a fragment in a larger degraded ecological landscape filled with exotic invasive plants (Apfelbaum and Haney 2012).

2. Enhance natural habitat to support biodiversity.
    a. The ecosystem consists of a rich diversity of native grasses, forbs, shrub, and trees.
    b. The site supports a wide range of insects, herptiles, birds, and mammals.
    c. Natural habitat can attract and support threatened and endangered species.
3. Provide a space for recreation and spiritual retreat.
    a. Create a space of beauty and biodiversity that inspires and heals.
    b. Provide trails through the area for people to use.
    c. Develop a gathering space with a pavilion that fits the space.
    d. Provide sitting areas with chairs and large rocks.
    e. Install a sculptural Clootie tree (from Celtic tradition).
    f. Create a space among the pines to hang hammocks.
4. Restore our relationship to the land.
    a. Receive and learn from the Earth upon which our life depends.
    b. Provide opportunities for people to care for the Earth in reciprocity.
    c. Offer an educational site for ecological integrity, stewardship, and spiritual restoration.
5. Provide opportunity for financial support.
    a. Communicate values of ecosystem services/benefits this site provides.
    b. Invite financial contributions in exchange of benefits to support land management.
    c. Promote free use of the land which may lead to use of facilities with rental fees.

As for ecosystem services or benefits this site will provide, goals 1 and 2 primarily relate to regulating services (for climate, air, water and pollination) and supporting services (for soil formation, cycling of water, air, and nutrients, and habitat) while goals 3 and 4 identify cultural services (for education, recreation, and renewal). Goals 1 and 2 include both structural and functional objectives for a healthy ecosystem.

These goals are economically feasible with financial contributions devoted to this project, projected cost-share assistance, in-kind contributions, and volunteer labor. As for ecological feasibility, a natural ecosystem that naturally occurs as a result of its resources and forces over time and one that is fully functioning and self-sustaining is not possible, for this site exists as a small fragment in a largely degraded area full of invasive species. At best what is feasible is a site that approximates or resembles a functioning prairie surrounded by a naturalistic edge. To achieve this will require sustained active management through the years to control invasives and succession.

Alternative pathways for ecological restoration

As described above, the need and purpose of this plan is to transform this degraded site dominated by exotic invasive species into a healthy, functioning ecosystem. A range of reasonable alternatives are listed below. Alternatives 4 and 5 assume the need to use herbicides to effectively remove tough, persistent invasive plants as the key stressors in the degraded site. With concerns about using herbicides, a note about this is in order. Proper site preparation with the removal of aggressive, nonnative perennial grasses and forbs determines success or failure of restoration (Apfelbaum and Haney 2010). There are many methods to remove existing vegetation from a site, such as smothering with plastic sheets, cardboard or newspaper covered with mulch for a growing season; successive cover crops for two years; repeated tillage every three weeks; bulldozing; and herbicide treatments. Of these various methods for this size of site dominated by a dense stand of fescue, using herbicides like glyphosate and broad leaf herbicides

as needed would be most practical and effective (Diboll n.d.). The EPA identifies glyphosate as an important herbicide for habitat restoration with minimal environmental impacts and low level of risk to human health (EPA 2020). Apfelbaum and Haney (2010) state that glyphosate has little soil persistence and very low toxicity, making it the preferred herbicide.

Alternative 1. Take no action and allow for natural succession.

Actions. Perform no action and simply allow ecological succession to follow its course. The current practice of annual mowing would stop. Discontinuing the practice of mowing, which maintains the existing stand of tall fescue (*Festuca arundinacea*), would facilitate succession of shrubs and trees to populate the area and eventually become woodland.

Outcomes. The likely outcome of this passive course of action would be a mixed population of both native and invasive plants. In time, the site would progress from grasses with increasing forbs to brambles to a mixed woodland with native and exotic shrubs and trees. Given existing seed in the soil and vegetation outside the site, the grassy meadow would likely be populated with native and desirable forbs like the butterfly weed (*Asclepias tuberosa*) spreading on the site. Black raspberry and blackberry (*Rubus spp*.), sumac (*Rhus spp*.), American plum (*Prunus americana*), Black cherry (*Prunus serotina*), oak (*Quercus spp*.), Eastern red cedar (*Juniperus virginiana*), and Eastern white pine (*Pinus strobus*) would become increasingly established, first by pioneer species like cherry and plum trees (*Prunus*) followed by late successional species like oaks (*Quercus spp.*). While these native species in the evolving plant community may be desired, Canada thistle (*Cirsium avense*), hairy vetch (Vicia villosa), crown vetch (*Coronilla varia*), Queen Anne's lace (*Daucus carota)* and Carolina horsenettle (*Solanum carolinense*), honeysuckle (*Lonicera spp.*), privet (*Ligustrum spp.)*, multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellate*), mahaleb cherry (*Prunus mahaleb*), Siberian elm (*Ulmus pumila*), and white mulberry (*Morus alba*) would invade and compete with the natives. While native, Canada goldenrod (*Solidago canadensis*) as an aggressive invader would likely form dense colonies.

While this alternative would involve no cost and labor, this passive course of action would not bring about the desired healthy ecosystem described above but shift the site from an unhealthy stand of exotic tall fescue to an unhealthy woodland largely populated by nonnatives and would remain as a degraded ecosystem. If ecological restoration for this site were taken up in the future, financial costs and labor would be much greater later due to the volume of invasive shrubs and trees that would need to be removed than if this were pursued now.

Alternative 2. Allow for succession and treat only woody nonnatives.

Actions. Stop mowing, which maintains tall fescue (*Festuca arundinacea*), then allow natural succession as with 1 above, but manage nonnative invasive shrubs and trees by mechanical and chemical control.

Outcomes. Succession would follow a similar course as described under alternative 1, but with native trees and shrubs. The majority of herbaceous groundcover would likely consist of nonnative grasses and forbs. Eventually, the existing meadow would become increasingly populated by native shrubs and trees as it develops into a woodland. This alternative would involve little herbicide, little cost, and moderate labor. While the woodland of America plum, eastern red cedar, smooth sumac, and oak (*Quercus spp*.) may be appealing and healthier than the present site, this would not provide the prairie that Pathways Retreat seeks.

Alternative 3. Manage entire site for an oak savanna.

Actions: Stop mowing then allow natural succession as with 1 and 2 above but use prescribed burning to control nonnative invasive shrubs and trees and native woody vegetation

intolerant of fire. During burns, protect black oak (*Quercus velutina*), bur oak (*Quercus macrocarpa*), and white oak (*Quercus alba*) saplings on the site until they are fire resistant. In addition to fire, use mechanical and chemical control on other woody species to create an open savanna-like landscape which naturally occurred in this bioregion. Spot treatment may also be done to manage nonnative grasses and forbs.

Outcomes. Herbaceous plants would be a mix of native and nonnative, depending on level of spot treatment of exotic grasses and forbs. With a fire regimen, the site would shift to an ecosystem resembling an oak savanna if all trees and shrubs were managed to maintain open tree cover. This would require burn permits from Indiana Department of Environmental Management (IDEM).

Alternative 4. Remove existing vegetation followed by control on nonnatives and woody plants.

Actions. Remove all existing vegetation, except desired native with repeated applications of glyphosate and broad leaf herbicide as needed over the course of two years to effectively kill perennial plants and reduce the seed bed of exotic plants (further described in part 3 below). Do not till or disturb the soil in order to not expose weed seed in the soil. Treat glyphosate resistant species with selective herbicides. Once the area is cleared of exotic species, simply allow new plant propagules to be naturally introduced to the site via wind or animals. Permit the site to naturally repopulate then spot treat nonnatives and control woody species to facilitate the establishment of native grasses and forbs. Treatment methods could include fire, chemical and mechanical control.

Outcomes. Given existing vegetation outside the site, there would likely be a re-invasion of nonnative grasses, forbs, and woody along with desired native species. Managing nonnatives, especially herbaceous plants, with mechanical and chemical control would involve continuous effort. Establishing a healthy, functioning prairie ecosystem would be limited with the likelihood of nonnative herbaceous plants occupying the ground and displacing native prairie plants. This course of action would involve considerable herbicide and intensive labor.

Alternative 5. Replace existing vegetation with native species followed by intensive management.

Actions. Prepare the site following the same course of action as alternative 3. But rather than allowing the area to repopulate on its own as with 4, seed the site with native grasses, sedges and forbs associated with prairie ecosystems in this bioregion. To establish this new ecosystem, follow up with initial mowing and eventual burning (described in part 3 below). Conduct burning every several years to control woody vegetation, except for desire oaks. As and after the prairie is established, scout for and treat invasive species so they don't get established on the site.

Outcomes. Following careful site preparation and diligent management, this site will most likely result in a plant community that resembles a prairie ecosystem. Over time and with continued management (with fire and controlling invasives), this may become a healthy, functioning ecosystem resembling a prairie with a savanna-like edge. While this would require considerable cost, herbicide and intensive effort, it could be one of the most attractive landscapes at Pathways Retreat and provide the most benefits, meeting goals described above.

Reflections on relating to the land

Whatever course of action is taken, it is important to undertake ecological restoration for this site with the intention of not only restoring the land but our relationship with the land (goal 4). This calls for a certain attentiveness and respect that comes from an awareness that we are not

above but part of nature and that we, from the faith perspective of Pathways Retreat, have a stewardship responsibility to "serve and protect" the Earth (Genesis 2:15). In a close, attentive relationship with nature, we seek to work *with* the land rather than impose our will *on* the land. This invites us to co-operate with the "generative forces of creation" (Wisdom 1:14) and allow the Earth to flourish with abundance, biodiversity and beauty as the Creator intends. This approach is aligned with a fundamental principle of ecological restoration to "pay attention to what nature wants and work with her" (Apfelbaum and Haney 2012, 10).

To better understand this ancient Hebraic approach to caring for the environment, we can turn to what may be a comparable approach with Indigenous wisdom and practice. The Society for Ecological Restoration (SER) calls attention to what Indigenous traditions provide. Traditional ecological knowledge (TEK) "involves reciprocity—sharing and restraint sustained by spiritual beliefs that regard plants and animals as human kin. TEK practices increase biodiversity and improve ecological resilience by creating fine-grained, landscape mosaics. . . Most importantly, TEK is inseparable from a culture's spiritual and social fabric. In the Indigenous worldview, it takes all of what it means to be human—body, mind, heart, and spirit—to understand something ecologically. Consequently, TEK offers important ecological insights, but also a web of knowledge that includes values that can help restore ecosystems" (Gann et al. 2019, S-11).

Drawing from the Indigenous Environmental Network, Robin Wall Kimmerer quotes: "Western science and technology, while appropriate to the present scale of degradation, is a limited conceptual and methodological tool—it is the 'head and hands' of restoration implementation. Native spirituality is the 'heart' that guides the head and hands . . . Cultural survival depends on healthy land and a healthy, responsible relationship between humans and the land. The traditional care-giving responsibilities which maintained healthy land need to be expanded to include restoration. Ecological restoration is inseparable from cultural and spiritual restoration, and is inseparable from the spiritual responsibilities of care-giving and world-renewal" (2013, 337).

Integrating scientific knowledge with Indigenous wisdom, Kimmerer calls for us not to treat the land as capital, property, or just natural resources to manage for ecosystem services. She calls for us to look upon and relate to the Earth as being sacred, enspirited, and sustainer of all living beings with whom we are related. As Thomas Berry put it, the universe is not a collection of objects but a communion of subjects. Kimmerer looks upon and relates to all plants and animals on this basis—viewing all members of our ecological community as subjects or who she calls kin (2013).

Kimmerer refers to the land as teacher and plants as the "first restoration ecologists" who show us the way to restore the Earth. She calls us to pay attention and learn from plants as a form of respect, humility, and reciprocity in restorative work. Kimmerer claims that beyond ecological restoration, is the restoration of relationship between plants and people. She states that while scientists know how to put ecosystems back together, they focus too much on soil and hydrology—that is, matter—to the exclusion of spirit. She calls for restoring right relationship with the land. "Restoring land without restoring relationship is an empty exercise. It is relationship that will endure and relationship that will sustain the restored land. Therefore, reconnecting people in the landscape is as essential as reestablishing proper hydrology or cleaning up contaminants. It is medicine for the earth" (2013, 338). And this medicine is also for ourselves. Following again the Indigenous principle of reciprocity, what we give we receive in return. In restoring the land, we restore ourselves. We would do well to follow this approach

rooted in the Potawatomi tradition, knowing that the Potawatomi people tended this site before they were forcibly displaced. We can honor them by honoring the land they tended.

Policy and regulatory framework related to proposed actions

This site is within the city limits of Goshen and this plan is aligned with Goshen's vision for its natural environment is to "respect and manage natural resources in a way that sustains, restores and enhances the natural environment" (Goshen 2014, NE-1). This plan would contribute to advancing the city's tree canopy goal by planting additional trees.

However, because this site is within the City of Goshen, regulations in the city code prohibit certain tree species from being planted. This plan does not include any prohibited species. City codes requires that "Naturalized landscaping shall be maintained and not contain weeds or other rank or noxious vegetation as defined in Ordinance Number 4066" (Goshen 2016, Section 5000.8.C Maintenance of Landscaping). It further stipulates under Article 9 for Rank Vegetation and Nonxious Weeds that property owners "cut or remove rank vegetation" (which the code does not define) within 150' of an adjacent property owner or public right-of-way unless it qualifies for exclusion under 6.9.1.2 as a "Wildlife project area in which the project is conducted and funded by an educational institution or a local, state or federal government entity" (Goshen 2016, 6-69). This project may qualify for this exclusion. In the case of Pathways Retreat's pollinator garden, the city did approve of this vegetation and its management by the road and along a neighbor's property. This patch consists of similar species and management practices as what is proposed in this plan. The board will need to address this point with the city to determine whether the proposed land use and management qualifies for the exception above like the pollinator garden and, if not, what would be required to proceed.

There are no other known municipal, state or federal policy or regulations that pertain to the proposed land use in this plan, except for applying for required burn permits from Indiana Department of Environmental Management (IDEM) in order to conduct prescribe fires. The restrictive covenant for the property limits housing construction but not vegetation.

This plan recommends that the site be enrolled in the DNR Classified Forest and Wildlands program. Because this land area is adjacent to 14 acres already in this DNR program, it qualifies for classification in that it will contain "grasslands that are dominated by native grasses or intermixed with other native herbaceous vegetation" (IN DNR 2016, IC 6-1.1-6-2.5 Wildlands Sec. 2.5; IN DNR n.d). Proposed plans are aligned with the goals of the classified land program and meet its requirements, except the pavilion which may need to be excluded from the area enrolled in the program. A DNR agent would make a determination on this.

Recommended federal, state, and local agencies for this project include:

- U.S. Fish and Wildlife Service (FWS), Jared O
- Indiana Department of Natural Resources (IN DNR) urban wildlife biologist, Jessica Merkling
- Indiana Department of Natural Resources (IN DNR) district forester, Ben Wilson
- Natural Resources Conservation Service (NRCS) / Elkhart County Soil and Water District Conservation, district conservationist, Wes Krug
- City of Goshen, department of Environmental Resilience, city forester, Aaron Kingsley

Plan Part 3: Reference System and Preferred Alternative

Reference system for project

A reference system is based on existing ecosystems that represent the approximate condition of land had degradation not occurred. These sites and other sources of information are used to create models with similar environmental factors and ecological aims of the project site (SER 2005; Gann et al. 2019).

The reference system for this project is based on two physical sites and two ecoregion resources. The first site is a prairie fragment and the second is a planted prairie. These sites were selected in consultation with natural resource practicioners on the basis of site conditions and biotic communities resembling aims of this project for a prairie ecosystem with a savanna-like ecotone.

Site 1: Prairie/savanna fragment: Sauk Indian Trail Prairie Plant Preserve

Location: 41.79395487853638, -85.50673636318022

Figure 9. Prairie fragment. Photo: Google Earth.

This quarter-acre prairie/savanna fragment lies on the Old Saulk Trail between US-12 and a railroad immediately west of Shimmel Road, approximately 28 miles northeast of project site. This site is also comparable to project site with Oshtemo sandy loam (NRCS, 2022) and full sun exposure. This site is selected as a reference for the savanna ecotone plant community. The site is bounded by two roadways and railroad track.

Paleo ecological evidence suggests that a major trail through this area was used by Indigenous people long before Europeans arrived. The Great Saulk Trail roughly followed the line of abundant forests to the north and open grasslands to the south (Ettema, 2010). The early rail line along this trail spared this fragment from being degraded by the plough.

The remnant, partially owned by the Michigan Department of Transportation and Michigan Southern Railroad, is described by the Michigan Nature Association's as a high-quality prairie/savanna remnant. This site, like many railroad prairies, was able to avoid agricultural development due to railroad usage. Furthermore, railroad companies used prescribed fire to prevent woody vegetation from encroaching on areas along the railroad. Sparks from passing trains were also known to ignite dry prairie grasses leading to additional burns. These fires helped to maintain these fragments as prairie ecosystems. Prescribed burns are performed today by Michigan Nature Association volunteers (Michigan Nature Association n.d.). With a history of burns, this land has been maintained as an intermediate seral plant community. If not burned or mowed, the site would likely become a woody ecosystem.

The Michigan Nature Association (n.d.) lists plants that have been observed in this unplowed prairie/oak savanna remnant. Woody species include black oak (*Quercus velutina*), bur oak (*Quercus macrocarpa*), smooth sumac (*Rhus glabra*), and American hazelnut (*Corylus americana)*. Herbaceous species include butterfly weed (*Asclepias tuberosa*), woodland sunflower (*Helianthus divaricatus*), yellow coneflower (*Echinacea paradoxa*), round-headed bush clover (*Lespedeza capitata*), Virginia mountain mint (*Pycnanthemum virginianum*), smooth

Solomon's seal (*Polygonatum biflorum*), big bluestem (*Andropogon gerardi*), and Indian grass (*Sorghastrum nutans*). While more herbaceous plant species are suspected on this site, additional information could not be obtained, nor could physical inspection be conducted due to heavy snowfall.

Figure 10. Savanna at site 1. Photo: Michigan Nature Assoc.

Figure 11. Flora at site 1. Photo: Michigan Nature Assoc.

Site 2: Planted prairie

Location: 8385 E 300 N Howe, IN 46746

This restored prairie of appropriately 2.5 acres is located at 8385 E 300 N Howe IN 46746, 35 miles east of project site. The site conditions are comparable to project site with dry, sandy ground and full sun exposure. The soil is predominantly Plainfield sand with some Boyer loamy sand. Land cover prior to degradation from conversion to agricultural was oak-hickory forest, as shown on right side of figure 4. This prairie is owned by Phil Bieberich who utilizes this prairie for his native seed company, Mongo Seed. Based on the NRCS calculator for this ecoregion (NRCS n.d.), the site was planted with the following species, most of which have persisted in this established ecosystem maintained by periodic burning.

- *Elymus canadensis* (Canada wild rye)
- *Schizachyrium scoparium (*little blue stem*)*
- *Bouteloua curtipendula* (side-oats grama)
- *Carex bicknellii* (copper-shouldered oval sedge)
- *Allium cernuum* (nodding wild onion)

- *Amorpha canescens* (lead plant)
- *Anemone cylidrica* (thimbleweed)
- *Aquilegia canadensis* (wild columbine)
- *Artemisia caudata* (beach wormwood)
- *Asclepias tuberosa* (butterfly milkweed)
- *Aster laevis* (smooth aster)
- *Aster novae-angliae* (New England aster)
- *Astragalus canadensis* (Canada milk vetch)
- *Baptisia leucantha* (white wild indigo)
- *Cacalia atriplicifolia* (pale Indian plantain)
- *Cassia hebecarpa* (wild senna)
- *Ceanothus americanus* (New Jersey tea)
- *Coreopsis palmata* (prairie coreopsis)
- *Coreopsis tripteris* (tall coreopsis)
- *Desmodium canadense* (showy tick-trefoil)
- *Helianthus occidentalis* (western sunflower)
- *Helianthus pauciflorus* (prairie sunflower)
- *Hypericum prolificum* (shrubby St. Johnswort)
- *Kuhnia eupatorioides corymbulosa* (false boneset)
- *Lespedeza capitata* (round-headed bush clover)
- *Lespedeza hirta* (hairy bushclover)
- *Lespedeza virginica* (slender bushclover)
- *Liatris aspera* (rough blazingstar)
- *Liatris scariosa neiuwlandii* (savanna blazingstar)
- *Lupinus perennis* (wild lupine)
- *Monarda fistulosa* (wild bergamot)
- *Monarda punctata* (dotted horsemint)
- *Penstemon digitalis* (foxglove beardtongue)
- *Penstemon hirsutus* (hairy beardtongue)
- *Potentilla argutta* (prairie cinquefoil)
- *Pycnanthemum virginianum* (mountain mint)
- *Ratibida pinnata* (yellow coneflower)
- *Rudbeckia hirta* (black-eyed susan)
- *Silphium perfoliatum* (cup plant)
- *Silphium terebinthinaceum* (prairie dock)
- *Solidago juncea* (early goldenrod)
- *Solidago nemoralis* (grey goldenrod)
- *Solidago rigida* (stiff goldenrod)
- *Solidago speciosa* (showy goldenrod)
- *Tephrosia virginiana* (goat's rue)
- *Tradescantia ohiensis* (Ohio spiderwort)
- *Verbena stricta* (hoary vervain)
- *Vernonia altissima* (tall ironweed)
- *Veronicastrum virginicum* (Culver's root)
- *Zizia aurea* (golden Alexanders)

Ecoregion descriptions.

Two ecoregion resources (Cohen et al. 2020; Harker et al. 1999) provided additional data for a reference system.

Dry sand prairies in this ecoregion are grassland communities dominated by little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), and Pennsylvania sedge (*Carex pensylvanica*). Occurring on loamy sands on well-drained to excessively well-drained, sandy glacial outwash, vegetation is often patchy and short compared to other prairie communities due to nutrient-poor soils. Soils for these ecosystems are typically medium to strongly acid and have low water-retaining capacity. Historically, these prairie and savanna ecosystems were maintained in open condition from droughty soils, frequent fires and growing season frosts which limited tree establishment. Due to fire suppression, most of these former prairies and savannas have been converted to forest. Prior to European settlement, fires were caused by lightning strikes and by Native Americans. Fires facilitated species diversity by increasing the availability of plant nutrients and promoting seed germination and seedling establishment (Cohen et al. 2020).

Common species of dry sand prairies in this ecoregion include: little bluestem, Pennsylvania sedge, New Jersey tea (*Ceanothus americanus*), flowering spurge (*Euphorbia corollata*), wild strawberry (*Fragaria virginiana*), long-bearded hawkweed (*Hieracium longipilum*), old field goldenrod (*Solidago nemoralis*), big bluestem, smooth pussytoes (*Antennaria parlinii*), wormwood (*Artemisia campestris*), butterfly weed (*Asclepias tuberosa*), prairie heart-leaved aster (*Symphyotrichum oolentangiense*), poverty grass, common rockrose (*Crocanthemum canadense*), rough blazing star (*Liatris aspera*), wild lupine (*Lupinus perennis*), panic grass (*Dichanthelium oligosanthes*), northern dewberry (*Rubus flagellaris*), black-eyed Susan (*Rudbeckia hirta*), early goldenrod (*Solidago juncea*), and common spiderwort (*Tradescantia ohiensis*). For a detailed list of characteristic species for this ecosystem, refer to pages A-270-272 in Harker et al. (1999). Noteworthy animals include ants, moles, mice, and skunks who contribute to soil mixing and aeration (Cohen et al. 2020).

Preferred alternative for restoration of this site

Preferred alternative

Of the five alternatives for restoration described in part 2, the preferred option is alternative 5—that is, replacing existing vegetation with native species and manage the site for a healthy ecosystem that resembles prairie ecosystem surrounded by a diversity of edge plant communities. Refer to *Map of plant communities* (figure 14) below for these areas.

This was chosen as the alternative that best meets the five goals stated in part 2 to:

1. Establish a healthy, functioning ecosystem.
2. Enhance natural habitat to support biodiversity.

3. Provide a space for recreation and spiritual retreat.
4. Restore our relationship to the land.
5. Provide opportunity for financial support.

Given the site conditions and what the reference systems hold, it is believed that degraded land at project location can, with proper management, meet the multiple criteria described for a healthy, sustainable ecosystem (goal 1). Given existing habitat on surrounding land, this alternative would provide a different ecosystem for greater biodiversity (goal 2). Beyond these environmental goals, this alternative would best serve cultural goals of the project. The open prairie would provide a spacious area for recreation, education, and spiritual retreat (goal 3) and activities to help people restore their relationship to the land (goal 4). The added beauty and biodiversity of this area may generate increased financial contributions and usage of building facilities (goal 5). While this course of action would require considerable cost, herbicide, and intensive effort, it could be an impressive landscape at Pathways Retreat and provide significant benefits.

Site preparation and plans

Preparing the site begins by following a fundamental principle of ecological restoration to "pay attention to what nature wants and work with her" (Apfelbaum and Haney 2012, 10). While the plan is to manage for a prairie ecosystem on the largest part of the project—thus manipulating the biota for this purpose—this plan also seeks to follow this principle by supporting the diverse habitats naturally forming around this area and paying attention to what is naturally occurring on the site. Supporting habitat diversity will not only increase biodiversity but also beauty in line with the project's environmental and cultural goals.

On two sides of project site, smooth sumac (*Rhus glabra*) and American plum (*Prunus americana*) are forming a colony together. This dense thicket can be an important habitat for birds with the cover and food these species provide at different seasons. On another side, a patch of black raspberry (*Rubus occidentalis*) has formed outside the trail that separates it from the prairie patch. Elsewhere, a patch of northern dewberry (*Rubus flagellaris*) is developing. These *Rhubus* spp. form yet another kind of habitat with cover and food close to the ground. In yet another area around the outside of the designated prairie area are black oak (*Quercus velutina*) and white oak (*Quercus alba*) trees. Co-operating with these species in the stand of native grasses and forbs, the plan is to plant a savanna-like ecotone between the prairie on the south side and woodland on the north side. These plants in different spaces will create a variety of edge habitats to support biodiversity and provide beauty across a small landscape.

As identified in part 1, invasive plant species dominate the site. Invasive species in a restoration context are a problem in that they (1) dominate a site or its seedbank, (2) may leave behind negative legacies after removal, or (3) can invade the restoration site and co-op the establishment of desired species (D'Antonio et al. 2016). The species identified in part 1 meet one of more of these criteria and are harmful in that they have undesirable ecological or economic impacts (with costs of control). To increase the likelihood of establishing a self-sustaining ecosystem with desired plant composition and ecological processes, all invasive species identified above need to be controlled. While total eradication is not possible, effective control of these problem species is a reasonable management goal.

To effectively control these invasive species and establish desired native plants in a healthy, functioning ecosystem, the following actions are recommended.

- Mow site dominated by fescue in early spring to stress this tough plant before applying glyphosate as a nonselective herbicide. Once this grass regreens, herbicide this invasive grass and all other herbaceous plants on the site. Repeat spraying as needed. Spray glyphosate resistant species like *Canada thistle (Cirsium avense)* and Carolina horsenettle (*Solanum carolinense*) with Milestone (aminopyralid).
- Cut stems of shrub and trees just above ground level (to protect equipment on the site) and treat stumps with 20-30% glyphosate to deaden these invasives and prevent resprouting.
- Allow two seasons of site prep to offset potential legacy effects from allelopathic properties of tall fescue (*Festuca arundinacea*), honeysuckle *(Lonicera spp.),* and other plants above known to be produce allelochemicals.
- Drill buckwheat (*Fagopyrum esculentum*) to grow as a smother crop after two treatments of glyphosate to kill of existing vegetation. Within 7-10 days after flowering, mow buckwheat to prevent seeding. Terminate by mowing and spray remaining surviving perennial plants.

- Drill winter wheat (*Triticum aestivum*) in early September of the first season and common oats (*Avena sativa*) in the second season as a second cover crop through the fall and early winter.
- Repeat herbicide treatments and cover crops a second year as a mop up operation and allow weed seed to germinate and be killed to reduce the seedbank, being careful to not disturb the soil in order to protect soil structure and not bring additional weed seeds to the surface.
- Select a wide diversity of native prairie grasses and forbs to maximize resource use and limit resources for would-be invaders and to fill niches to resist invasion by non-natives.
- Scout site and surrounding area for invasive plants. Remove seed source and cut and treat stems with glyphosate concentrate.
- Monitor annually and treat invasive species with early detection, rapid response.

In addition to invasive species, there are ecophysiological stresses to address.

- *Light*. Most of the site has full sun except for shade from a few black oak (*Quercus velutina*) and white oak (*Quercus alba*) trees. Because a savanna effect is desired, shade impacts on species around these trees are acceptable, if not desirable, to help create different plant communities from the larger area unaffected by shade. There is concern for faster growing native grass and forb species outcompeting slower growing species for sufficient light as they get established. However, the most significant stressor for light is the presence of exotic species like Asian bush honeysuckle (*Lonicera spp*.), privet (*Ligustrum spp*.), and tall fescue (*Festuca arundinacea*) shading out desired species.
- *Water*. The key water stressor is the dry, sandy soil on the site. According to Web Soil Survey, available water capacity is rated as low and depth to water table is more than 80 inches. The dense cover of tall fescue (*Festuca arundinacea*) would likely outcompete native herbaceous plants in this plan. Once the ground thaws, soil samples will be collected to determine amount of top soil for holding water over deep, Coloma sand and assess how limited water will be on the site.
- *Nutrients*. With sandy soil on the site, the soil has low fertility as it cannot hold nutrients as wells as soils with more clay and silt. This, however, may be an advantage as native grasses and forbs selected for traits more tolerant of nutrient deficient soil than exotic species around the site on more fertile, loamy soils.

While low nutrients are a limiting factor, available water is likely the greatest constraint due to (1) dry, sandy soil, (2) the dominant cover of tall fescue, and (3) longer, hotter drier summers that are projected with climate changes in this region.

To mitigate these stressors, especially water constraints, the following actions can be taken.

- Remove all exotic, invasive plants that compete for water, especially tall fescue (*Festuca arundinacea*).
- Select native grass and forb species with traits that tolerate dry soils.
- Include a strong component of graminoids like prairie drop seed (*Sporobolus heterolepis*) as a cool season species and little blue stem (*Schizachyrium scoparium*) as a warm season species to resist invasion of fescue spp. around the site.
- Plant a nurse species to provide a measure of cover to reduce drying of soil and reduce invasion of exotic species.
- Provide supplement irrigation during droughty conditions to help plants get established.

Considering how native plant populations are established and persist, this plan recommends several actions.

- Make the prairie patch size as large as possible to reduce the risk of local extinction and increase probability of contributing migrants to other prairie fragments.
- Plant with heavier densities to increase the number of individuals, genetic diversity, and reproductive rates for the initial establishment of the population.
- Locate patch close to other fragments on the larger property for recruiting immigrants to increase genetic diversity and help colonize open niches. While linking patches is not feasible on the site, patches can be located as close together as possible.

Plant immigration from surrounding sources may be reliable. Based on species present in surrounding populations, the following herbaceous plants may naturally join the planting site.

- Butterflyweed (*Asclepias tuberosa)*
- Common milkweed (*Asclepias syriaca*)
- Flat-top goldenrod (*Euthamia graminifolia*)
- Ohio spiderwort (*Tradescantia ohiensis*)
- Wild bergamot (*Monarda fistulosa*

Around the prairie planting, the following woody species may be recruited for the desired edge.

- American plum (*Prunus americana*)
- Eastern red cedar (*Juniperus virginiana*)
- Northern dewberry (*Rubus flagellaris*)
- Smooth sumac (*Rhus glabra*)

While black oak (*Quercus velutina*) could be recruited from the larger population, white (*Quercus alba*) and bur (*Quercus macrocarpa*) trees (also associated with oak savannas) may be strategically planted instead on the edges to introduce these more desirable species into the site. These two species will increase the diversity of oak species, add beauty, and provide an additional range of mast for wildlife.

While certain species may naturally be introduced to the planting area, barriers limit other native plants according to assembly theory (Temperton et al. 2016). Key dispersal barriers include a large private golf course to the north and east and residential developments to the west and south. Surrounding these barriers are large farm fields, except for a quarter-acre patch a half mile away. Two other prairie patches of around a quart-acre will be planted within 300 yards of this project. The key colonization barriers are a dense stand of tall fescue (*Festuca arundinacea*) and other nonnative invasives established on the site as described in part 1 of the plan. Established invasive vegetation would create strong competition for new native species this plan will introduce to the site according to priority effects (Temperton et al. 2016). In addition to limited niches for new seed and competition for light, water and nutrients for new plants, are allelopathic effects of the tall fescue and bush honeysuckle (*Lonicera spp.*).

These barriers may be addressed through applying assembly in the following ways.

- The soil on the site will function as an abiotic filter against a high number of exotics around the site on more fertile soil. Because the site consists of dry, sandy soil with less fertility, it has the advantage of providing a stronger abiotic filter against invasives that require or prefer more fertile soil than prairie plants selected for this project (Temperton et al. 2016).
- Effectively kill all existing vegetation on the site with herbicide over the course of two years to remove current competition. This is especially important to reduce the negative

allelopathic impacts of tall fescue (*Festuca arundinacea*) on prairie grasses and forbs (Renne et al. 2004) and certain trees (Orr et al. 2005). Allow plant matter from the fescue to decompose to reduce impact on planted species (Peters et al. 2005). This will also allow other plant litter to decompose, as litter inhibits seedling recruitment (Temperton et al. 2016).

- Select a mix of native grasses, sedges, and forbs with similar traits as existing invasives and traits that meet the site conditions. Following assembly rule with competitive exclusion, plant desired species before propagules of invasives are introduced and allow priority effects to work where species that arrive first define who can establish after that (Temperton et al. 2016).
- Plant a high number of different plants from among grass, sedge and forb groups for species and functional diversity. Communities with more species and groups function better than those with fewer and more similar species (Temperton et al. 2016).
- Seed at a high rate. While this will increase planting costs, it will increase the likelihood of establishing a new prairie plant community with greater species richness and abundance (Suding 2016).
- Include legumes in the mix, as they have been shown to assist with facilitation of establishment of grassland species (Temperton et al. 2016). Because many grassland species establish better in low nutrient soil, do not plant nitrogen fixing legumes before but at the same time the prairie is sown. Added nitrogen would benefit weed species and thereby give them a competitive advantage.
- Include nurse plants in the seed mix as they have been shown to provide favorable microsites for the germination and establishment of other species by moderating soil temperature and conserving moisture (Temperton et al. 2016).

Seed selection is critical to project success. In addition to selecting seed from local genomes for plants that are best adapted to project locale, it is also important to consider future impacts of climate change. Based on these considerations, it is recommended that seed be purchased from Mongo Seed with a prairie specialist who grows seed 30 miles east of the project location. This specialist put together the seed list below for this plan based on prairie grasses and forbs native to the ecoregion with the NRCS seed selection tool (NRCS n.d.). The DNR wildlife biologist would review and approve this is the project receives cost-share assistance.

For native tree and shrub seedlings, this plan recommends plants from Indiana DNR nursery. Not only is this the least expensive source for native seedlings, but they also are from 230 miles south and one climate zone warmer (6a) than the site zone (5b/6a). Having stock from this warmer zone may help trees better adapt to projected climate changes than seedlings from this zone.

Assume that some species will perish with climate changes since these changes will happen far faster than plants can adapt. Despite the most careful planning and management, some species will likely become extirpated. Land managers need to do the best they can according to what they know and learn along the way, then trust the resilient forces of nature to tend what's outside human control.

Just as careful work went into site preparation, diligent work must follow with managing this ecosystem. Controlling invasives will be critical on an ongoing basis, recognizing that this site is surrounded by a larger degraded ecological landscape with a high population of exotic species that can be carried in by wind, birds, and mammals. This will require regular monitoring and

treatments (mechanical and chemical) of invasive herbaceous plants, shrubs, vines and trees (Apfelbaum and Alan 2012).

Additionally, a prairie ecosystem requires prescribed burning to mimic natural disturbances associated with grassland prairies. This is an important disturbance practice to manage healthy grassland prairie ecosystems (Apfelbaum and Haney, 2010). Potawatomi peoples, who inhabited the region, were known to use prescribed burns to manage prairie patches and savannas according to Luke Gaschow, former director of Merry Lea Environmental Center (February 2, 2022, interview).

Table of actions

The following table of actions, timing, labor, and materials outlines site preparation. Hours listed in parentheses are estimated hours for volunteers or employees to perform actions.

	Date	***Action***	***Labor (hrs.)***	***Materials***
	Year 1			
1.	March	Cut and kill nonnative woody vegetation (identified in part 1) in prairie area and unwanted natives in edges per management notes below; claim firewood, then burn rest on large stumps and vines	Volunteers or employees (20)	Chainsaws, loppers, glyphostate in sprayer, skid steer if needed; fuel to start fire
2.	March	Transplant trees around site	Steve Thomas	Skid steer mounted tree spade
3.	April	Mow and cut as much fescue as possible to stress prior to spraying per IDNR, Division of Fish and Wildlife (2006)	Volunteer (3)	Commercial mower and brush cutter with grass blade
4.	May	Spray herbicide to kill existing herbaceous ground cover, except retaining trails	Blue Heron contractors	Their equipment
5.	May	Spot treat surviving plants	Volunteers or employees (3)	Backpack sprayer with herbicide
6.	Mid May	Remove unwanted woody vegetation on outside areas of site; remove soap bars from tree saplings. Make and install cages for oaks north of prairie	Bethany students (20)	Handsaws, loppers, and glyphosate in sprayer; 3-4’ wire rabbit fence for cages
7.	~~June~~	~~Plant buckwheat as a cover crop with no-till drill (per SARE 2007, 90-92; Björkman 2008)~~	~~Volunteer (4)~~	~~Tractor, no-till drill, and buckwheat seed (*Fagopyrum esculentum*)~~

8.	~~July~~	~~Mow buckwheat within 7-10 days of first flower to control seed set~~	~~Volunteer (3)~~	~~Tractor with bushhog~~
9.	~~Late July~~	~~Remow buckwheat as mulch for oats~~	~~Volunteer (2)~~	~~Commercial mower~~
10.	August	Spray herbicide to kill surviving herbaceous ground cover, except trails	Blue Heron contractors	Their equipment
11.	August	Herbicide surviving weeds outside prairie	Volunteers or employees (4)	Backpack sprayer with herbicide
12.	~~Early September~~	~~Plant winter wheat as cover crop (per SARE 2007, 111-115)~~	~~Volunteer (4)~~	~~Tractor, no-till drill, and winter wheat (*Triticum aestivum*) seed~~
13.	Mid-September	Install deer guards and soap on tree saplings and spray repellant; mulch around tree seedlings	Goshen College students (30)	Deer guards, zip ties, perfume soap, paper clips, Plantskyyd
14.	October 1	Order DNR wildlife packets; order before packets sell out	Volunteer (1)	IN DNR form online
15.	**Year 2**			
16.	Early April	Plant wildlife packets for edges	Volunteers or employees (6)	IDNR wildlife packets, drills with auger bits, dibble bars
17.	~~April~~	~~Kill wheat with a roller crimper at soft-dough stage or with herbicide.~~	~~Volunteer (3)~~	~~Tractor with roller crimper in front or commercial mower~~
18.	May	Spray herbicide to kill existing herbaceous ground cover, except retaining trails	Blue Heron contractors	Their equipment
19.	May	Spot treat surviving plants	Volunteers or employees (5)	Backpack sprayer with herbicide
20.	Mid May	Remove unwanted woody vegetation on outside areas of site; remove soap bars from tree saplings.	Bethany students (20)	Handsaws, loppers, and glyphostate in sprayer
21.	~~June~~	~~Plant buckwheat as a cover crop with no-till drill (per SARE 2007, 90-92; Björkman 2008)~~	~~Volunteer (4)~~	~~Tractor, no-till drill, and buckwheat seed (*Fagopyrum esculentum*)~~
22.	~~July~~	~~Mow buckwheat 7-10 days of first flower to control seed set~~	~~Volunteer (3)~~	~~Tractor with bush hog~~
23.	~~Late July~~	~~Remow buckwheat to reduce vegetative matter as mulch for oats~~	~~Volunteer (2)~~	~~Commercial mower~~

24.	August	Spray herbicide to kill surviving herbaceous ground cover, except trails which will keep as is	Blue Heron contractors	Their equipment
25.	August	Herbicide surviving weeds outside prairie	Volunteers or employees (4)	Backpack sprayer with herbicide
26.	Last August	Place boulders in prairie; clear planting areas of debris	Volunteers or employees (6)	Backhoe and skid steer
27.	~~Early September~~	~~Plant common oats as cover crop (per SARE 2007, 93-97)~~	~~Volunteer (4)~~	~~Tractor, no-till drill, and common oats (*Avena sativa*) seed~~
28.	Mid-September	Install deer guards and soap on tree saplings and spray repellant; mulch seedlings	Goshen College students (30)	Deer guards, zip ties, perfume soap, paper clips, Plantskyyd
29.	~~October~~	~~Apply to IDEM for burn permit for burn in April~~	~~Volunteer (2)~~	~~Online permit application (IDEM n.d.)~~
30.	December	Broadcast and cultipack seed	Blue Heron contractors	Their equipment and ordered seed
31.	**Year 3**			
32.	April	Apply straw mulch over prairie	Volunteers or employees (4)	Clean, weed free winter wheat straw; avoid rye straw
33.	June	Mow prairie per Diboll (n.d.a,c) when dry at 6-8" several times once weeds reach 12" to suppress weed and seeding	Volunteer (4)	Flail type mower, skid steer mounted cutter, or brushcutter with grass blade
34.	July	Mow prairie as above	Volunteer (4)	As above
35.	August	Mow prairie as above	Volunteer (4)	As above
36.	September	Monitor and treat perennial weeds	Volunteer (4)	Backpack sprayer
37.	**Year 4**			
38.	July	Mow prairie per Diboll (n.d. 7-8) to 12"	Volunteer (4)	As above
39.	August	Mow prairie per Diboll (n.d. 7-8) to 12"	Volunteer (4)	As above
40.	September	Treat perennial weeds and invasives by cut and daub stems before seed set	Volunteers or employees (15)	Hand pruners, glyphosate concentrate and daubers
41.	**Year 5**			
42.	April	Burn prairie per Diboll (n.d., 8); protect desired tree seedlings	Volunteers or employees (16)	Drip torch, fire swatters, water tank, backpack sprayers
43.	April	Treat exotic cool season grasses after burning	Volunteers or employees (3)	Backpack sprayer with grass specific herbicide

44.	May	Install plant plugs for species like leadplant, New Jersey tea et al. for better establishment	Volunteers or employees (8)	18 volt cordless drill and 3” planting augers
45.	September	Treat perennial weeds and invasives by cut and daub stems before seed set	Volunteers or employees (15)	Hand pruners, glyphosate concentrate and daubers
46.	**Years later**			
47.	Annually	Monitor and treat invasives with mechanical and chemical control before seed forms; or remove and burn seed heads	Volunteers or employees	Brush cutting saw; pruners, glyphosate and daubers, glyphosate in weed wand
48.	Every 3 yrs	Repeat prescribed burns every 3 years; rotate per Diboll (n.d.s)	Volunteers or employees	Drip torches, fire swatters, water tank, backpack sprayers

Table 1. Table of actions, timing, labor, and materials.

The schedule above does not include prep work for installing features for goal 3 (under part 2) other than placing boulders in the prairie before final cover crop and seeding.

Map of plant communities

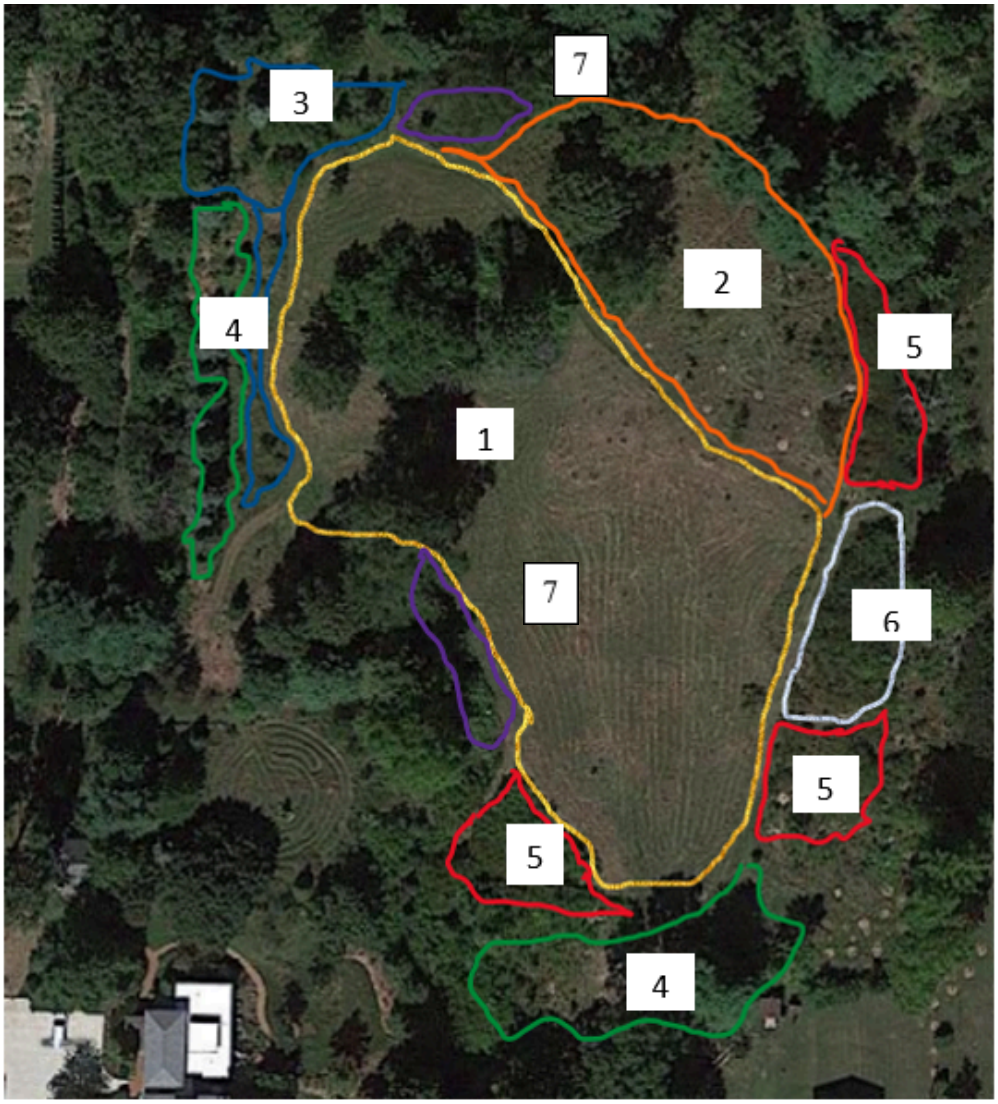

Figure 15. Map of plant communities. Photo: Google Earth.

Key to plant communities

1: Short profile prairie

2: Oak savanna ecotone

3: Edge with wildlife packet

4: Screen with eastern red cedar

5: Existing smooth sumac

6: Existing American plum

7: Existing raspberry and dew berry

Management notes

To maintain this restoration area as a healthy prairie ecosystem, refer to the publications by Neil Diboll listed under references at the end of this plan. For a general guide on identifying and managing invasive plants, refer to Miller (2013).

Chemical control of invasives, weeds and unwanted woody vegetation include the following. Applicators using these and other herbicides shall follow the label.

- To effectively treat shrubs and trees, cut stems as close to the ground as possible and treat top of sapwood on remaining stem with approximately 20% glyphosate (from mixing equal parts of 41% concentrate with soft, not hard water).
- To treat hard-to-kill woody vines like periwinkle (*Vinca minor*) and wintercreeper (*Euonymus fortune)*, cut vines with a power brush cutting saw close to the ground followed by repeated foliar treatments with a mix of glyphosate, triclopyr mix, and methylated bean oil.
- To control exotic grasses around forbs and woody seedlings, use grass selective herbicide like clethodim.
- To control forbs around grasses, use a broadleaf herbicide like triclopyr.
- To control resistent forbs like Carolina horsenettle (*Solanum carolinense*) and *Canada thistle (Cirsium avense)*, treat with Milestone.

For prescribed burns, consult the resources by Neil Diboll listed under references.

Prairie and edge installation

The seed list below is based on the NRCS wildlife habitat calculator for the site's bioregion and observations from reference system above. This plan recommends that contractors from Blue Heron be engaged to frost seed this mix in December after site preparations are complete. They can sow the seed in the prairie area and in designated edge areas outside the trail.

Graminoid species

- *Bouteloua curtipendula* (side-oats grama)
- *Carex bicknellii* (copper-shouldered oval sedge)
- *Elymus canadensis* (Canada wild rye)
- *Koeleria macrantha* (June grass)
- *Schizachyrium scoparium* (little blue stem)
- *Sporobolus heterolepis* (prairie dropseed)

Forb species

- *Amorpha canescens* (lead plant)
- *Aquilegia canadensis* (wild columbine)
- *Asclepias tuberosa* (butterfly milkweed)
- *Aster azureus* (sky blue aster)
- *Aster laevis* (smooth aster)
- *Aster sericeus* (silky aster)
- *Baptisia leucantha* (white wild indigo)
- *Coreopsis palmata* (prairie coreopsis)
- *Eryngium yuccifolium* (rattlesnake master)
- *Helianthus occidentalis* (western sunflower)
- *Kuhnia eupatorioides corymbulosa* (false boneset)
- *Lespedeza capitata* (round-headed bush clover)
- *Lespedeza hirta* (hairy bushclover)
- *Lespedeza intermedia* (wand-like bushclover)

- *Lespedeza violacea* (violet bushclover)
- *Lespedeza virginica* (slender bushclover)
- *Liatris aspera* (rough blazingstar)
- *Liatris scariosa neiuwlandii* (savanna blazingstar)
- *Lupinus perennis* (wild lupine)
- *Monarda fistulosa* (wild bergamot)
- *Monarda punctata* (dotted horsemint)
- *Penstemon digitalis* (foxglove beardtongue)
- *Penstemon hirsutus* (hairy beardtongue)
- *Potentilla argutta* (prairie cinquefoil)
- *Pycnanthemum tenuifolium* (slender mountai mint)
- *Pycnanthemum virginianum* (mountain mint)
- *Ratibida pinnata* (yellow coneflower)
- *Rudbeckia hirta* (black-eyed susan)
- *Solidago nemoralis* (grey goldenrod)
- *Solidago rigida* (stiff goldenrod)
- *Solidago speciosa* (showy goldenrod)
- *Tephrosia virginiana* (goat's rue)
- *Tradescantia ohiensis* (Ohio spiderwort)
- *Verbena stricta* (hoary vervain)
- *Zizia aptera* (heart-leaved alexanders)
- *Zizia aurea* (golden alexanders)

For the savanna-like ecotone between prairie and woodland on the north side, this plan proposes to draw from the Indiana state nursery for woody species and recruit others from existing species around the site. Each IN DNR wildlife packet (IDNR n.d.b) contains ten each of the following native species that are associated with oak savanna communities (Harker et al. 1999): American plum (*Prunus americana*), grey dogwood (*Cornus racemose*), American hazelnut (*Corylus americana*), common chokecherry (*Prunus virginiana*), and persimmon (*Diospyros virginiana*).

Other species associated with this ecosystem like black raspberry (*Rubus occidentalis*), northern dewberry (*Rubus flagellaris*), and smooth sumac (*Rhus glabra*) will be recruited from around the site.

The oak trees (*Quercus spp*.) in the ecotone will need to be managed so that canopy cover does not exceed 50% to maintain a savanna-like appearance and function.

As for plant cover of trails for walking and as firebreaks, consult with specialists from Blue Heron on the species of existing grasses to determine invasive potential. The hope is that current grassy trails may be kept. If not, consider a “no mow” grass blend for the trails and around sitting areas.

Refer to *Map of plant communities* (figure 14) for where these species will be planted.

(Spreadsheet of projected expenses for restoration is provided on the next page.)

Spreadsheet of projected expenses for restoration

Projected expenses for years 1-5:

Project expenses	
Item	**Cost**
2 -2.5 gallons of glyphosate @ 45 ea.	90
Half gallon of triclopyr @ 70/gal.	35
4 ounces of Milestone @ 3/oz.	15
Methylated seed oil adjuvant	15
2 hours tree spade work @70/hr.	140
2 rolls of wire rabbit fence @ 40 ea.	80
	1,56
4 herbicide treatments herbicide 390 ea.	0
Prairie installation	550
Buckwheat seed for two plantings	120
Winter wheat seed for one planting	60
Common oats seed for one planting	70
	2,28
Prairie seed for 1.5 acres	0
Seed for .25 acre edge planting	380
4 No-till drill rentals @ 20 ea.	80
4 rentals of brush cutter for skid steer @ 200 ea.	800
2 DNR wildlife packs @ 70 ea.	140
40 gallons of fuel @ 3/gal.	120
Bars of perfume soap from bulk case	10
10 bails of winter wheat straw @ 4 ea.	40
300 plug plants @ 1.50 ea.	450
1 Drip torch	190
	7225
Funding sources	
Annual tax savings from classifying land 980/yr	3,92
x 4	0
	3,00
Estimated cost-share from conservation agencies	0
Additional contributions	305
	7,22
	5

Gifts in kind for this project include use of tractor, bush hog, and skid steer.

Total volunteer/employee hours (shown with labor in table): 268 hours for the first 5 years. Pathways Retreat has had the benefit of many volunteers and groups perform necessary stewardship actions. It is recommended that someone with sufficient knowledge and skill be appointed to oversee technical aspects of restoration work so that actions are effectively carried out for project success.

As a continuing source of funding support, it is recommended that Pathways Retreat enroll its land into the DNR Classified Forest and Wildlands program (IDNR n.d.a) then devote the approximately $980 per year in tax savings to manage the land according to the stewardship plan that a state agent would create with Pathways Retreat as part of the enrollment process. (The stewardship plan may be based on this restoration plan if adopted by Pathways Retreat.)

Expected outcomes from proposed actions

As a result of the actions above, continuous control of invasives, and management with prescribed burns, this degraded land may be expected to reasonably meet the criteria (under goal 1) for a more healthy, sustainable ecosystem than what currently exists. To reach an ecosystem that resembles a prairie ecosystem may take 5-10 years as the prairie and edge communities get established. The first few years will not look attractive to most people as perennial plants focus their energy on growing root systems. But in time, this land will spring forth with greater biodiversity and beauty than is currently seen.

Given that this area is surrounded by a degraded landscape full of invasives, the degree to which this land can be fully restored will be limited. Furthermore, there will always be unanticipated issues and factors outside our control, so plans may not go as intended. In such cases, there is need to learn and adapt along the way. Nevertheless, it is a reasonable expectation that this fragment of three acres can be regenerated as a healthy functioning ecosystem within the 17 acres of diverse habitats for Pathways Retreat.

How may outcomes be measured? Restoration outcomes of prairie plant communities are best measured by species composition relative to reference systems in 3-15 years, recognizing that restored areas typically will not reach species composition of natural reference systems (Walden 2016). While both quantitative and qualitive measures are best to determine successful outcomes, “quantitative measurements are not feasible for most restoration projects, nor are they always necessary to assess the effectiveness of the restoration action. Implementation and effectiveness determinations for habitat restoration projects are often visually obvious and do not require extensive quantitative measurements. This is especially true when projects attempt to change a targeted habitat parameter by 50 percent or more” (Woodward and Hollar 2011, 2). Qualitative measurement can be done with “before” and “after” photographs through the years.

Through diligent and continued stewardship of this land, project goals may be met to (1) establish a healthy, functioning ecosystem, (2) enhance natural habitat to support biodiversity, (3) provide a space for recreation and spiritual retreat, (4) restore human relationship to the land, and (5) provide opportunity for financial support.

How will success be measured? The following indicators are provided under each of the goals.

1. Indicators for a healthy, functioning ecosystem:
    - Plant composition after establishment in 5 to 15 years resembles described reference systems as measured by species count and photographs.
    - Prairie ecosystem is stable with functional plant groups.
    - Recruited plants (identified above) from the area are present in the community.
    - Invasive species identified in part 1 are rare and under control.
    - Grass and forb species are self-sustaining except for actions that mimic natural disturbances (like prescribed burning and mechanical control of woody species).
2. Indicators for enhanced natural habitat to support biodiversity:
    - The ecosystem consists of a rich diversity of native grasses, forbs, shrubs, and trees.

- A range of insects, herptiles, birds, and mammals are observed on the site compared to their relative absence on the present site.
- Endangered species like Lincoln's Sparrow or monarch butterfly (a candidate for the endangered species list) are observed on the site.

3. Indicators for a space for recreation and spiritual retreat:
   - Increased usage of trails and sitting areas in prairie area.
   - Retreatants and others report experiences of inspiration and restoration in surveys.
4. Indicators for restoring human relationship to the land:
   - Groups use the restoration area for environmental education.
   - Increased engagement in environmental stewardship measured in volunteer hours.
   - Users and volunteers report increased care for the Earth in surveys.
5. Indicators for increasing opportunity for financial support:
   - Annual tax reductions of nearly $1,000 from enrollment in DNR classified wildlands program are available for land stewardship actions.
   - Increased contributions from users in the donation box.
   - Increased requests for facilities following experience on the land observed in survey responses.

As these goals and outcomes are accomplished, stakeholders will be affected in positive ways. Retreatants at Pathways Retreat will have different and additional spaces for rest, reflection and renewal. Members of the community who use the land will enjoy a prairie with greater beauty and biodiversity than what is currently present. Pathways Retreat will realize significant tax savings after its 3+ acres are added to the existing 14 acres in the DNR classified wildlands program. Pathways will likely receive additional contributions to support its retreat programs and land stewardship. Local schools and Goshen College will have another outdoor lab for environmental education. Natural resource agencies and officers will have helped to restore another fragment and have a demonstration site for ecological restoration. Community volunteers, like Master Naturalists, seeking to care for the Earth will have a meaningful place to serve ecological restoration. All who use and serve this land will also experience various health and spiritual benefits (Wolf, 2016; Wolf et al. 2019; Wolf et al. 2020).

One outcome may be misperceived as negative to one stakeholder—the City of Goshen. Once this land is in the DNR classified wildlands program, the City will receive less property tax revenue from this property than before. However, the benefits to the community and ecosystem will offset this, especially as this land, along with the rest of the property, promotes the care of our urban ecosystem and serves the interests of the City for environmental resilience.

As this regenerated ecosystem is established and tended, it will help bring to fruition the vision of a naturalistic and cultural landscape that restores the land, people, and their relationship to the Earth. Put in the faith language of Pathways Retreat, this degraded land will be renewed so that it once again is a place of beauty, abundance, and biodiversity aligned with the Creator’s intention for shalom on Earth.

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