NRCS

West Virginia Pollinator Handbook

WV NRCS Ecological Sciences
In conjunction with the
WV Division of Natural Resources
and
The Xerces Society for Invertebrate Conservation

A Field Office Technical Guide Reference to management of pollinators and their habitats

United States Department of Agriculture

NRCS

Cover Photo: Eastern tiger swallowtail on milkweed in Randolph County, WV.
Photo: C. Shrader NRCS, WV

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CONTRIBUTORS:

Elizabeth Byers, Wildlife Diversity Biologist, WVDNR, Elkins, WV
Harry W. Godwin, Research Scientist, Agricultural Research Service, Beaver, WV
Walt Kordek, Assistant Chief, Wildlife Div. & Tech. Support Units, WVDNR, Elkins, WV
Barbara McWhorter, Forester, USDA NRCS, Morgantown, WV
Eric Mader, Assistant Pollinator Program Director, The Xerces Society, Portland Oregon
Susan Olcott, Wildlife Diversity Biologist, WVDNR, Elkins, WV
Casey Shrader, WV State Biologist, USDA Natural Resources Conservation Service, Morgantown, WV

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Introduction

The work of bees and other pollinators is something that touches us all through the food we eat, the clothes we wear, and the landscapes we enjoy. Pollinators are an integral part of our environment and vital for our agricultural systems; they are important in 35% of global crop production. Animal pollinators include bees, butterflies, moths, some wasps, flies, beetles, ants, bats and hummingbirds. Worldwide, there are an estimated 20,000 species of bees, with approximately 4,000 species native to the United States. The non-native European honey bee (*Apis mellifera*) is the most important crop pollinator in the United States. However, the number of honey bee colonies is in decline because of disease and other factors, making native pollinators even more important to the future of agriculture. Native bees provide free pollination services and are often specialized for foraging on particular flowers, such as squash, berries, or orchard crops. This specialization results in more efficient pollination and the production of larger and more abundant fruit from certain crops. Native bees contribute an estimated three billion dollars worth of crop pollination annually to the U.S. economy.

The Natural Resources Conservation Service (NRCS) can assist landowners by suggesting locally appropriate plants, offering advice on how to provide nesting opportunities or provide areas for foraging or egg-laying habitats for organisms that provide pollination services.

This document is provided as a tool for NRCS field offices and landowners. It focuses on native bees, the most important pollinators in temperate North America; but also addresses the habitat needs of butterflies and, to a lesser degree, hummingbirds and beneficial insects. Emphasis is given to providing habitat for native bees and butterfly species, not the European honey bee. It contains references for assisting landowners and providing sound information regarding the application of conservation practices to restore, enhance or create habitat for organisms that provide pollination services. References and information within this book will be updated or additional materials will be provided periodically as they become available.

A male eastern tiger swallowtail (*Papilio glaucus*) nectaring at a common milkweed (*Asclepius syriaca*). Many adult butterflies drink flower nectar as their only food. This provides energy that allows their flight and other activities.

Photo: *C. Shrader NRCS WV*

Pollination Services in West Virginia

Why should you care about pollinators? Over one hundred crop species in North America require a visit from an insect pollinator to be productive and approximately one out of every four mouthfuls of food or beverage consumed requires insect pollination. Directly and indirectly, insect pollinated crops in North America are worth almost $30 billion annually – including food, medicines, dyes, and fabric fibers.

In temperate zones, most conspicuous showy flowers are pollinated by insects, especially bees. Almost all herbaceous wildflowers are insect pollinated, and several trees and shrubs, including the dogwoods, redbud, sassafras, spicebush, the magnolias and many willows. Most native insect pollinated plants are adapted to a specific group of pollinators that are active at a specific time of the year. They are the proper size and have the right body construction to carry pollen to more effectively pollinate the plant. Without native pollinators, plant diversity and the ecosystem it supports, would be greatly reduced causing a cascade effect on other species survival. As plants are the basis of terrestrial food webs, their reproduction is essential for the integrity of the system. Their reproduction depends on native pollinators.

Insects and flowering plants diversified and evolved together, resulting in the most widespread occurrence of mutual interdependence in the natural world. The shape, position, chemical and visual attributes of the flower determines which type of pollinator is most likely to be attracted to it. Bee pollinated flowers are usually open and accessible, but many are irregular in shape such as legumes, often requiring bees to disturb petals and other structures to gain access to nectar. This in turn disturbs pollen and ensures pollination in the process. Ultraviolet patches and lines on petals of some flowers guide bees to nectar and pollen. Flower species that have broad flower heads or large flowers that are elevated above surrounding vegetation, such as milkweeds, attract butterflies. Flies are significant in pollinating several trees, including sassafras, and are attracted to small, open shallow blooms. Other fly or beetle species are attracted to the rancid smelling blooms of skunk cabbage, red trillium and jack-in-the-pulpit, mistaking them for carrion on which to lay eggs. Hummingbirds are especially attracted to red tubular flowers that grow in the open such as bee balm and phlox. Pollen is deposited around their head, and transferred to other flowers. Other beneficial insects, including some beetles, transfer pollen as they clamber around blooms in search of food or mates.

The process of pollination is required to provide the fruits that other organisms depend upon as food.
Photo: *C. Shrader, NRCS WV*

West Virginia is agriculturally based in livestock and grassland. This is due to a number of factors, but mainly because of the steep topography and shallow soils which are more suited to the cow than the plow. With the exception of some orchard areas in the eastern panhandle, crops that are heavily dependent upon the pollination services by insects are not as significant. In some counties, there are farmers that grow truck or vegetable crops such as squash or pumpkins and other niche crops that rely on pollination services, yet that critical aspect of production has often been overlooked when developing farm plans and

conservation practices. In the past, native bees and feral honey bees could meet the pollination needs of small orchards, tomato and pumpkin fields, and berry patches, because these farms were typically adjacent to areas of habitat that harbored important pollinators.

However, in other parts of the country farms are often larger and do not have the same nearby habitat to support native pollinators. To ensure adequate pollination services, producers now rely on European honey bees. Often agricultural producers pay large rental fees to pollinate the crops that they raise. Research however, shows that native bees can be important pollinators in agricultural fields as long as enough habitat is available to support them. On occasion it is possible to encounter wild colonies of honey bees in West Virginia. However, the frequency is extremely rare.

This house honey-tree was photographed in Monongalia County, WV.

Photo: *Sue Olcott, WVDNR*

Pollinators have been declining worldwide. European honey bee hive failures are a worrisome, but well documented fact. Unknown to most people however, is that some native bees and other pollinators are also declining. Degradation and fragmentation of habitat, complete loss of habitat and pesticide use are all contributing factors to these declines. Some plants have declined and become endangered principally because of the loss of specific pollinators. Biologists are now required to hand pollinate some endangered Hawaiian plants, and fruit growers in some parts of China must hand pollinate their crops because pesticide use has killed off bees around orchards. In northwestern states such as Washington and Oregon, pollination services are hired at very expensive rates. These rates have increased in some cases due to the cost of rearing European honey bees and maintaining a viable population due to the presence of parasitic mites and the phenomena of colony collapse disorder (CCD). In West Virginia, with some care and planning, native pollinators can flourish using some straightforward and simple practices to provide foraging plants and nesting sites.

West Virginia Native Bee and Butterfly Diversity

West Virginia is blessed with abundant diversity of landscapes varying in topography, elevation, climate and aspect. The state has a wide variance of ecological communities and ecosystems ranging from high elevation red spruce forests, remnant of arboreal forests in Canada, to low-lying bottomland hardwoods that line the larger river systems of the state and mixed mesophytic hardwood forests scattered throughout the hills. Among and within this range of ecological communities are scattered pastures, meadows, woodlands, barrens, bogs, oxbows and cliffs.

The U. S. National Vegetation Classification is a hierarchical system that defines levels of vegetative species compositions to varying levels of detail. The lowest, or finest, classification units are called associations, and these are named after the dominant and diagnostic plant species in the community. There are currently one hundred forty-six (146) associations (and still counting) described in the National Vegetation Classification that are attributed to West Virginia. This provides an overwhelming abundance of available habitats and diversity.

Agriculture, mineral extraction, urban areas and timber harvesting have left footprints of varying sizes, shapes and vegetative age classes that few other places in the Eastern United States possess. As an example, West Virginia provides refuge and breeding habitat for many neotropical migrant bird species due to the large contiguous acreage of forest at varying elevations. Therefore, West Virginia could be considered as an ecological source for many of those species. Similarly, the same variance in ecological factors, anthropogenic disturbances, vegetation and landuse provides an abundance of opportunistic macroinvertebrates throughout the landscape. While crop production may not necessarily be the main thrust of pollinator conservation in this state, there is merit to establish the same diversity of habitat and provide an ecological source for these organisms to thrive and provide pollination services that indirectly benefit biological diversity and the environment as a whole.

Bumblebee (*Bombus* sp.) on tall bellflower (*Campanula americana*) near Webster Springs, WV

Photo: *C. Shrader NRCS, WV*

Given the demise of many managed honey bee colonies, it is important to diversify the pollinators upon which many growers rely. Hundreds of species of native bees are available for crop pollination. These unmanaged bees provide a free and valuable service. Some native bee species, like mason and bumble bees, are active when conditions are too cold and wet for honey bees. In the Appalachian region where the climate is cooler and wetter bumble bees are a workhorse of pollination. In addition, native bees are sometimes more efficient than honey bees for specific crops. For example, some native bee species are able to buzz-pollinate flowers. This process produces an intense vibration deep inside the anthers of certain flowers causing them to release pollen. Honey bees are unable to perform this function. Plants, such as tomatoes, cranberries, and blueberries, produce larger and more abundant fruit when buzz pollinated. In some situations, like hybrid seed production, native bees may improve the efficiency of

foraging honey bees by causing honey bees to move between rows of cultivars.

Most native bees are unlikely to sting. Yellow jackets (*Vespula* sp.) hornets (*Dolichovespula* sp.) and other wasps are not bees, nor are they significant pollinators. They are, however, fantastic predators of soft- bodied insect pests and need not be indiscriminately destroyed.

The following list is divided by orders: Lepidoptera (butterflies and moths), Hymenoptera (bees), Diptera (true flies), and Coleoptera (beetles). For the purposes of this document, species of pollinators will focus primarily on bees and butterflies and to much lesser degrees beneficial insects (i.e. Dipterans and Coleopterans). There are other families that more than likely provide pollinator services, however the pollination provided is either negligent, the habitat is not feasible or practical to provide or the presence of the species is ubiquitous. It has been compiled from both personal field observation and published data which is scanty at best. An attempt has been made to list these pollinators in order of abundance, but this is extremely difficult due to local environmental factors and changing conditions or differing criteria where monitoring occurs. Refer to the Appendix of this document for a list of the most common bee species in West Virginia and their local abundance.

Lepidoptera	*Colias eurytheme*	Alfalfa butterfly
	Colias philodice	Clouded sulphur
Butterflies and Moths*	*Everes comyntas*	Eastern Tailed-blue
	Phyciodes tharos	Pearl crescent
	Erynnis juvennalis	Juvenal's duskywing
	Polites peckius	Peck's skipper
	Epargyreus clarus	Silver-spotted skipper
	Poanes hobomok	Hobomok skipper
	Poanes zabulon	Zabulon skipper
	Lycaena phlaeas	American copper
	Wallengrenia egeremet	Northern broken dash
	Papilio polyxenes	Black swallowtail
	Hemaris sp.: thysbe; diffinis	Clearwing moths

Hobomok skipper *(Poanes hobomok)* **in Marshall County, WV.**

Photo: *S. Olcott, WVDNR*

** There exist numerous other butterflies and moths that contribute to pollination. However, within our region, these are typical. To accurately estimate any given species, current surveys would need to be performed.*

Hymenoptera (Bees) *Refer to the Appendix for more information regarding bee species in West Virginia*	*Apis mellifera*	Honey bees
	Bombus spp.	Bumble bees
	Agapostemon virescens	Sweat bees
	Colletides spp.	Cellophane bees
	Xylocopa virginica	Large Carpenter bees
	Andrenides spp.	Mining bees
	Megachilides spp.	Leaf-cutter, mason bees

Honey bee (*Apis melifera*) **on white clover.**
Photo: *S. Olcott, WVDNR*

Diptera (True flies)	*Syphid* spp.	Hover & Flower Flies
	Bombylid spp.	Bee Flies
	Tachinidae spp.	Tachinid Flies
	Lucilia & Calliphora spp.	Green & Blue Bottle Flies
	Dolichopodides spp.	Long-legged Flies
	Condylostylus spp.	

Long-legged Fly (*Condylostylus* sp.)
Photo by permission: *S. Cresswell*

Coleoptera (Beetles)	*Melyridae*	Soft-winged flower beetles
	Lycidae	Net-winged beetles
	Cantharidae	Soldier beetles
	Dermestidae	Carpet beetles
	Ripiphoridae	Wedge-shaped beetles
	Scarabaeidae	Scarab beetles
	Phalacridae	Shining flower beetles
	Cerambycidae	Long-horn beetles

Soldier beetle (*Canarthis* sp.) **on boneset.**
Photo: *S. Olcott, WVDNR*

Pollinator Biology and Habitat

Natural areas with abundant native forbs that flower when the main crop is not in bloom, such as the goldenrod adjacent to this apple orchard can support resident pollinator populations over the season.

Photo: *Toby Alexander, NRCS VT*

Natural areas, on, close and adjacent to, farms can serve as refugia for native wild pollinators. Protecting, enhancing or providing habitat is the best way to conserve native pollinators and provide pollen and nectar resources that support them. On farms with sufficient natural habitat, native pollinators can provide all of the pollination for some crops.

Pollinators have three basic habitat needs. These include 1) foraging plants, 2) nesting sites; and 3) protection or shelter. Pollinators must have access to a diversity of plants with overlapping blooming times so that flowers are available to forage from early in the spring until late in the fall. Because pollinator needs vary, it is important to provide flowers of different sizes, shapes, and colors, in order to support a diverse community of bees.

Second, they need places to nest. The majority of native bees are solitary, and none build the wax or paper structures we associate with honey bees or wasps. Most bees nest in small interconnected tunnels and cells they construct underground. Others nest in narrow tunnels often left behind by beetle larvae in dead trees and a few use the soft pith in some plants. Whether underground or in snags, most solitary bees spend the greater part of the year maturing in their nest (brood) cells. In these cells, they are vulnerable to mechanical nest disturbances such as deep soil tillage or tree removal.

Bumble bees are the most familiar social bee group native to the United States. They require small cavities, either in trees, underground, or under clumps of fallen grass. Often, they move into old rodent burrows. Because their nests are started anew each spring by overwintering queens, bumble bees need both cavities to raise their young as well as undisturbed duff for queens to burrow and hibernate through the winter.

Finally, bees need protection from most pesticides. Insecticides are primarily broad-spectrum and are therefore deadly to bees. Furthermore, indiscriminate herbicide use can remove many of the flowers that bees need for food.

General Pollinator Habitat Requirements

Pollinator		Food	Shelter
Solitary Bees		Nectar and Pollen	Most nest in bare or partially vegetated, well-drained soil; many others nest in narrow tunnels in dead standing trees, or excavate nests within the pith of stems and twigs; some construct domed nests of mud, plant resins, saps, or gums on the surface of rocks or trees
Bumble Bees		Nectar and Pollen	Most nest in small (softball size) cavities, are often underground in abandoned rodent nests or under clumps of grass. May also occur in hollow trees, bird nests or walls
Butterflies and Moths	Egg	Non-feeding stage	Usually on or near larval host plant
	Caterpillar	Leaves of larval host plants	Larval host plants
	Pupa	Non-feeding stage	A protected site such as a shrub, tall grass, a pile of leaves or sticks or, in the case of some moths, underground
	Adult	Nectar; some males obtain nutrients, minerals, and salt from rotting fruit, tree sap, animal dung and urine, carrion, clay deposits, and mud puddles	Protected site such as a tree, shrub, tall grass or a pile of leaves, sticks or rocks
Ruby-throated hummingbirds Not significant pollinators.		Nectar, insects, tree sap, spiders, caterpillars, aphids, insect eggs, and willow catkins; respond well to red, deep-throated flowers, such as cardinal flower, trumpet creeper or penstemons	Trees, shrubs and vines.

Adapted from: *Native Pollinators. Feb. 2006. Fish and Wildlife Habitat Management Leaflet. No. 34.*

Pollinator Conservation and Farm Planning

A growing emphasis within the NRCS is to take a "whole farm" or Resource Management System (RMS) approach to conservation. This means that an attempt is made to consider all resource concerns within the landscape including soil, water, air, plants, animals, energy and social considerations. As projects are being considered, field conservation staff must constantly weigh the potential economic and environmental costs against the benefits of the practices they help implement.

Habitat enhancement for native pollinators on farms, especially with native plants, provides multiple benefits. In addition to supporting pollinators, native plant habitat will attract beneficial insects that prey on crop pests and may lessen the need for pesticides on the farm. Pollinator habitat (early successional stage) can also provide habitat for other wildlife, serve as corridors to facilitate movement, help stabilize and build soil, and improve water quality. Conversely it would be prudent for planners to become familiar with locally common agricultural pests and their biology in order to prevent inadvertent increases in those pests when promoting pollinators.

This document provides a four-step approach to pollinator conservation which includes: (**1**) advice on recognizing existing pollinator habitat; (**2**) steps to protect pollinators and existing habitat; (**3**) methods to create, further enhance or restore habitat for pollinators; and (**4**) methods for managing habitat for the benefit of a diverse pollinator community.

Monarch caterpillar on butterflyweed.

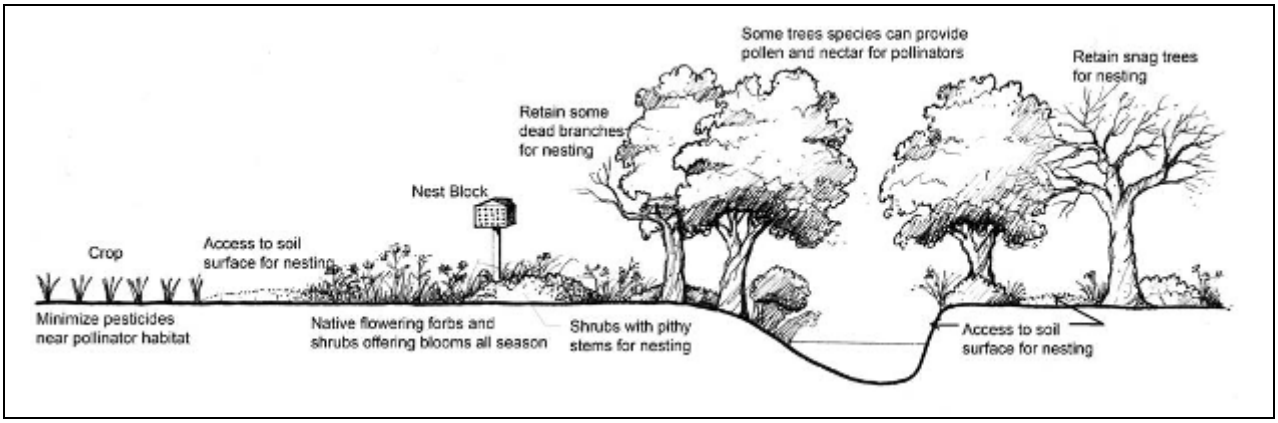
Adult monarch butterfly on coneflower.

Photos: *Tom Allen, WVDNR*

Many of the NRCS conservation practices that we plan and implement on a regular basis can be significant pollinator enhancement practices by simply considering different methods of application to the landscape. With a little forethought, these practices can improve the overall aesthetics of the landscape by adding color and structure from early spring to late fall.

I. Recognizing Existing Pollinator Habitat

Many landowners may potentially already have an abundance of habitat for native pollinators on or near their land; having semi-natural or natural habitat available significantly increases pollinator populations. Linear habitats along field margins such as field edges, hedgerows, and drainage ditches offer both nesting and foraging locations for a variety of pollinators. Woodlots, conservation areas, utility easements, farm roads, and other untilled areas may also contain good habitat. Often, marginal areas, less fit for crops, may be best used and managed as pollinator habitat. Here we provide advice on recognizing specific habitat resources so that they can be factored into farm planning.



Many existing landscapes already possess food, nesting sites and other critical resources for pollinators. After: Agroforestry Note – 34: *Enhancing Nest Sites for Native Bee Crop Pollinators*

Existing Plant Composition

Many acres within West Virginia already possess good to excellent plant composition and plant communities that provide pollinator habitat. When assessing pollen and nectar resources, it is important to look at all of the potential plant resources on and around a landowner's or farmer's property and which species of plants are heavily visited by bees and other pollinators. These plants may include insect-pollinated crops, as well as the flowers and forbs in buffer areas, forest edges, hedgerows, roadsides, natural areas, fallow fields, etc. Insect-pollinated crops may supply abundant forage for short periods of time, and such flowering crops should be factored into an overall farm plan if a landowner is interested in supporting wild pollinators. However, for pollinators to be most productive, nectar and pollen resources are needed outside the period of crop bloom.

As long as a plant is not a noxious or state-listed invasive weed species that should be removed or controlled, landowners might consider allowing some of the native or non-native forbs that are currently present on the property to bloom prior to their crop bloom, mow them during crop bloom, then let them bloom again afterward. (Refer to the lists of State and Federal Noxious Weeds in Section II of the FOTG for more information).

For example, dandelion (*Taraxacum* spp.), clover (*Trifolium* spp.), and other non-native plants may often serve as good pollinator plants. These type of forbs could be mowed while an adjacent crop blooms in order to continue to provide nectar and pollen resources without interruption. Of course, one must weigh the benefits to crop pollination against potential negative effects on ground nesting wildlife and native bee populations. As an example for vegetable producers, some portions of those types of crops could be

allowed to bolt to continue to provide resources outside and beyond the bloom period. Some crops are secondarily beneficial. In addition to providing pollinator resources, the predators and parasitoids of pests are attracted to the flowers of arugula, chervil, chicory, mustards and other greens and support pest management.

When evaluating existing plant communities on the margins of cropland, a special effort should be made to conserve very early and very late blooming plants. Early flowering plants provide an important food source for bees emerging from hibernation, and late flowering plants help bumble bees build up their energy reserves before entering winter dormancy.

Early successional habitat containing trees, shrubs and forbs is a key to providing resources for pollinators.

Photo: *C. Shrader, WV NRCS*

Keep in mind that small bees may only fly a couple hundred yards, while large bees, such as bumble bees, easily forage a mile or more from their nest. Therefore, taken together, a diversity of flowering crops, wild plants on field margins, and plants up to a half mile away on adjacent land can provide the sequentially blooming supply of flowers necessary to support a resident population of pollinators.

Nesting and Overwintering Sites

Bees need nest sites to be productive and increase populations. Indeed, to support populations of native bees, protecting or providing nest sites is as important as providing floral resources. Similarly, if butterfly habitat is a management objective, caterpillar host plants are necessary for strong populations of those species. It is ideal to have nesting and forage resources in the same habitat patch, but bees are able to adapt to landscapes in which nesting and forage resources are separated. However, it is important that these two key habitat components are not located too far apart.

Native bees often nest in inconspicuous locations. Many excavate tunnels in bare soil, others occupy tree cavities, and a few even chew out the soft pith of the stems of plants like elderberry (*Sambucus* spp.) or blackberry (*Rubus* spp.) to make nests. It is important to retain or encourage as many naturally occurring sites as possible and to create new ones where appropriate.

Most of North America's native bee species (about 70 percent or very roughly 2,800 species) are ground nesters. These bees usually need direct access to the soil surface to excavate and access their nests. Ground-nesting bees seldom nest in rich soils, so poorer quality sandy or loamy sand soils may provide fine sites. The great majority of ground-nesting bees are solitary, though some will share the nest

The majority of native bees nest underground as solitary individuals. From above ground, these nests often resemble ant hills. **Photo:** *Eric Mader, The Xerces Society*

entrance or cooperate to excavate and supply the nest. Still other species will nest independently, but in large aggregations with as many as hundreds or thousands of bees excavating nests in the same area.

Approximately 30 percent (around 1,200 species) of bees in North America are wood nesters. These are almost exclusively solitary. Generally, these bees nest in abandoned beetle tunnels in logs, stumps, and snags. A few can chew out the centers of woody plant stems and twigs, such as elderberry (*Sambucus* spp.), sumac (*Rhus* spp.), and in the case of the large carpenter bees, even soft pines and yellow poplar (*Liriodendron tulipfera*). Dead limbs, logs, or snags should be preserved wherever possible. Some wood-nesters also use materials such as mud, leaf pieces, or tree resin to construct brood cells in their nests.

Bumble bees are native species usually considered to be social. There are about 45 species in North America. They nest in small cavities, such as abandoned rodent nests under grass tussocks or in the ground. Leaving patches of rough undisturbed grass in which rodents can nest will create future nest sites for bumble bees. Bunch grasses, including many warm season grasses, tend to provide better nesting habitat than do sod-forming varieties. Structural landscape features such as brush piles, fence or hedgerows, and stone fences also provide nesting habitat for bumble bees.

A secondary benefit of flower-rich foraging habitats is the provision of egg-laying sites for butterflies and moths. These species lay their eggs on the plant on which their larva will feed once it hatches. Some butterflies may rely on plants of a single species or a closely related group of plants (genus) for host-plants. The monarch butterfly is an example of a species that relies on a single genus of plants, the milkweed (*Asclepias* spp.). Whereas others may exploit a wide range of plants, such as swallowtail butterflies (*Papilio* spp.) whose larvae can eat a range of trees, shrubs, and forbs. In order to provide egg-laying habitat for the highest number of butterflies and moths, landowners should first provide plants that can be used by a number of species. Later, those plants can be supplemented with host plants targeted for more specialized species.

Fallow areas can be used to provide forage, nesting habitat and refugia for pollinators.
Photo: *Jeff Norment, Maine NRCS*

II. Protecting Pollinators and their Habitat

When farmers and landowners recognize the potential pollinator habitat on their land, they can then work to protect these resources. In addition to conserving the food and nest sources of their resident pollinators, they can take an active role in reducing mortality of the pollinators themselves. While insecticides are an obvious threat to beneficial insects like bees, other common farm operations or disturbance, such as mowing or tilling, can also be lethal to pollinators.

Minimizing Pesticide Use

Pesticides may be detrimental to a healthy community of native pollinators. Insecticides not only kill pollinators, but sub-lethal doses can affect their foraging and nesting behaviors, often preventing plant pollination and bee reproduction. Herbicides can kill plants that pollinators depend on when crops are not in bloom, thus reducing the amount of foraging and egg-laying resources available.

Broad-spectrum chemicals should be avoided if at all possible. If pesticides cannot be avoided, they should be applied directly on target plants to prevent drift. Crops should not be sprayed while in bloom and fields should be kept weed free (or mowed just prior to insecticide applications). This discourages pollinators from venturing into the crop if sprayed outside of the bloom period. Night-time spraying, when bees are not foraging, is one way to reduce bee mortality. Periods of low temperatures may also be beneficial for spraying since many bees are less active in cooler conditions. However, the residual toxicity of many pesticides tends to last longer in cool temperatures. Dewy nights may cause an insecticide to remain wet on the foliage and be more toxic to bees the following morning.

Even small amounts of pesticides may be detrimental to pollinators such as this foraging sweat bee (*Agapostemon* sp.).

Photo: *T. Alexander, Vermont NRCS*

In general, while pesticide labels may list hazards to honey bees, the potential dangers to native bees are often not listed. Many native bees are much smaller in size than honey bees and are affected by lower doses of chemicals. Also, honey bee colonies may be covered or moved from a field, whereas wild bees will continue to forage and nest in areas that have been sprayed.

The use of selective pesticides that target a narrow range of insects, such as *Bacillus thuringiensis* (*Bt*) for moth caterpillars, is one way to reduce or prevent harm to beneficial insects like bees. Generally, dusts and fine powders are more dangerous than liquid formulations. This is in part because the dust and fine particles of the pesticide become trapped in the pollen collecting hairs of bees. The chemicals are consequently fed to developing larvae.

Alternatives to insecticides are also available for some pests, such as pheromones for mating disruption, and kaolin clay barriers for fruit crops. Local West Virginia University Extension Service personnel may be able to assist with the selection of less toxic pesticides or with the implementation of integrated pest management (IPM) programs. Refer to the WV conservation practice standard (595) Integrated Pest Management or your WVU County Extension Agent for more information at: http://ext.wvu.edu/ .

Landowners who encourage native plants for pollinator habitat will inevitably be providing habitat that will also host many beneficial insects that help control pests naturally. This may result in less dependency of pesticide application.

Formulation	Hazard Level to Pollinators
Dust	Worst
Wettable Powder	
Flowable	
Emulsifiable Concentrate	
Soluble Powder	
Solution	
Granular	Least

Pesticide hazard levels to pollinators adapted from Agroforestry Note No. 35 *Pesticide Considerations for Native Bees in Agroforestry***, June 2007. USDA**

In addition to providing pollinator habitat, windbreaks, hedgerows, and conservation buffers can be effective barriers to reduce pesticide drift from adjacent fields. Spray drift can occur as either spray droplets or vapors. Factors effecting drift include weather, method of application, equipment settings, and spray formulation.

Weather related drift increases with temperature, wind velocity, convection air currents, and during temperature inversions. Wind related drift can be minimized by spraying during early morning or in the evening when wind velocity is often lower. However, even a light wind can cause considerable drift. Pesticide labels will occasionally provide specific guidelines on acceptable wind velocities for spraying a particular product. Always check and follow those recommendations when present.

Mid-day spraying is also less desirable because as the ground warms, rising air can lift the spray particles in vertical convection currents. These droplets may remain aloft for some time, and can travel many miles.

Similarly, during temperature inversions spray droplets become trapped in a cool lower air mass and move laterally along the ground. Inversions often occur when cool night temperatures follow high day temperatures. These are usually worst during early morning before the ground warms. Low humidity and high temperature conditions also promote drift through the evaporation of spray droplets and the corresponding reduction of particle size.

Spray application methods and equipment settings also strongly influence the potential for drift. Since small droplets are most likely to drift the longest distances, aerial applications and mist blowers should be avoided where feasible. Standard boom sprayers should be operated at the lowest effective pressure and with the nozzles set as low as possible. Drop nozzles should be used to deliver insecticide within the crop canopy where it is less likely to be carried by wind currents. Regardless of the chemical or type of application equipment used, sprayers should be properly calibrated to ensure that excess amounts of pesticide are not applied.

Nozzle type also has a great influence on the amount of drift a sprayer produces. Turbo jet, raindrop, and air-induction nozzles produce less drift than conventional nozzles. Standard flat fan or hollow cone nozzles are generally poor choices for reduction of drift. Select only nozzles capable of operating at low pressures (15 to 30 psi) to produce larger, heavier droplets. Finally, oil-based chemical carriers produce

smaller, lighter droplets than water carriers and should also be avoided when possible. Consider using thickening agents if they are compatible with the pesticide.

If pesticide use is an integral part of the farm operation and it is not practical to eliminate from the operation, landowners should be provided risk assessments using NRCS protocols such as a pesticide screening tool (i.e. Win-PST)

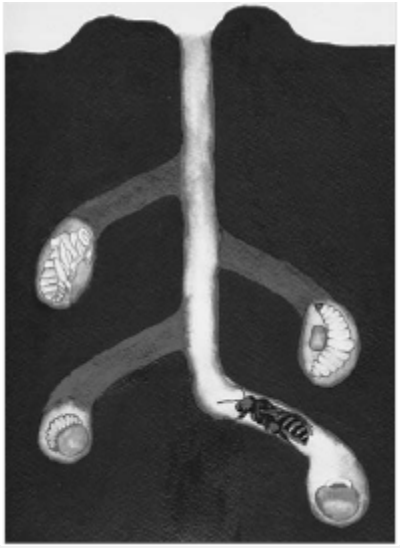
Minimizing the Impact of Mowing, Haying or Grazing

Disturbance is part of a management regime of many organisms. Disturbance in a farm setting is often frequent and abrupt. Many of the pollinators that exist in this region utilize early successional habitats for egg-laying and foraging. Early successional habitat is dependent upon disturbance. Disturbance in a farm setting occurs as tilling, mowing, haying, grazing, etc. When developing disturbance strategies with pollinators in mind, it is important to consider the timing, amount and intensity of the disturbance.

A general rule is that only 25% to 33% of pollinator habitat should be disturbed by mowing, grazing, or haying at any one time in order to protect overwintering pollinators, foraging larvae and adults, as well as other wildlife. The area disturbed should not totally eliminate a resource critical to pollinator habitat such as the only area providing pollen nectar resources during a given period. This will allow for re-colonization of the disturbed area from nearby undisturbed refugia, an important factor in the recovery of pollinator populations after disturbance. In order to maximize foraging and egg-laying opportunities, maintenance activities should be avoided while plants are in flower. Ideally, mowing in areas where pollinator habitat is important should be done only in the late fall or early winter.

Protecting Ground Nesting Bees

In order to protect nest sites of ground-nesting bees, tilling or other disturbance of bare or partially bare ground that may be occupied by nesting bees should be avoided. Grazing such areas may also disturb ground nests. Similarly, using fumigants like Chloropicrin for the control of soil-borne crop pathogens (such as *Verticillium* wilt), or covering large areas with plastic mulch could be detrimental to beneficial ground nesting insects like bees. Weed control alternatives to tillage include the use of selective crop herbicides and hooded sprayers for between row herbicide applications.



Solitary ground-nesting native bees spend most of the year growing through the egg, larval, and pupal stages while hidden in their nest cells underground.

Illustration courtesy Sarina Jepsen – The Xerces Society, Agroforestry Note 32. August 2006)

Protecting Tunnel Nesting Bees

Tunnel nesting bees will make their homes in the abandoned tunnels of wood-boring beetles and the pithy centers of many woody plant stems. Allowing snags and dead trees to stand (so long as they do not pose a risk to property or people) and protecting shrubs with pithy or hollow stems, such as elderberry (*Sambucus* spp.), raspberry and blackberry (*Rubus* spp.), boxelder (*Acer negundo*), and sumac (*Rhus* spp.) will provide nesting opportunities for these solitary bees.

Supporting Managed Honey Bees

With a social structure consisting of a single queen, her daughter-workers, and male drones whose only purpose is to mate, honey bees represent what most people think of when bees are discussed. Their habit of producing useful products like excess honey and wax has inspired people to keep them in man-made hives since at least 900 BC. While not native to North America, the European honey bee (*Apis mellifera*) remains a crucial agricultural pollinator. Upon its introduction to North America in 1622, the honey bee initially thrived with feral colonies rapidly spreading across the continent by swarming from managed hives. Swarming is the process by which an overgrown colony divides with half the colony flying away to establish a new nest.

People have been keeping honey bees in man-made hives since 900 BC. Photo: USDA

Unfortunately the subsequent accidental introduction of several major parasitic mites and bee diseases has slowly devastated both feral and managed honey bees in the United States. Habitat degradation and pesticide issues have also taken a dramatic toll on honey bee populations. The result is that with the exception of feral Africanized honey bees, which escaped from a research facility in Brazil in 1957 and slowly moved north through the southwestern U.S. few feral honey bees exist in North America. Similarly, the number of managed honey bee hives in the U.S. has declined by 50% since 1945, while the amount of crop acreage requiring bee pollination continues to rise.

Beekeepers have also suffered in recent years due to declining honey prices, the result of low cost imported honey. As a result, many commercial beekeepers have increasingly turned to a pollination-for-hire business model, making much of their income by renting bees to growers who need their crops pollinated. The advantage of honey bees to growers is they can be transported long distances and because of their perennial nature, they can rapidly be deployed in large numbers at any time of year.

Solutions to the many parasite and disease problems facing honey bees will require additional research and new management practices. The issue of habitat degradation however, can be addressed now. The same habitat enhancement guidelines that promote native bee populations also promote honey bee populations and honey bee health. The critical factor for all bees is the presence of abundant pollen and nectar sources throughout spring, summer and fall.

One habitat requirement for honey bees that is generally not as critical for native bees is access to water. Honey bees require water to cool their hives through evaporation (which they carry back to the hive in their stomach). Preferred water sources are shallow and calm with low approaches where bees can stand while they drink. It is imperative that water sources be clean and free of pesticides or other chemicals.

III. Enhancing and Developing New Pollinator Habitat

Landowners who want to take a more active role in increasing the population of resident pollinators can increase the available foraging habitat to include a range of plants that bloom and provide abundant sources of pollen and nectar throughout spring, summer and fall.

Such habitat can take the form of designated pollinator meadows or bee pastures, nectar corridors, demonstration gardens, orchard understory plantings, hedgerows and windbreaks with flowering trees and shrubs, riparian re-vegetation efforts, flowering cover crops, green manures, field borders and other similar efforts.

Diverse plantings of native forbs, such as wild indigo (*Baptisia alba)* should be prioritized to support the greatest abundance and diversity of pollinators.
Photo: *Eric Mader, The Xerces Society*

Locally native plants are preferred over non-native plants due to their adaptations to local soil and climatic conditions, greater wildlife value, and their mutually beneficial co-evolution with native pollinators. However, non-native plants could be suitable on disturbed sites, for specialty uses such as cover cropping or where native plant sources are not available. Mixtures of native and non-native plants could be possible, so long as non-native species are naturalized and not invasive. It should be noted that a number of common, naturalized species such as birdsfoot trefoil (*Lotus corniculatus*), white clovers (*Trifolium* spp.) and alfalfa (*Medicago sativa*) provide a good source of nectar to pollinators and are easily established, particularly in an agricultural setting.

A. SITE SELECTION

Site selection for installing new pollinator enhancement habitat should begin with a thorough assessment of exposure (including aspect and plant shade) and soil conditions, but also must take into account land use and available resources.

Aspect - In general, areas of level ground, with full sun throughout the day and good air circulation offer the most flexibility. East and south-facing slopes may also be acceptable as long as erosion is controlled during the installation process. Unless the site is located near a large body of water, west-facing slopes in many climates are often subjected to hot afternoon sunlight, and drying winds. Under such conditions west-facing slopes should be utilized to provide nest sites for ground nesting bees and bumble bees.

Sun Exposure - Since some plants require full sun or shaded conditions to thrive, the planting design should allow for sun-loving plants to remain in full sun as the habitat matures. Plantings may also be installed in several phases. For example, if trees and shrubs are concurrently planned or utilized, they should be allowed to completely develop an over-story prior to planting shade-loving herbaceous plants below. Generally, shade intolerant plants will flower more and provide greater amounts of nectar and pollen, when they receive more sunlight than when they are partially shaded.

Soil Characteristics - Soil type is an important consideration when selecting a site. Some plants grow, reproduce and flower better in specific soil textures (i.e. sands, silts, clays, or loams). Drainage, pH,

organic content, bulk density, and compaction are some of the other factors that will influence plant establishment and productivity. Most of these factors can be determined from local soil surveys, and the NRCS Web Soil Survey http://websoilsurvey.nrcs.usda.gov/app/ . Planning should emphasize those plants that will be adapted for the particular soil conditions and moisture regimes anticipated.

Fertility, soil pathogens, the presence of rhizobium bacteria, and previous herbicide use should also be considered during the planning process. Soil fertility will be most critical during early plant establishment, especially on previously cropped lands. As the habitat matures, few if any inputs should be required, especially if native plants are selected.

Similarly, some previously cropped areas may harbor soil-borne pathogens that could inhibit plant development. Where such conditions are known to exist, pathogen-resistant plant species should be considered. Conversely some soil microorganisms, such as rhizobium bacteria, are essential for the successful establishment of legumes. If rhizobium bacteria are absent in the soil, specially inoculated seed is often available. It is always a good idea to use inoculated seed to obtain the maximum germination. Finally, pesticide residues or herbicides like atrazine and trifluralin can inhibit seed germination. These chemicals, soil pathogens, beneficial microorganisms and soil fertility can all be tested for by state, and extension soil laboratories. At a minimum, a soil test is recommended to determine fertility prior to establishment, and then periodically (2-5 years) after establishment.

Adjacent Land Use - Adjacent plant communities and existing land use on neighboring lands must also be considered. Even if weeds are eliminated prior to planting, the presence of invasive plants adjacent to a restored habitat may result in a persistent problem requiring continuous maintenance and management. Adjacent cropland may also present a challenge unless the enhancement site is protected from pesticide drift. Adjacent crops may change seasonally, so it is important to consider the timing of floral resources and coordinate resources accordingly.

Marginal Land - Some otherwise marginal land, such as drainage ways waterways and buffer systems may be suited for pollinator plantings. While trees may be problematic on such sites, forbs will not prevent future maintenance and these sites may actually help absorb excess nutrients from wastewater.

Ditches, field buffer strips and borders, and even grassed waterways can be planted with pollinator-friendly plants rather than or in conjunction with grass. Legumes such as clover and alfalfa along with grasses could be utilized in these types of situations.

Size and Shape - Generally, the larger the planting area, the greater the potential benefit to pollinator species. Ideally, an area considered for enhancement should be at least one-half ($^1/_2$) acre in size, with two acres or more providing even greater benefits. With herbaceous plantings, large, square planting blocks will minimize the edge around the enhancement site and thus reduce susceptibility to invasion by weeds surrounding the perimeter. However, linear corridor plantings (e.g. along a stream or a hedgerow, or a crop border) will often be more practical. Where these linear plantings are installed, a minimum width of 10 feet should be considered. However, certain conservation practice standards require different widths for specific purposes. Planners should refer to the criteria outlined within NRCS practice standards to determine the proper widths of linear plantings.

Regardless of planting shape, to build sufficient resident pollinator numbers for reliable pollination services in cropland settings, consider requiring one or two acres for every 25 acres of cropped field.

B. HABITAT DESIGN

When designing a pollinator planting, first consider the overall landscape and how the new habitat will function with adjacent crops and cropland. From there, focus on the specifics of the planting such as species diversity, bloom time, plant density and the inclusion of grasses for weed control and soil stabilization.

Old fields often provide a good mix of flowering forbs and woody species. This St. John's-wort (*Hypericum elipticum*) is a native plant attractive to many species of pollinators. Consider the flowering times of plants. The name St. Johns-wort alludes to the time of flowering of many members of this genus on or around June 24th (St. John the Baptist's Day).

Photo: *C. Shrader, NRCS, WV*

Landscape Considerations - The first step in good habitat design is the consideration of how the area you are working with fits in (functions) with the adjacent landscape features.

Attempt to place the new habitat area close enough to crops requiring pollination to be of significant value. Flight distances of small native bees might be as little as 500 feet, while larger bumble bees may forage up to a mile away from their nest. This may require some general understanding of the types of bees or other pollinators currently within the local area. Thus, crops that depend heavily upon bumble bees for pollination, such as cranberries or blueberries, might still benefit from pollinator habitat located some distance from the field. It should be noted however, that even bumble bees prefer habitat as close to the crop as possible. This sort of arrangement would minimize the encroachment of unwanted pollinator plants into crops while still supporting a strong local population of bees.

Similarly, the new habitat should be located as closely as possible to any existing pollinator populations that may inhabit the new area. Fallow or natural areas, existing abandoned fields, or unmanaged

landscapes can all make a good starting place for habitat enhancement. In some cases these areas may already have abundant nest sites, such as fallen trees or bare ground, but only lack the floral resources to support a larger pollinator population. Be aware of these existing habitats and consider improving them with additional pollinator plants, nesting sites, protection or exclusion from livestock or construction of habitat areas adjacent to them.

Diverse Plantings - Diversity is a critical factor in the design of pollinator enhancement areas. Flowers should be available throughout the entire growing season; or at least whenever adjacent crops needing pollination are not in bloom. It is desirable to include a diversity of plants with different flower colors, sizes and shapes, varying plant heights and growth habits to encourage and benefit the greatest numbers and diversity of pollinators. Most bee species are generalists, which mean that they feed on a range of plants throughout their life cycle. Many others, including some important crop pollinators, only forage on a single family or even a single genus of plants.

Choose plants with a variety of flower shapes in order to attract a diversity of pollinators. Some flowers appear almost closed which require bees to crawl inside the petals to obtain nectar rewards. Other species are long and tubular shaped requiring insects like butterflies that have long tongues to obtain the resources. Color is another important consideration. Bees typically visit flowers that are purple, violet, yellow, white, and blue. Butterflies visit a similarly wide range of colors including red, whereas flies are primarily attracted to white and yellow flowers. Thus, by having several plant species flowering at once, and a sequence of plants flowering through the spring, summer and fall, habitat enhancements are able to support a wide range of pollinating insects that fly at different times of the season.

Natural ecosystems are typically comprised of many species of plants and animals. Diverse plantings that resemble natural native plant communities are also the most likely to resist pest, disease and weed epidemics; and thus will confer the most pollinator benefits over the greatest amount of time. Species found in association with each other in local natural areas are likely to have the same light, moisture, and nutrient needs such that when these species are put into plantings they are more likely to form stable communities.

Native milkweeds (*Asclepias* spp.) are vital as both food and larval feeding sites.

Photo: *C. Shrader WV, NRCS*

The concept of creating or maintaining diverse plant communities is so that in the event of pest or disease epidemics, the community as a whole may be able to persist. Often times, planners may not be aware of the amount of diversity needed or if the species identified for enhancement or creation is sufficient to perform pollinator functions. If this is a concern the level of diversity should be measured. The level of plant

community diversity can be measured in several ways. One system used in managed woody plant ecosystems is the 10-20-30 Rule. This rule states that a stable managed plant community should contain no more than ten percent of a single plant species, no more than twenty percent of single genera, and no more than thirty percent of a single family. The table below illustrates an example of woody diversity using the 10-20-30 Rule using a mixture of ten species.

When determining what species would be suitable and eventually forming stable communities, it is important to account for the existing plants and surrounding communities on adjacent sites. The plants that already exist may be factored into the amount of diversity if they are to be left on the site.

Common Name	Family	%	Genus	%	Species	%
sugar maple	Aceraceae	20	*Acer*	10	*saccharum*	10
red maple	Aceraceae		*Acer*	10	*rubrum*	10
common elderberry	Caprifoliaceae	10	*Sambucus*	10	*canadensis*	10
dogwood	Cornaceae	10	*Cornus*	10	*florida*	10
black locust	Fabaceae	10	*Robinia*	10	*pseudoacacia*	10
witch-hazel	Hamamelidaceae	10	*Hamamelis*	10	*virginiana*	10
tulip poplar	Magnoliaceae	10	*Liriodendron*	10	*tulipfera*	10
black cherry	Rosaceae	30	*Prunus*	10	*serotina*	10
common serviceberry	Rosaceae		*Amelanchier*	20	*arborea*	10
roundleaf serviceberry	Rosaceae		*Amelanchier*		*sanguinea*	10
TOTAL		**100**		**100**		**100**

This simplified example assumes planting ten different tree and shrub species in a given area.

Plant Density and Bloom Time - Plant diversity should also be measured by the number of plants flowering at any given time. Research has found that when eight or more species of plants with different bloom times are grouped together at a single site, they tend to attract a significantly greater abundance and diversity of bee species. In some studies, bee diversity continues to rise with increasing plant diversity and only starts to level out when twenty or more different flower species occur at a single site.

Therefore, at least three different pollinator plants within each of three blooming periods are recommended (i.e. early, mid or late season). Refer to the plant tables in the Appendix of this document for a list of species and corresponding bloom periods. Under this criterion, at least nine blooming plants should be established in pollinator enhancement sites. The exception to this is that when only woody species are established for pollinators, it is acceptable to establish species using the bloom period as very early, early and mid since there are so relatively few late blooming woody species. Be aware that establishment of trees without including an herbaceous component is not the most beneficial method to enhance a pollinator area. Herbaceous species are absolutely critical to ensuring that nectar and pollen resources are available throughout the season.

Season	Bloom Time
Very Early	March (or earlier) to April
Early	March through May
Mid	May through July
Late	July through Sept (or later)

Critical bloom periods for West Virginia.

It is especially important to include woody and herbaceous plants that flower early in the season. Many native bees, such as bumble bees and some sweat bees, produce multiple generations of offspring each year. More forage available early in the season will lead to greater reproduction and more bees in the middle and end of the year. Early forage may also encourage bumble bee queens that are emerging from hibernation to start their nests nearby, or simply increase the success rate of nearby nests. Conversely, it is also important to include

plants that flower late in the season to ensure that queen bumble bees are strong and numerous going into winter hibernation.

Clusters of single species should be planted where possible. Herbaceous or woody shrub single species clump-plantings of at least three feet by three feet blocks are more attractive to pollinators than widely scattered species or randomly dispersed small clumps. The goal is for the established blocks to form a solid block of color when in flower. Larger single-species clumps such as a cluster of perennials or shrubs more than twenty-five square feet in size may be ideal for attracting pollinators and providing efficient foraging.

Quick Blooming Reference to Common Native Trees and Shrubs in West Virginia

TREES			SHRUBS		
Name (Genus) [1]	**Approximate Flowering Period in West Virginia [2]**		**Name (Genus) [1]**	**Approximate Flowering Period in West Virginia [2]**	
Willow (*Salix* sp.)	March to May	Very Early	Redbud (*Cercis* sp.)	March to April	Very Early
Serviceberry (*Amelanchier* sp.)	March to May	Very Early	Paw-Paw (*Asimina* sp)	March April	Very Early
Red Maple (*Acer rubrum*)	March to April	Very Early	Hawthorn (*Crataegus* sp.)	May	Mid
Blackgum (*Nyssa sylvatica*)	April to May	Early	Elderberry [3] (*Sambucus* sp.)	April to July	Mid
Cherry (*Prunus* sp.)	May	Early	Blueberries (*Vaccinium* sp.)	May to June	Mid
Black Locust (*Robinia* sp)	May to June	Mid	Wild Rose (*Rosa* sp.)	May to July	Mid
Tulip Poplar (*Liriodendron* sp.)	May to June	Mid	Rhododendron (*Rhododendron* sp.)	June to July	Mid
Basswood (*Tilia* sp.)	May to July	Mid	Spiraea (*Spiraea* sp.)	June to September	Late
Sourwood (*Oxydendron* sp.)	July to Aug	Late	Raspberries [3] (*Rubus* sp.)	Spring to Summer	Late

[1] *Check sources for species and varieties that are adapted to the local climate and condition.*

[2] *The actual flowering period depends upon the species, elevation and year-to-year variation. It may actually last only a short portion of the period listed. It is important to consult with plant experts to develop a list of overlapping bloom times.*

[3] *When twigs are clipped on these plants, the soft pith provides nesting opportunities for small tunnel-nesting bees. Nectar and pollen may or may not be provided in abundance depending on the species.*

Inclusion of Grasses – Most herbaceous communities naturally occur in conjunction with one or more species of grasses. Typically these ecosystems contain a greater diversity of forbs, but most generally contain at least one dominant grass or sedge species in their compositions. In West Virginia, most of the grasses that naturally occur are cool season domesticated grasses like orchardgrass, fescue, timothy or bluegrass. We are familiar with these grasses due to their use for forage or erosion control. However, there are some naturally occurring warm season grasses (native grasses) that are typically scattered throughout naturally occurring herbaceous communities. These may include species such as little bluestem (*Schizachyrium scoparium*), purpletop (*Tridens flavus)* or big bluestem (*Andropogon gerardii)*. In general warm season bunch grasses (which produce most of their leaf mass in the summer) are more

favorable than cool season grasses which grow quickly in the spring, and thus potentially shade or crowd out developing forbs. Warm season grasses appear later in the growing season, are considered not ideal forages or erosion control plants by most landowners and are consequently disregarded as having little value. However, these grasses and sedges often provide forage resources for beneficial insects or the larval growth stages of some native butterflies. They also are potential nesting sites for colonies of bumble bees and overwintering sites for beneficial insects, such as predaceous ground beetles. The combination of grasses and forbs also form a tight living mass that over time will resist weed colonization.

Strive for an herbaceous plant community that mimics a local native ecosystem to maximize pollinator habitat. Therefore, if these naturally occurring species are not readily available, herbaceous plantings could include at least one warm season bunch grass or sedge (on wetter sites). This is in addition to the three or more forbs or shrubs from each of the three bloom-periods. This scenario results in a minimum of ten (10) plant species per planting. Acceptable bunch grasses are included within the Plant Tables in the appendix of this document and in the recommended species mixes. The table below also shows appropriate species to include in plantings and during evaluation of habitat.

Care should be taken that grasses do not dominate pollinator sites. Anecdotal evidence suggests that tall grasses crowd out forbs more easily than short grasses, and that cool season grasses are more competitive against many forbs than warm season grasses. Seeding rates for grasses should also not exceed seeding rates for forbs. As a general rule sedges or grasses should comprise no more than ten percent of the total seeding mixture. Planting in the fall should also favor forb development over grasses.

The use of warm season grasses requires special attention to the details of establishment and management (seedbed preparation, planting and weed control). Full establishment may take as long as three years. The extra effort required to establish these grasses is offset by the wildlife benefits it provides.

There are instances where planting both woody and herbaceous species is appropriate (e.g. riparian areas and other existing corridor landscapes). However, plantings are usually either herbaceous or woody. It is often difficult to establish woody and herbaceous species simultaneously on the same site for a variety of reasons including the shade tolerance requirements, crown spacing, competition and other factors. In most instances it is recommended to establish vegetation in phases.

Bunchgrasses and Sedge Species Suitable for Inclusion in Pollinator Habitat

<table>
<tr><th colspan="2">Bunchgrass Species Suitable For WV</th><th>Wetland Status Indicator</th><th>Comments</th></tr>
<tr><td>big bluestem</td><td>Andropogon gerardii</td><td>FAC</td><td rowspan="4">These seeds are lighter and more difficult to disperse. They are best established using a broadcast seeder in conjunction with a seed dispersal material.</td></tr>
<tr><td>little bluestem</td><td>Schizachyrium scoparium</td><td>FACU</td></tr>
<tr><td>broomsedge</td><td>Andropogon virginicus</td><td>FACU</td></tr>
<tr><td>Indiangrass</td><td>Sorghastrum nutans</td><td>UPL</td></tr>
<tr><th colspan="2">Sedge Species Suitable For WV</th><td rowspan="2">FACW</td><td rowspan="2">Many species of sedges and rushes would fit the role especially Carex, spp. and Juncus spp.</td></tr>
<tr><td>shining sedge</td><td>Carex lurida</td></tr>
</table>

Principal Crops in West Virginia and Corresponding Bloom Periods

If the goal is to provide habitat in critical periods when crops are not in bloom, it is important to understand the bloom periods of at least the locally important crops being grown in your area. Below is a table of a few common crops. This might assist planners to determine what to establish for periods when pollen and nectar are absent; or when space or landscape factors restrict the amounts of forage provided. There are many different cultivars and varieties of crops. Therefore the bloom time will vary significantly depending on the species, hardiness and variety planted. Planners should discuss the specific plant and rotation to understand the critical time periods for pollination. Note that many crops are wind pollinated (e.g. corn, some bean species, tomatoes and peppers) however insects sometimes assist the pollination process and habitat should be provided all season long when a part of the system is in this rotation.

CROP	BLOOM PERIOD
squash	Mid June through Late July
pumpkin	Mid June through Late July
apple (orchards)	late April through mid May
blueberry	**highly variable** – April through mid May
strawberry	**highly variable** – mid May through early June

C. PLANT SELECTION AND SEED SOURCES

First, choose plants with soil and sunlight requirements that are compatible with the site where they will be planted. The plant tables located in the appendix provide a starting point for selecting widely distributed and regionally appropriate pollinator plants. If these plants are not available, other closely related species might serve as suitable replacements. Often these species are listed as spp. in the plant tables. Contact the State Biologist, Plant Materials Specialist or NRCS Forester to determine other suitable species. Also, refer to the Tree and Shrub List for West Virginia (MOATSL) in Section IV of the FOTG which includes information related to corridor spacing, soil drainage class, and shade tolerance for many common native woody species. If utilizing spacing from these tables utilize the wider ranges of spacing to allow fuller crown development and increased bloom.

A black swallowtail (*Papilio polyxenes*) nectaring on a Turk's Cap lily (*Lilium superbum*) in Pocahontas County, WV.
Photo: *C. Shrader WV, NRCS*

Woody plants may be established for pollinators in a variety of settings. Since hedgerows and riparian corridors are appropriate places to establish pollinator habitats, desirable species should be selected that encourage use by pollinators and bloom throughout as much of the season as possible. Since trees and shrubs typically are available prior to the bloom period of most herbaceous plants, they are often the most visited of plants by bees early in the season. Conversely, woody species stop blooming earlier in the growing season and the floral resources then become unavailable for the remainder of the season. Therefore, it is not advisable to depend solely upon woody species to provide pollinator resources.

Many species of woody plants are wind pollinated. It is important to utilize trees and shrubs that are known to be pollinated by insects. Examples of species that are wind pollinated are: hickories (*Carya* sp.), Ash (*Fraxinus* sp.) and Oaks (*Quercus* sp.). These species should not be utilized as principle pollinator species.

Woody plantings may be utilized to enhance an area by interspersion of woody species in already existing woodlands, riparian areas or hedgerows. They may also be established as stand-alone woody plantings to provide corridors or nectaring areas. Use caution when planting woody species around orchards and certain crops as some species may provide alternate hosts or vectors for plant diseases (e.g. cedar apple rust).

Woody pollinator plantings should be at least one-half acre (0.5 acres) in size. A woody pollinator mix must also contain at least three species in each that the three blooming periods as discussed above (**very early, early** and **mid)**. Trees and shrubs should be planted in close enough proximity to aid in pollinator access but far enough apart to allow for maximum crown development and bloom. Planting materials may be seedlings, bare root, containerized or balled and burlapped.

Successful pollinator planting and survival is an ongoing concern in West Virginia due to the tremendous potential of mortality from deer browse and other factors. Before considering pollinator projects that contain tree plantings, weigh the considerations of seedling, shrub and forb planting protection, maintenance and exclusion prior to implementation. In this part of the country, following disturbance natural succession and subsequent volunteer species provide ancillary or primary pollinator resources. Where possible, take into consideration the availability of these naturally occurring species to minimize the amount of planting and take them into consideration when evaluating the success of pollinator plantings.

Scarlet Bee Balm (*Monarda didyma*) is a showy native perennial attractive to many pollinators in West Virginia.

Photo: *C. Shrader, WV NRCS*

Native Plants - Native plants are adapted to the local climate and soil conditions where they naturally occur. Native pollinators are generally adapted to the native plants found in their habitats. Some common horticultural plants do not provide sufficient pollen or nectar rewards to support large pollinator populations. Just because a certain species of horticultural variety of plants produce a large visually attractive flower does not necessarily mean that the plant produces nectar or pollen in necessary quantities to sustain pollinators. In addition, some non-native plants have the ability to invade and colonize new regions at the expense of exiting native plant communities. Often native plants have co-evolved with the pollinators that frequent them and are uniquely adapted to be most efficiently pollinated by those native insects.

Native and indigenous perennial plants are advantageous because they generally:

1) require fewer fertilizers and do not usually require pesticides for maintenance;
2) may require less water than other non-native plantings;
3) provide permanent shelter and food for wildlife;
4) are less likely to become invasive than non-native plants; and
5) promote biological diversity.

Using native plants will help provide connectivity to existing native plant populations particularly in regions with fragmented habitats. Providing connectivity on a landscape level increases the ability for species to move in response to environmental shifts and increases the genetic variability potential.

The cost of native plants may appear to be more expensive than non-native alternatives when comparing costs at the nursery, but when the costs of maintenance (e.g. weeding, watering, fertilizing) are calculated over the long-term, native plantings can ultimately be more cost-efficient for pollinator enhancement. Native plantings also give the added benefit of enhancing native biological diversity and are the logical choice to enhance native pollinators.

Seed Sources - The term local eco-type refers to seed and plant stocks harvested from local sources often within a few hundred miles. Where available and economical, native plants and seed should be procured from local eco-type providers. Plants selected from local sources will generally establish and grow well because they are adapted to the local conditions.

Commercially procured seed should be certified according to West Virginia state laws and recommendations. Seed certification guarantees a number of quality standards, including proper species, germination rate and a minimum amount of weed seed or inert material. It is always recommended to purchase certified seed when possible.

Transplants - In addition to seed, enhancement sites could be planted with plugs, container grown, containerized, bare-root, livestakes or balled and burlapped stock. Refer to the West Virginia conservation practice (612) Tree and Shrub Establishment or other appropriate standards for more information.

Herbaceous plants purchased as plugs have the advantage of rapid establishment and earlier flowering, although the cost and feasibility of using plugs can be prohibitive for large plantings. Transplanted forbs also typically undergo a period of shock during which they may need mulching and supplemental water to insure survival.

Similarly, woody plants may also require mulching and supplemental water after planting. In general, container grown and balled and burlapped woody plants have a higher survival rate and are available in larger sizes. They are typically more expensive than bare-root or containerized plants. Containerized trees and shrubs are plants that were either hand-dug from the ground in a nursery setting, or were harvested as bare-root seedlings, then placed in a container. Although the cost of containerized plants is typically low, they should be examined for sufficient root mass before purchase to ensure successful establishment. The cost of containerized plants may be prohibitive on larger sites.

Tricolored bumble bee (*Bombus ternarius*) visiting an apple blossom in New England.

Photo: *C. Stubbs, Univ. of Maine*

Livestakes or waddles are cuttings of woody plants made during the dormant season. These are frequently used on moist soils at minimal cost; particularly if there is a source of the species nearby. Typically they are used in conjunction with willow species in riparian or frequently flooded areas. Hardwood species with rooting ability can be found in NRCS' Plant Materials Technical Note- No. 1 located at: http://www.plant-materials.nrcs.usda.gov/pubs/mipmctn7266.pdf .

Avoid nuisance plants - When selecting plants, avoid ones that act as alternate or intermediate hosts for crop pests and diseases. Similarly, economically important agricultural plants (or closely related species) are generally a poor choice for enhancement areas, because without intensive management, they may serve as a host reservoir for insect pests and crop diseases. For example commercial apple growers may prefer not to see native crabapple trees used in adjacent conservation plantings for wildlife because the trees are likely to harbor various insect pests and disease spores. Cranberry growers may prefer not to have wild blueberry planted near their operations for similar reasons. It is prudent to be familiar with the crops and their commonly associated diseases within the local area of consideration.

As an example, some common non-native thistles in West Virginia are actually fairly good nectar resources for native bees and butterflies. However, the negative effects of encouraging propagation, the negative perception and the potential proliferation of potentially noxious weeds far outweigh the benefits. For those reasons, some species were not listed in the lists of pollinator plants in the appendix of this document. Similarly, native roses and common yard species like dandelion and plantain were excluded to avoid the same perceived effects. This is not to suggest that these species are not beneficial to pollinators. They should be retained if feasible and evaluated as a beneficial resource where they occur.

Non-Native Plant Materials - While in most cases native plants are preferred, non-native ones may actually be more appropriate for some applications. These include practices that involve cover crops, temporary bee pasture plantings or buffers between crop fields and adjacent native plantings. Often times it is necessary to include non-native or introduced species to fill in gaps of bloom times, provide additional color or provide pollinator resources during cropping sequences. These low cost plantings can also attract beneficial insects; some of which may predate or parasitize crop pests. For more information on suitable non-native plants for pollinators refer to the Plant Tables in the Appendices of this handbook.

The tables provide a list of non-natives that are non-invasive and could be used in conjunction with native species in mixes or established as individual stands. Any other non-native species utilized should not be invasive or established at the expense of native plant species. This is not a complete list and there are certainly other species that could be used. Consult with technical specialists to determine the suitability of those species.

Horticultural varieties of native and non-native species may provide large blooms and attractive colors for people and pollinators alike. However, they frequently do not provide the pollen and nectar rewards of native species.

Photo: *C. Shrader, WV NRCS*

Pollinator Plant Mixes – There are numerous commercial mixes available for sale online and through mail order catalogues. Many of these mixes would be appropriate to establish pollinator habitat. However, the species utilized in some mixes often do not meet the bloom requirements set forth in this document; do not contain native plants indigenous to West Virginia; and/or do not provide pollinator resources throughout the growing season. Many commercial mixes are often tailored for aesthetics to human visual appeal as opposed to production of pollen and nectar. They frequently contain horticultural varieties of plant species that have been propagated for variations in bloom or color but lack the ability to produce pollinator resources. In addition, these mixes frequently contain non-native species that could be aggressive in native ecosystems. It is important to utilize true pollinator mixes and ensure that these mixes contain native species and will produce food and nectar throughout the growing season in the mid-Atlantic. In addition to the mixes outlined in the appendix of this document, it is acceptable to utilize those mixes that have been established by The Xerces Society and are labeled for use in West Virginia. These mixes are available from The Xerces Society at: http://www.xerces.org/ .

D. CREATING ARTIFICIAL NEST SITES

There are many successful ways to provide nesting sites for different kinds of native bees, from drilled wooden blocks to bundles of reeds to bare ground or adobe bricks. The Xerces Society's book *Attracting Native Pollinators* provides detailed information on how to build artificial nest sites. Generally, increasing nesting opportunities will result in at least a short-term increase in bee numbers.

Most native bees nest in the ground. The requirements of one species, the alkali bee (*Nomia melanderi*) are so well understood that artificial nesting sites are created commercially to provide reliable crop pollination for alfalfa in eastern Washington and Idaho. Unlike the alkali bee, however, the precise conditions needed by most other ground-nesting bees are not well known. Some species nest in the ground at the base of plants, and others prefer smooth packed bare ground. Landowners can create conditions suitable to a variety of species by maximizing areas of undisturbed, untilled ground and/or constructing designated areas of semi-bare ground, or piles of soil stabilized with bunch grasses and wildflowers. Such soil piles might be constructed with soil excavated from drainage ditches or silt traps. Different species of bees prefer different soil conditions, although research shows that many ground nesting bees prefer sandy, loamy sand or sandy loam soils.

In general, these constructed ground nest sites should receive direct sunlight, and dense vegetation should be removed regularly (through very light disking or herbicide use), making sure that some patches of bare ground are accessible. Once constructed, these nest locations should be protected from digging and compaction.

Colonization of these nest sites will depend upon which bees are already present in the area, their successful reproduction and population growth, and the suitability of other nearby sites. Ground-nesting bee activity can be difficult to observe because there is often little above ground evidence of the nests. Tunnel entrances usually resemble small ant mounds, and can range in size from less than $^1/_8$ inch in diameter to almost $^1/_2$ inch in diameter, depending on the species.

A mason bee (*Osmia lignaria*) closes off the entrance to its hollow stem nest with mud.

Photo: *Mace Vaughan, The Xerces Society*

In contrast to ground-nesting bees, other species such as leafcutter and mason bees naturally nest in beetle tunnels and similar holes in dead trees. Artificial nests for these species can be created by drilling a series of holes into wooden blocks. A range of hole diameters will encourage a diversity of species, providing pollination services over a longer period of time. Commercially produced bee blocks, consisting of a wood block drilled with a series of dead-end tunnels are now widely available. These types of bee nests were initially developed in the 1960's by alfalfa seed producers in the western U.S. to attract and manage large numbers of the non-native alfalfa leafcutter bee. More recently artificial nests have been modified to manage the blue orchard bee (*Osmia lignaria*) for orchard fruit and almond pollination. These artificial nests contain tunnels that are uniform size and depth. However because they are designed to suit specific species, they may either be too large or too small for many other species. Also, the blue orchard bee is active only in the spring and will not pollinate later flowering fruits and vegetables. Nest blocks with a greater diversity of hole sizes and depths are active throughout the year.

A drilled bee nest block.

Photo: *Toby Alexander, Vermont NRCS*

Such blocks can be constructed by drilling nesting holes between $^3/_{32}$ and $^3/_8$ inches in diameter, at approximately $^3/_4$ inch centers, into the side of a block of preservative-free lumber. The holes should be smooth inside, and closed at one end. The height of the nest is not critical, but should at least be 8 inches above the ground. The depth of the hole, however, is critical. Holes less than $^1/_4$ inch diameter should be 3 to 4 inches deep. For holes $^1/_4$ inches or larger, a 5 to 6 inch depth is best. Nest blocks should be hung in a protected location where they receive strong indirect sunlight and are protected from rain. Large

blocks tend to be more appealing to bees than small ones, and colonization is often more successful when blocks are attached to a large visible landmark (such as a building), rather than hanging from fence posts or trees. Refer to the Invertebrate Conservation Fact Sheet *Nests for Native Bees* and the Fish and Wildlife Habitat Management Leaflet Number 20 entitled *Artificial Nesting Structures.* The West Virginia conservation practice standard pertaining to artificial nesting structures for native bees should be followed when recommending these strategies.

HOLE DIAMETER	HOLE DEPTH	HEIGHT
less than 1/4 inch	3 to 4 inches deep	Minimum of 8 inches from ground level
larger than 1/4 inch	5 to 6 inches deep	

Recommended nesting block hole size, depth and height

Under the best circumstances artificial nests can attract large numbers of tunnel-nesting bees and boost their local populations. However, because the nests concentrate the bees in unnaturally large numbers within a relatively small space, they are susceptible to infestations of parasites and diseases after a few seasons. Without regular sanitation or the phasing out of nest materials, these parasites and diseases threaten long-term pollinator health. Contaminated nest blocks left unattended in the landscape continue to attract wild bees from the surrounding area and have the potential to cause mortality to bees. However, with proper management, these nests can maintain healthy bee populations indefinitely.

In order to be sustainable over the long term, artificial nests will require routine maintenance. The use of paper straws to line nesting holes is recommended because bee-occupied straws can be removed, stored and overwintered or destroyed if needed. Empty nest blocks can then be annually cleaned using a mild solution of bleach water to reduce the risk of mold, parasites and disease. To further resist the build-up of parasites and risk of disease, nest blocks need to be replaced every three years.

Many tunnel-nesting bees do not forage far from their nest site, so multiple blocks may be useful adjacent to cropland that requires pollination. For areas where natural nest cavities may be limited, supply at least two to three blocks per acre, each with at least 20 drilled holes per block.

In addition to wooden blocks, artificial nests could be constructed with bundles of paper straws, cardboard tubes or sections of reed or bamboo cut so that a natural node forms the inner wall of the tunnel.

IV. Management and Maintenance of Pollinator Habitat

Early successional habitat is a conservation priority in the Northeast because many species of wildlife dependent on this habitat type are experiencing population declines. These habitats are typically transitional and require different levels of disturbance to be maintained. Examples of early successional habitats include weedy areas, grasslands, old fields, blueberry barrens, shrub thickets, and young forest. Disturbance and management can be accomplished through mowing, brush hogging, disking, cutting, prescribed grazing, herbicide application, timber harvest and other methods. While existing efforts to create and manage these habitats has been focused on birds and mammals, these areas also provide excellent habitat for pollinators. Early successional habitats provide a diversity of native and naturalized grasses, forbs, shrubs and trees that provide both food (pollen and nectar) and cover.

Old fields often provide a good mix of flowering forbs and woody species. Common and beneficial forbs include dandelion (*Taraxacum* spp.), clover (*Trifolium* spp.), vetch (*Vicia* spp.), milkweed (*Asclepias* spp.), mustard (*Brassica* spp.), St. John's-wort (*Hypericum* spp.), wild bergamot (*Monarda fistulosa*), mint (Family Lamiaceae), goldenrod (*Solidago* spp.) and aster (Family Asteraceae). Wet areas may have marsh marigold (*Caltha palustris*), vervain (*Verbena* spp.), white turtlehead (*Chelone galbra*), joe pye weed (*Equpatorium purpureum*), and boneset (*Equpatorium perfoliatum*).

Great spangled fritillary (*Speyeria cybele.*) **on swamp milkweed in Marshall County, WV.**

Photo: *S. Olcott, WVDNR*

Early successional shrubs and trees are found in disturbed forests and shrub communities, but many will colonize old fields as well. Species such as cherry (*Prunus* spp.), willow (*Salix* spp.), blueberry (*Vaccinium* spp.), rose (*Rosa* spp.), hawthorn (*Crataegus* spp.), apple (*Malus* spp.), raspberry and blackberry (*Rubus* spp.), dogwood (*Cornus* spp.), viburnum (*Viburnum* spp.) and *Spiraea* spp. (e.g. meadowsweet) provide an important source of nectar and/or pollen. Many of these woody species flower during spring when flowering forbs are scarce, making them very important for successful pollinator reproduction. Finally, early successional habitats with a woody component may provide important nesting habitat for tunnel nesting bees.

When creating a new early successional area, focus attention on large blocks of habitat. Five acre blocks or larger will provide the most benefit to the greatest number of species both vertebrate and invertebrate. Larger openings with plenty of sun will favor shade intolerant plant species that are often sought by pollinators and other wildlife. To be most effective, new habitat areas should be created adjacent to existing open habitats. For additional information, refer to the NRCS Conservation Practice Standard (647) Early Successional Habitat Development and Management and the NRCS Fish and Wildlife Habitat Management Leaflet Number 41.

The establishment of new early successional pollinator habitat requires special attention to the details of establishment, management and maintenance. This is a three step process:

1. Seedbed and Site Preparation
2. Planting
3. Stand Maintenance

*Weed suppression must be considered during all phases of pollinator planting.

Establishment of a large complete self-sustaining pollinator stand may take as long as three years. The extra effort required to establish these species is offset by longevity of the stand and the benefits they provide. Smaller patches of habitat such as backyards or small garden-type plantings will require significantly less effort and maintenance.

WOODY ESTABLISHMENT

Site preparation, establishment and maintenance of trees and shrubs should follow the West Virginia conservation practice standards (612) Tree and Shrub Establishment and (490) Tree and Shrub Site Preparation as appropriate.

HERBACEOUS SEEDBED AND SITE PREPARATION

Native pollinator habitat should be planted by either conventional (disking or broadcasting) or no-till methods. No-till establishment is the preferred method since there is minimum soil disturbance, thus reducing weed competition and soil erosion. Conventional seeding may be used for establishment on areas that have been recently cropped or where weedy competition will be minimal and the risk of erosion is limited.

Any existing cover must be eliminated by herbicide application or tillage. That decision must be made early, as both methods will be the most successful if started in the fall. This is especially important when a site has a dense sod cover or there is a potential for weed competition. Consult the West Virginia University Extension Service to determine the best herbicide combination and apply it at the appropriate time in the fall. Consider using a cover crop if conventional tillage is used in the fall to prepare the site.

Since often times these types of plantings are slow to establish, competition control is critical to success. Conventional seedbed preparation, herbicide application or both may be needed to control competition prior to planting. It is important to allow adequate time to complete this process.

Herbicide Use

Often times areas selected for pollinator enhancements are already in sod bound conditions requiring removal of an existing stand prior to establishing more beneficial vegetation. This table contains suggestions for controlling competing, non-desirable vegetation prior to native forb establishment. In most instances this requires application of some form of herbicide. Sometimes more than one application (or burn-down) is necessary.

If two burndowns are planned, records should indicate that the herbicide was applied to the field twice. Some forbs and wildflowers may not be compatible with imazameth containing products (check label for compatibility). All herbicides should be applied and used according to their label recommendations and may slightly differ from that listed below.

METHOD	SETTING	TIMING	PROCEDURE
Single Burn-Down This option should not be used when tall fescue or orchardgrass is the predominant cover. Two herbicide burndowns are recommended when fescue is the predominant cover.	Grassland adjacent to cropland or other area needed for pollinators	Spring	1. Remove excess vegetation in fall or winter via mowing or close grazing 2. Apply herbicide after vegetation has grown 4 to 6 inches in April – May 3. Apply broad spectrum herbicide product
Double Burn-Down This option should be used when tall fescue or orchardgrass is the predominant cover.	Grassland adjacent to cropland or other area needed for pollinators	Fall & Spring	1. Remove excess vegetation in late summer (Aug-Sept.) by mowing or grazing. 2. Apply broad spectrum herbicide after vegetation has actively grown to 4 to 6 inches in Sept/Oct. Follow all label instructions. 3. Apply broad spectrum herbicide just prior to planting and after remaining vegetation grows 4 to 6 inches in April-May. Follow all label instructions.

Note that some pesticides can leave residues within the soil that are harmful to pollinators and native forbs. Utilize all pesticides according to the label directions and utilize only to establish habitat.

HERBACEOUS PLANTING

The species discussed in this document will grow throughout the entire growing season in West Virginia. Some species will actively grow and senesce early in the season while others may not actively start growing until the mid-point of the season, initiating bloom much later in the summer. Many of the species within this document require a cool, moist period prior to germination. This process is known as a stratification period. Most seed may be purchased already stratified. Stratified seed should be planted between April 1and May 15. Un-stratified seed may be planted in the fall (November 15 – March 1). However, this method is not recommended due to the low success rates, low germination and additional length of time required to establish the stand. Check with the supplier to determine if any seed will require stratification or specific storage methods prior to planting.

Most of the species listed within this document are measured (and usually sold) in lbs per acre of Pure Live Seed (PLS). They usually have a lower germination rate than many other common species. Therefore, it is essential when purchasing and planting native forbs that the quantities of seeds are based on PLS.

Commercial seed mixes are typically sold based on planting area size. Depending on the region, and the species included in each mix, $^1/_4$ to $^1/_3$ lb. is required for each 1,000 sq. ft. As a general rule, for areas of $^1/_2$ acre in size, 5 to 10 lb. of seed is required; and for areas of 1 acre in size, 10 to 20 lb. of seed is necessary. This results in approximately 20 to 40 seeds per square foot of planting area.

When actually planting seeds, it is imperative to establish good seed-to-soil contact. However, planting most native species too deep within the soil will result in failed plantings. Generally speaking, regardless

of the planting method used the seeding depth should never exceed ¼ inch. Plantings deeper than ¼ inch will almost always fail.

Seeds of native plants are very different from most seeds to which landowners are accustomed. They are generally very small in size, often times in the millions of seeds per pound. Some species of native plants important to pollinators have smooth seeds, while others may have fluffy "beards" or other material that makes them difficult to be seeded through conventional no-till seeders. It is often difficult to determine the uniformity of dispersal when planting and may require some trial and error in methods of establishment. If possible utilize fluff boxes and other specialized equipment geared specifically for native plant establishment. Specialized drills have seed boxes with dividers, agitators and oversized drop tubes and may be adjusted for shallow planting depths.

Conventional Seeding

Many times small areas may be established using hand or cyclone seeders; or similar equipment that is adapted to all terrain vehicles or small tractors. If using these methods, the seedbed must be prepared by tillage (disking and/or plowing) to a depth of three inches. After tillage, make at least one trip over the field using a cultipacker to firm the seedbed. It is imperative that the seedbed be dry and firm to ensure proper planting depth. Saturated soils should never be cultipacked or planted to avoid getting the seed too deep. On poorly or somewhat poorly drained soils cultipacking may not be a feasible option. Utilize equipment suitable to maneuver in wetter environments or use hand equipment and ensure good seed coverage as best as possible by hand methods.

Another effective method for competition control is to establish native plantings immediately following an annual row crop such as corn. However, it is imperative to know the pesticides utilized and allow ample time for residual chemicals to be removed from the soil prior to establishment. Some chemical pesticides are not only harmful to pollinators but also will be harmful to the native plants to which they depend. Some chemicals are active within the soil long after they have been applied. Refer to the section of this document dealing with pesticide use.

Seed may be broadcast if accomplished in a uniform manner and should always be cultipacked after seeding. Pre-mixing the seed with 200 lbs/acre of pelletized lime and utilizing an airflow applicator is an effective method. Strive for 35-40 seeds per square foot. Wind speed should be minimal when using this method.

Broadcast fluffy seed with a drop or cyclone type spreader. A carrier may be used to help distribute the seed. The following carriers could be used: lime at 200 lbs/acre; wheat at 40 lbs/acre; or oats at 32 lbs/acre. Since fluffy seed will only broadcast as far as the carrier, make sure your passes overlap to ensure even coverage. If wheat or oats are used as a carrier, mow them prior to seed head formation.

No-Till Using a Truex or Other Seed Drill

No-till establishment of native forbs unfortunately requires the use of herbicides. Herbicides should always be applied according to the directions, precautions and restrictions indicated on the label. Utilize only the amount of herbicide necessary. NRCS does not recommend or make specific herbicide recommendations. Recommendations and information regarding the use of herbicides may be obtained by contacting the West Virginia University Extension Service.

Weed suppression and competition control is vital to establishing successful stands of pollinator habitat. There are several steps required to achieve competition control. The first step is to mow (or graze) the

area to a very low height in late summer followed immediately by a herbicide application. If possible, after mowing and prior to herbicide application, remove any plant matter on the surface. This provides a better seedbed and allows for more herbicide contact with the vegetation and may allow reduced herbicide use in necessary subsequent applications.

Usually, a second herbicide application should be planned; this should always occur where dense fescue or orchardgrass stands exist. This application should occur just prior to planting and after any surviving vegetation has regrown to a height of 4 to 6 inches. All herbicide applications should be performed when vegetation is actively growing.

HERBACEOUS STAND MAINTENANCE

Always allow enough time for establishment prior to disturbance of the stand, which may take as long as three years. During this period exclude livestock, maintain weed suppression measures and monitor the stand density for the intended purpose for the life of the stand.

Habitat plantings specifically for pollinators should remain undisturbed to the greatest extent possible throughout the growing season so that insects are able to utilize flower pollen and nectar resources (for adult stages) and vegetative parts of plants for food and cover resources (for immature/larval stages).

If site maintenance must occur during the growing season in order to maintain the open, species rich habitat preferred by pollinators, establish a system for managing a percentage (50% or less) of the site each year on a three to five year rotation. (See the diagram on the following page.) This will allow for re-colonization of disturbed habitat from the surrounding area. Ideally, disturbance should not occur every year, but be sure to prioritize a management scenario that will maintain the desired habitat components and a diversity of habitats.

Weed Suppression During the Establishment Period

Competition control remains the most important part of pollinator establishment for up to three years after planting. Weed control during the establishment period is usually achieved by mechanical (mowing or disking) or (if absolutely necessary) by chemical methods. Native pollinator stands can generally be top clipped to control competition during the establishment period without harm to the forbs since most of the growth occurs below ground during the establishment year.

Use caution when determining what species of vegetation are considered as “weeds”. Some native species of forbs (intended or unintended) may provide pollinator resources and serve as supplemental resources. Where possible, reserve the application of pesticides for situations when the stand is being invaded by noxious alien species that threaten to choke out more beneficial species.

Never apply nitrogen during the planting year. This encourages cool season grasses and other competition. Lime may be applied if desired but is usually not necessary. Consider the need and use of fertilizers carefully since these are generally also not required and tend to encourage undesirable competition.

Planting Year

Mow the planting as needed to control weeds. As a general rule, never allow undesirable vegetation to exceed 18 inches or form seed heads. Mow at a height of 4 to 6 inches or just above seedling height. In the event of a noxious or alien invasive species is threatening the existence of the stand and where

feasible, a “wickbar” or similar device may be used to selectively apply pollinator-friendly herbicides. However, many warm season grasses and wildflowers neither are not post-emergent herbicide tolerant nor are many pollinator-friendly.

Second and Third Year after Planting

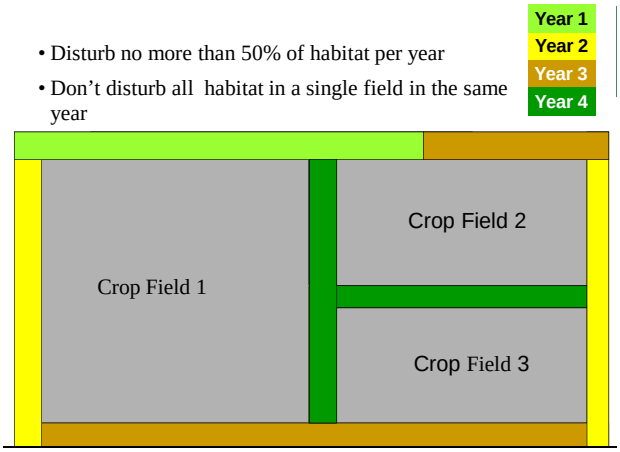
Plantings should be inspected in the early spring. If undesirable or noxious, alien or invasive species comprise more than thirty percent of the stand mow the area very short until the forbs start to green up.

Throughout the growing season mow as needed above the seedling height to prevent weeds from overtaking the stand. However never mow more than 30-50 percent of the stand at one time to prevent removing sources of nectar and pollen.

If it is necessary apply lime, phosphorus, and potassium only if soil tests indicate that they are needed (i.e. pH is less than 5.5, or P and K test results are in the "low" range). Nitrogen should not be applied.

Fourth Year after Planting

By the fourth year, the stand should be well established. Established stands do not require frequent attention, but periodic disturbance is necessary to stimulate growth of desirable vegetation and to eliminate encroachment of undesirable or rank vegetation. The type and frequency of management will depend on the size and composition of the planting. For optimum pollinator habitat, all management practices should be conducted on a schedule where only thirty to fifty percent of the stand is disturbed annually. Management and maintenance activities may include, mowing or haying, weed control, grazing and light disking to rejuvenate the stand. Phosphorus and/or potassium may be applied moderately where desired or needed. Careful consideration should be given to the application of nitrogen. If nitrogen is required, apply 40 to 80 pounds of nitrogen per acre split in two applications: one as growth of the stand begins and the second in mid-summer.



A Simplified disturbance scenario for pollinator habitat. After *H. Henry, NRCS*

In subsequent years continue to mange for maintenance of open sunny areas and remove or girdle large undesirable trees that begin to shade out the more desirable forbs and shrubs. Control invasive plants to lessen any negative impacts to the habitat.

Mowing and Haying

Mowing is the most common method used to control rank growth and rejuvenate stands. However, simply cutting these species and leaving the residue is not effective. If left on the surface, it could eventually smother the new growth and inhibit new growth. Usually mowing in combination with a light disking regime is the best method of disturbance to pollinator habitat. At a minimum, practice rotational mowing which entails mowing different parts of a field each year and schedule management for late fall after resident bees have become inactive.

On sites where soils are too wet in the spring (or other times) to mow, disturbance may be performed in during periods when the soil is at its driest point. Often times the driest periods for these areas are during critical bloom periods for plants that provide pollinator resources. Management schedules should account for these periods and take precautions not to remove more than fifty percent of the pollinator resources in one disturbance period. Also remember to allow sufficient recovery periods before winter dormancy. Stands containing warm season grasses should be allowed to reach a minimum height of 10 inches before the first killing frost. To maximize benefits, mow any given area on a 2 to 3 year rotation to control unwanted, rank and woody growth. Where feasible, mow only one-third to one-half of the stand each year. The remaining areas will provide year-round pollinator food and cover.

Remember that frequent mowing can be detrimental to pollinators. Balance the mowing schedule to allow plants such as dandelion and clover to periodically bloom. Raise the height of mowers to allow these common annuals to bloom and re-bloom where it is feasible.

Light Disking

Light disking may temporarily reduce the density of the stand, provide openings in the planting, facilitates the maximum amount of bloom, prevents the stand from becoming rank and allows movement of other wildlife. It should occur on a managed scheduled rotation. Rotation length depends on a number of factors including composition, stand size and density. Most typical stands should be disked on rotations of 2-3 or 3-4 years. It is important to remember to disk only 30 to 50 % of the stand each year.

On sites where soils are too wet in the spring (or other times) to mow, disturbance may be performed in during periods when the soil is at its driest point. Often times the driest periods for these areas are during critical bloom periods for plants that provide pollinator resources. Management schedules should account for these periods and take precautions not to remove more than fifty percent of the pollinator resources in one disturbance period.

Prescribed Flash Grazing

Livestock may be utilized to manipulate stand density and remove residue. Flash grazing is controlled, rotational grazing and is a good tool to influence or maintain a plant community. Grazing should generally occur at only light intensities with a long rest-rotation schedule of grazing. In some instances this method may provide the most benefits with the least amount of impacts on wildlife. However, this technique should only be performed in accordance with a grazing plan with pollinator habitat as the primary objective. Note that some native forbs may exhibit livestock toxicity. Always check to ensure the stand will not harm livestock prior to implementing this method. Livestock can quickly eliminate the floral resources from an area, so it is imperative that grazing be monitored closely.

The amount of grazing is determined by how many head of livestock are placed on the stand and how long they are allowed to graze the stand. As a management tool, rotational grazing should always be used. Native grasses should only be grazed to a minimum height of 12 inches and livestock should not graze more than one-half of the above ground height of other plants in the stand before removal. Most plants need to have some growth in the fall in order to build root reserves for wintering and initiating spring growth. This requires a minimum of 40 days, corresponding closely with the optimum rest period for warm season grasses of 42 to 49 days. As a general rule never utilize this method 30 days prior to the first killing frost to provide this reserve. Flash grazing an established stand of forbs and grasses for pollinators should occur no more frequently than every two to three years.. This residual growth is excellent overwinter cover and may provide nesting areas for bumble bees the following spring.

V. Pollinator Habitat and NRCS Practices

The Natural Resources Conservation Service supports the use of native species in many of their conservation practices. In fact, most any vegetative practices may be made pollinator friendly by including species that provide pollinator resources. In many instances simply incorporating native flowering forbs into conservation practices intended for other specific purposes is consequently beneficial to pollinators; even if the primary conservation activity is implemented for another purpose. A good example is during selection of tree species to plant for a forested riparian buffer. Select species that have multiple consecutive flowering times, yet still provide the water quality and other benefits for which the buffer is primarily intended. Selecting pollinator-friendly native species for these practices can provide many additional conservation benefits. However, an enhancement for pollinators should not compromise other intended functions of a practice. For example, plants attractive to pollinators could be used in a grassed waterway, but the planting should not interfere with the hydraulic function of the practice and the primary objective of stabilizing erosion.

Planners should look closely at the **Considerations** and the **Criteria** portions of the NRCS practice standards to identify recommendations that could benefit pollinators.

The table on the following pages is a quick reference to NRCS practice standards, their criteria, considerations and jobsheets to aid in planning the appropriate practices for pollinators. This table only includes those practices that have been revised with current criteria and/or considerations. Some practices have specific pollinator jobsheets while others have had existing jobsheets modified to include pollinators. Some jobsheets may be utilized without any further modification. As other standards are periodically revised this list will likely change.

Key	
X	Pollinator information has been provided in a revised conservation practice standard or standalone pollinator jobsheet
M	Pollinator information has been added or modified into a currently existing jobsheet
E	Planners may utilize the existing jobsheet to establish pollinator habitat

Practices that are capable of being utilized as pollinator enhancements are:

Conservation Practice Name (Units)	Code	Relevance to Pollinator Habitat	Consideration	Criteria	Pollinator Job Sheet Available
Artificial Nesting Structures for Wildlife (No.)	**INT**	This interim practice describes the design construction and placement of artificial nesting structures such as nesting blocks or nesting bundles for bees.	**X**	**X**	**X**
Alley Cropping (Ac.)	**311**	This practice has a consideration added to it that includes native trees or shrubs or row covers (e.g. various legumes) that provide nectar or pollen (see *Agroforestry Note 33*).	**X**	**--**	**E**
Brush Management (Ac.)	**314**	This practice is to be utilized to reduce or eliminate noxious woody plants and help maintain pollinator-friendly early successional habitat. Where possible, establish replacement species prior to removal to provide pollinator resources when noxious species are suspected of providing the principle source of pollinator habitat.	**X**	**X**	**X**
Channel Bank Vegetation (Ac.)	**322**	A consideration to include diverse flowering trees, shrubs, and forbs was added to this standard. When improving channel banks there is a unique opportunity to supply early-flowering willow (Salix spp.) and, in dry areas, late flowering native forbs (e.g. goldenrod (*Solidago* spp.) to enhance and supplement areas for native pollinators.	**X**	**--**	**--**
Conservation Cover (Ac.)	**327**	This practice will allow planners and clients to create customized types of vegetative covers (herbaceous and/or woody) to provide blocks of habitat areas (bee pastures) or other pollinator enhancements. Include diverse mixtures of plants to increase diversity and ensure flowers are in bloom for as long as possible and provide nectar and pollen throughout the season.	**X**	**X**	**X, E**

Conservation Practice Name (Units)	Code	Relevance to Pollinator Habitat	Consideration	Criteria	Pollinator Job Sheet Available
Conservation Crop Rotation (Ac.)	**328**	Include rotation plantings of forbs that provide abundant forage for pollinators (e.g. various legumes, buckwheat, phacelia, etc.). Moving insect-pollinated crops no more than 800 feet during a rotation will help maintain the local populations of native bees. Planners should consider crop rotations that include a juxtaposition of diverse crops with bloom timing that overlaps through the season to support pollinator populations. Growers might also consider using Integrated Pest Management to minimize insecticides and/or using bee-friendly insecticides in cover crop rotations.	**X**	**X**	**--**
Contour Buffer Strips (Ac.)	**332**	This practices' primary purpose is to control erosion on steep cropland; however, it could be beneficial to include diverse legumes or other forbs that provide pollen and nectar for native pollinators. Establish a minimum of three species of forbs that bloom during consecutive bloom periods (one in each blooming period). More forbs are recommended up to a maximum of ten total species. Establishment should not compromise the intended principle purpose.	**X**	**--**	**M**
Contour Orchard and Other Perennial Crops (Ac.)	**331**	This practice has been revised to include a consideration for pollinators. When establishing contours, utilize the areas between the contours to provide forage for pollinators. Select species that provide multiple benefits to insects and augment the period of crop bloom.	**X**	**--**	**--**
Cover Crop (Ac.)	**340**	This practice is critical in cropland settings to provide supplemental forage for pollinators that either provide pollen and nectar outside the bloom period of the principle crop; or supplemental resources during the bloom period. It may consist of one or more species and rotations.	**X**	**X**	**X**
Critical Area Planting (Ac.)	**342**	A consideration was added to include plant species that provide abundant pollen and nectar for native pollinators where feasible.	**X**	**--**	**E**

Conservation Practice Name (Units)	Code	Relevance to Pollinator Habitat	Consideration	Criteria	Pollinator Job Sheet Available
Early Successional Habitat Development/Management (Ac.)	**647**	This pollinator practice may be utilized as the primary maintenance practice for retaining pollinator habitat; or it could be utilized to create openings or areas for pollinators. Strip disking and mowing should be used to revitalize rank stands and improve vegetative structure and density. Inter-seeding of non-native, non-invasive or native plants can benefit pollinators, but are seldom enough to provide resources throughout the season. In some situations, openings in otherwise less suitable cover may be established to provide open and sunny habitat for pollinators.	**X**	**X**	**M, E**
Field Border (Ac.)	**386**	This practice may provide nesting, foraging and various other forms of habitat along edges of fields. It provides early successional habitat by planting pollinator species a minimum of 20 feet wide to plants that provide resources throughout the year.	**X**	**X**	**X, E**
Filter Strip (Ac.)	**393**	Filter strips can be used to provide supplemental pollinator resources within crop fields; especially in areas where there the landscape is somewhat homogenous. However, the primary purpose of the filter strip should not be compromised. Increasing the flow length (10 feet) on the downstream side of the filter strip and including legumes or other forbs that provide pollen and nectar is a good secondary resource.	**X**	**X**	**M**
Forage and Biomass Planting (Ac.)	**512**	A consideration was added to include diverse legumes (e.g. alfalfa, clovers) or other forbs that provide pollen and nectar for native pollinators. **NOTE: Criteria for establishment of warm season grass species for purposes other than forage and biomass is located under conservation practice standard (327) Conservation Cover.**	**X**	**--**	**--**
Forage Harvest Management (Ac.)	**511**	Delayed harvest of areas utilized for hayland to provide forage areas for pollinators. Delayed or idling of fields in rotations of 2-3 years provides areas for bumble bee nesting and forbs.	**X**	**X**	**M**
Forest Stand Improvement (Ac.)	**666**	This practice has had a consideration added that can help maintain open understory and forest gaps that support diverse forbs and shrubs that provide pollen and nectar for pollinators.	**X**	**--**	**E**

Conservation Practice Name (Units)	Code	Relevance to Pollinator Habitat	Consideration	Criteria	Pollinator Job Sheet Available
Grassed Waterway (Ac.)	**412**	A consideration was added to this standard to avoid or protect important wildlife habitat, such as woody cover or wetlands when determining the location of the grassed waterways. If trees and shrubs are incorporated, they should be retained or planted only in the periphery so they do not interfere with hydraulic functions. Medium or tall bunch grasses and perennial forbs may also be planted along waterway margins to improve pollinator habitat. Waterways with these wildlife features are more beneficial when connecting other habitat types; e.g., riparian areas, wooded tracts and wetlands. When possible, select species of vegetation that can serve multiple purposes, such as benefiting wildlife, while still meeting the basic criteria needed for providing a stable conveyance for runoff. Include diverse legumes or other forbs that provide pollen and nectar for native pollinators. The criteria is to include a minimum of three species (one in each concurrent bloom period) to supply additional pollen and/or nectar resources. Flow length should be increased a minimum of 10 feet.	**X**	**X**	**M**
Hedgerow Planting (Ft.)	**422**	The minimum width for hedgerows where the principle purpose is to provide pollinator habitat is **25 feet**. Include trees and shrubs that provide pollen and nectar during the entire growing season (a minimum of three woody species in the bloom periods of very early, early and mid season). Consider integrating shrubs that provide nesting cover for tunnel nesting bees or provide artificial nesting blocks, and management that provides semi-bare ground and un-mowed herbaceous strips for bumble bees. This practice also can help reduce drift of pesticides onto areas of pollinator habitat as well. Consider using this practice alone or in combination with other practices to create a minimum pollinator enhancement of at least one-half acre.	**X**	**X**	**X**

Conservation Practice Name (Units)	Code	Relevance to Pollinator Habitat	Consideration	Criteria	Pollinator Job Sheet Available
Herbaceous Weed Control (Ac.)	**315**	This practice is to be utilized to reduce or eliminate noxious herbaceous plants in order to maintain or restore a native plant community or maintain an established plant community that supports native pollinators (O&M). Where possible, establish replacement species prior to removal to provide pollinator resources when noxious species are suspected of providing the principle source of pollinator habitat. In addition, apply herbicides in wildlife friendly methods to prevent harm to native pollinators and their food sources.	**X**	**X**	**--**
Integrated Pest Management (Ac.)	**595**	Criteria for direct contact pesticide risks to pollinators and other beneficial species in the application area were added that require at least two IPM mitigation techniques from the Pesticide Direct Contact section of Agronomy Technical Note 5 - *Pest Management in the Conservation Planning Process*. A consideration was added for biological pest management to include plantings that attract beneficial insects that predate or parasitize crop pests. Plants commonly used for pest management beneficial to bees include: yarrow (*Achillea* spp.), phacelia (*Phacelia* spp.), and sunflowers (*Helianthus* spp.)	**X**	**X**	**X**
Prescribed Grazing (Ac.)	**528**	Flash grazing or long rotation periods can create disturbance regimes and assist in maintaining early successional habitat and associated flowering plants. This practice should be utilized as an O&M practice to maintain well established stands of pollinator habitat. For pollinator habitat disturbance regimes, flash grazing should have long rotation periods and should be performed no more frequently than every two to three years.	**--**	**--**	**M**
Residue and Tillage Management, No-Till/Strip Till/Direct Seed (Ac.)	**329**	This practice has the ability to provide protection of nest sites by converting tillage operations to no-till or minimal tillage. Leaving standing crop residue can protect bees that are nesting in the ground at the base of the plants they pollinate (i.e., squash). Tillage digs up these nests (located 0.5 to 3 feet underground) or blocks the emergence of new adult bees the preceding year. This practice should be utilized primarily to protect established nest sites in vegetable crop settings.	**X**	**X**	**X**

Conservation Practice Name (Units)	Code	Relevance to Pollinator Habitat	Consideration	Criteria	Pollinator Job Sheet Available
Restoration and Management of Rare and Declining Habitats (Ac.)	**643**	A consideration was added to this practice. It could be used to provide diverse locally grown native forage (forbs, shrubs, and trees) and nesting resources for pollinators. Many specialist pollinators are closely tied to rare plants or habitats and these plants and rare plants may significantly benefit from efforts to restore and\or manage rare habitat. However, pollinator plants should only be planted if they were part of the rare ecosystem you are trying to restore.	**X**	**--**	**--**
Riparian Forest Buffer (Ac.)	**391**	Include trees, shrubs, and forbs especially chosen to provide pollen and nectar during the entire growing season for pollinators. This practice also can help reduce drift of pesticides to areas of pollinator habitat.	**X**	**X**	**E**
Riparian Herbaceous Cover (Ac.)	**390**	Include diverse forbs and native grasses or sedges that provide pollen and nectar during the entire growing season for native bees.	**X**	**X**	**M**
Stream Habitat Improvement and Management (Ac.)	**395**	A consideration was added to this standard to select plants for adjoining riparian areas. These can include trees, shrubs, and forbs that provide pollen and nectar for pollinators. Maximizing plant diversity in riparian areas will result in more pollinators and other terrestrial insects to feed fish in the streams.	**X**	**--**	**M**
Streambank and Shoreline Protection (Ft.)	**580**	Upon the next revision of this standard, a consideration will be added to remind planners that shrubs, trees and forbs especially chosen that provide pollen and nectar for pollinators (e.g., willow -*Salix* spp., dogwood -*Cornus* spp. and goldenrod -*Solidago* spp.) could be included in almost any restoration plan.	**X**	**--**	**--**
Stripcropping (Ac.)	**585**	This standard contains criteria to establish at least three species (one in each bloom period) that provide supplemental forage before, during and after the primary crop bloom was added. There are also considerations to include diverse legumes or other forbs that provide pollen and nectar for native pollinators were included. If insect pollinated crops are grown, plants used in adjacent strips of vegetative cover may be carefully chosen to provide complementary bloom periods prior to and after the crop.	**X**	**X**	**X**
Tree/Shrub Establishment (Ac.)	**612**	Include trees and shrubs especially chosen to provide pollen and nectar for pollinators, or host plants for butterflies, and nesting habitat for tunnel nesting bees.	**X**	**X**	**E**

Conservation Practice Name (Units)	Code	Relevance to Pollinator Habitat	Consideration	Criteria	Pollinator Job Sheet Available
Upland Wildlife Habitat Management (Ac.)	**645**	This practice has been revised to include the WV Pollinator Handbook and habitat appraisal methodology and the requirements to report this practice. It should be the governing practice utilized to provide and establish pollinator habitat in West Virginia.	**X**	**X**	**--**
Vegetative Barriers (Ft.)	**601**	Upon the next revision of this standard, this practice will have a consideration added to include plants that provide pollen and nectar for pollinators as long as they are of a stiff, upright stature for impeding surface water flow. Refer to the West Virginia Pollinator Handbook or contact the State Biologist for recommendations of specific plants.	**X**	**--**	**--**
Vegetated Treatment Area (Ac.)	**635**	Consider utilizing plants that provide pollen and nectar for pollinators. Plants that have characteristics that could be utilized for vegetated treatment areas may also serve as supplemental pollinator forage. Refer to the West Virginia Pollinator Handbook or contact the State Biologist for recommendations of specific plants.	**X**	**--**	**--**
Wetland Enhancement (Ac.)	**659**	A consideration will be added to this standard. Wetland and adjacent uplands could be enhanced such that trees, shrubs and forbs are selected to provide pollen and nectar for pollinators. Snags should be identified and protected or nest blocks for bees erected to provide supplemental nesting areas. Some forbs used for restoration will enable pollinator reproduction.	**X**	**--**	**E**
Wetland Restoration (Ac.)	**657**	When restoring wetlands and adjacent upland, consider including trees, shrubs, and forbs that provide pollen and nectar for pollinators. Snags should be identified and protected or nest blocks for bees erected to provide supplemental nesting areas. Some forbs used for restoration will enable pollinator reproduction.	**X**	**--**	**E**
Wetland Wildlife Habitat Management (Ac.)	**644**	A consideration was added o this standard. Wetlands and adjacent uplands can include trees, shrubs, and forbs especially chosen to provide pollen and nectar for pollinators. Snags can be protected or nest blocks for bees erected.	**X**	**--**	**--**

Conservation Practice Name (Units)	Code	Relevance to Pollinator Habitat	Consideration	Criteria	Pollinator Job Sheet Available
Windbreak/Shelterbelt Establishment (Ft.)	**380**	Include trees, shrubs, and forbs especially chosen to provide pollen and nectar for pollinators. These areas may also be used to develop nesting habitats or place nesting structures for native bees. Windbreaks and shelterbelts also will help reduce drift of insecticides to areas of pollinator habitat.	**X**	**X**	**E**

The tables below list the primary practices anticipated to be used to provide pollinator resources. Primary practices have specific criteria geared toward providing resources to pollinators. Secondary practices are practices that could have pollinator benefits if it is installed with pollinators in mind. Secondary practices have other principle purposes but have considerations for pollinators in the standard. Other practices may have criteria or considerations outlined within the standard that could be useful in addressing the needs of pollinators. All primary practices should ideally be planned under (645) Upland Wildlife Habitat Management as component practices.

Reference Guide to Various Pollinator Requirements and Corresponding Conservation Practices

Pollinator Resource		Primary Conservation Practice Code and Name	Secondary Conservation Practice Code and Name	
FOOD	Forage (diverse sources of pollen and nectar that support pollinators from early in the spring to late in the fall)	327 Conservation Cover 328 Conservation Crop Rotation 340 Cover Crop 386 Field Border 390 Riparian Herbaceous Cover 391 Riparian Forest Buffer 422 Hedgerow Planting 612 Tree/Shrub Establishment	311 Alley Cropping 322 Channel Bank Vegetation 331 Contour Orchard and Other Perennial Crops 332 Contour Buffer Strips 342 Critical Area Planting 393 Filter Strip 395 Stream Habitat Improvement and Management	412 Grassed Waterway 512 Forage and Biomass Planting 585 Stripcropping 635 Vegetated Treatment Area 644 Wetland Wildlife Habitat Management 657 Wetland Restoration 659 Wetland Enhancement 666 Forest Stand Improvement
NESTING	Nest sites (stable ground, holes in wood, cavities for bumble bees, or overwintering sites for bumble bee queens)	329 Residue & Tillage Management, No-Till/Strip Till/Direct Seed 386 Field Border 390 Riparian Herbaceous Cover 391 Riparian Forest Buffer 422 Hedgerow Planting 511 Forage Harvest Management 647 Early Successional Habitat Development/Management INT Artificial Nesting Structures for Wildlife *	380 Windbreak/Shelterbelt Establishment 395 Stream Habitat Improvement and Management 580 Streambank and Shoreline Protection 601 Vegetative Barriers 643 Restoration and Management of Rare and Declining Habitats 644 Wetland Wildlife Habitat Management	657 Wetland Restoration 659 Wetland Enhancement 666 Forest Stand Improvement

Pollinator Resource		Primary Conservation Practice Code and Name	Secondary Conservation Practice Code and Name	
REFUGE	Pesticide protection (refuge from spray, buffers to drift, etc.)	380 Windbreak/Shelterbelt Establishment 386 Field Border 391 Riparian Forest Buffer 422 Hedgerow Planting 595 Integrated Pest Management 612 Tree/Shrub Establishment	322 Channel Bank Vegetation 393 Filter Strip 395 Stream Habitat Improvement and Management 412 Grassed Waterway 601 Vegetative Barriers 635 Vegetated Treatment Area	657 Wetland Restoration 659 Wetland Enhancement
O&M	Site management for pollinators	314 Brush Management 315 Herbaceous Weed Control 511 Forage Harvest Management 528 Prescribed Grazing 647 Early Successional Habitat Development/Management	643 Restoration and Management of Rare and Declining Habitats 644 Wetland Wildlife Habitat Management 657 Wetland Restoration 659 Wetland Enhancement	666 Forest Stand Improvement

*Note that *Artificial Nesting Structures for Wildlife* is an interim conservation practice standard and as of June 2011 has not been assigned a 700 series number for use in WV. Therefore it has been identified as practice code INT. Check with the State Biologist to determine the current status.

Appendices

I. Financial Resources

The following table is an excerpt from Using Farm Bill Programs for Pollinator Conservation - Technical Note No. 78, August 2008

The following are Farm Bill conservation programs that could be used to promote pollinators on working lands either directly or indirectly; and may provide financial assistance for implementation of pollinator friendly conservation practices. All programs are voluntary. Please see the NRCS or FSA Web sites for more information (http://www.nrcs.usda.gov/programs/) (http://www.fsa/usda.gov).			
PROGRAM	**PURPOSE**	**LAND ELIGIBILITY**	**TYPE OF ASSISTANCE**
Agricultural Management (AMA)	Program to address and mitigate rick associated with issues such as water management, water quality and erosion control by incorporating conservation into their farming operations.	Producers may construct or improve water management structures or irrigation structures; plant trees for windbreaks or to improve water quality; and mitigate risk through production diversification or resource conservation practices, including soil erosion control, or transition to organic farming on agricultural land, nonindustrial private forest land, or other land on which agricultural products, livestock or forest-related products are produced.	Provides technical and financial assistance to eligible producers through various incentive and other payments for installation of conservation practices. Contact the local NRCS office for more information.
Conservation Reserve Enhancement Program (CREP)	Land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. An offshoot of the Conservation Reserve Program, CREP emphasizes partnerships among State, Tribal, or local governments, private groups, and the USDA.	Lands that address an agriculture-related environmental issue of State significance such as impacts to water quality, loss of critical habitat for various wildlife species, soil erosion, and reduced habitat for fish populations. The West Virginia CREP helps reduce agricultural runoff and sediment from entering the Cheat, Kanawha, Little Kanawha, Monongahela, Potomac, and Ohio River Watersheds.	Annual payment plus cost-share of up to 50% of the eligible costs to install the practice. CREP contracts require a 10- to 15-year commitment to keep lands out of agricultural production. CREP is administered by FSA; NRCS provides technical assistance. Contact the NRCS or Farm Services Agency (FSA) local office for more information.

The following are Farm Bill conservation programs that could be used to promote pollinators on working lands either directly or indirectly; and may provide financial assistance for implementation of pollinator friendly conservation practices. All programs are voluntary. Please see the NRCS or FSA Web sites for more information (http://www.nrcs.usda.gov/programs/) (http://www.fsa/usda.gov).			
PROGRAM	**PURPOSE**	**LAND ELIGIBILITY**	**TYPE OF ASSISTANCE**
Conservation Reserve Program (CRP)	Land retirement program encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers. Addresses issues raised by State, regional, and National conservation initiatives.	Highly erodible land, wetland, streamside areas in pasture land, and certain other lands. Eligible wetlands must have been cropped 3 of 10 previous years, highly erodible cropland 4 of 6 previous years. Pollinators are high priority wildlife under CRP practice CP38 Safe Acres for Wildlife Enhancement.	Financial assistance for establishing permanent cover and conservation practices, and annual rental payments for land enrolled in 10- to 15-year contracts. Additional financial incentives are available for some practices. CRP is administered by FSA; NRCS provides technical land eligibility determinations, conservation planning, and practice implementation. Contact the NRCS or FSA local office.
Conservation Stewardship Program (CSP) *formerly the Conservation Security Program*	Addresses resource concerns comprehensively by 1) undertaking additional conservation activities; and 2) improving, maintaining, and managing existing conservation activities. The CSP encourages farmers to broadly improve their conservation effort to protect water and air quality, improve soil quality, store carbon in soils, add wildlife habitat, conserve water, and save energy.	Private agricultural land, and forested land incidental to agriculture. Land converted to cropland since 2008 is not eligible.	Annual payments based on expenses, foregone income, and environmental benefits; 5-year contracts renewable for another 5 years. Contact the local NRCS office.
Environmental Quality Incentives Program (EQIP)	Promotes agricultural production and environmental quality as compatible National goals by helping eligible participants install or implement structural and management practices.	Land on which agricultural commodities, livestock, or forest-related products are produced.	Financial assistance for installed conservation practices or 100% of foregone income; contracts run 1 year past last practice installation, up to 10 years. Up to 3 years of incentive payments for certain management practices. Contact the NRCS local office.

The following are Farm Bill conservation programs that could be used to promote pollinators on working lands either directly or indirectly; and may provide financial assistance for implementation of pollinator friendly conservation practices. All programs are voluntary. Please see the NRCS or FSA Web sites for more information (http://www.nrcs.usda.gov/programs/) (http://www.fsa/usda.gov).			
PROGRAM	**PURPOSE**	**LAND ELIGIBILITY**	**TYPE OF ASSISTANCE**
Grassland Reserve Program (GRP)	Help owners and operators protect grazing uses and related conservation values by restoring and conserving eligible land through rental contracts, easements, and restoration agreements.	Historical grassland used primarily for grazing that has high conservation, ecological, or archeological value.	Financial assistance for restoration; annual payment up to 75% of the grazing value of the land for 10-, 15-, or 20-year rental contracts, or easement payments no greater than fair market value less the encumbered grazing value for permanent easements or easements for the maximum duration allowed under State law. GRP is jointly administered by NRCS, FSA, and U.S. Forest Service. Contact the NRCS or FSA local office.
Wetland Reserve Program (WRP)	Land retirement program to restore, protect, or enhance wetlands on private lands.	Farmed wetland or wetland converted to agriculture before 1985, together with functionally dependent adjacent land, or cropland or grassland that was used for agricultural production prior to natural flooding.	Private lands: 1) Permanent easement payment equal to forgone value plus 100% of restoration costs; or 2) 30-year easement payment (75% of forgone value) plus 75% of restoration costs; or 3) restoration cost-share agreement (usually 10 years) with payment of 75% of restoration costs. Contact the NRCS local office.
Wildlife Habitat Incentive Program (WHIP)	Develop wildlife habitat on private lands.	High-priority fish and wildlife habitats, especially habitat for declining species, otherwise unfunded beneficial practices, or locally determined fish and wildlife priority habitats.	Financial assistance for conservation practices under standard 5- to 10-year contracts, or higher rates for a limited number of 15-year contracts. Contact the NRCS local office.

Defenders of Wildlife maintains a summary of state and regional financial incentive programs through the **Biodiversity Partnership** project. A number of these incentive programs may be suitable for pollinator conservation and could be used in conjunction with NRCS conservation programs. Information can be found at http://www.defenders.org/programs_and_policy/biodiversity_partners/

II. Plant Tables

A WORD CONCERNING POLLINATOR PLANTS

The following lists were largely compiled with the assistance of Elizabeth Byers and Sam Norris of the WV Natural Heritage Program, WV Division of Natural Resources. In order to reduce the size and length of the lists, some species were not included due to their infrequency of occurrence or the commercial availability was questionable. Where there were many species of the same genus and those species were all suitable with very little difference among the plant, the genera was listed as *spp.* This indicates that there are multiple species within a genus that could be useful for pollinator enhancement purposes. Consult technical experts to determine if a particular species is suitable for use, propagation and the flowering characteristics.

These tables contain: Two species of native vines, twelve species suitable for cover crops/green manures, five beneficial vegetable crops, twenty-four beneficial non-invasive, non-native plants, one hundred nineteen species of native pollinator friendly plants and eighteen beneficial native genera. Only perennial plants were identified for use in the pollinator plant tables (Tables A and B). This is not to imply that annual and biennial plants do not provide food or other resources for pollinators and cannot be utilized. The premise is that flowering annuals are usually present throughout the West Virginia landscape and in the settings where these practices are usually applied. The establishment of permanent habitat consisting of perennials would be more economical and provide greater benefit over a longer period of time. Note that some USDA programs may not provide financial assistance for establishment of annual plants under some circumstances.

It is not imperative to plant or establish only the native plants that are listed in this document. However, it is highly suggested to include the maximum amount of native species practical. Often times it is necessary to include non-native or introduced species to fill in gaps of bloom times, provide additional color or to provide pollinator resources during cropping sequences. Any non-native species utilized should not be invasive or established at the expense of native plant species. The list of non-natives that are non-invasive and could be used in conjunction with native species in mixes or established as individual stands is included. There are certainly other species that could be utilized. Consult with technical specialists to determine the suitability of those species.

There is a vast array of native forbs to choose from when designing pollinator enhancements. The following tables include native species to consider using when planning hedgerows, at the base of one or both sides of a hedgerow, riparian buffers, windbreaks, alley cropping, field borders, filter strips, waterways, bee pastures, nectar corridors or any planting to enhance conditions for pollinators. The following are just some of the plant options that you might want to consider. Pay close attention to overlapping bloom periods and the appropriate plant for the site conditions. Species should be selected according to light regimes, moisture requirements, height, pH concerns, color and blooming periods. They may require supplemental irrigation and fertilization. Establishment of perennial plants or a complete thriving population may take a few years, but will often last for an extended period of time.

There are numerous native vines that provide resources for pollinators in West Virginia. These species are not easily established or propagated, and/or most are not widely available commercially. This list is provided for information to clients that they may recognize existing value within the landscape. If these species are identified within the landscape they should be encouraged and retained.

PLANT TABLE NOTES AND DEFINTITIONS:

1. Invasive species as defined by the WVDNR are not included on this list. Rare and imperiled species tracked by the WV Natural Heritage Program are also not included.

2. **Wetland** – These codes are based on National Wetland Inventory indicator status, updated for West Virginia in 2009 and is included to provide insight to the areas for establishment (e.g. wetland restoration, flood prone areas, etc.). Use this to determine potential candidates for establishment for wetter areas or more dry conditions.

    - **OBL**: Obligate wetland taxon. Occur almost always (estimated probability >99%) under natural conditions in wetlands.
    - **FACW**: Facultative wetland taxon. Usually occur in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
    - **FAC**: Facultative taxon. Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
    - **FACU**: Facultative upland taxon. Usually occur in non-wetlands (estimated probability 67%-99%), but occasionally found in wetlands (estimated probability 1%-33%).
    - For the purposes of this document, if the field is blank the wetland code is considered upland (**UPL**)

3. **Form**: Describes the type of plant as:

    T – tree
    S – shrub
    T/S – tree/shrub
    V – vine *
    F – forb (wildflower)
    G – graminoid (grass or sedge)

** There are a few native vines that provide resources for pollinators in West Virginia. These species are not widely commercially available. The few species included within this list are primarily listed for planning information and to inform clients that these species are valuable where they occur naturally. Therefore they should be retained when management practices are implemented. Consult technical experts to determine if a species is suitable for use, propagation and the flowering characteristics.*

4. **Shade Tolerance:** Describes the relative tolerance for this plant to grow in shade conditions.

    Intolerant: will not tolerate shaded conditions
    Intermediate: will tolerate partially shaded conditions
    Tolerant: will tolerate full shade and usually does not prefer full sun

5. **Bloom Periods** are defined as follows:
    March (or earlier) to April = **Very Early Season***
    March through May = **Early Season**
    May through July = **Mid Season**
    July through Sept **(**or later) = **Late Season**

    Counts as a single blooming period for herbaceous plantings.

** Note that **Very Early** and **Early** plants may constitute one blooming period. Very early blooming plants are not critical or required for overlapping bloom times in herbaceous plantings.*

6. **Drainage** – refers to the range of soil drainage that the plant species will tolerate. Class is defined as follows:

    - **Well Drained**: Water is removed from the soil readily but not rapidly and available to plants most of the growing season. Wetness does not inhibit growth of roots for significant periods.
    - **Moderately Well Drained**: Water is removed from the soil somewhat slowly during some periods. These soils are wet for only a short time during the growing season. They may contain a slowly pervious layer or receive periodic heavy rainfall or both.
    - **Somewhat Poorly Drained**: Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of some plants. They commonly have a slowly pervious layer or receive periodic heavy rainfall or both.
    - **Poorly Drained**: Water is removed so slowly that the soil remains saturated for significant portions or remains wet for long periods during the growing season. Free water is commonly at the surface. Poor drainage may result from high water tables, slowly draining pervious layers within the profile, seepage or any combination of these factors.

7. **Pollinator Preference** – The identified plant species produce resources that attract, support or are pollinated by native bees, butterflies, hummingbirds, various beneficial insects, beetles or flies. There are a few species that provide mostly nesting and overwintering protection; although these species do may also provide some secondary pollinator resources. Some plants provide resources for multiple insects; therefore they may have multiple codes. These codes are identified as follows:

    NB – Native Bee Species
    BU– Native Butterfly Species
    H – Ruby-throated Hummingbirds
    BI – Beneficial Insects
    B – Beetles
    F – Flies
    N/O – Nesting and Overwintering

8. **Height at Maturity** – This indicates the potential height the plant will reach upon maturing and may vary depending upon local site conditions such as soil fertility, sunlight, climate, etc.

9. **pH Range** – This range indicates the minimum and maximum soil pH, of the top 12 inches of soil, within the plant's known geographical range.

10. **spp**. – These are taxons listed to indicate that there are multiple species within this genus that could be useful for pollinators and/or habitat enhancement purposes. Consult technical specialists to determine if a particular species is suitable for use, propagation, commercial availability and the flowering characteristics.

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Acer rubrum	Red Maple	Very Early	Red	90	Tolerant	4.5 – 7.5	NB	Well – Somewhat Poorly	T	FAC
Actaea racemosa	Black Cohosh	Late	White	3	Tolerant	5.0 – 7.9	NB, BU, F	Moderately Well – Somewhat Poorly	F	
Agastache scrophulariifolia	Purple Giant Hyssop	Mid	Purple	4	Intermediate	5.9 – 8.0	NB, BU	Well – Somewhat Poorly	F	
Agastache spp.	Hyssop	– –	– –	– –	– –	– –	NB, BU	– –	F	
Amelanchier arborea	Common Serviceberry	Very Early	White	50	Tolerant	4.8 – 7.5	NB, BU	Moderately Well – Somewhat Poorly	T	FAC
Amelanchier spp.	Sarvice	– –	– –	– –	– –	– –	NB, BU	– –	T	– –
Andropogon gerardii	Big Bluestem	Mid	Yellow	6	Intolerant	6.0 – 7.5	N/O	Well – Moderately Well	G	FAC
Andropogon virginicus	Broomsedge	Late	Yellow	3	Intolerant	4.7 – 9.0	N/O	Well – Moderately Well	G	FACU
Apocynum androsaemifolium	Spreading Dogbane	Mid	Pink	3	Intolerant	5.0 – 7.5	NB, BU, BI	Well – Moderately Well	F	FAC
Apocynum cannabinum	Indian – Hemp	Mid	White	3	Intermediate	4.5 – 7.0	NB, BU, BI	Well – Somewhat Poorly	F	FAC
Asclepias syriaca	Common Milkweed	Mid	Pink	5	Intermediate	5.0 – 7.5	NB, BU, BI	Well – Somewhat Poorly	F	FACU
Asclepias tuberosa	Butterflyweed	Mid	Orange	3	Intermediate	5.0 – 7.0	NB, BU, BI, H	Well – Moderately Well	F	
Asclepias spp.	Milkweeds	Mid	– –	– –	– –	– –	NB, BU, BI	– –	F	– –

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Asimina triloba	Common Pawpaw	Very Early	Purple	30	Tolerant	4.7 – 7.2	NB	Moderately Well – Poorly	T	FACU
Baptisia tinctoria	Yellow Wild Indigo	Early	Yellow	2	Intolerant	5.8 – 7.0	NB	Well – Moderately Well	F	
Baptisia australis	Blue False Indigo	Early	Purple	3	Intolerant	5.9 – 7.8	NB	Well – Moderately Well	F	
Bidens laevis	Smooth Beggartick	Late	Yellow	3	Intermediate	5.0 – 7.0	NB	Poorly	F	OBL
Bidens spp.	Tickseeds	Late	– –	– –	– –	– –	NB	– –	F	
Bignonia capreolata	Crossvine	Mid	Red	60	Intermediate	5.0 – 6.5	H	Moderately Well – Somewhat Poorly	V	FAC
Blephilia ciliata	Downy Woodmint	Late	Purple	3	Intermediate	5.1 – 7.9	NB, B	Well – Moderately Well	F	
Campsis radicans	Trumpet–Creeper	Late	Red	20	Intolerant	4.9 – 6.8	NB H	Moderately Well – Somewhat Poorly	V	FAC
Carex lurida	Shallow Sedge	Late	Green	3	Intermediate	4.9 – 6.8	N/O	Poorly	G	OBL
Carex spp.	Sedges	Late	– –	– –	– –	– –	N/O	– –	G	– –
Castanea pumila	Allegheny Chinquapin	Mid	Yellow	20	Intermediate	4.5 – 6.6	NB, BU	Well – Moderately Well	T	
Ceanothus americanus	New Jersey – Tea	Mid	White	3	Tolerant	4.3 – 6.5	NB, BU, H	Well – Moderately Well	S	
Cephalanthus occidentalis	Common Buttonbush	Late	White	20	Tolerant	4.7 – 8.6	NB, BU	Poorly	S	OBL

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Cercis canadensis	Eastern Redbud	Very Early	Purple	16	Tolerant	5.0 – 7.8	NB, BU	Well – Somewhat Poorly	T/S	FACU
Chelone glabra	White Turtlehead	Late	White	3	Intermediate	5.5 – 7.5	BU	Poorly	F	OBL
Claytonia virginica	Virginia Springbeauty	Early	Pink	1	Tolerant	5.0 – 7.0	NB, F	Well – Somewhat Poorly	F	
Clethra acuminata	Mountain Sweet – Pepperbush	Late	White	15	Tolerant	5.5 – 7.5	NB	Well – Somewhat Poorly	S	
Clinopodium vulgare	Wild Basil	Late	Purple	4	Intermediate	5.0 – 7.5	NB	Well – Moderately Well	F	
Conoclinium coelestinum	Blue Mistflower	Late	Blue	2	Intermediate	5.5 – 7.5	BU	Moderately Well – Somewhat Poorly	F	
Coreopsis lanceolata	Long – Stalk Tickseed	Mid	Yellow	2	Intolerant	6.0 – 7.0	NB, BU, BI	Moderately Well – Somewhat Poorly	F	FACU
Crataegus spp.	Hawthorn	Mid	– –	– –	– –	– –	NB, BU, H	Well – Somewhat Poorly	S	– –
Delphinium tricorn	Dwarf Larkspur	Early	Purple	1	Tolerant	5.8 – 7.8	NB, BU	Well – Somewhat Poorly	F	
Diospyros virginiana	Persimmon	Early	Yellow	50	Tolerant	4.7 – 7.5	NB	Well – Somewhat Poorly	T	FAC
Dodecatheon meadia	Shooting Star	Early	White	2	Tolerant	4.5 – 7.5	NB	Well – Moderately Well		FACU
Doellingeria umbellata	Flat topped White Aster	Late	White	3	Intermediate	5.5 – 7.9	NB, BU	Somewhat Poorly – Poorly	F	FACW
Eupatorium fistulosum	Common Joe Pye Weed	Late	Purple	11	Intermediate	5.0 – 7.5	NB, BU	Moderately Well – Somewhat Poorly	F	FAC

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Eupatorium perfoliatum	Boneset	Late	White	4	Intermediate	5.0 – 7.5	NB, BU	Somewhat Poorly – Poorly	F	FACW
Eupatorium serotinum	Late Thoroughwort	Late	White	6	Intermediate	5.0 – 7.5	NB, BU	Moderately Well – Somewhat Poorly	F	FAC
Eupatorium spp.	Joe –Pye Weed	Late	– –	– –	– –	– –	NB, BU	– –	F	– –
Gaylussacia baccata	Black Huckleberry	Mid	White	2	Tolerant	4.5 – 6.5	NB	Well – Moderately Well	S	FACU
Gentiana andrewsii	Bottle Gentian	Late	Purple	1	Intermediate	5.8 – 7.2	NB	Somewhat Poorly – Poorly	F	FACW
Geranium maculatum	Spotted Geranium	Early	Purple	2	Intermediate	5.5 – 8.5	NB, BU	Well – Somewhat Poorly	F	FACU
Helenium autumnale	Yellow Sneezeweed	Late	Yellow	4	Intolerant	4.0 – 7.0	NB, BU	Somewhat Poorly – Poorly	F	FACW
Helianthus tuberosus	Jerusalem Artichoke	Late	Yellow	10	Intermediate	4.0 – 7.0	NB, BU	Well – Somewhat Poorly	F	FAC
Helianthus spp.	Sunflowers	Late	Yellow	– –	– –	– –	– –	– –	F	– –
Hibiscus moscheutos	Eastern Rosemallow	Late	White	6	Intolerant	4.0 – 7.5	NB, BU, H	Poorly	F	OBL
Hydrophyllum virginianum	Shawnee Salad	Early	Blue	2	Tolerant	5.7 – 7.5	NB	Moderately Well – Somewhat Poorly	F	FAC
Hypericum spp.	St. Johns-Wort	Mid	Yellow	– –	– –	– –	– –	– –	S	– –
Juncus spp.	Rushes	Late	– –	– –	– –	– –	N/O	– –	G	– –

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Kalmia latifolia	Mountain Laurel	Mid	Purple	5	Tolerant	4.5 – 5.5	BU	Well – Moderately Well	S	FACU
Lamium amplexicaule	Henbit	Early	Purple	1	Intermediate	4.0 – 8.9	NB	Well – Somewhat Poorly	F	
Lespedeza intermedia	Intermediate Lespedeza	Late	Purple	3	Intermediate	5.0 – 9.0	NB	Well – Somewhat Poorly	F	
Lespedeza virginica	Virginia Bushclover	Late	Purple	3	Intermediate	5.7 – 9.0	NB	Well – Somewhat Poorly	F	
Liatris aspera	Rough Blazingstar	Late	Purple	3	Intolerant	5.6 – 7.5	NB, BU, H	Well – Moderately Well	F	
Liatris spicata	Gay Feathers	Late	Purple	4	Intermediate	5.6 – 7.5	NB, BU, H	Moderately Well – Poorly	F	FAC
Lilium canadense	Canada Lilly	Mid	Pink	2	Intolerant	4.9 – 7.0	NB, BU	Moderately Well – Somewhat Poorly	F	FAC
Lilium superbum	Turk's Cap Lilly	Mid	Orange	4	Intolerant	5.8 – 7.8	NB, BU	Somewhat Poorly – Poorly	F	FACW
Liriodendron tulipifera	Tuliptree	Mid	Yellow	120	Intolerant	4.5 – 6.5	NB, H	Well – Moderately Well	T	FACU
Lobelia cardinalis	Cardinal – Flower	Late	Red	3	Intermediate	5.8 – 7.8	BU, H	Somewhat Poorly – Poorly	F	FACW
Lobelia siphilitica	Great Blue Lobelia	Late	Blue	3	Intermediate	5.6 – 7.8	BU	Moderately Well – Somewhat Poorly	F	FACW
Lupinus perennis	Wild Lupine	Early	Blue	2	Intermediate	5.8 – 7.8	NB, BU	Well – Moderately Well	F	
Mentha arvensis	Wild Mint	Late	White	2	Intermediate	5.0 – 7.0	NB, BU	Somewhat Poorly – Poorly	F	FACW

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Mertensia virginica	Virginia Bluebells	Very Early	Blue	2	Tolerant	4.5 – 8.0	NB, BU	Moderately Well – Poorly	F	FACW
Mimulus ringens	Square Stemmed Monkey Flower	Mid	Blue	2	Intermediate	5.8 – 8.9	NB	Somewhat Poorly – Poorly	F	OBL
Monarda clinopodia	Basil Balm	Mid	White	3	Intermediate	5.6 – 7.6	NB, BU	Well – Moderately Well	F	
Monarda didyma	Scarlet Beebalm	Late	Red	3	Intermediate	5.0 – 8.1	NB, BU, H	Moderately Well – Somewhat Poorly	F	FAC
Monarda fistulosa	Wild Bergamot	Late	Purple	3	Intermediate	5.6 – 7.5	NB, BU	Well – Moderately Well	F	
Monarda media	Purple Bergamot	Late	Pink	3	Intermediate	4.9 – 7.0	NB	Moderately Well – Somewhat Poorly	F	
Morus rubra	Red Mulberry	Early	Green	70	Intermediate	5.0 – 7.0	NB	Well – Somewhat Poorly	T/S	FAC
Nyssa sylvatica	Blackgum	Early	White	95	Tolerant	4.5 – 6.0	NB	Well – Somewhat Poorly	T	FAC
Oxydendrum arboreum	Sourwood	Late	White	35	Intermediate	5.0 – 7.5	NB, BU	Well – Somewhat Poorly	T	
Penstemon canescens	Eastern Gray Beard Tongue	Early	Purple	2	Intermediate	5.0 – 7.5	NB, BU, H	Well – Moderately Well	F	
Penstemon digitalis	Foxglove Beardtongue	Early	Purple	4	Intermediate	5.5 – 7.0	NB, BU, H	Moderately Well – Somewhat Poorly	F	FAC
Penstemon hirsutus	Hairy Beardtongue	Early	Purple	2	Intermediate	5.5 – 7.1	NB, H	Well – Somewhat Poorly	F	
Penstemon laevigatus	Smooth Beardtongue	Early	Purple	2	Intermediate	5.5 – 7.1	NB	Moderately Well – Somewhat Poorly	F	FACU

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Phlox divaricata	Wild Blue Phlox	Mid	Purple	3	Intermediate	5.5 – 7.2	NB, BU, H	Well – Somewhat Poorly	F	FACU
Phlox spp.	Phlox	– –	– –	– –	– –	– –	NB, BU	– –	F	– –
Photinia melanocarpa	Black Chokeberry	Early	White	6	Tolerant	4.4 – 6.5	NB, BU	Moderately Well – Somewhat Poorly	S	FAC
Physocarpus opulifolius	Eastern Ninebark	Mid	Purple	10	Intolerant	4.5 – 6.5	NB, BU	Somewhat Poorly – Poorly	T/S	FACW
Physostegia virginiana	Obedient Plant	Late	Purple	3	Intolerant	4.9 – 7.8	NB, BU, H	Moderately Well – Somewhat Poorly	F	
Prunus americana	American Plum	Early	White	30	Intermediate	5.0 – 7.0	NB, BU	Well – Moderately Well	T/S	FACU
Prunus serotina	Black Cherry	Early	White	100	Intolerant	4.0 – 7.5	NB, BU	Well – Somewhat Poorly	T	FAC
Pycnanthemum flexuosum	Narrowleaf Mountainmint	Late	Pink	5	Intolerant	4.6 – 7.0	NB, BU, BI	Well – Moderately Well	F	
Pycnanthemum spp.	Mountainmints	– –	– –	– –	– –	– –	NB, BU, BI	– –	F	– –
Rhododendron arborescens	Smooth Azalea	Mid	White	18	Tolerant	4.2 – 5.7	BU, H	Moderately Well – Poorly	S	FAC
Rhododendron calendulaceum	Flame Azalea	Mid	Orange	20	Tolerant	4.2 – 5.7	NB, BU, H	Well – Moderately Well	T/S	FACU
Rhododendron maximum	Great Laurel	Mid	Pink	20	Tolerant	5.5 – 7.4	NB, BU	Moderately Well – Somewhat Poorly	S	FAC
Rhododendron periclymenoides	Pink Azalea	Mid	Pink	10	Tolerant	4.3 – 5.5	NB, BU	Moderately Well – Somewhat Poorly	S	FAC

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Rhododendron spp.	Laurels, Rhododendrons	– –	– –	– –	– –	– –	NB, BU	– –	S	– –
Robinia pseudoacacia	Black Locust	Mid	White	70	Intermediate	4.6 – 8.2	NB, BU	Well – Somewhat Poorly	T	FACU
Rubus allegheniensis	Allegheny Blackberry	Mid	White	6	Intolerant	4.6 – 7.5	NB, BU	Well – Somewhat Poorly	S	
Rubus spp.	Blackberries, Raspberries	– –	– –	– –	– –	– –	NB, BU	– –	S	– –
Rudbeckia laciniata	Green – Head Coneflower	Late	Yellow	8	Tolerant	4.5 – 7.0	NB, BU	Somewhat Poorly – Poorly	F	FACW
Salix nigra	Black Willow	Very Early	Green	65	Intolerant	4.8 – 8.0	NB	Somewhat Poorly – Poorly	T/S	FACW
Salix spp.	Willows	– –	– –	– –	– –	– –	NB, BU	– –	– –	– –
Salvia lyrata	Lyreleaf Sage	Mid	Blue	4	Intermediate	5.5 – 7.5	NB, BU	Well – Somewhat Poorly	F	
Sambucus nigra ssp. canadensis	Black Elderberry, Common Elder	Mid	White	7	Intermediate	5.0 – 8.9	N/O, BU	Well – Somewhat Poorly	S	FAC
Sambucus racemosa	Red Elder	Early	White	10	Intermediate	5.2 – 7.2	N/O, BU	Well – Somewhat Poorly	S	FAC
Schizachyrium scoparium	Little Bluestem	Late	Yellow	3	Intolerant	5.0 – 8.4	N/O	Well – Moderately Well	G	
Scrophularia lanceolata	Early Figwort	Early	Purple	3	Intolerant	4.5 – 7.6	NB, BU, BI	Well – Moderately Well	F	FACU
Sedum ternatum	Wild Stonecrop	Early	White	1	Tolerant	3.9 – 7.1	NB, BU	Well – Moderately Well	F	

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Senna hebecarpa	Wild Hairy – fruited Senna	Late	Yellow	6	Intolerant	5.0 – 7.0	NB	Well – Moderately Well	F	FAC
Senna marilandica	Wild Senna	Late	Yellow	6	Intermediate	4.0 – 7.0	NB	Moderately Well – Somewhat Poorly	F	FAC
Silene virginica	Fire – Pink	Mid	Red	1	Intermediate	5.0 – 7.0	BU, H	Well – Moderately Well	F	
Silene spp.	Pinks	– –	– –	– –	– –	– –	BU, H	– –	F	– –
Silphium trifoliatum	Whorled Rosinweed	Late	Yellow	6	Intolerant	5.5 – 7.2	NB	Well – Moderately Well	F	
Solidago altissima	Tall Goldenrod	Late	Yellow	4	Intermediate	5.2 – 7.3	NB, BU, BI	Well – Somewhat Poorly	F	
Solidago canadensis	Canada Goldenrod	Late	Yellow	3	Intolerant	4.8 – 7.5	NB, BU, BI	Moderately Well – Somewhat Poorly	F	FACU
Solidago gigantea	Giant Goldenrod	Late	Yellow	8	Intermediate	4.0 – 8.0	NB, BU, BI	Moderately Well – Somewhat Poorly	F	FACW
Solidago juncea	Early Goldenrod, Yellow – Top	Late	Yellow	4	Intolerant	5.0 – 7.5	NB, BU, BI	Well – Moderately Well	F	
Solidago spp.	Goldenrods	– –	– –	– –	– –	– –	NB, BU, BI	– –	F	– –
Spiraea alba	White Meadowsweet	Late	White	3	Intermediate	4.3 – 6.8	NB, BU	Moderately Well – Somewhat Poorly	S	
Spiraea tomentosa	Steeplebush	Late	Pink	6	Intolerant	4.5 – 7.0	NB, BU	Somewhat Poorly – Poorly	S	FACW
Symphyotrichum laeve	Smooth Blue Aster	Late	White	3	Intolerant	5.9 – 7.0	NB, BU, BI	Well – Moderately Well	F	

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Symphyotrichum lateriflorum	Calico Aster	Late	White	3	Intolerant	5.9 – 7.0	NB, BU, BI	Well – Moderately Well	F	FAC
Symphyotrichum novae – angliae	New England Aster	Late	Purple	4	Intermediate	5.2 – 7.5	NB, BU	Somewhat Poorly – Poorly	F	FACW
Symphyotrichum patens	Late Purple American – Aster	Late	Purple	3	Intolerant	4.9 – 7.9	NB, BU	Well – Moderately Well	F	
Symphyotrichum pilosum	Heath Aster	Late	White	3	intolerant	5.4 – 7.0	NB, BU, BI	Well – Moderately Well	F	UPL
Symphyotrichum praealtum	Willowleaf American – Aster	Late	White	3	Intolerant	5.5 – 7.5	NB, BU	Somewhat Poorly – Poorly	F	FACW
Symplocarpus foetidus	Skunk – Cabbage	Very Early	Red	1	Tolerant	4.0 – 7.0	NB	Poorly	F	OBL
Tilia americana	American Basswood	Mid	Yellow	90	Intermediate	4.5 – 7.5	NB, BU, BI	Well – Moderately Well	T	
Tradescantia virginiana	Virginia Spiderwort	Early	Blue	1	Intermediate	4.0 – 8.0	NB, BU, BI	Well – Moderately Well	F	
Tradescantia ohiensis	Ohio Spiderwort	Early	Blue	1	Intermediate	4.0 – 8.0	NB, BU, BI	Moderately Well – Somewhat Poorly	F	FAC
Tradescantia subaspera	Zig-Zag Spiderwort	Early	Purple	1	Intermediate	4.5 – 9.0	NB, BU, BI	Well – Moderately Well	F	
Vaccinium corymbosum	Highbush Blueberry	Mid	White	10	Shade Intolerant	4.7 – 7.5	NB	Somewhat Poorly – Poorly	S	FACW
Vaccinium pallidum	Upland Low Blueberry	Mid	White	2	Intolerant	4.1 – 6.9	NB	Well – Moderately Well	S	
Vaccinium stamineum	Deerberry	Mid	White	6	Tolerant	4.0 – 7.0	NB	Well – Moderately Well	S	FACU

A. Native Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Vaccinium spp.	Blueberries, Huckleberries	– –	– –	– –	– –	– –	NB	– –	– –	– –
Verbena hastata	Blue Vervain	Late	Blue	5	Intolerant	5.1 – 7.1	NB	Somewhat Poorly – Poorly	F	FACW
Vernonia gigantea	Giant Ironweed	Mid	Purple	5	Intolerant	5.6 – 8.2	NB, BU	Moderately Well – Somewhat Poorly	F	FAC
Vernonia noveboracensis	New York Ironweed	Mid	Purple	4	Intolerant	5.2 – 8.8	NB, BU	Moderately Well – Somewhat Poorly	F	FAC
Veronicastrum virginicum	Culver's Root	Mid	White	4	Intolerant	4.8 – 8.8	NB	Well – Moderately Well	F	FACU
Viburnum opulus	American Cranberrybush	Mid	White	6	Intolerant	5.5 – 7.5	NB, BU	Somewhat Poorly – Poorly	S	FACW
Viburnum lentago	Nannyberry	Mid	White	25	Tolerant	5.0 – 7.0	NB, BU	Moderately Well – Somewhat Poorly	T/S	FAC
Vicia americana	American Vetch	Mid	Purple	1	Intolerant	5.9 – 7.2	NB, BU	Moderately Well – Somewhat Poorly	F	
Vicia caroliniana	Carolina Wood Vetch	Mid	White	1	Intermediate	4.9 – 7.9	BU	Well – Somewhat Poorly	F	FACU

NOTE: *Native taxons listed as* spp. *indicate that there are multiple species within this genus that could be useful for pollinators and habitat enhancement purposes. Consult technical experts to determine if a species is suitable for use, propagation and the flowering characteristics.*

B. Non-Native, Non- Invasive Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Annual Perennial Biennial	Pollinator Preference	Drainage	Form	Wetland
Calluna vulgaris	Heather, Ling	Late	Pink	3	Intermediate	4.5 – 6.5	P	BU	Well – Somewhat Poorly	S	FAC
Catalpa bignonioides	Southern Catalpa	Mid	White	65	Intermediate	5.5 – 7.5	P	NB, BU	Moderately Well – Somewhat Poorly	T	FAC
Catalpa speciosa	Northern Catalpa	Mid	White	60	Intolerant	5.5 – 7.0	P	NB	Well – Somewhat Poorly	T	FAC
Chamaecrista fasciculata	Partridge Pea	Late	Yellow	2	Tolerant	5.5 – 7.5	A	NB, BU	Well – Moderately Well	F	FACU
Chelone lyonii	Pink Turtlehead	Late	Pink	3	Intermediate	5.5 – 7.5	P	BU	Somewhat Poorly – Poorly	F	FACW
Coreopsis grandiflora	Bigflower Coreopsis	Mid	Yellow	2	Intermediate	5.0 – 7.0	P	NB, BU	Well – Moderately Well	F	
Echinacea purpurea	Echinacea	Mid	Purple	1	Intolerant	6.5 – 7.2	P	NB, BU	Well – Somewhat Poorly	F	
Erica tetralix	Crossleaf Heath	Late	Purple	2	Intermediate	5.3 – 7.0	P	NB	Well – Somewhat Poorly	S	FACU
Filipendula rubra	Queen – Of – The – Prairie	Mid	Pink	4	Intolerant	5.5 – 7.5	P	BU	Moderately Well – Somewhat Poorly	F	FACW
Gaillardia aristata	Common Gaillardia		Yellow	2	Intolerant	5.5 – 7.9	P	NB, BU	Well – Moderately Well	F	
Helianthus maximiliani	Maximillian Sunflower	Late	Yellow	5	Intolerant	6.0 – 8.0	P	NB	Well – Somewhat Poorly	F	
Liatris scariosa	Devil's – Bite	Late	Purple	2	Intolerant	5.8 – 7.5	P	NB, BU	Well – Moderately Well	F	FACU

B. Non-Native, Non- Invasive Plants Suitable for Pollinator Applications in West Virginia

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Annual Perennial Biennial	Pollinator Preference	Drainage	Form	Wetland
Liatris squarrosa	Blazing Star	Late	Purple	2	Intolerant	5.8 – 7.5	P	NB, BU	Well – Moderately Well	F	
Lotus corniculatus	Birdsfoot Trefoil *	Mid	Yellow	2	Intolerant	5.0 – 8.0	P	NB	Well – Moderately Well	F	FACU
Medicago sativa	Alfalfa*	Mid	Blue	2	Intolerant	6.0 – 8.5	P	NB	Well – Moderately Well	F	
Onobrychis viciifolia	Sainfoin*	Mid	Red	2	Intolerant	6.0 – 8.5	P	NB	Well – Moderately Well	F	
Pontederia cordata	Pickerelweed	Early	Blue	3	Intolerant	4.9 – 8.7	P	BU	Poorly	F	OBL
Ratibida columnifera	Red – Spike Mexican – Hat	Late	Yellow	3	Intolerant	5.9 – 7.0	P	NB, BU	Well – Moderately Well	F	
Scilla siberica	Siberian squill	Very Early	Purple	1	Intolerant	5.8 – 7.5	P	NB, BU	Moderately Well – Somewhat Poorly	F	
Thymus praecox	Wild Thyme	Late	Purple	1	Intermediate	5.5 – 7.5	P	NB, BU	Well – Somewhat Poorly	F	
Verbena stricta	Hoary Vervain	Late	Purple	4	Intermediate	5.5 – 7.5	P	NB, BU	Well – Somewhat Poorly	F	
Trifolium incarnatum	Crimson clover	Early	Red	2	Intolerant	5.5 – 7.5	A	NB	Well – Somewhat Poorly	F	
Trifolium pratense	Red clover *	Mid	Red	1	Intolerant	6.0 – 7.5	P	NB	Well – Somewhat Poorly	F	
Trifolium repens	White clover *	Early	White	1	Intolerant	6.0 – 7.5	P	NB	Well – Somewhat Poorly	F	

NOTE: *The list above provides non-native, non-invasive species that could be used in conjunction with native species in mixes, or established as individual stands. These species may be utilized in conjunction with grasses for erosion control or for permanent areas adjacent to cropland (alleys, etc.). An* ***** *indicates that this species could be utilized for erosion control and/or forage mixes. Monitor the establishment of these stands closely to determine the potential to invade or spread. There are certainly other species that could be utilized. Consult with technical specialists to determine the suitability of other species. Any non-native species utilized should not be invasive or established at the expense of native plant species.*

C. Common Crop Species Useful to Pollinators

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Annual Perennial Biennial	Pollinator Preference	Drainage	Form
Brassica napus	Rape	Early	Yellow	4	Intolerant	6.0 – 7.2	B/A	NB	Well – Moderately Well	F
Brassica nigra	Black Mustard	Early	Yellow	3	Intolerant	5.6 – 7.6	A	NB	Well – Moderately Well	F
Cucumis melo	Cantaloupe	Mid	Yellow	4	Intolerant	5.0 – 7.5	A	NB	Well – Moderately Well	V
Cucurbita pepo	Pumpkin	Mid	Orange	5	Intolerant	5.6 – 7.6	A	NB	Well – Moderately Well	V
Raphanus sativus	Radish	Mid	Purple	2	Intolerant	5.0 – 7.5	B/A	NB, BU	Well – Moderately Well	F

NOTE: *The list above identifies only a few beneficial pollinator crops. Due to the variability of crops produced and the varieties and horticultural crosses utilized throughout the region, bloom times, color variations and pH requirements will vary. Planners should always consult with growers to determine the specifics of crops planted and the rotations used.*

D. Non-Native Plants Suitable For Use In Crop Rotations, Cover Crops And Green Manures

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Annual Perennial Biennial	Pollinator Preference	Drainage	Form
Borage officinalis	Borage	Early	Blue	1.5	Intolerant	6.0 - 7.5	A	NB	Well -Moderately Well	F
Trifolium incarnatum	Crimson Clover	Early	Red	1.5	Intolerant	5.5 - 7.5	A	NB	Well - Somewhat Poorly	F
Vicia villosa	Hairy vetch	Early	Purple	1.5	Intolerant	6.0 - 7.5	A	BU	Well -Moderately Well	F
Vicia atropurpurea *	Purple vetch	Mid	Purple	1	Intolerant	5.5 - 6.5	A	BU	Well -Moderately Well	F
Brassica spp.	Mustard	Mid	Yellow	4	Intolerant	--	A	NB	Well -Moderately Well	F
Medicago sativa	Alfalfa	Mid	Blue	2	Intolerant	6.0 - 8.5	P	NB, BU	Well -Moderately Well	F
Trifolium repens *	White clover	Mid	White	0.5	Intolerant	6.0 - 7.5	P	NB	Well-Somewhat Poorly	F
Melilotus alba	Sweet White Clover	Mid	White	5	Intolerant	5.0 - 8.0	A	NB	Well -Moderately Well	F
Melilotus officinalis	Yellow Sweet Clover	Late	Yellow	5	Intolerant	6.5 - 8.0	A,B, P	NB	Well – Moderately Well	F
Trifolium pretense *	Red clover	Mid	Red	0.5	Intolerant	6.0 - 7.5	P	NB	Well-Somewhat Poorly	F
Fagopyrum esculentum	Buckwheat	Late	White	2	Intolerant	6.0 - 8.5	A	NB	Well -Moderately Well	F
Phacelia tanacetifolia	Phacelia	Early	Blue	1.5	Intolerant	5.8 – 7.5	A	NB	Well -Moderately Well	F

NOTE: *Taxons listed as* spp. *indicate that there are multiple species within this genus that could be useful for pollinators and habitat enhancement purposes. Consult technical experts to determine if a species is suitable for use, propagation and the flowering characteristics. An * indicates that this species could be incorporated into pollinator-friendly erosion control mixes. A number of non-native plants used for cover crops, green manures, or short-term plantings are productive forage sources for pollinators. These species may be suitable to augment existing habitats and/or to correspond with gaps in bloom times while providing supplemental resources for pollinators. Some of these species could become weedy or have the potential to spread to adjacent communities; so select appropriate species for your needs and monitor their development on the site.*

E. Plants Principally Pollinated by Flies or Beetles

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	pH Range	Pollinator Preference	Drainage	Form	Wetland
Actaea racemosa	Black Cohosh	Late	White	3	Tolerant	5.0 – 7.9	F	Moderately Well – Somewhat Poorly	F	
Chamaelirium luteum	Fairywand	Mid	White	3	Intermediate	5.5 – 7.5	F	Somewhat Poorly	F	FAC
Claytonia virginica	Virginia Springbeauty	Early	Pink	1	Tolerant	5.0 – 7.0	B, F	Well – Somewhat Poorly	F	FACU
Erigeron philadelphicus	Philadelphia Fleabane	Mid	Purple	2	Intermediate	4.8 – 7.8	F	Well – Somewhat Poorly	F	FACU
Erigeron annuus	Daisy Fleabane	Mid	White	2	Intermediate	4.8 – 7.8	F	Well – Somewhat Poorly	F	FACU
Erigeron spp.	Fleabanes	– –	– –	– –	– –	– –	F	– –	F	– –
Fragaria virginiana	Virginia Strawberry	Early	White	1	Intolerant	5.0 – 7.5	F	Well – Moderately Well	F	FACU
Hesperis matronalis	Dame's Rocket	Early	Purple	4	Intermediate	5.0 – 7.0	F	Well - Somewhat Poorly	F	
Sassafras albidum	Sassafras	Very Early	Green	75	Intermediate	4.5 – 7.3	F	Well – Somewhat Poorly	T	FACU
Symplocarpus foetidus	Skunk – Cabbage	Very Early	Red	1	Tolerant	4.0 – 7.0	B	Poorly	F	OBL
Zizia aurea	Golden Alexanders	Mid	Yellow	2	Intermediate	5.5 – 6.9	F	Well – Somewhat Poorly	F	FAC

These species may be suitable to augment existing habitats or substitute within pollinator mixes. Many other species of plants are visited by flies and beetles. This list only identifies a few that are principally pollinated by those insects. **NOTE:** *Taxons listed as spp. indicate that there are multiple species within this genus that could be useful for pollinators and habitat enhancement purposes. Consult technical experts to determine if a species is suitable for use, propagation and the flowering characteristics.*

III. Plant Mixes

WOODY MIXES

Woody plants may be established for pollinators in a variety of settings. Since hedgerows and riparian corridors are appropriate places to establish pollinator habitats, desirable species should be selected that encourage use by pollinators and bloom throughout as much of the season as possible. Since trees and shrubs typically are available prior to the bloom period of most herbaceous plants, they are often the most visited of plants by bees early in the season. Conversely, woody species stop blooming earlier in the growing season and the floral resources are not available throughout the growing season. Therefore, it is not advisable to depend solely upon woody species to provide pollinator resources. **For this reason, it is acceptable when installing exclusively woody species enhancements to utilize bloom periods of very early, early and mid-season. Late season species are not required.**

Many species of woody plants are wind pollinated. It is important to utilize trees and shrubs that are known to be principally pollinated by insects. Examples of species that are wind pollinated are: hickories (*Carya* sp.), Ash (*Fraxinus* sp.) and Oaks (*Quercus* sp.). These species should not be utilized as pollinator species. Check with the state staff specialist if you are uncertain as to the methods of pollination for a particular species not listed in this document.

Woody plantings may be utilized to enhance an area by interspersion of woody species in already existing woodlands, riparian areas or hedgerows. They may also be established as stand-alone woody species pollinator friendly plantings to provide corridors or nectaring areas. Use caution when planting woody species around orchards and certain crops as these species may provide alternate hosts to some plant diseases (e.g. cedar apple rust).

Deer browse, labor and cost of materials, disease and maintenance are important considerations when choosing to establish woody plants. Consider these carefully prior to investment of large plantings.

Woody pollinator planting mixes that contain only woody species must be at least one-half acre (0.5 acres) in size. A woody pollinator mix must also contain at least three species in each of the three blooming periods (**very early, early** and **mid)**. Trees and shrubs should be planted in close proximity to aid in pollinator access but far enough apart to allow for maximum crown development and bloom. Planting materials may be seedlings, bare root, containerized or balled and burlapped.

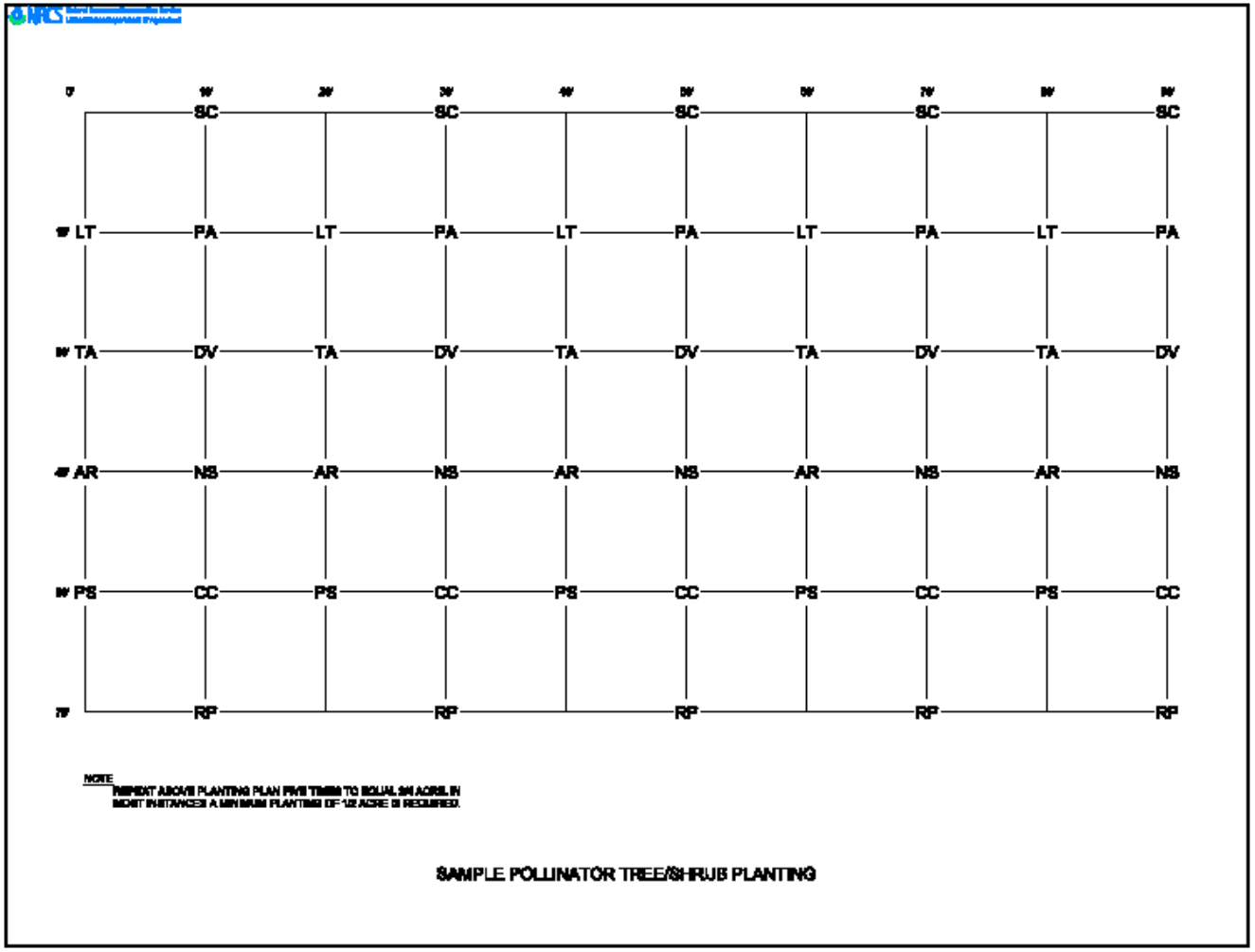
Installation of trees and shrubs should follow the West Virginia Conservation Practice Standard (612) Tree and Shrub Establishment and (490) Tree and Shrub Site Preparation as appropriate. For pollinator mixes that incorporate herbaceous and woody species to provide pollinator resources throughout the season refer to the West Virginia conservation practice (327) Conservation Cover.

Tree plantings for pollinators may be planted in several ways. They may be intermingled into existing stands of species (e.g. riparian areas); they may be planted in linear plantings (hedgerows and forest riparian buffers) or as blocks of stand-alone enhancements. Many species may be utilized that bloom throughout the required periods; however consider the arrangement, spacing and placement with regard to shade tolerance. Refer to the example mixes and drawing on the following pages. The mixes are examples which contain commercially available seedlings and meet the specified bloom periods.

GENERAL WOODY SPECIES MIX FOR POLLINATORS

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity	Shade Tolerance	Form	*Pollinator Preference	Plants	Spacing	Shelters
Acer rubrum	**Red Maple**	**Very Early**	Red	90	Tolerant	T	NB	25	10’ x 10’ to 15’ x 15’	Not Required
Sambucus canadensis	**Elderberry**		White	7	Intermediate	T/S	NB	25	10’ x 10’ to 15’ x 15’	Not Required
Cercis canadensis	**Eastern Redbud**		Purple	16	Tolerant	T/S	NB, BU	25	10’ x 10’ to 15’ x 15’	Not Required
Prunus americana	**American Plum**	**Early**	White	30	Intolerant	T/S	NB, BU	25	10’ x 10’ to 15’ x 15’	Not Required
Diospyros virginiana	**Persimmon**		Yellow	50	Tolerant	T	NB	25	10’ x 10’ to 15’ x 15’	Not Required
Nyssa sylvatica	**Blackgum**		White	95	Tolerant	T	NB	25	10’ x 10’ to 15’ x 15’	5’
Prunus serotina	**Black Cherry**		White	100	Intolerant	T/S	NB, BU	25	10’ x 10’ to 15’ x 15’	5’
Robinia pseudoacacia	**Black Locust**	**Mid**	White	70	Intermediate	T	NB, BU	25	10’ x 10’ to 15’ x 15’	Not Required
Liriodendron tulipifera	**Tuliptree**		Yellow	120	Intolerant	T	NB, H	25	10’ x 10’ to 15’ x 15’	5’
Tilia Americana	**American Basswood**		Yellow	90	Intermediate	T	NB, BU	25	10’ x 10’ to 15’ x 15’	5’

NOTE: 250 plants @ 10’ x 10’ spacing = ~ 0.57 acres
250 plants @ 12’x 15’ spacing = ~ 0.86 acres
250 plants @ 15’x 15’ spacing = ~ 1.33 acres



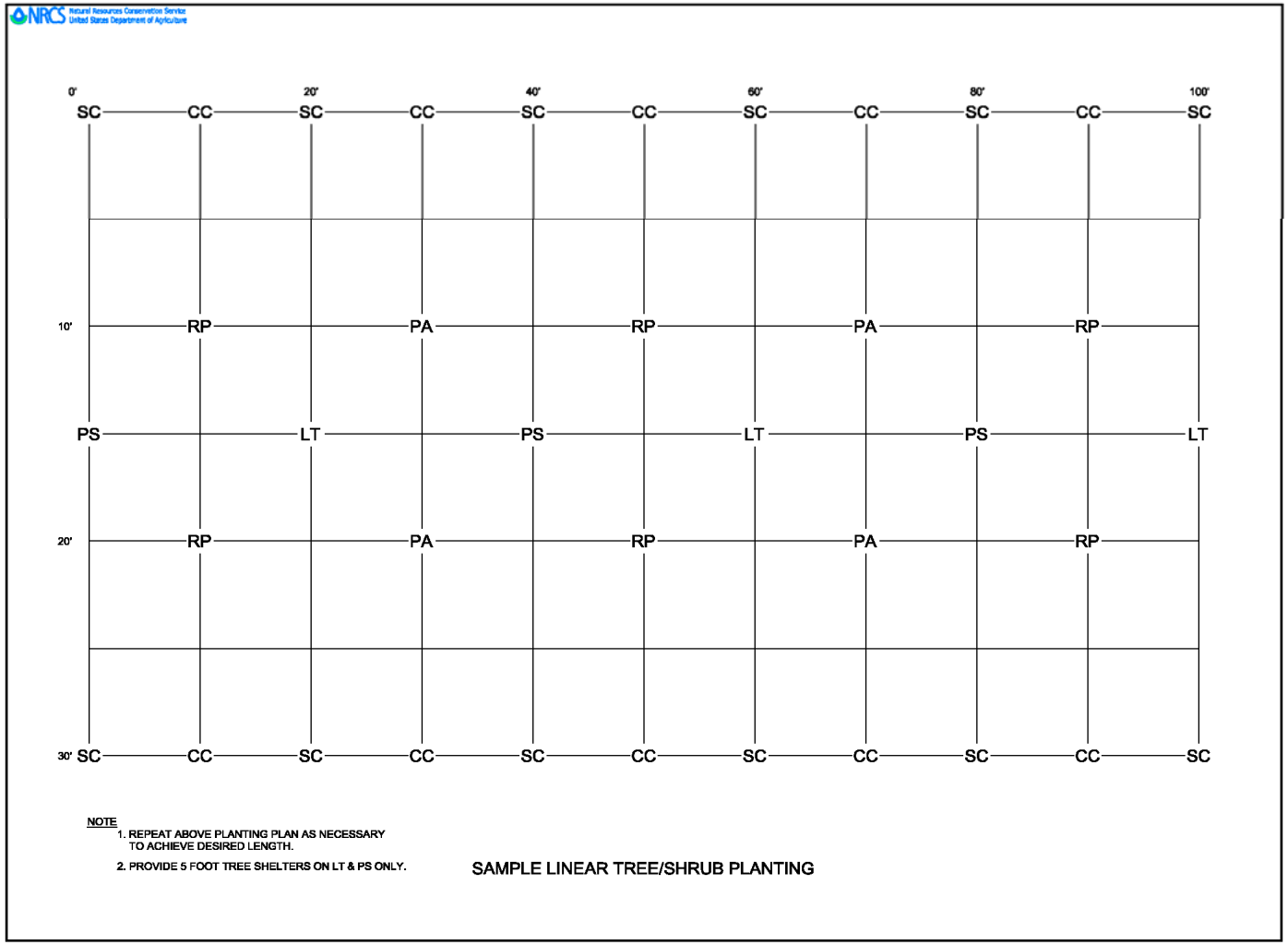
SC– *Sambucuscanadensis*
LT- *Liriodendron tulipfera*
PA-*Prunus americana*
PS-*Prunus serotina*
DV- *Diospyros virginiana*

NS - *Nyssa sylvatica*
CC-*Cercis canadensis*
RP-*Robinia pseudoacacia*
AR-*Acer rubrum*
TA-*Tilia americana*

LINEAR WOODY SPECIES MIX FOR POLLINATORS* *(For use in and around hedgerows, fence rows, ditch lines, etc.)*

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity	Shade Tolerance	Form	*Pollinator Preference	Plants	In-Row Spacing	Shelters
Sambucus canadensis	**Elderberry**	**Very Early**	White	7	Intermediate	T/S	NB	25	10’ x 10’	Not Required
Cercis canadensis	**Eastern Redbud**		Purple	16	Tolerant	T/S	NB, BU	25	10’ x 10’	Not Required
Prunus americana	**American Plum**	**Early**	White	30	Intolerant	T/S	NB, BU	25	20’ x 20’	Not Required
Prunus serotina	**Black Cherry**		White	100	Intolerant	T/S	NB, BU	25	20’ x 20’	5’
Robinia pseudoacacia	**Black Locust**	**Mid**	White	70	Intermediate	T	NB, BU	25	20’ x 20’	Not Required
Liriodendron tulipifera	**Tuliptree**		Yellow	120	Intolerant	T	NB, H	25	20’ x 20’	5’

***Not recommended for riparian corridors**



SC– *Sambucus canadensis*
LT- *Liriodendron tulipfera*
PA-*Prunus americana*

PS-*Prunus serotina*
CC-*Cercis canadensis*
RP-*Robinia pseudoacacia*

HERBACEOUS MIXES

There are many species of plants that provide resources for native pollinators. The lists provided in this document only identify some of the more common perennial and a few annual species. The mixes provided in this document have been developed with consideration of availability, bloom period, benefit to pollinators, site adaption and several other factors. Every effort was made to recommend species that meet all criteria. However, due to market variability, seasonal availability and many other factors, each species may not be available or practical each year. Therefore it is up to the planners and clients to work together with the seed provider to substitute suitable species to fill in any gaps in recommended mixes. Utilize the native plant lists within this document to evaluate suitable substitutes.

Many nurseries and seed companies provide their own blends of pollinator mixes. Pollinator mixes are variable and may provide the same benefits as those listed in these documents. It is important to check the species included in the mix to ensure that the species included are native, they meet pollinator needs throughout the season and do not have the potential to become invasive. Check with state staff specialists or the seed provider if it is unclear.

- **General All Purpose Mix for Pollinators –** This forb/grass mix is suitable for most soil conditions and shade requirements. It provides pollen and nectar resources for a wide variety of native bees and butterflies while adding a grass component. Maximum height is 10 to 11 feet upon maturity. This mix is designed to create, enhance and augment existing habitat. Minimum establishment should be 0.5 acres in most situations.
- **Wet Site Mix for Pollinators –** This mix is suitable for a variety of open meadow sites that contain moist to saturated conditions (moderately well to poorly drained soils) and receive at least partial sun during the day. It provides pollen and nectar resources for a wide variety of native bees and butterflies while adding a native sedge component. This mix is designed to create, enhance and augment existing habitat. Minimum establishment is 0.5 acres in most situations.
- **Dry Site Mix for Pollinators –** This forb/grass mix is suitable for dry site conditions, most upland, well drained sites with lower fertility, fitting a variety of shade requirements. It provides pollen and nectar resources for a wide variety of native bees and some butterflies while adding a warm season bunch grass component. This mix is designed to create, enhance and augment existing habitat. Minimum establishment is 0.5 acres in most situations.
- **General Site Mix for Butterflies –** This forb/grass mix is suitable for most site conditions and most shade requirements. It provides pollen and nectar resources for some native bees but is tailored to native butterflies. It adds a warm season bunch grass component for structure. This mix is designed to enhance and augment existing native habitat. Minimum establishment is 0.5 acres in most situations.
- **Spot Area Pollinator Mix –** This seed mix is a good compromise of native and non-native pollinator plants where cost is an issue and native plant restoration is not the primary objective (such as smaller urban gardens, vacant lots, orchard understory plantings, highly degraded sites, etc.). It is better suited for small, open, very sunny areas (less than 0.5 acres). The included species are adaptable and will naturalize in most soil condition but will not tolerate saturation. Management may include mowing closely every other early spring and regular applications of lime.
- **Linear Conservation Cover Plant Mix for Pollinators –** This mix could be utilized to establish along linear corridors such as drainage ditches, riparian areas, hedgerows, field borders or other corridors where pollinator habitat is required. It is also suitable to small block or patch style habitat. Consider utilizing this mix and general mixes to create pollinator corridors in sunny locations. It is primarily established in smaller amounts (0.5 acres or less).

GENERAL ALL PURPOSE HERBACEOUS SEEDING MIX FOR POLLINATOR HABITAT

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	Percent of Total Mix	Number of Seeds (per lb)	Baseline Seeding Rate (lbs/ac)
Baptisia tinctoria	**Yellow Wild Indigo**	**Early**	Yellow	3	Intolerant	6%	300,000	0.42
Penstemon digitalis	**Hairy Beardtongue**		Purple	4	Intermediate	5%	400,000	0.26
Tradescantia virginiana	**Virginia Spiderwort**		Blue	1	Intermediate	8%	1,750,000	0.10
Asclepias syriaca	**Common Milkweed**	**Mid**	Pink	5	Intermediate	12%	70,000	3.62
Apocynum cannabinum	**Indian – Hemp**		White	3	Intermediate	6%	500,000	0.25
Asclepias tuberosa	**Butterflyweed**		Orange	3	Intermediate	6%	70,000	1.81
Vernonia noveboracensis	**New York Ironweed**		Purple	4	Intolerant	5%	300,000	0.35
Pycnanthemum virginianum	**Virginia Mountainmint**	**Late**	Pink	3	Intermediate	2%	3,872,000	0.01
Monarda fistulosa	**Wild Bergamot**		Purple	3	Intermediate	5%	1,272,500	0.08
Symphyotrichum lateriflorum	**Calico Aster**		White	3	Intolerant	10%	800,000	0.26
Liatris spicata	**Gay Feathers**		Purple	4	Intermediate	10%	100,000	2.11
Eupatorium fistulosum	**Common Joe Pye Weed**		Purple	11	Intermediate	10%	2,000,000	0.11
Solidago speciosa	**Showy Goldenrod**		Yellow	4	Intolerant	5%	1,340,000	0.08
Schizachyrium scoparium	**Little Bluestem**		Yellow	3	Intolerant	10%	200,000	1.06
TOTAL						**100%**		**10.52**

This mix assumes 35 seeds per ft^2 and average purity and germination rates of 85%. Approximate cost $137.00/lb

WET SITE SEEDING MIX FOR POLLINATOR HABITAT

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	Percent of Total Mix	Number of Seeds (per lb)	Baseline Seeding Rate (PLS lbs/ac)
Zizia aurea	**Golden Alexanders**	**Early**	Yellow	2	Intolerant	2.0%	172,000	0.23
Penstemon digitalis	**Foxglove Beardtongue**		Purple	4	Tolerant	6.0%	400,000	0.32
Tradescantia ohiensis	**Ohio Spiderwort**		Blue	1	Intermediate	10.0%	158,000	1.34
Mimulus ringens	**Square Stemmed Monkey Flower**	**Mid**	Blue	2	Intermediate	3.0%	22,900,000	0.00
Asclepias incarnata	**Swamp Milkweed**		Purple	5	Intermediate	4.0%	70,000	1.21
Vernonia noveboracensis	**New York Ironweed**		Purple	4	Intolerant	5.0%	300,000	0.35
Symphyotrichum novae – angliae	**New England Aster**	**Late**	Purple	4	Intermediate	11.0%	1,100,000	0.21
Eupatorium perfoliatum	**Boneset**		White	4	Intermediate	11.0%	2,880,000	0.08
Eupatorium maculatum	**Spotted Joe Pye Weed**		Purple	5	Intermediate	11.0%	1,440,000	0.16
Helenium autumnale	**Common Sneezeweed**		Yellow	5	Intermediate	6.0%	1,464,000	0.09
Solidago patula	**Rough Leaved Goldenrod**		Yellow	5	Intermediate	6.0%	700,000	0.18
Liatris spicata	**Gay Feathers**		Purple	4	Intermediate	6.0%	100,000	1.27
Lobelia siphilitica	**Great Blue Lobelia**		Blue	3	Intermediate	3.0%	7,760,000	0.01
Lobelia cardinalis	**Cardinal-Flower**		Red	3	Tolerant	6.0%	11,293,000	0.01
Carex lurida	**Shallow Sedge**		Green	1	Intolerant	10%	250,000	0.84
TOTAL						**100.00%**		**6.30 lbs/acre**

This mix assumes 35 seeds per ft^2 and average purity and germination rates of 85%. 6.00 lbs per acre at an approximate cost of $206.00/lb

DRY SITE SEEDING MIX FOR POLLINATOR HABITAT

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	Percent of Total Mix	Number of Seeds (per lb)	Baseline Seeding Rate (PLS lbs/ac)
Penstemon canescens	**Eastern Gray Beard Tongue**	**Early**	Purple	2	Intermediate	2.0%	400,000	0.11
Penstemon hirsutus	**Hairy Beardtongue**		Purple	2	Intermediate	7.0%	425,000	0.35
Tradescantia virginiana	**Virginia Spiderwort**		Blue	1	Intermediate	9.0%	1,750,000	0.11
Apocynum cannabinum	**Indian – Hemp**	**Mid**	Pink	3	Intolerant	6.0%	500,000	0.25
Coreopsis lanceolata	**Long – Stalk Tickseed**		Yellow	2	Intermediate	5.0%	221,000	0.48
Asclepias syriaca	**Common Milkweed**		Pink	5	Intermediate	10.0%	70,000	3.01
Vernonia noveboracensis	**New York Ironweed**		Purple	2	Intermediate	10.0%	300,000	0.70
Baptisia tinctoria	**Yellow Wild Indigo**	**Late**	Yellow	2	Intolerant	6.0%	800,000	0.16
Solidago nemoralis	**Gray Goldenrod**		Yellow	2	Intolerant	9.0%	1,008,000	0.19
Monarda fistulosa	**Wild Bergamot**		Purple	3	Intermediate	6.0%	1,272,500	0.10
Symphyotrichum laeve	**Smooth Blue Aster**		Blue	3	Intolerant	10.0%	1,014,000	0.21
Symphyotrichum pilosum	**Heath Aster**		White	3	Intolerant	10.0%	700,000	0.30
Schizachyrium scoparium	**Little Bluestem**		Yellow	3	Intolerant	10.0%	200,000	1.06
TOTAL						**100.00%**		**7.03**

This mix assumes 35 seeds per square foot at 85% purity and germination rates for one acre; 7lbs. per acre at an approximate cost of $116.00 /lb

GENERAL SITE MIX FOR BUTTERFLIES

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	Percent of Total Mix	Number of Seeds (per lb)	Baseline Seeding Rate (lbs/ac)
Tradescantia ohiensis	**Ohio Spiderwort**	**Early**	Blue	1	Intermediate	8%	158,000	1.01
Lupinus perennis	**Wild Lupine**		Blue	2	Intermediate	2%	19,000	2.22
Gaillardia aristata	**Common Gaillardia**		Yellow	2	Intolerant	8%	186,436	0.91
Asclepias tuberosa	**Butterflyweed**	**Mid**	Orange	3	Intermediate	10%	70,000	3.01
Apocynum cannabinum	**Indian – Hemp**		Pink	3	Intolerant	5%	500,000	0.21
Coreopsis lanceolata	**Long-Stalk Tickseed**		Yellow	2	Intolerant	9%	221,000	0.86
Andropogon gerardii	**Big Bluestem**		Yellow	6	Intolerant	6%	144,000	0.88
Penstemon digitalis	**Foxglove Beardtongue**		Purple	1	Intermediate	10%	800,000	0.26
Monarda fistulosa	**Wild Bergamot**	**Late**	Purple	3	Intermediate	11%	1,272,500	0.18
Echinacea purpurea	**Purple Coneflower**		Purple	1	Intolerant	14%	115,664	2.55
Symphyotrichum lateriflorum	**Calico Aster**		White	3	Intolerant	11%	800,000	0.29
Solidago juncea	**Early Goldenrod**		Yellow	4	Intolerant	11%	2,538,000	0.09
TOTAL						**100.00%**		**12.47**

This mix assumes 35 seeds per square foot at 85% purity and germination rates for one acre; 12.5 lbs per acre at an approximate cost of $124.00/lb

SPOT AREA POLLINATOR MIX

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	Percent of Total Mix	Number of Seeds (per lb)	Baseline Seeding Rate (lbs/ac)
Trifolium repens	**White Clover***	**Early**	White	1	Intolerant	4.0%	711,867	0.12
Trifolium incarnatum	**Crimson Clover ***		Red	1	Intolerant	4.0%	149,760	0.56
Gaillardia aristata	**Perennial Blanketflower**		Yellow	2	Intolerant	5.0%	186,436	0.57
Trifolium pratense	**Red Clover**	**Mid**	Red	1	Intolerant	4.0%	272,160	0.31
Coreopsis grandiflora	**Largeflower Tickseed**		Yellow	2	Intermediate	10.0%	160,000	1.32
Echinacea purpurea	**Purple Coneflower**		Purple	1	Intolerant	10.0%	115,664	1.82
Coreopsis lanceolata	**Long – Stalk Tickseed**		Yellow	2	Intolerant	10.0%	221,000	0.95
Medicago sativa	**Alfalfa**		Blue	2	Intolerant	10.0%	226,800	0.93
Centaurea cyanus	**Bachelor Button ***	**Late**	Blue	3	Intolerant	10.0%	90,000	2.34
Helianthus maximiliani	**Maximillian's Sunflower**		Yellow	5	Intolerant	5.0%	216,000	0.49
Verbena stricta	**Hoary Vervain**		Purple	4	Intermediate	10.0%	471,000	0.45
Ratibida pinnata	**Grey Headed Coneflower**		Yellow	4	Intolerant	10.0%	1,000,000	0.21
Liatris aspera	**Rough Blazingstar**		Purple	4	Intolerant	8.0%	256,000	0.66
TOTAL						**100.00%**		**10.73**

Species listed with an asterisk are reseeding annuals. This mix assumes 35 seeds per square foot at 85% purity and germination rates for one acre; 11lbs per acre at an approximate cost of $31.00/lb.

LINEAR CONSERVATION COVER PLANT MIX FOR POLLINATORS

Scientific Name	Common Name	Bloom Period	Flower Color	Height at Maturity (feet)	Shade Tolerance	Percent of Total Mix	Number of Seeds (per lb)	Baseline Seeding Rate (lbs/ac)
Lupinus perennis	**Wild Lupine**	**Early**	Blue	2	Intermediate	2.0%	19,000	2.22
Gaillardia aristata	**Common Gaillardia**		Yellow	2	Intolerant	10.0%	186,436	1.13
Baptisia tinctoria	**Yellow Wild Indigo**		Yellow	3	Intolerant	6%	300,000	0.42
Asclepias syriaca	**Common Milkweed**	**Mid**	Pink	5	Intermediate	10.0%	70,000	3.01
Vernonia noveboracensis	**New York Ironweed**		Purple	4	Intolerant	5.0%	300,000	0.35
Coreopsis lanceolata	**Long-Stalk Tickseed**		Yellow	2	Intolerant	12.0%	221,000	1.15
Andropogon gerardii	**Big Bluestem**		Yellow	6	Intolerant	10.0%	144,000	1.47
Monarda media	**Purple Bergamot**	**Late**	Purple	3	Intermediate	5.0%	1,200,000	0.09
Monarda fistulosa	**Wild Bergamot**		Purple	3	Intermediate	5.0%	1,272,500	0.08
Helianthus decapetalus	**Thin-leaved Sunflower**		Yellow	4	Intermediate	5.0%	504,000	0.21
Liatris spicata	**Gay Feathers**		Purple	4	Intermediate	10.0%	100,000	2.11
Symphyotrichum lateriflorum	**Calico Aster**		White	3	Intolerant	10.0%	800,000	0.26
Eupatorium fistulosum	**Common Joe Pye Weed**		Purple	11	Intermediate	10.0%	2,000,000	0.11
TOTAL						**100.00%**		**12.61**

This mix assumes 35 seeds per square foot at 85% purity and germination rates for one acre; 14.0 lbs per acre at an approximate cost of $105.00/lb.

IV. Sources of Plant Materials

The following list contains nurseries that may provide native plant materials that would be suitable for pollinator enhancements. Carefully select production facilities that can provide sources of native plants that will tolerate local climate and environmental conditions. Consider the time factors for shipment, planting and storage and order appropriately. Some companies may charge additional fees for custom mixes and special orders for pollinators. This list is by no means all inclusive and other suppliers are certainly able to provide quality native plants. This list is provided as a courtesy to clients and planners and does not constitute an endorsement or certify to the acceptable quality of any of the products sold by the supplier.

Note also that some nurseries specialize in shrubs, trees or herbaceous plants and some specialize in providing seed. Be sure and request specific information on the plants that you require prior to purchase. Always request certified seed when an option is available.

The Xerces Society

The Xerces Society also provides native mixes that are suitable for pollinator habitat. Mixes created and approved by the Xerces Society could also be utilized to establish pollinator habitat. Mixes selected must be approved for use in West Virginia. These seed mixes may or may not meet the requirements for NRCS-administered private landowner conservation programs, such as the Environmental Quality Incentives Program (EQIP), the Wildlife Habitat Incentives Program (WHIP), the Conservation Stewardship Program (CSP), and the Conservation Reserve Program (CRP). For cost-share approval, please consult the local NRCS Service Center prior to purchase. Check with state technical specialists to determine if the mixes meet the bloom period requirements necessary for West Virginia. Mixes may be found online at: http://www.xerces.org/pollinator-seed/ .

Plant Materials Centers

Some Plant Materials Centers are available to assist in establishing protocols for planting and maintaining pollinator habitats. Their mission is to evaluate plants for their use in treating soil and water conservation resource concerns. Some plant material centers actually work specifically with pollinator habitat establishment and have pollinator specialists to assist with establishment of habitat. Information may be found at: http://plant-materials.nrcs.usda.gov/ . Contact the Plant Materials Center to determine how they may assist.

Commercial Nurseries

There are many commercial nurseries that provide native plants. These species are frequently more expensive than common horticultural varieties. It is important to compare prices and attempt to obtain plants from providers within your USDA Climate zone and ensure that the stock is hardy for the area planned. It is important to compare stock types, sizes, prices, species and type of materials when deciding upon the plants to purchase.

Nurseries	Address	City/State/Zip	Phone	Fax	Internet Site
State Operated Nurseries					
Augusta Forestry Center	POB 160	Crimora, VA 24431	540-363-5732	540-363-5055	
Clements StateTree Nursery	POB 8	West Columbia, WV 25287	304-675-1820		www.wvforestry.com
Garland Gray Forestry Center	19127 Sandy Hill Road	Courtland, VA 23837	804-834-2855	804-834-3141	www.dof.state.va.us
Marrietta State Nursery	POB 428	Reno, OH 45773	877-691-8733		http://ohiodnr.com/
New Kent Forestry Center	11301 Pocahontas Trail	Providence Forge, VA 23140	804-966-2201	804-966-9801	www.dof.state.va.us
Zanesville State Nursery	5880 Memory Road	Zanesville, OH 43701	877-691-8733		http://ohiodnr.com/
Commercial Nurseries					
Appalachian Nurseries Inc.	POB 87	Waynesboro, PA 17268	717-762-4733		
Arborgen	PO Box 840001	Summerville, SC 29484-8401	843-851-4129	843-832-2164	www.arborgen.com
Atlantic Star	620 Pyle Rd.	Forest Hill, MD 27050	470- 838-7950		atlantic@iximd.com
Benedict Nurseries	1054 S. Salisbury Blvd	Salisbury, MD 21801	410-742-2266		
Bobtown Nursery	RR 1 Box 436-P	Melfa, VA 23410	800-201-4714	757-787-8611	
Bowman's Hill Wildflower Preserve	P.O. Box 685	New Hope, PA 18938	215-862-2924	215-862-1846	www.bhwp.org/native
Carino Nurseries	POB 538	Indiana, PA 15701	800-223-7075		www.carinonurseries.com
Conservation Services, Inc.	300 W. Beverly Street	Staunton, VA 24401	540-213-8733	540-213-2445	
Doyle Farm Nursery	158 Norris Road	Delta, PA 17314	717-862-3134		

Nurseries	Address	City/State/Zip	Phone	Fax	Internet Site
England's Herb Farm	33 Todd Rd.	Honey Brook, PA	610-273-2863	610-273-2556	
Ernst Conservation Seed Co.	9006 Mercer Pike	Meadville, PA 16335	800-873-3321	814-336-5191	www.ernstseed.com
Environmental Concern	PO Box P,	St. Michaels, MD 21663	410-745-9620	410-745-3517	www.wetland.org
Environmental Seed Producers.	P.O. Box 947	Albany, OR 97321-0354	805-733-4975	541-928-5581	www.wildflowerseed.com
Flickingers' Nursery (conifer specialist)	P.O. Box 245	Sagamore, PA 16250	800-368-7381	724-783-6528	www.flicknursery.com
Gary's Perennials	1122 E. Welsh Road	Maple Glen, PA 19002	800-898-6653	215-628-0216	
G & G Nursery	P.O. Box 420 7800 Ohio River Rd	Lesage, WV 25537	304-762-2100		www.gngnursery.com
Great Lakes Nursery Co	1002 Hamilton St	Wausau, WI 54403	888-733-3564	715-848-9436	www.greatlakesnursery.com
Greenwood Nursery			800-426-0958		www.greenwoodnursery.com
Ingleside Plantation Nurseries	5870 Leedstown Road	Oak Grove, VA 22443	800-883-4637	804-224-2032	www.inglesidenurseries.com
Kneehigh Nursury Inc.	2 Deerfield Ln.	Indiana, PA 15701	724-349-4611	724-349-6650	
Lake County Nursery	Box 122	Perry, OH 44081	216-259-5571		www.lakecountynursery.com
Land Reforms Nursery & Landscape	35703 Loop Rd.	Rutland, OH 45775	740-742-3478		
Lawyer Nursery Inc.	950 Highway 200 W.	Plains, MT 59859-9706	800-551-9875	406-826-5700	www.lawyernursery.com
Lower Marlboro Nursery	P.O. Box 1013	Dunkirk, MD 20754	301- 812-0808	301-812-0808	
Mary's Plant Farm and Landscape	2410 Lanes Mill Road	Hamilton, OH 45013	513-894-0022	513-892-2053	

Nurseries	Address	City/State/Zip	Phone	Fax	Internet Site
Maryland Natives Nursery, Inc.	9120 Hines Road	Baltimore, MD 21234	410-529-0552	410-529-3883	www.marylandnativesnursery.com
Mellinger's	2310 West South Range Rd.	North Lima, OH 44452	800-321-7444	330-549-3716	
Mountain Laurel Nursery	POB 339	Bud, WV 24716	304-294-7412	304-294-7158	
Munro Ecological Services Inc.	990 Old Sumneytown Pike	Harleysville, PA 19438	610-287-0671	610-287-0672	
Musser Forest, Inc.	Rt 119N POB 340	Indiana, PA 15701	724-465-5685	412-465-9893	www.musserforests.com
Native Garden Design	Rt. 2 Box 484	Salt Rock, WV 25559	304-541-0184		
Octoraro Native Plant Nursery	6126 Street Rd	Kirkwood, PA 17536	717-529-3160	717-529-4099	www.octoraro.com
Pine Grove Nursery, Inc.	RD #3 Box 146 Pine Grove Nursery Rd	Clearfield, PA 16830	800-647-1727	814-765-2363	
Roundstone Native Seed	9758 Raider Hollow Road	Upton, KY 42784	270-531-3034	270-531-3036	
Shooting Star Nursery	444 Bates Rd.	Frankfort, KY 40601	502-223-1679	502-875-2231	
Spaulding Landscaping and Homeview Farm	Rt. 1 Box 39	Shepherdstown, WV 25443	304- 876-2096		
Sunshine Farm & Gardens	HC 67 Box 539B	Renick, WV 24966	304-497-2208		www.gardenweb.com/sunshine
Sylva Native Nursery & Seed	1683 Sieling Farm Rd	New Freedom, PA 17349	717-227-0486	717-227-0484	www.sylvanative.com
Tennessee Nursery Co	HCR 77 Box B-1	Altamont, TN 37301	931-692-4252	931-692-4266	www.tnnursery.net
Van Pines Nursery, Inc.	7550 - 144th Ave	West Olive, MI 49460	800-888-7337		
Virginia Natives	PO Box D	Hume, VA 22639	540-364-1665	540-364-1665	

Nurseries	Address	City/State/Zip	Phone	Fax	Internet Site
Virginia Provenzano Landscape Design & Garden	420 Dam # 4 Rd.	Shepherdstown, WV 25443	304- 267-6924		
Wetland Supply Co./Native Plant Nursery	1633 Gilmar Rd.	Apollo, PA 15613	724-327-18307	724- 733-3527	
Williams Forestry and Associates	P.O. Box 1011	Jackson, OH 45640	740-286-2842		
Xerces Society, The	4828 SE Hawthorne Blvd.	Portland, OR 97215	(855) 232-6639	(503) 233-6794	www.xerces.org/pollinator-seed

NOTE: *This information is provided as a service and constitutes no endorsement by the USDA or the NRCS of any service or supplier listed. Errors and omissions may occur; therefore other sources should be consulted. Plants utilized should be suited for your particular hardiness zone. It is recommended that plants be obtained from your hardiness zone or colder.*

V. Common Bees of West Virginia

The following table outlines bee genera typically found in West Virginia. Individual life history details for certain species may vary from the general genus-level characteristics described here. There are certainly more genera that are found in the Mountain State; however these are the most commonly encountered.

Family	Genus	Nest Site	Sociality	Time of Year	Abundance	Common Name & Notes
Andrenidae	Andrena Protandrena Anthemurgus Calliopsis Macrotera Panurginus Perdita Pseudopanurginus	Ground	Solitary & Communal	All season	Abundant	Commonly called mining bees. They are among the most common North American bees and are very common in the spring.
Apidae	Anthophora	Wood & Ground	Solitary	Spring & Summer	Local	Mining bees. Males sometimes form sleeping aggregations, clustering together on a plant stem.
	Apis	Hives	Social	All season	Abundant	Honey bees.
	Bombus	Rodent burrows, large cavities	Social	All season	Abundant	Bumble bees.
	Ceratina	Stems	Solitary	All season	Abundant	Small carpenter bees.
	Eucera	Ground	Solitary	Summer & Fall	Common	Long-horned bees: often associated with sunflowers and related species.
	Hapropoda	Muddy Streambanks	Solitary	Spring	Local	One species occurs and is locally common, especially near its preferred floral source blueberries.
	Melissodes	Ground	Solitary	Summer & Fall	Common	Long-horned bees: often associated with sunflowers and related species.
	Nomada	Parasite	N/A	All season	Abundant	All species cuckoo bees, laying their eggs in the nests of other species. Usually black and yellow, hairless and wasp-like in appearance.
	Peponapis	Ground	Solitary	Summer	Common	Called “squash bees” due their close association with

Family	Genus	Nest Site	Sociality	Time of Year	Abundance	Common Name & Notes
Apidae (continued)						squash, often nesting at the base of squash and pumpkin plants and pollinating the flowers early in the morning
	Svastra	Ground	Solitary	Summer	Common	Long-horned bees: often associated with sunflowers and related species.
	Xenoglossa	Ground	Solitary	Summer	Common	Called “squash bees” due their close association with squash, often nesting at the base of squash and pumpkin plants and pollinating the flowers early in the morning
	Xylocopa	Wood	Nest sharing	All season	Common	Large carpenter bees: often resemble bumble bees in size and color, but are typically shinier and have less hair.
Colletidae	Colletes	Ground	Solitary	All season	Common	Polyester bees: nests are lined with a waterproof cellophane-like glandular secretion.
	Hylaeus	Stems & Ground	Solitary	Summer	Common	Yellow-faced bees: typically very small, wasp-like in appearance.
Halictidae	Agapostemon	Ground	Communal & Solitary	All season	Common	Green sweat bees: usually metallic green in color.
	Augochlora	Wood	Solitary	Spring & Summer	Common	Sweat bees: so named for their occasional attraction to perspiration.
	Augochlorella	Ground	Social	All season	Common	Sweat bees.
	Augochloropsis	Ground	Nest sharing	Summer	Local	Sweat bees.
	Halictus	Ground	Social & Solitary	All summer	Abundant	Sweat bees. Unlike other bees, Halictus may be regularly found foraging at twilight. They may nest as solitary individuals or complex

Family	Genus	Nest Site	Sociality	Time of Year	Abundance	Common Name & Notes
						colonies with multiple queens and hundreds of workers.
	Lasioglossum (Dialictus)	Ground	Communal & Social	All season	Abundant	Sweat bees: One of the largest and most common genera often overlooked due to their small size.
	Sphecodes	Parasite	N/A	All season	Abundant	Cuckoo bee. Eggs lain in the nests of other bees.
Megachilidae	Chelostoma	Wood & Stone Cavities	Solitary	Summer	Common	Leafcutter, resin, and mason bees.
	Coelioxys	Parasite	N/A	Summer	Common	Cuckoo bee. Eggs lain in the nests of other bees.
	Heriades	Wood & Stone Cavities	Solitary	Summer	Uncommon	Leafcutter, resin, and mason bees.
	Hoplitis	Wood, Stone Cavities, Masonry	Solitary	Summer	Local	Mason bees.
	Megachile	Wood, Ground, & Stone Cavities	Solitary	Summer	Local	Leafcutter bees. Some species clip circular leaf sections to line their nests, and to seal off nest entrances.
	Osmia	Wood & Stone Cavities	Solitary	Spring & Summer	Abundant	Leafcutter and mason bees. Nest entrances closed with mud or masticated leaf pieces.
	Paranthidium	Ground	Solitary	Summer	Rare	Leafcutter, resin, and mason bees.
	Stelis	Parasite	N/A	Summer	Uncommon	Cuckoo bee. Eggs lain in the nests of other bees.

*(Adapted from *The Bee Genera of Eastern Canada* by Laurence Packer, Julio Genaro, and Cory Sheffield. Canadian Journal of Arthropod Identification. No. 3. 2007, and the Great Sunflower Project, Gretchen LaBuhn. 2008. (http://www.greatsunflower.org) Information revised by Harry W. Godwin, Biologist, AFSRC, ARS, USDA, Beaver, WV and Eric Mader, The Xerces Society Portland, OR.

Bee Identification

***Andrena* (mining bee)**
Photo: Eric Mader

Calliopsis
Photo: Eric Mader

***Apis (*honey bee)**
Photo: Toby Alexander

***Bombus* (bumble bee)**
Photo: Gene Barickman

Ceratina
Photo: Eric Mader

***Melissodes* (long-horn bee)**
Photo: Mace Vaughan

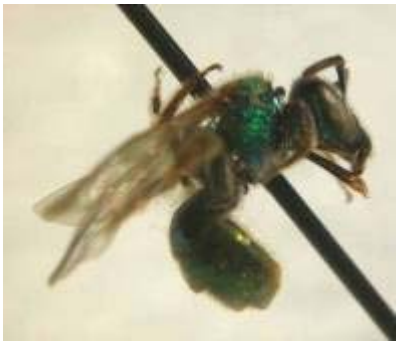
***Nomada* (cuckoo bee)**
Photo: Eric Mader

***Xylocopa* (large carpenter bee)**
Photo: Gene Barickman

***Agapostemon* (green sweat bee)**
Photo: Eric Mader

Bee Identification (continued)

***Augochlorella* (sweat bee)**
Photo: Eric Mader



***Halictus* (sweat bee)**
Photo: Mace Vaughan

***Lasioglossum* (sweat bee)**
Photo: Eric Mader

***Anthidium* (carder bee)**
Photo: Eric Mader

***Coelioxys* (cuckoo bee)**
Photo: Eric Mader

***Hoplitis* (mason bee)**
Photo: Eric Mader

***Megachile* (leafcutter bee)**
Photo: Eric Mader\

***Osmia* (mason bee)**
Photo: Connie Stubbs

VI. Additional Information

In addition to this document, information on pollinator habitat conservation is widely available through a number of other publications, websites, and organizations.

Agronomy Technical Note No. 5 *Pest Management in the Conservation Planning Process* - February 2011
USDA Technical Note Number 78 – *Using Farm Bill Programs for Pollinator Conservation,* August 2008

USDA NATIONAL AGROFORESTRY CENTER (http://www.unl.edu/nac)

Agroforestry Note 32 - *Agroforestry: Sustaining Native Bee Habitat for Crop Pollination* – August 2006
Agroforestry Note 33 - *Improving Forage for Native Bee Crop Pollinators* - August 2006
Agroforestry Note 34- *Enhancing Nest Sites for Native Bee Crop Pollinators* - February 2007
Agroforestry Note 35- *Pesticide Considerations for Native Bees in Agroforestry* - June 2007

THE XERCES SOCIETY FOR INVERTEBRATE CONSERVATION (http://www.xerces.org)

Invertebrate Conservation Fact Sheet – *Nests for Native Bees,* The Xerces Society for Invertebrate Conservation

Invertebrate Conservation Fact Sheet – *Butterfly Gardening,* The Xerces Society for Invertebrate Conservation

Invertebrate Conservation Fact Sheet – *Plants for Native Bees in North America,* The Xerces Society for Invertebrate Conservation

Invertebrate Conservation Fact Sheet – *Pollinators in Natural Areas, A Primer on Habitat Management,* The Xerces Society for Invertebrate Conservation

Invertebrate Conservation Fact Sheet – *Nests for Native Bees,* The Xerces Society for Invertebrate Conservation

Invertebrate Conservation Fact Sheet – *Northeast Plants for Native Bees,* The Xerces Society for Invertebrate Conservation

Invertebrate Conservation Fact Sheet – *Tunnel Nests for Native Bees – Nest Construction and Management,* The Xerces Society for Invertebrate Conservation

The Xerces Society for Invertebrate Conservation *Farming for Bees – Guidelines for Providing Native Bee Habitat on Farms*

The Xerces Society for Invertebrate Conservation *Making Room for Native Pollinators – How to create Habitat for Pollinator Insects on Golf Courses*

The Xerces Society for Invertebrate Conservation *Making More Room – A Companion to Making Room for Native Pollinators: Oregon's Butterflies, Local Plants and Extra Resources*

The Xerces Society for Invertebrate Conservation *Pollinator Friendly Parks – How to Enhance Parks, Gardens, and Other Greenspaces for Native Pollinator Insects*

NORTH AMERICAN POLLINATOR PROTECTION CAMPAIGN (NAPPC)
(http://www.pollinator.org)

Plight of the Pollinator – *Save Money, Time and Energy with IVM and Energy Rights of Way for Wild Pollinators,* Rights of Way task Force and NAAPC

Selecting Plants for Pollinators – *A Regional Guide for Farmers, Land Managers, and Gardeners in the Central Appalachian Broadleaf Forest/Coniferous Forest/Meadow Province* – Pollinator Partnership and NAPPC

Selecting Plants for Pollinators - *A Regional Guide for Farmers, Land Managers, and Gardeners in the Central Appalachian Broadleaf Forest/Oceanic Province* – Pollinator Partnership and NAPPC

WILDLIFE HABITAT COUNCIL AND NRCS (http://www.wildlifehc.org)

Wildlife Habitat Council/NRCS -Fish and Wildlife Habitat Management Leaflet, Number 24 - *Integrated Pest Management (IPM) and Wildlife,* April 2004
Wildlife Habitat Council/NRCS -Fish and Wildlife Habitat Management Leaflet, Number 34 – *Native Pollinators,* February 2006

INTERNET RESOURCES

General Pollinator Information

1. The Xerces Society Pollinator Conservation Program http://www.xerces.org/Pollinator_Insect_Conservation
2. USDA ARS Logan Bee Lab www.loganbeelab.usu.edu
3. Logan Bee Lab-list of plants attractive to native bees http://www.ars.usda.gov/Main/docs.htm?docid=12052
4. U.S. Forest Service Pollinator Information http://www.fs.fed.us/wildflowers/pollinators/index.shtml
5. U.S. Fish & Wildlife Service Information http://www.fws.gov/pollinators/Index.html
6. NAPPC Pollinator friendly practices http://www.nappc.org/PollinatorFriendlyPractices.pdf
7. Urban bee gardens http://nature.berkeley.edu/urbanbeegardens/index.html
8. Vermont Butterfly Survey-Vermont Center for Ecostudies http://www.vtecostudies.org/VBS/
9. North American Pollinator Protection Campaign (NAPPC) http://www.pollinator.org

Habitat Restoration with Native Plants

1. Considerations in choosing native plant materials http://www.fs.fed.us/wildflowers/nativeplantmaterials/index.shtml
2. Selecting Native Plant Materials for Restoration http://extension.oregonstate.edu/catalog/pdf/em/em8885-e.pdf
3. Native Seed Network http://www.nativeseednetwork.org/ has good species lists by ecological region and plant communities
4. Prairie Plains Resource Institute has extensive guidelines for native plant establishment using agricultural field implements and methods http://www.prairieplains.org/restoration_.htm

Public Outreach (VA Native Plant Society Brochures)

1. Hedgerows http://www.loudounwildlife.org/PDF_Files/Hedgerows.pdf
2. Do I have to mow all that? http://www.loudounwildlife.org/PDF_Files/No_Mow_Brochure.pdf

West Virginia Bee Information (Discover Life.Org)

1. List of Native West Virginia Bee Species: http://www.discoverlife.org/nh/cl/US/WV/AMNH_BEES.cl

Nursery Information

1. FindNurseries.com http://www.findnurseries.com
2. West Virginia Division of Natural Resources: http://www.wvdnr.gov/Wildlife/NativeVegetation.shtm

Support for various aspects of pollinator habitat may be obtained by contacting individuals responsible for technical or programmatic support. It is always best to start with the most local of contacts to ensure that the information provided is accurate.

Local and State Technical Support

CONTACT	TITLE	AGENCY	LOCATION	INFORMATION
Local District Conservationist		NRCS	Local USDA Service Center	www.wv.nrcs.usda.gov
Susan Olcott	Biologist	WVDNR	WVDNR Farmington, WV	304-825-6787
Casey Shrader	Biologist	NRCS	NRCS State Office Morgantown, WV	304-284-7581
Barbara McWhorter	Forester	NRCS	NRCS State Office Morgantown, WV	304-284-7576
Local County Agent	Extension Specialist	WVU Extension	West Virginia University Morgantown, WV	http://ext.wvu.edu/

West Virginia Programmatic Support

AGENCY	PROGRAM	CONTACT	LOCATION	INFORMATION
NRCS	Environmental Quality Incentives Program (EQIP)	State Program Manager	Morgantown, WV	http://www.wv.nrcs.usda.gov
	Wildlife Habitat Incentives Program (WHIP)			
	Conservation Security Program (CSP)			
FSA	Conservation Reserve Program (CRP)	State Program Manager	Morgantown, WV	http://www.fsa.usda.gov
	Conservation Reserve Enhancement Program(CREP)			

Regional Technical Support

AGENCY	CONTACT	LOCATION	PHONE
NRCS	Hank Henry	East National Technology Support Center Greensboro, NC	336-370-3349
USDA PMC	John Vandevender	USDA Plant Materials Center	304-445-3005
The Xerces Society	Vacant	East National Technology Support Center Greensboro, NC	--
The Xerces Society	Eric Mader	Assistant Pollinator Program Director The Xerces Society for Invertebrate Conservation 4828 SE Hawthorne Blvd., Portland, OR	855-232-6639

VII. Glossary

Bee Pasture – an area reserved usually near crop production fields comprised of one or more species of annual or perennial plants that provide pollen and nectar resources before, during and outside the time required for pollination of the crop produced.

Bloom Period – typical time of year that a plant will flower. Bloom times are described within this document as Very Early, Early, Mid and Late. They are based on the following timeframes:

- March (or earlier) to April = **Very Early Season**
- March through May = **Early Season**
- May through July = **Mid Season**
- July through Sept = **Late Season**

Bunch Grass – a species of grass, which possess a growth characteristic of forming a clump as it matures. These species do not typically form sods and are sporadically scattered throughout the landscape. While some cool season grasses are bunchgrasses, the majority are warm season grasses. As pollinator habitat they provide attachment points for beneficial insects and egg laying sites.

Burndown – herbicide application to eliminate a cool season species or other vegetation prior to establishment of more beneficial species.

Caterpillar – the larval form of a member of the order Lepidoptera (the insect order comprising butterflies and moths). They are mostly herbivorous in food habit, with some species being insectivorous. Caterpillars are voracious feeders and many of them are considered pests in agriculture. The common Woolly Bear Caterpillar is shown below which is not known to cause damage to agricultural crops.

The Banded Woolly Bear Caterpillar (*Pyrrharctia isabella***)**
Photo: *IronCh 2006*

Adult Isabella Tiger Moth (*Pyrrharctia isabella***)**
Photo: *Steve Jurvetson*

Conservation Practice – science-based, proven technical criteria for implementation of various techniques to establish, manage, construct or maintain vegetation, structures or systems of natural resources. NRCS plans and assists in installation of conservation practices.

Cover Crop – crops planted primarily to manage soil fertility, soil quality, water, weeds, pests, diseases, biodiversity and wildlife; or to prevent erosion and to improve soil quality (especially by adding nitrogen). Cover crops can be made pollinator friendly by adding appropriate flowering species.

Early Successional Habitat – early successional vegetation is considered collectively as grasses, forbs, shrubs and saplings. Usually areas that are idle, fallow, field borders, fencerows, pivot corners, ditch banks consist of early successional habitat.

Enhancement – for the purposes of this document, a pollinator enhancement is a planting of woody or herbaceous plants or any other practice that directly affects pollinator habitat by providing additional food, shelter or nest sites for organisms providing pollination services.

Exotic – for the purposes of this document this is defined as a plant occurring in the State that is not native to North America north of Mexico.

Floristic Quality Index (FQI) – native plants listed in the FOTG may have FQI ratings associated with them to give an overall indication of their suitability for use in native ecotypes and other settings. This rating is based on faithfulness to a natural plant community and tolerance of and/or dependence on disturbance (particularly human disturbance). A rating of zero indicates species are exotic and/or highly tolerant of disturbance. A rating of 10 indicates species that are restricted to pristine, natural, undisturbed habitats. Species with low values may be easier to establish in disturbed settings, while those with higher values may reflect higher quality natural habitats that would benefit from protection.

FOTG – the NRCS Field Office Technical Guide. The primary scientific references for NRCS. It contains technical information about the conservation of soil, water, air, and related plant and animal resources.

FSA-Farm Service Agency – Farm Service Agency is an agency within the USDA which serves farmers, ranchers, and agricultural partners through the delivery of agricultural programs.

Green Manure – a type of cover crop grown primarily to add nutrients and organic matter to the soil. They are typically grown for a specific period and then plowed under and incorporated into the soil. Green manures can be made pollinator friendly by adding appropriate flowering species

Integrated Pest Management (IPM) – integrated pest management (IPM) is an agricultural pest control strategy that utilizes a variety of complementary strategies including cultural management (growing practices) life cycle analysis and chemical management, among others to control organisms that cause agricultural harm.

Introduced – for the purposes of this document it is a plant native elsewhere in North America north of Mexico which has been intentionally planted in WV and is now escaped and surviving without cultivation.

Invasive - for the purposes of this document this is defined as those plants (native or otherwise) that have been known to spread aggressively in habitats where they are not normally found. Typically these species have very low FQI scores.

Local Ecotype – describes a genetically distinct geographic variety, population or race within a species (or among closely related species), which is adapted to specific environmental conditions and capable of interbreeding.

Native Plant – for the purposes of this document it is a plant considered to have occurred in WV prior to European settlement and that still occurs naturally within the state.

Nectar – a sweet liquid secreted by flowers of a plant, which attracts the insects or birds that pollinate the flower. It is consumed by pollinators, such as hummingbirds and insects, and gathered by honey bees for making honey.

Nectar Corridor – on a large scale, these are pathways of food sources for migratory species such as monarch butterflies and various hummingbirds scattered along great distances which sustains them over, and during migration. On a smaller (farm planning) scale, these areas are fashioned along ditches, hedgerows, riparian areas, etc. to facilitate movement throughout a pollination area and/or provide pollinator resources in the form of nectar and pollen. Cumulatively, small scale corridors may be beneficial to provide resources in a watershed scale and so on.

Non-native – a taxon considered not to have occurred in West Virginia prior to European settlement but still may occur within the state.

Noxious – an invasive species that has been designated by county, state or or national agricultural authorities as one that is injurious to agricultural and/or horticultural crops, natural habitats and/or ecosystems, and/or humans or livestock. Refer to Section II of the Field Office Technical Guide for a list of those species within West Virginia.

NRCS (Natural Resources Conservation Service) – a federal agency of the United States Department of Agriculture which assists with implementing strategies to solve soil, water, air, plant and animal resource concerns primarily on private lands.

Pesticide Drift - the physical movement of pesticide droplets or particles through the air at the time of pesticide application or soon thereafter from the target site to any non- or off-target site.

Plant Materials Center (PMC) – an office of the USDA Plant Materials Program. The centers have responsibilities for assembling, testing, releasing, and providing for the commercial production and use of plant materials and plant materials technology for programs of soil, water, and related resource conservation and development. The PMC responsible for this area is located in Alderson, WV.

Pollinator – an organism that transfers pollen from one seed plant to another, unwittingly aiding the plant in its reproduction. Common pollinators include insects, especially bees, butterflies, and moths, some birds and bats.

Pupa – the non-feeding stage between the larva and adult in the metamorphosis of holometabolous (bees, moths, butterflies or some beetles) insects, during which the larva typically undergoes complete transformation.

Shrub – perennial, multi-stemmed woody vascular plant that is usually less than 14 to 15 feet in height and usually less than 3.0 inches in diameter at breast height. Shrubs typically have several stems arising from or near the ground, but may be taller than 5 meters or single-stemmed under certain environmental conditions.

Social Bee – (eusocial) bees that live in colonies and work together to build nests, provide food and raise offspring. Only a few native bee species are social including bumble and sweat bees.

Solitary Bee – bees that after mating prepare and provision their own nests without cooperation with other bees. The great majority of bee species are solitary.

Tree – a woody vascular plant usually greater than 3.0 inches in diameter at breast height and usually greater than 15 feet in height (exclusive of woody vines).

Swarming – the process by which an overgrown bee colony divides with half the colony flying away to find a new nest.

Vine – twining/climbing plant with relatively long stems which can be woody or herbaceous.

Warm Season Grass – a species of grasses that grow best when the weather is hot and other species' growth are declining. They begin growing when the soil temperature is above 50^{o} F and continue to grow until the soil temperature reaches nearly 90^{o} F (usually May - September). They may form clumps or sods.

Win-PST-Windows Pesticide Screening Tool – WIN-PST is an environmental risk screening tool for pesticides. NRCS field office conservationists, extension agents, crop consultants, pesticide dealers and producers can use it to evaluate the potential of pesticides to move with water and eroded soil/organic matter and affect non-targeted organisms. NRCS Pest Management Policy (November 2001) requires the use of WIN-PST or other NRCS-approved environmental risk analysis tools in supporting the development of the pest management component of a conservation plan.

West Virginia Division of Natural Resources (WVDNR) – the state wildlife agency responsible for fish, and wildlife (game and non-game) and other natural resources within the State of West Virginia.

Xerces Society, The – a nonprofit organization that protects wildlife through the conservation of invertebrates and their habitat. Established in 1971, the Society is involved in invertebrate protection worldwide through the implementation of various conservation programs. NRCS has an existing Memorandum of Understanding (MOU) at the national level with The Xerces Society.

POLLINATOR HABITAT ASSESSMENT

Directions: This habitat assessment should be performed on one contiguous five (5) acre block. Designate the pollinator enhancement area on the conservation plan map. If the client wishes to enhance a greater amount of habitat use multiple assessments (one per 5 acres). If the client controls less than five acres utilize the area immediately surrounding the acreage to be enhanced to perform the assessment. A client must control a minimum of two (2) contiguous acres to be eligible for pollinator enhancements under this assessment.

1. Prior to or concurrent with a field visit, determine in consultation with the client, a contiguous five acre block to be evaluated and designate it on the conservation plan map. All enhancements must be implemented within this area. Site selection for installing new pollinator enhancements should begin with a thorough assessment of exposure including aspect, shade and soil conditions; but also must take into account landuse and available resources.
2. After/during an in-field assessment, complete the following questions to the best of your ability and write in the baseline scores for each question for all sections. (Sections I through VIII)
3. Determine the baseline point total of all sections. A summary table is provided at the end of the document.
4. At the end of each section, determine and select practices that will increase the baseline score for that section. (**These are the pollinator enhancement practices (PEP) that could be planned to improve habitat.**) Mark a ✓ by the practices to be installed. Other practices could also be utilized with State Biologist concurrence. If the practice will be installed multiple times within the same evaluation area, multiply the PEP times the number of installations (e.g. installation of two hedgerows = 2 hedgerows x 3pts = 6 points)
5. Planners should focus on improving the lowest section score first (by addition of PEP). If the baseline score is already at the maximum baseline value, PEP for maintenance purposes should only apply.
6. A minimum total baseline score of 25 must be obtained to participate in pollinator habitat enhancement.
7. In order to report the conservation practice (645) Upland Wildlife Habitat Management for pollinator habitat, the pollinator enhancement points (PEP) must yield an improvement from the baseline score to the enhancement score as shown in the evaluation summary

CLIENT INFORMATION

Owner/Operator:	**Field Office:**	
County:	**Watershed:**	
Assisted By:	**Date:**	
Location Description:		
Total Acreage to be evaluated for Pollinator Habitat _____ acres	**Client controls: _____acres***	**Assessment #_____of_____**

**Client must control a minimum of 2 acres and minimum total enhancement(s) must be greater than or equal to one-half acre excluding nesting structures.*

Notes/Sketch:

I. GENERAL LANDUSE CHARACTERISTICS

Of the following landuses, how many are available within the five acres evaluated? cropland, woodland, grassland, urban, farm headquarters (barn and feed lots, etc)

Habitat component	Values	Baseline Score
4 or more	3	
3	2	
2	1	
1	0	

Does the land owner control more than 5 contiguous acres?

Habitat component	Values	Baseline Score
Yes	1	
No	0	

Is cropland (including orchards) one of the landuses within the area being evaluated? (Does not include hayland and must be utilized to produce an agricultural commodity once in the last 2 years).

Habitat component	Values	Baseline Score
Yes	1	
No	0	

Do the five acres evaluated contain more than 4 acres of woodland (80% or greater)

Habitat component	Values	Baseline Score
Yes	0	
No	1	

What is the dominant slope of the area being evaluated? Refer only to soil types present within the acreage evaluated.

Habitat component	Values	Baseline Score
A	4	
B	3	
C	2	
Other	1	

TOTAL EXISTING SCORE FOR THIS SECTION IS _____ OUT OF 10 POSSIBLE

Select Pollinator Enhancement Points (PEP) to increase the baseline score for this section (see reverse also):

Conservation Practice	Eligible Pollinator Enhancement Narrative Codes	PEP	✓
N/A	N/A	N/A	N/A

II. CROPLAND INFORMATION

Of the acreage evaluated cropland comprises the following amount:		
Habitat component	**Values**	**Baseline Score**
greater than 30% (1.5 acres or more)	5	
20-30% (1.0-1.4 acres)	4	
10-19% (0.5-1.3 acres)	3	
less than 10% (less than 0.5 acres)	2	
no cropland *	0	

** If no cropland exists within the evaluated area, skip the Cropland Information section and proceed to section III. Score this section as zero total baseline points.*

Which of the following does the cropland within the 5 acres evaluated produce?		
Habitat component	**Values**	**Baseline Score**
Fruit orchard or insect pollinated crop	5	
Truck crops (e.g. melon, pumpkin, tomato, etc)	4	
Flower or other specialty crops (e.g. *Geranium* sp., *Chrysanthemum* sp., etc.)	3	
Row crops such as soybeans, corn, wheat, etc.	1	
None identified	0	

Identify the tillage type that best represents the current operation.		
Habitat component	**Values**	**Baseline Score**
No-Till	2	
Strip Till	1	
Conventional Tillage	0	
Other	0	

Are any of the following crops produced within the area being evaluated: **pumpkins, squash, cantaloupes or watermelons** (minimum size of 0.25 acre)		
Habitat component	**Values**	**Baseline Score**
Yes	1	
No	0	

Is some form of mulch utilized for weed control? (plastic, paper, wood chips, etc)		
Habitat component	**Values**	**Baseline Score**
Yes	0	
No	1	

Is some form of cover crop being utilized within the area evaluated or within the farming operations immediately adjacent to the area being evaluated?		
Habitat component	**Values**	**Baseline Score**
Yes	1	
No	0	

Crops within the evaluated area are:		
Habitat component	**Values**	**Baseline Score**
grown in different locations throughout the tract and are rotated more than 800 feet apart	0	
rotated throughout the tract but are never more than 800 feet from one another	2	
grown in the same fields every year but crops are rotated	1	
N/A	0	

If a cover crop is currently utilized is it one of the following: **crimson clover, vetch, mustards, alfalfa, red clover** or **buckwheat**		
Habitat component	**Values**	**Baseline Score**
Yes	2	
No (other cover crop)	1	
N/A	0	

Are crop fields within the area evaluated associated with herbaceous field borders?		
Habitat component	**Values**	**Baseline Score**
Field borders average at least 20 feet wide on 2 or more sides of the field	3	
Field borders on at least two sides and average less than 20 feet wide	2	
Field borders exist but are different than above	1	
No field borders	0	

Visually estimate the center of the crop fields within the area you are evaluating. What is the average distance from the approximate center of cropping area or orchard to the field edge?		
Habitat Component	**Values**	**Baseline Score**
< 400 feet	3	
400-800 feet	2	
800-1,200 feet	1	
>1,200 feet	0	

TOTAL EXISTING SCORE FOR THIS SECTION IS _____ OUT OF 25 POSSIBLE

See reverse to select Pollinator Enhancement Points (PEP) to increase the baseline score for this section:

Conservation Practice	Eligible Pollinator Enhancement Narrative Codes	PEP	✓
(311) Alley Cropping	A	+4	
(327) Conservation Cover	D1	+4	
	D5	+3	
(328) Conservation Crop Rotation	E	+3	
(329) Residue and Tillage Management, No-Till/Strip Till/Direct Seed	F1	+2	
	F2	+1	
(331) Contour Orchard and Other Perennial Crops	G	+4	
(332) Contour Buffer Strips	H	+4	
(340) Cover Crop	I	+2	
(386) Field Border	L1	+4	
(393) Filter Strip	O	+3	
(412) Grassed Waterways	P	+3	
(585) Stripcropping	V	+4	
(647) Early Successional Habitat Management and Development	Y2	+1	
	Y3	+1	

III. GRASSES, FORBS & EARLY SUCCESSIONAL HABITAT INFORMATION

Of the area evaluated what best describes the ratio of grasses to forbs in the area being evaluated: (minimum grassland size of 1/4 acre must exist within the evaluated acreage)

Habitat Component	Values	Baseline Score
<10% forbs, no grassland or less than 1/4 acre of grassland	0	
10% - 30% forbs	1	
30% - 50% forbs	3	
50% - 85% forbs	4	
>85% forbs	5	

Note if at least 1/4 acre of grassland does not exist within the area evaluated; score this question as zero baseline points.

Visually estimate how much of the acreage evaluated is considered early successional and not used for production of food or fiber?

Habitat Component	Values	Baseline Score
<10% or **no early successional habitat available**	0	
10% - 30%	1	
30% - 50%	2	
50% - 85%	3	
>85%	4	

**Early successional vegetation is considered collectively as grasses, forbs, shrubs and saplings less than 15 feet in height. Not used for production of food or fiber means areas that are idle, fallow (2 out of 3 years), field borders, fencerows, pivot corners, ditch banks, wetland and riparian areas or nearby natural areas. For example, hayland or pasture would not qualify.*

Of the area described above as early successional, what best describes the diversity of the area?

Habitat Component	Values	Baseline Score
Dominated exclusively by native plants (flowering woody and herbaceous plants with 10 to 30% grasses)	4	
A mixture of native forbs and naturalized (non-invasive) plants (orchardgrass, clovers, etc.) and some woody species	3	
More than 70% of the evaluated area is dominated by woody species and grasses forbs	2	
Monocultures of single species or very limited diversity of species	1	
More than 25% of evaluated area consists of invasive or noxious woody or herbaceous species (Johnsongrass, reed canarygrass, Japanese stiltgrass, tree-of-heaven, etc)	0	

Are there areas comprising at least 1/4 acres of clump-forming or bunch grasses (broomsedge, little bluestem, big bluestem, sedges, rushes, etc.) that are within the area evaluated?

Habitat Component	Values	Baseline Score
Yes	1	
No	0	

How much of the vegetation within the acreage being evaluated currently receives some management which includes grazing, mowing, harvesting or other regular disturbance treatment?		
Habitat Component	**Values**	**Baseline Score**
>50%	3	
25-50%	4	
25% or less	2	
<10%	1	
None	0	

TOTAL EXISTING SCORE FOR THIS SECTION _____ OUT OF POSSIBLE 20

Select Pollinator Enhancement Points (PEP) to increase the baseline score for this section:

Conservation Practice	**Eligible Pollinator Enhancement Narrative Codes**	**PEP**	**✓**
(314) Brush Management	B	+1	
(315) Herbaceous Weed Control	C	+1	
(327) Conservation Cover	D2	+4	
(342) Critical Area Planting	J	+1	
(386) Field Border	L2	+2	
(511) Forage Harvest Management	S	+2	
(512) Forage and Biomass Planting	T	+1	
(647) Early Successional Habitat Management and Development	Y1	+1	
	Y2	+1	
	Y3	+1	

IV. LIVESTOCK

What best describes the type of livestock access to the areas being evaluated for pollinator habitat?		
Habitat Component	**Values**	**Baseline Score**
unrestricted or continuously grazed	0	
flash grazing (<30 days per year)	3	
access through rotational grazing	2	
allowed to graze stubble (aftermath grazing)	2	
no access or no livestock present	1	

Is there currently a grazing management plan in place for the area evaluated?		
Habitat Component	**Values**	**Baseline Score**
Yes	1	
No	0	
N/A	0	

If yes, does the management plan allow fallow areas for greater than 365 days between grazing or access?		
Habitat Component	**Values**	**Baseline Score**
Yes	1	
No	0	
N/A	0	

TOTAL EXISTING SCORE FOR THIS SECTION _____ OUT OF POSSIBLE 5

Select Pollinator Enhancement Points (PEP) to increase the baseline score for this section:

Conservation Practice	Eligible Pollinator Enhancement Narrative Codes	PEP	✓
(472) Access Control	R	+1	
(512) Forage and Biomass Planting	T	+1	
(528) Prescribed Grazing	U1	+2	

V. POLLINATOR BUFFERS & CORRIDORS

Does the area evaluated contain linear corridors such as abandoned fencerows, hedgerows, windbreaks, utility rights of way, or riparian areas?

Habitat Component	Values	Baseline Score
Yes	1	
No	0	

Are natural sources of permanent water available within the area evaluated (e.g. wetlands, ponds, perennial streams, etc)? Minimum pond size is 75X 75 feet or ~1/8 acre

Habitat Component	Values	Baseline Score
Yes	1	
No	0	

Do forested riparian areas greater than 35 feet wide measured from top of bank exist within the area being evaluated?

Habitat Component	Values	Baseline Score
Yes	1	
No	0	

If riparian areas exist, what best describes the condition of the riparian area?

Habitat Component	Values	Baseline Score
Dominated by woody species with controlled access 35 feet or greater in width.	4	
Combination of grasses and woody species less than 35 feet wide with livestock access controlled	3	
Consists of mostly non-native pasture or hay species such as fescue or orchardgrass with controlled or uncontrolled livestock access	2	
Consists of some bare ground and minimum vegetation (invasive and/or native) with uncontrolled access by livestock	1	
No riparian areas (N/A)	0	

**Width of riparian areas should be measured from top of bank.*

Are opportunities available for linking multiple linear areas together to form nectar corridors* within a field, drainage area, or watershed? (e.g. hedgerows, field borders, riparian areas, adjoining properties, etc)

Habitat Component	Values	Baseline Score
Yes	2	
No	0	

**Linked corridors or nectar corridors are defined as on a large scale as pathways of food sources for migratory species such as monarch butterflies and various hummingbirds; scattered along great distances which sustain them over, and*

during migration. On a smaller (farm planning) scale, these areas are fashioned along ditches, hedgerows, riparian areas, etc. to facilitate movement throughout an area and/or provide pollinator resources in the form of nectar and pollen. Cumulatively, small scale corridors may be beneficial to provide resources in a watershed scale and so on.

Are there areas surrounding or adjacent to ditches, roadsides, fencerows, hedgerows, etc. that will be used for development of pollinator habitat?		
Habitat Component	**Values**	**Baseline Score**
Yes	1	
No	0	

TOTAL EXISTING SCORE FOR THIS SECTION _____ OUT OF POSSIBLE 10 POINTS

Select Pollinator Enhancement Points (PEP) to increase the baseline score for this section:

Conservation Practice	Eligible Pollinator Enhancement Narrative Codes	PEP	✓
(327) Conservation Cover	D4	+3	
(380) Windbreak/Shelterbelt Establishment	K	+4	
(386) Field Border	L2	+3	
(390) Riparian Herbaceous Cover	M	+4	
(391) Riparian Forest Buffer	N	+4	
(393) Filter Strip	O	+3	
(412) Grassed Waterways	P	+3	
(422) Hedgerow Planting	Q	+4	

VI. NESTING SITES

Are soils within the evaluated area predominantly sandy loams?		
Habitat component	**Values**	**Baseline Score**
Yes	1	
No	0	

Identify any and all of the following that are found within the acreage being evaluated (list all that apply):		
Habitat Component	**Values**	**Baseline Score**
standing or fallen snags at least 18 inches in diameter	1	
artificial bee nesting blocks or artificial bundles	2	
elderberry shrubs >3 x 3 ft in size (or at least 10 plants within the area evaluated)	1	
blackberry or raspberry shrubs (*Rubus* spp.) >3 x 3 ft in size (or at least 10 plants within the area evaluated)	1	
patches of bare ground consisting of sandy loams (min. of 3 x 3 ft)	1	

Are areas of warm season grasses, bunch grasses, or fallow and idle areas of cool season grasses available for periods of 180 days or more?		
Habitat Component	**Values**	**Baseline Score**
Yes	1	
No	0	

What is the dominant (>50%) soil drainage class within the area evaluated**?** (Refer to Soil Survey)		
Habitat Component	**Values**	**Baseline Score**
Poorly Drained	1	
Somewhat Poorly Drained	1	
Well Drained to Moderately Well Drained	2	

TOTAL EXISTING SCORE FOR THIS SECTION _____ OUT OF POSSIBLE 10

Select Pollinator Enhancement Points (PEP) to increase the baseline score for this section (see reverse also):

Conservation Practice	Eligible Pollinator Enhancement Narrative Codes	PEP	✓
(528) Prescribed Grazing	U1	**+2**	
(612)Tree/Shrub Establishment	D6	**+1**	

Conservation Practice	Eligible Pollinator Enhancement Narrative Codes	PEP	✓
(647) Early Successional Habitat Management and Development	Y4	**+1**	
(7XX) Artificial Nesting Structures for Wildlife	Z	**+2**	

VII. PESTICIDE USE

Are pesticides used within the area for plants or animal control?		
Habitat Component	**Values**	**Baseline Score**
at least annually within the area evaluated	0	
less than annually or infrequently within the area evaluated (e.g. rights of way)	1	
at least annually immediately adjacent to the area evaluated (neighbor or other part of property)	2	
less than annually or infrequently immediately adjacent to the area evaluated	3	
Within 1/4 mile (may or may not be on lands not owned by the client)	4	
Pesticides are not utilized or N/A	5	

Identify the method most commonly utilized for chemical application to control pests within the area evaluated.		
Habitat Component	**Values**	**Baseline Score**
Not utilized, organic, or N/A	3	
Boom Sprayed	1	
Aerial Application	0	
backpack sprayed or hand sprayed	2	
wick applied	2	

Are utility rights of ways sprayed or maintained by herbicide or other chemical applications within the evaluated area?		
Habitat Component	**Values**	**Baseline Score**
Yes	0	
No	1	
No utility rights of way	1	

If pesticides are utilized are they applied as:		
Habitat Component	**Values**	**Baseline Score**
Powder	0	
Liquid	1	
Not utilized	1	

TOTAL EXISTING SCORE FOR THIS SECTION _____ OUT OF POSSIBLE 10

Select Pollinator Enhancement Points (PEP) to increase the baseline score for this section:

Conservation Practice	Eligible Pollinator Enhancement Narrative Codes	PEP	✓
(327) Conservation Cover	D3 (linear only)	+2	
(386) Field Border	L2	+2	
(422) Hedgerow Planting	Q	+3	
(595) Integrated Pest Management	W	+3	

VIII. EXISTING PRACTICES

Are any of the following practices being actively applied to existing resources within the area of evaluation?
Mark all that apply

Habitat Component	Values	Baseline Score
Livestock exclusion to riparian areas, wetlands or streams	1	
Actively applying some form of Integrated Pest Management w/ plan and documentation	1	
No-Till Farming	1	
Practicing seasonal residue management of a minimum of 30% residue or greater with no fall plowing (evaluated area must contain cropland)	1	
Strip disking for terrestrial wildlife species on a rotational basis	1	
Strip mowing for terrestrial wildlife species on a rotational basis	1	
Management of a warm season grass species (big bluestem, little bluestem, switchgrass, Indiangrass etc) of 1/4 contiguous acre or more	1	
Bee rental for crop pollination	1	
Rotational grazing with a minimum of 3 paddocks	1	
Mechanical invasive species control (minimum 1/2 acre of multiflora rose, autumn olive, etc) in conjunction with targeted herbicide applications.	1	
TOTAL		

TOTAL EXISTING SCORE FOR THIS SECTION _____ OUT OF POSSIBLE 10

Potential conservation practices or other relevant information that may be used to increase the Existing Practices score are:

Conservation Practice	Eligible Pollinator Enhancement Narrative Codes	PEP	✓
N/A	**N/A**	**N/A**	**N/A**

EVALUATION SUMMARY

Section	Pollinator Habitat Assessment Component	Baseline Score	PEP	Total Possible Points
I	General Landuse Characteristics		**N/A**	10
II	Cropland			25
III.	Grasses, Forbs and Early Successional Habitat			20
IV	Livestock			5
V	Pollinator Buffers & Corridors			10
VI	Nesting Sites			10
VII	Pesticide Use			10
VIII	Existing Practices		**N/A**	10
	TOTAL			**100**

NOTES:

- Client must control a **minimum of two (2) contiguous acres** of any landuse to participate in pollinator initiative
- Total minimum point threshold for pollinator habitat improvement is **25 points**
- Total minimum size of all **enhancements is one-half acre** (artificial nesting structures do not count toward enhancement size)
- In order for a FO to report the conservation practice (645) Upland Wildlife Habitat Management for pollinator habitat utilize the following method:
    - If the baseline score is **25 – 40;** increase total score by 10 points through addition of PEP
    - If the baseline score is **41 – 56**; increase total score by 8 points through addition of PEP
    - If the baseline score is **57 – 72**; increase total score by 6 points through addition of PEP
    - If the baseline score is **73 – 88**; increase total score by 4 points through addition of PEP
    - Baseline score greater than 88 points requires a minimum 1 point increase through the addition of PEP (i.e. maintenance)

Example:

Baseline Score = **58** points. Therefore the planner must increase the score by 6 points. So, multiply

6 points of PEP required through selection of practices

Note: (645) Upland Wildlife Habitat Management may only be reported for acreage in which the client controls.

Conservation Practice	Narrative Code	Pollinator Enhancement Narratives	PEP	Applied Setting
(311) Alley Cropping	**A**	Utilize existing or install new alley cropping system to provide continuous pollen and nectar forage within a single area. Utilize tree species that have complementary flowering periods to crops. By paying careful attention to bloom periods and using multiple species. Diverse native forbs and shrubs may be planted in rows for cut flowers, berry production, or the nursery market as well as benefitting pollinators.	**+3**	Cropland
(314) Brush Management	**B**	Establish control of woody invasive species such as autumn olive, paulownia, tree of heaven and multiflora rose which is invading or threatens to invade established pollinator habitat. *This PEP may be used as standalone PEP or as maintenance PEP.*	**+1**	Non-Cropland
(315) Herbaceous Weed Control	**C**	This maintenance or establishment practice involving the control of herbaceous invasive species which is invading or threatens to invade established pollinator habitat; or to remove and control noxious species prior to establishment. *This PEP may be used as an establishment or maintenance PEP.*	**+1**	All
(327) Conservation Cover	**D1**	Plant a permanent enhancement within 500 feet of crop fields consisting of native, herbaceous perennials containing a minimum of ten (10) herbaceous species which includes three species in each bloom period of very early or early , mid and late and also one species or warm season grass or sedge- minimum size one-half acre	**+3**	Cropland
	D2	Plant a permanent enhancement consisting of native, herbaceous perennials containing a minimum of ten (10) herbaceous species which includes three species in each bloom period of very early or early , mid and late and also one species or warm season grass or sedge- minimum size one-half acre	**+3**	Non-Cropland
	D3	Establish linear herbaceous cover of native, herbaceous perennial pollinator friendly species along hedgerows, at the base of one or both sides of a hedgerow, windbreaks, shrubby field borders or other corridors to enhance pollinator habitat. Planting must contain a minimum of ten (10) herbaceous species which includes three species in each bloom period of very early or early , mid and late and also one species or warm season grass or sedge - minimum size 1/4 acre. *Utilize (390) Riparian Herbaceous Cover for similar enhancements to riparian areas.*	**+2**	All
	D4	Establish a woody pollinator (linear or block style) planting that provides pollinator resources throughout the season a minimum of nine species (3 in each of the very early, early and mid season). Plantings must be at least one-half acre in size. HINT: *This PEP cannot be combined with Hedgerow Planting (422).*	**+2**	Non-Cropland
	D5	Establish a woody block pollinator planting within 500 feet of cropland that provides pollinator resources throughout the season, or to provide resources outside of the crop bloom period. A minimum of 9 species (3 in each of the very early, early and mid season) must be established. Plantings are a minimum of one-half acre in size.	**+2**	Cropland
(328) Conservation Crop Rotation	**E**	Install or facilitate a rotation of pollinator friendly crops and fields of blooming pollinator-friendly species during critical bloom times. Crops should not be rotated more than 800 feet and utilize rotations that create overlapping bloom periods. Overlapping bloom periods must occur in a minimum of two fields. Hint: *Where possible this practice should be utilized in conjunction with (340) Cover Crop, etc. to achieve multiple PEP scores.*	**+3**	Cropland

Conservation Practice	Narrative Code	Pollinator Enhancement Narratives	PEP	Applied Setting
(329) Residue and Tillage Management, No-Till/Strip Till/Direct Seed	**F1**	Implement a residue management system on truck or vegetable crops to emphasize availability of bare ground by leaving standing crop residue to protect bees that are nesting in the ground at the base of the plants they pollinate (i.e. squash, watermelons, pumpkins).	**+2**	Cropland
	F2	Include a minimum of one row of un-harvested or 5 feet of undisturbed refugia along edges of fields to provide nesting sites for ground nesting bees.	**+1**	
(331) Contour Orchard and Other Perennial Crops	**G**	Establish pollinator-friendly vegetative ground cover in alleys between rows of trees/vines, in row furrows on terraces and diversions to provide habitat for beneficial species and pollinators. A minimum of two pollinator-friendly species (legumes and/or flowering forbs that make up at least 30% of the total planting mix) regardless of bloom period must be included. Refer to the WVPH for information regarding suitable plant species. Select species that augment the existing crop bloom period. *This may be used as standalone PEP or in combination with other PEP (i.e. 612 Tree/Shrub Establishment).*	**+3**	Cropland
(332) Contour Buffer Strips	**H**	Include diverse pollinator friendly legumes or other forbs that provide pollen and nectar for native pollinators. Include a minimum of three species of forbs that bloom during consecutive bloom periods (one in each blooming period) of very early or early, mid and late within the buffer strips. Inclusion of pollinator species should not compromise the intended function.	**+3**	Cropland
(340) Cover Crop	**I**	Implement a pollinator friendly cover crop identified in the WVPH. (minimum of one –half acre) *Cover crop must have a bloom period outside the principle crop bloom . This may be used as standalone PEP or in combination with other PEP (i.e. 328 Conservation Crop Rotation).*	**+2**	Cropland
(342) Critical Area Planting	**J**	Establish critically eroding areas with pollinator friendly species within the evaluated area. A minimum of three perennial pollinator friendly species (legumes and/or flowering forbs that make up at least 30% of the total seed composition) regardless of bloom period must be included. Select species from the WVPH suitable for erosion control and that are pollinator -friendly. Inclusion of pollinator species should not compromise the intended function.- Minimum size 1/4 acre	**+1**	All
(380) Windbreak/ Shelterbelt Establishment	**K**	Install and orient pollinator friendly species as indicated in the WVPH to shelter pollinator enhancement areas against pesticide drift and/or provide habitat, improve aesthetics or create barriers to use. Utilize bloom periods of very early, early and mid-season. A woody shelterbelt/windbreak pollinator mix must contain at least three species in each of the three blooming periods (very early, early and mid).	**+3**	All
(386) Field Border	**L1**	Install and orient permanent pollinator field borders adjacent to crop fields to eliminate or reduce pesticide use/drift and/or increase pollinator habitat. Field border is a minimum of 20 feet wide and contains at least ten species (three species in each of the bloom periods very early or early, mid and late season) including one warm season grass or sedge species.	**+3**	Cropland
	L2	A permanent pollinator herbaceous field border is established that surrounds grassland (e.g. hayland or other grass areas) consisting of flowering forbs. The field border is a minimum of 20 feet wide and contains at least ten species (three species in each of the bloom periods very early or early, mid and late season) including one warm season grass or sedge species.	**+2**	Non-Cropland

Conservation Practice	Narrative Code	Pollinator Enhancement Narratives	PEP	Applied Setting
(390) Riparian Herbaceous Cover	**M**	Install an herbaceous riparian buffer adjacent to streams or waterbodies a minimum of 35 feet wide or 1.5 times the width of the stream whichever is greater and a minimum of 15 feet for water bodies. Cover must consist of a minimum of 10 species which include at least one native grass or sedge. Of the 10 species utilized, a minimum of three species must be established in each of the bloom periods of very early or early, mid and late season. *This PEP may be utilized in conjunction with 391 or as standalone practice.*	**+3**	All
(391) Riparian Forest Buffer	**N**	Install and orient a riparian buffer consisting of woody pollinator friendly species to reduce pesticide drift and/or increase pollinator habitat. A minimum of nine woody species should be utilized (three in each of the blooming periods very early, early and mid). Width and other specifications must meet current RFB criteria. *This PEP may be used as a standalone practice or in conjunction with 390, 472, etc.*	**+3**	All
(393) Filter Strip	**O**	Include legumes or other forbs that provide pollen and nectar for native pollinators but does not compromise the original intended function. The minimum additional flow length shall be 10 feet. A total of ten species shall be established for pollinators; including a minimum of one native grass species and three species of forbs in each of the bloom periods. *This PEP may be used as a standalone practice or in conjunction with 391 or other similar PEP.*	**+2**	All
(412) Grassed Waterways	**P**	Install pollinator friendly perennial species in addition to those species utilized for erosion control or improve water quality. Flow length must be increased a minimum of 10 feet. A minimum of one plant species in each bloom period is required. Include management to maintain those species.	**+2**	All
(422) Hedgerow Planting	**Q**	Install and orient (where feasible) a pollinator-friendly hedgerow to shelter, connect or provide pollinator areas. The minimum width is 25 feet and minimum length . Utilize a minimum of six species of trees and/or shrubs consisting of at least two woody species in each of the bloom periods very early, early and mid season. HINT: *Utilize multiple hedgerows or other linear practices to connect nectar corridors in a given area.*	**+3**	All
(472) Access Control	**R**	Provide access control of pollinator establishment areas (including riparian corridors) with fence or other means to exclude herbivory of planted or protected stands. *Utilize in conjunction with other PEP.*	**+1**	All
(511) Forage Harvest Management	**S**	**Deferred harvesting** of forage producing areas in order to leave areas for pollinators and create nesting sites for bumble bees. Mow no more than one-third of an entire grassland stand in any given year (sections, strips etc.) This can be done by harvesting only one-third of a single field; or no more than one-third of the entire acreage of a stand in a year. Harvesting should occur in 2-4 year cycles with field(s) or portions of a field(s) to remain undisturbed for a period of time (fallow). A longer rotation yields greater diversity in composition and structure. A minimum of one-half acre must be deferred per area evaluated. *This PEP may be used as a standalone or as maintenance.*	**+2**	Non-Cropland
(512) Forage and Biomass Planting	**T**	Include a minimum of 30% perennial pollinator friendly species to planned forage plantings (legumes and/or flowering forbs that make up at least 30% of the total seed composition). Where possible coordinate bloom periods to adjacent cropland. Refer to the WVPH for species suitable for inclusion into forage mixes. Minimum of one acre.	**+1**	Grassland

Conservation Practice	Narrative Code	Pollinator Enhancement Narratives	PEP	Applied Setting
(528) Prescribed Grazing	**U1**	**Deferred grazing** may be used to leave areas for pollinators and create nesting sites for bumble bees and some forage for pollinators. Graze no more than one-third of an entire grassland stand in any given year. This can be done by grazing only one-third of a single field; or no more than one-third of the entire acreage of a stand in a year. Grazing should occur in 2-4 year cycles with field(s) or portions of a field(s) to remain undisturbed for a period of time (fallow). A longer rotation yields greater diversity in composition and structure. A minimum of one-half acre must be deferred per area evaluated.	**+2**	Grassland
	U2	**Flash grazing** of established pollinator stands on an every third year basis (maximum frequency) as a management tool to remove rank growth and remove accumulated residues. *Utilize this PEP for maintenance.*	**+1**	
(585) Stripcropping	**V**	Implement a strip cropping system if insect pollinated crops are grown. Plants used in adjacent strips of vegetative cover are carefully chosen to provide complementary bloom periods prior to and/or after the crop bloom. This must include a minimum of three species (one in each of the blooming periods) that bloom very early or early, mid and late season. *Hint: Corn and soybean rotations are not considered insect pollinated crops*.	**+4**	Cropland
(595) Integrated Pest Management	**W**	Development of an Integrated Pest Management Plan that incorporates the following: • Utilization of equipment and/or herbicides specifically designed for pollinators whenever possible • Use elective pesticides that target a narrow range of insects, (e.g. *Bacillus thuringiensis* (*Bt*) for moth caterpillars) • Request that utilities be notified to reduce or eliminate spray and maintain rights of way by alternative means. • Application of pesticides during evening hours or after dark • If applicable, discontinue the use of any standard flat fan or hollow cone nozzles; and replace with drift reduction nozzles (e.g. turbo jet, raindrop and air-induction nozzles) and/or utilization of nozzles capable of operating at low pressures (15 to 30 psi) • Operate standard boom sprayers at the lowest effective pressure with nozzles set as low as possible. • If drop nozzles are utilized they should be used to deliver insecticide within the crop canopy. • Discontinue the utilization of any oil-based chemical carriers • Where possible, use thickening agents if they are compatible with the pesticide. • Where applicable, utilize liquid chemical pesticides as opposed to powders • Landowners will be provided risk assessments and explanations of assessments using NRCS protocols from a pesticide screening tool (i.e. Win-PST). At a minimum the Pesticide Active Ingredient Rating Report must be provided. HINT: *This PEP is utilized only on cropland where pesticides are actively being applied.*	**+3**	All

Conservation Practice	Narrative Code	Pollinator Enhancement Narratives	PEP	Applied Setting
(612) Tree and Shrub Establishment	**D6**	Establish or incorporate woody pollinator plantings that provide nesting sites for bees with species such as elderberry or blackberry (*Sambucus* spp. or *Rubus* spp.) box elder or sumac (*Acer negundo* or *Rhus* spp.) to provide pithy areas for nesting. Inclusion of these species should not compromise the intended function. A minimum of 20 total plants per area evaluated. *This PEP may be used as a standalone PEP or in combination with other PEP (i.e. 327, 342, etc.).*	**+1**	All
(647) Early Successional Habitat Management and Development	**Y1**	**Openings** for pollinators may be created in forested cover types when open sunny areas are missing in the evaluated area utilizing this practice. Pollinator openings should be a minimum of one acre in size and consist of at least three species of forbs in each in each of the bloom periods very early or early, mid and late season (nine total species). Mixes shall also contain one species of native warm season grass or sedge. Pollinator enhancement openings should be created in the same fashion and with the same considerations as other wildlife openings. *This PEP should only be utilized where the majority of the evaluated area cover type is forest (greater than 80%). Use with caution due to invasive potential.*	**+1**	Woodland
	Y2	**Disking** may be utilized as a maintenance practice on established stands for retaining pollinator habitat and to revitalize rank stands and improve vegetative structure and density. Disk to achieve 70% bare ground at a maximum frequency of once every third year after stands are established. *Use this PEP for maintenance of practices such as (386) Field Border, (327) Conservation Cover, etc.*	**+1**	All
	Y3	**Deferred mowing of non-hay producing areas** may be used to leave areas for pollinators and create nesting sites for bumble bees. Mow no more than one-third of an entire grassland stand in any given year. This can be done by harvesting only one-third of a single field; or no more than one-third of the entire acreage of a stand in a year. Mowing should occur in 2-4 year cycles with field(s) or portions of a field(s) to remain undisturbed for a period of time (fallow). Longer rotations are encouraged. A minimum of one-half acre must be deferred per area evaluated.	**+1**	Grassland
	Y4	**Brush pile** creation for areas designated for native bees. A minimum of 2 per acre and a maximum of 7piles per five acres are required.	**+1**	All
(INT)* Artificial Nesting Structures for Wildlife	**Z**	Construct 2 nesting blocks, stem or tube bundles, bumble bee boxes per acre and place as indicated within the WVPH and/or the Invertebrate Conservation Fact Sheet-*Nests for Native Bees*. A maximum of 12 per five acres evaluated. Where possible utilize multiple nest structure types. *Utilize this PEP one time per evaluated area.*	**+2**	

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**This interim practice has not yet been assigned a practice code number.*

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