Habitat Installation Guide

Pennsylvania

WILDLIFE HABITAT (420) & CONS. COVER (327)
for Pollinators & Beneficial Insects

Conservation Practice Specifications

Definition and Purpose

These instructions provide in-depth guidance on how to establish and maintain pollen-and nectar-rich wildflower habitat for pollinators and beneficial insects. The requirements and considerations in this guide are in addition to NRCS criteria applicable all purposes for the planned conservation practice. To plan a specific project, use this guide and checklist along with NRCS–PA Practice Standards. Consult with NRCS Biologists or State Specialists for site-specific guidance. Refer to NRCS Monarch Resources and Guides for the Greater Appalachian Mountains Region (see references), when monarch butterflies are a target species.

Conservation Objectives

Depending on conservation objectives and project design, pollinator habitat may also provide food and cover for other wildlife, reduce soil erosion, protect water quality, and attract other beneficial insects—such as predators and parasitoids of crop pests.

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The Xerces Society for
Invertebrate Conservation

www.xerces.org

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Revised edition

Updated in August 2019 by Kelly Gill, Mace Vaughan, and Sara Morris of the Xerces Society.

Editing and layout

Sara Morris, The Xerces Society.

Photographs

Cover: black-eyed Susans (*Rudbeckia hirta*) and marsh blazing star (*Liatris spicata*) blooming in a diverse pollinator planting [left]; pure green sweat bee (*Augochlora pura*) on wingstem (*Verbesina alnifolia*) [top right]; monarch (*Danaus plexippus*) caterpillar on common milkweed (*Asclepias syriaca*) [bottom right]. We thank the photographers who generously allowed use of their images. Copyright of all photographs remains with the photographers.

- **Jim Cairns, USDA–NRCS:** Figure 14.
- **David O'Shields:** Figures 12; 13; 15.
- **Linda Rinta:** Figure 1A.
- **Justin Wheeler:** Cover [*left*]; Figure 21.
- **Dave Williams:** 10.
- **The Xerces Society/Nancy Lee Adamson:** Figures 5A–C; 18.
- **The Xerces Society/Brianna Borders:** Figure 6A.
- **The Xerces Society/Jessa Kay Cruz:** Figure 7A; 9C.
- **The Xerces Society/James Eckberg:** Figures 1B–C.
- **The Xerces Society/Sarah Foltz Jordan:** Figures 2A–C; 6B–C; 7B–C; 11; 16.
- **The Xerces Society/Kelly Gill:** Cover [*top right*, *bottom right*]; Figures 3B–C; 4; 8; 9A–B; 17; 19; 20.
- **The Xerces Society/Mace Vaughan:** Figure 3A.

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Planning Considerations

Key Site Characteristics

Assess the following site characteristics and conditions when selecting a location for establishing pollinator habitat:

- **Pesticide Drift:** Habitat must be protected from pesticides (especially insecticides and bee-toxic fungicides and herbicides). Only sites with no to very low risk for pesticide drift should be established as new habitat. This includes some pesticides approved for use on organic farms. See references for more information.
- **Accessibility:** New habitat should be accessible to equipment for planting and maintenance operations.
- **Sunlight:** Most of the native wildflowers recommended in this guide grow best in full sunlight.
- **Slope:** Do not disturb steep slopes or highly erodible lands. For re-vegetating sites with erosion concerns, use Critical Area Planting (342) or other suitable Practice Standards.
- **Weed Pressure:** Prioritize areas with low weed pressure to the extent possible when seeding wildflower habitat. Areas with high weed pressure require more time and effort to prepare for planting. It is important to identify dominant weed cover (annual or perennial; broadleaf, grass, or woody), most abundant weed species on site, and their reproductive methods (seed, rhizomes, etc.) as it will help significantly in planning for site preparation (selecting most effective weed control methods and timing), and follow-up weed management during establishment.
- **Site History:** Factors such as past plant cover (e.g., weeds, crops, grass sod, and/ or native plants), use of pre-emergent herbicides or other chemicals, and soil compaction can affect plant establishment. It is also important to know if sites may have poor drainage or may be prone to flooding, as these conditions make habitat establishment more difficult and require a plant mix adapted for the site.
- **Soils:** Most plants listed in the Appendix of this guide are tolerant of many soil conditions and types, however all plants establish better when matched with soil moisture, drainage, and other site-specific conditions.
- **Irrigation:** Establishing plants from plugs, pots, or bare root will require irrigation. Irrigation is generally not needed for plantings established from seed.
- **Other Functions:** The site may offer opportunities to serve other functions, such as run-off prevention, stream bank stabilization, wildlife habitat, or windbreaks. Those factors can influence plant choice and/ or design.

Plant Selection

Native Plants: Focus plant selection on native perennial plants that provide pollen- and nectar-rich forage for pollinators and other beneficial insects and larval food plants for butterflies and moths. Include non-competitive native grasses at a low rate (grass not to exceed 25% of the mix by based on number of seeds per square foot).

Non-Native Plants: Plant selection should focus on pollen- and nectar-rich native plants, but non-invasive, non-native plants (naturalized species) may be used when cost and/ or availability are limiting factors. Please see the Appendix for acceptable non-native plants. Non-native plants, such as buckwheat or clover, may be planted as part of a crop rotation or in a perennial crop understory using the Cover Crop Practice Standard (340), to increase the value of crop fields to pollinators. **Do not include non-native plants when restoring natural areas, in areas of rare and declining habitats, or where there is potential for negative impacts on other threatened or sensitive habitats types or at-risk species.**

Alternate Pest or Disease Hosts: In most cases, native pollinator plants do not serve as alternate hosts for crop pests or diseases, but selected plants should be cross-referenced for specific crop pest or disease associations. Research indicates that weedy borders harbor more pests than are found in diverse native plantings.

Seed Mix Requirements and Specifications: If you are designing a custom plant list, individual species should be chosen so that there are **consistent and adequate** floral resources throughout the seasons. In order to achieve this goal, a minimum of three species from each blooming period (early, mid, and late season), should be included. Plant mix composition (i.e., percent of each species) can be designed to complement adjacent crop bloom time or other abundant species in the landscape, with more plants blooming immediately before and after adjacent crops.

Important: NRCS conservation practices have specific guidelines for seed mix design and quality. While these guidelines are recommended best practices for seed mix design (and encouraged for all pollinator habitat plantings), seed mixes must meet NRCS practices standards and specifications when pollinator or monarch butterfly habitat is being established thought participation in NRCS conservation programs.

See the Appendix for a list of acceptable pollinator plants for Pennsylvania and additional information on seed quality criteria, pollinator seed mix design, including considerations for monarch butterflies.

Requirements

Site Preparation

Site preparation is one of the most important and often inadequately addressed components for project success. It is also a process that may require more than one season of effort to reduce competition from invasive, noxious, or undesirable non-native plants and reduce the weed seed bank prior to planting. ***In particular, site preparation should focus on the removal of perennial weeds*** (there are more options to address annual or biennial weeds after planting).

Regardless of whether the objective is to establish herbaceous or woody vegetation, more effort and time spent eradicating undesirable plants prior to planting will result in higher success rates in establishing the targeted plant community. **Table 1** provides three options for site preparation. For additional organic (non-herbicide) site preparation options, see The Xerces Society's guidelines, *Organic Site Preparation for Wildflower Establishment* (xerces.org/guidelines-organic-site-preparation/).

NOTE: If weed pressure is high, then the weed abatement strategies detailed in **Table 1** should be repeated for an additional growing season. High weed pressure conditions are characterized by:

- Persistent, year-round cover of undesirable plants (covering >50% of the site);
- Sites where weeds have been actively growing (and producing seed) for multiple years;
- Sites dominated by introduced sod-forming grasses, rhizomatous forbs, and/or invasive woody plants (e.g., reed canarygrass, smooth brome, Canada thistle, mugwort, autumn olive, buckthorn, Japanese knotweed). See PA Invasive Species list for more information (nrcs.usda.gov/wps/portal/nrcs/main/pa/technical/ecoscience/invasive/).

Previously cropped lands—those that have been cultivated or in sod for several years—are generally lower in weed pressure.

Table 1: Site Preparation Methods

METHOD: Non-Selective (Non-Persistent) Herbicide* **(Figure 1)**

Where to Use
- Conventional farms and organic farms*
- Areas with a low risk of erosion or water quality impacts
- Areas accessible to sprayer

Timing
- **TOTAL TIME:** 6+ months
- **BEGIN:** Early spring after the first weed growth
- **PLANT:** Fall dormant seeding dates, delay until spring when wet conditions are prohibitive to fall seeding

Basic Instructions:

1. Mow existing thatch as needed before beginning herbicide treatments to expose new weed growth to the herbicide spray.
2. Apply a non-selective, non-persistent herbicide as per label as soon as weeds are actively growing in the early spring.
3. Repeat herbicide applications throughout the spring, summer, and early fall as needed (whenever emerging weed seedlings reach 4–6" or per label instructions if recommended treatment height is different for the specific formulation being used).
4. For any herbicide-resistant weeds, mow the area to prevent flowering and seed development as necessary.
5. Plant pollinator seed mix (and any transplants) in the fall after a hard frost, waiting at least 72 hours after the last herbicide treatment. Refer to the Planting Methods section of this document for specific recommendations.

⚠ **NOTE: Do not till.** Avoid any ground disturbance that may bring up additional weed seed. An additional year of site preparation is recommended if weed pressure is particularly high. Consult with local extension or other certified weed control specialist if a more targeted herbicide is required for weed species that do not respond to a non-selective herbicide. Avoid use of herbicides that are bee-toxic (e.g., Paraquat and Gramoxone).

* *Choice of herbicide must be acceptable to OMRI for organic operations; or, if not, used outside of certified ground AND approved by an organic certifier.*

Figure 1: The site on the left (A) was prepared with a single glyphosate treatment, leaving a significant stubble layer and persisting weedy grasses. It is not ready for planting. The center photo (B) shows a site that was treated for an entire growing season with repeated glyphosate treatments (applied whenever new weeds appeared). Following these treatments, the stubble was removed with a flail mower and was ready for planting (C). Neither site was cultivated.

Table 1: Site Preparation Methods

METHOD: Solarization ⓘ (Figure 2)

Where to Use
- Conventional farms and organic farms
- Areas with a low risk of erosion
- Areas accessible to mowing equipment
- Locations with full sun and well-drained soils

Timing
- **TOTAL TIME:** 6+ months
- **BEGIN:** Spring
- **PLANT:** Fall dormant seeding dates, delay until spring when wet conditions are prohibitive to fall seeding

Basic Instructions:

1. Mow, rake, or lightly harrow and smooth the site in the spring (raking off debris and removing rocks, stumps, to avoid puncturing plastic, if necessary).
2. After smoothing the site, dig a trench around the perimeter and lay UV-stabilized plastic (such as high tunnel plastic) covering entire planting area (if more than one sheet of plastic is needed, overlap edges to prevent gaps). Bury the edges of the plastic in trenches and backfill with soil to prevent airflow between the plastic and the ground. Weigh down the center of the plastic, if necessary, to prevent the wind from lifting it. Use greenhouse repair tape for any rips that occur during the season.
3. Remove the plastic in mid-fall before the weather cools and the area beneath the plastic is recolonized by nearby rhizomatous weeds.
4. Immediately plant the pollinator seed mix. Refer to Planting Methods section of this document for specific bed preparation recommendations.

⚠ **NOTE:** Solarization may not be as effective in years when summer sun or high temperatures are limited. **Do not till.** Avoid any ground disturbance that may bring up additional weed seed. An additional year of site preparation is recommended if weed pressure is particularly high.

ⓘ For additional details on solarization, see our guidelines, *Organic Site Preparation for Wildflower Establishment.*

Figure 2: Solarization is an effective method to prepare a site for future planting. For optimal results, the site should get full sun and be accessible to equipment. Begin by cultivating and smoothing the site in early spring. Mowing (instead of cultivating) is also an option, and is preferred if the weed species present are tolerant to, or their growth/spread is exacerbated by, cultivation. Equipment, such as a trencher on a tractor, can be used to dig a trench around the perimeter (A). Next, lay UV-stabilized plastic (B) and bury the edges (C), weighing down the center with rocks if necessary to prevent airflow between the plastic and the ground. Throughout the season, repair any holes in the plastic with high-tunnel repair tape, to keep the temperature high. Remove the plastic in early fall, and if adequate weed control is achieved, immediately plant the pollinator seed mix without tilling the site (see Table 2 Methods for Planting Wildflower Seed for instructions).

METHOD: Mechanical (with Smother Crop Option) ⓘ (Figure 3)

Where to Use
- Conventional or organic sites with low risk of erosion
- Areas accessible to cultivation equipment and irrigation
- On sites with well-moderately drained soils (avoid tillage during wet conditions)

Timing
- **TOTAL TIME:** 6+ months
- **BEGIN:** Early spring after the first weed growth
- **PLANT:** Varies with method

Basic Instructions:

1. Lightly disk in early spring as soon as field is accessible and before winter/spring annual weeds flower. Time tillage to appropriate soil moisture levels (i.e., dry enough) to be free of clods. Minimize soil disturbance by setting equipment to most shallow depths possible, but deep enough to work up soil adequately. If the site has dense overgrown vegetation, mow before tilling.
2. Wait least 2–3 weeks after initial till to allow existing organic matter time to decompose.
3. Then begin shallow cultivation to encourage non-dormant weed seed in top inches of soil germinate. Minimize soil disturbance by using cultivation equipment that is compatible with site conditions and can be set to cultivate at shallow depths (≤4"). Evaluate effectiveness of cultivation implements and adjust as necessary.
4. After cultivation, smooth and firm the soil (cultipacker, tow-behind or push lawn roller) to enhance seed-soil contact, as weed seeds germinate more readily with good seed-soil contact.

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Table 1: Site Preparation Methods

METHOD: Mechanical (with Smother Crop Option)ⓘ CONTINUED

5. Repeat mechanical shallow cultivation (flame cultivation can be an alternative) at 3–5 week intervals (or before weeds reach 6" tall; do not allow formation of seedheads and weed seed dispersal) for an entire growing season,
—OR—
6. ***RECOMMENDED*** use mechanical methods in spring in combination with a warm season cover/smother crop (e.g., buckwheat) to reduce soil disturbance and suppress weed growth. Two successive buckwheat plantings is recommended where conditions permit.

ⓘ For detailed instructions on site preparation using smother cropping, including timelines, procedures, seeding rates, and termination (and other site preparation methods not included here) see The Xerces Society's *Organic Site Preparation for Wildflower Establishment* and associated timelime check lists for the East/Midwest region (Links to both in references).

Figure 3: Disking and harrowing compacted soil (A) will break up large and small clods of dirt, bringing up dormant weed seed that will then germinate and be killed by subsequent tillage. For sites with low weed pressure, repeated shallow cultivation for an entire growing season can be enough to prepare a site for seeding (B). On sites with higher weed pressure, repeated shallow cultivation in spring followed by successive warm season cover crops—like this site with a buckwheat (*Fagopyrum esculentum*) smother crop blooming in late August (left of line)—can provide increased weed suppression before being terminated in the fall.

Planting Methods

Recommended planting methods are site-specific. Factors such as equipment availability should be taken into consideration. Installing and maintaining habitat should fit into general farm management practices as much as possible. Pre-project site conditions, especially weed competition, should be addressed prior to planting. **Table 2** covers several planting options.

Seeding wildflowers: Planting from seed can be a lower-cost way to establish wildflowers. Seeding requires **excellent site preparation** to reduce weed pressure since weed control options are limited when the wildflowers start to germinate.

Newly-planted areas should be clearly marked to protect them from herbicides or other disturbances.

Figure 4: Black-eyed Susans (*Rudbeckia hirta*), purple coneflower (*Echinacea purpurea*), and wild bergamot (*Monarda fistulosa*) in an established pollinator meadow.

Seeding Dates

FALL/DORMANT SEEDING ***dates are recommended for most sites:*** Most native wildflowers are best planted in the late fall (mid-October–early November). The exact date will vary by location and annual weather patterns, but should coincide with the first hard/killing frost dates and when daytime temperatures are consistently 45°F and below, but before the ground freezes. **Caution:** Wet field conditions can be prohibitive to fall/dormant seeding. Delay seeding until spring where wet fall conditions are prohibitive.

SPRING SEEDING: Mid-April–end of May. These dates coincide with the last spring frost dates throughout Pennsylvania. The exact date will vary by region and annual weather patterns. **Caution:** Seeding after June 1st will increase weed competition and require additional effort for weed control during the first year of establishment.

Table 2 (next page) outlines several possible seeding methods.

Table 2: Methods for Planting Wildflower Seed

METHOD: Broadcasting Seeders or Hand-Broadcasting (Throwing Seed) (Figures 5 & 6)

Pros

- ⊕ Inexpensive
- ⊕ Easy to use
- ⊕ Can often accommodate poorly cleaned seed
- ⊕ Many models and sizes of broadcasters are commonly available, including hand held crank and larger tractor or ATV mounted models

Cons

- ⊖ Requires a smooth seed bed
- ⊖ Seed should be pressed int o the soil after planting
- ⊖ Difficult to calibrate
- ⊖ Some models of broadcast seeders cannot accommodate large seeds

Basic Instructions:

1. Remove as much stubble as possible prior to seeding, creating a smooth, lightly-packed seed bed. The soil surface can be lightly hand-raked or harrowed to break up crusted surfaces, but do not cultivate the site (cultivation will bring up additional weed seed).
2. Seeds of similar sizes can be mixed together and bulked up with an inert carrier ingredient such as sand, fine-grained vermiculite, clay-based kitty litter, gypsum, or polenta (fine cornmeal). Use two to three parts bulking agent for each part seed by volume. These inert carriers ensure even seed distribution in the mix, provide visual feedback on where seed has been thrown, and make calibration easier.
3. The broadcast-seeding equipment used should have a flow gate that closes down small enough to provide a slow, steady flow of your smallest wildflower seed. Models with an internal agitator are also preferred. It is recommended to divide seed into several batches and seed in installments to ensure proper seeding rate and coverage.
4. Make sure flow gate is closed before filling seeder with seed mix. Planting should begin with the flow gate set to the narrowest opening, to allow at least two perpendicular passes over the seed bed for even distribution. Very large seed can be planted separately with the flow gate set to a wider opening.
5. For small sites (e.g., less than one to two acres), seed can also be hand broadcast (similar to scattering poultry feed). When hand- broadcasting, divide the seed into at least two batches, bulk the seed mix with an inert carrier, and sow each batch separately (scatter the first batch evenly over the site while walking in parallel passes across the site, and then walk in passes perpendicular to the previous passes to scatter the second batch) to ensure seed is evenly distributed.
6. Regardless of how it is broadcast, do not cover the seed with soil after planting. A water-filled turf grass roller (available for rent at most hardware stores) or a cultipacker should be used to press the seed into the soil surface. Natural precipitation or light overhead irrigation can also help ensure good seed-soil contact. Floating row-cover can be used, if necessary, to protect seeds and small seedlings against predation.

Figure 5: For broadcast seeding, seed of similar size is mixed together (A). Dry sand, kitty litter, or another inert carrier is added at a ratio of at least 2:1 (more for larger sites) and then mixed (B). The mix is divided into separate batches for broadcasting in more than one pass (to ensure adequate coverage). When hand-broadcasting seed, walk in perpendicular passes over the entire planting area (B). Hand-crank "belly grinder" type seeders (C) are inexpensive and can broadcast seed more evenly than hand-scattering on larger sites. ***Note:*** It can be difficult to plant very large and very small seed together in a single seed mix using mechanical broadcasters. Use an inert carrier and walk in at least two perpendicular passes to ensure the most even seed distribution possible.

Figure 6: When planting native wildflowers by hand-broadcasting or with a mechanical broadcaster or drop-seeder (Figure 8), the seed should be planted directly on the soil surface (A). After broadcasting, roll the site with a turf roller (B) or cultipacker (C).

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Table 2: Methods for Planting Wildflower Seed

METHOD: Drop Seeders or Fertilizer Spreaders (Dropping Seed) (Figures 6 & 7)

Pros

- ⊕ Inexpensive
- ⊕ Easy to use
- ⊕ Even seed dispersal
- ⊕ Can accommodate both large and small seed
- ⊕ Many models and sizes are commonly available (hand-powered turf grass seeders are most common, but larger tractor-drawn "pasture seeder" models also exist)

Cons

- ⊖ Requires a smooth, level seed bed
- ⊖ Seed should be pressed into the soil after planting
- ⊖ Hand-powered models are time consuming for large areas (over 1/2 acre)
- ⊖ Calibration requires trial and error

Basic Instructions:

1. Remove as much stubble as possible prior to seeding, creating a smooth, lightly packed seed bed. The soil surface can be lightly hand-raked or harrowed to break up crusted surfaces, but do not cultivate the site (cultivation will bring up additional weed seed).
2. Seed of similar sizes can be mixed together and bulked up with an inert carrier ingredient such as sand, fine grained vermiculite, clay-based kitty litter, or gypsum. Use two to three parts bulking agent for each part seed by volume. These inert carriers ensure even seed distribution in the mix, provide visual feedback on where seed has been thrown, and make calibration easier. It is recommended to divide seed into several batches and seed in installments to ensure proper seeding rate and coverage.
3. Make sure flow gate is closed before filling seeder with seed mix. Planting should begin with the drop gate set to the narrowest opening, to allow at least two perpendicular passes over the seed bed for even distribution. Very large seed can be planted separately with the drop gate set to a wider opening.
4. Do not cover the seed after planting. A water-filled turf grass roller (available for rent at most hardware stores) or a cultipacker should be used to press the seed into the soil surface. Natural precipitation or light overhead irrigation can also help ensure good seed-soil contact. Floating row cover can be used, if necessary, to protect seeds and small seedlings against predation.

Figure 7: Lawn fertilizer spreaders (A) are a commonly available tool, whereas tractor-powered spreaders (B) and dropseeders (C) are ideal for large planting sites (5+ acres) because they can broadcast over larger areas and only require a tractor to operate. In both cases, models with internal agitators are preferred to prevent clogging. For best results, divide the seed into separate batches, grouping seed of similar sizes for planting together with the flow gate adjusted accordingly. **NOTE:** Grain drills, unlike native seed drills (Figure 8), are not designed to handle wildflower seeds, many of which are very small. However, with simple modifications, most types of grass-seed planters or granulated fertilizer spreaders can be used with good results.

METHOD: Native Seed Drills (Drilling Seed)ⓘ (Figure 8)

Pros

- ⊕ Convenient for planting large areas
- ⊕ Seed box agitators and depth controls are designed specifically for planting small and fluffy native seeds at optimal rate and depth. ***CAUTION:** *specify seed be packaged separately by species when ordering seed mix so seed types can be placed in proper seed box pre-mixed seed cannot be properly separated*
- ⊕ Can plant into a light stubble layer
- ⊕ Seeds are planted in even rows, allowing for easier seedling recognition
- ⊕ Does not require seed to be pressed into soil surface after planting (e.g., cultipacking)

Cons

- ⊖ Expensive and not readily available in some areas
- ⊖ Difficult to calibrate for small areas (less than one acre) or small amounts of seed
- ⊖ Not effective on sloped sites or uneven terrain (can result in uneven seed distribution)
- ⊖ Requires a tractor and an experienced operator to set planting controls
- ⊖ Seed with a lot of chaff can clog delivery tubes

Basic Instructions:

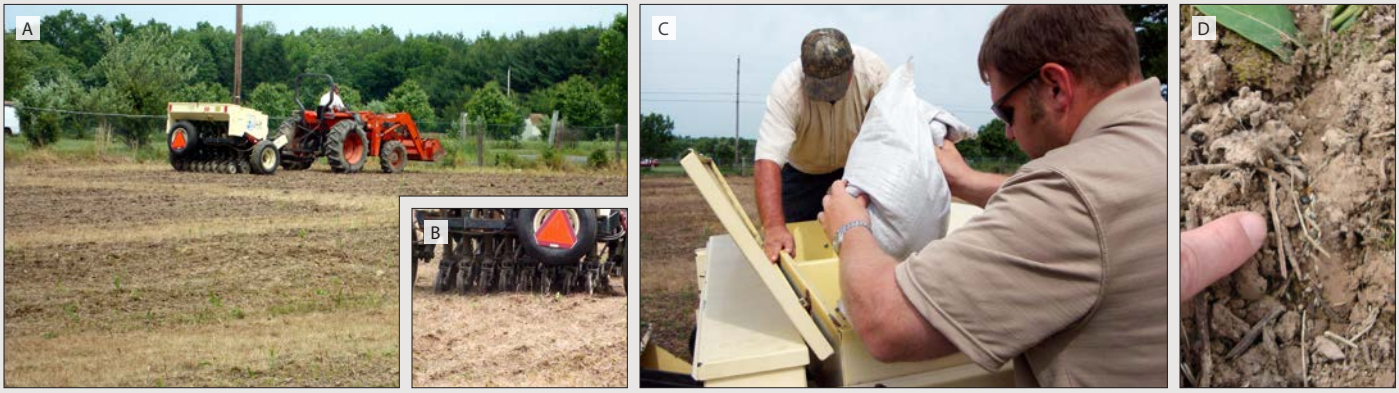
1. Plant only when the soil is dry enough to prevent sticking to the coulters. Under wet conditions, small seed is likely to stick to mud-caked parts of the drill, rather than the ground.
2. Keep seed separated by species until ready to plant. Prior to planting, seed should be organized into batches of large smooth seed, small smooth seed, and tufted seed that does not flow easily. Loosely fill seed boxes (do not compact seed into them) with the appropriate seed batch for each box. Seed quantities that do not cover the agitator should be planted using some other method, since the drill is difficult to calibrate for small volumes of seed.
3. As a general rule, the planting depth for a particular seed should be no more than 1.5× its diameter. To achieve this for most wildflower seed, set the depth controls to plant no deeper than ¼" (consult with the seed vendor for specific guidelines on very sandy soils). Small wildflower seed should be planted on the soil surface. Stop periodically to check planting depth.
4. Operate the drill at less than 5 mph, stopping periodically to check for any clogging of planting tubes (usually observed as a seedbox that is remaining full). Clogging is most common with fluffy seed, or seed with a lot of chaff. Avoid backing up the drill as it will likely cause clogging.

ⓘ For information on native seed drill calibration, see NRCS publication: www.plant-materials.nrcs.usda.gov/pubs/mipmctn10591.pdf

Table 2: Methods for Planting Wildflower Seed

METHOD: Native Seed Drills (Drilling Seed) CONTINUED

Figure 8: Native seed drills (A) are the ideal tool for large planting sites (5+ acres). Typical models can plant in a light stubble layer (B), have separate seed boxes for different sizes of seed (C) , and have depth controls for optimal seed placement (D). **Such drills need an experienced operator and careful calibration.**



METHOD: Transplanting Forbs and Woody Plants (Figure 9)

Pros

- ⊕ Provides mature nectar and pollen resources more quickly
- ⊕ Does not require specialized planting equipment (except for large trees)
- ⊕ Preferred for plants with limited seed availability, which are expensive or difficult to establish from seed
- ⊕ Transplants can be established more easily in weedy sites with adequate mulching

Cons

- ⊖ Expensive and time consuming for large areas
- ⊖ Transplants typically require irrigation during establishment
- ⊖ Require protection from animal damage until established

Basic Instructions:

1. Regular shovels are adequate for transplanting most container stock. Dibble sticks or mechanical transplanters are helpful for plug-planting. Power augers and mechanical tree spades can be used to install larger plants. Transplanting can occur any time the ground can be worked outside of frost dates or prolonged periods of hot, dry, or windy weather.
2. Measure the planting to determine how many plants will be needed for the recommended spacing.
   a. **For woody shrubs:** Space plants on 4'–10' centers (depending upon size at maturity).
   b. **For herbaceous plants:** Space plants closer on 2'– 3' centers.
3. Stage the transplants in position with proper spacing prior to installing plants in the ground.
4. Pre-dig and pre-irrigate holes. If soil is compacted, degraded, or depleted, add compost to each hole before installing plant materials.
5. Install plants by placing them in holes and backfilling with soil as needed. Lightly tamp soil around the plant to increase soil-root contact and minimize potential for frost heaving. Ensure plants are at proper depth with the root collar flare (woody plants) or soil at the top of plugs flush with soil (ground) level.
6. Follow-up irrigation is dependent upon weather and specific site conditions. Irrigate with at least 1" of water per week (except during natural rain events), for the first two years after establishment. Use long, deep watering to encourage deep root system development. Avoid shallow irrigation. Irrigate at the base of plants (or use drip irrigation). Avoid overhead irrigation that would encourage weed growth. Once plants are established, irrigation should be removed or greatly decreased.
7. Protect plants from above-ground animal browse/damage with guards, tree tubes, or fencing. In cases where rodent damage may occur, below-ground wire cages are recommended. Newly-planted areas should be clearly marked to protect them from herbicides or other disturbances.
8. Mulching is recommended to reduce weed competition and to retain moisture during the establishment phase. Recommended materials include untreated wood chips, bark dust, weed-free straw, (e.g., rice straw), nut shells, grape-seed pumice, or other regionally appropriate mulch materials that contain no viable seeds. To prevent rodent damage, do not mulch within one foot of seedling.

Figure 9: Deterrents like a deer fence (A), trunk protectors (B), or below ground wire cages (C), can protect transplants during establishment by reducing browsing by herbivores and trunk damage from mowers or weeding operations. Protective materials should be removed as soon as possible (i.e., when plants are well established and no longer vulnerable to animal damage) to avoid impeding plant growth.

Post Planting Establishment Requirements

Maintenance During Establishment (Short-Term)

Weed control is critical in the first and second years after planting. If the site is well prepared, then less effort will be required for weeding after project installation. Maintenance practices must be adequate to control noxious and invasive species and may involve tools such as mowing, burning, hand-hoeing, or spot-spraying with herbicides. Weeds should be prevented from going to seed in, or adjacent to, the project area during the first two years after planting to help ensure long-term success. Familiarity with the life cycle of weeds will facilitate appropriate timing of management activities. Since young wildflower and weed seedlings may look alike, care should be taken to properly identify weeds before removal.

To ensure good establishment, controlling weeds is the biggest priority in the first year after seeding a perennial wildflower mix. The most common method for weed control during establishment is frequent high-mowing in the first year after seeding wildflowers to prevent weeds from producing and dispersing seed in the wildflower planting. Control weeds in adjacent areas to eliminate sources from which weeds can spread. Repeated high-mowing can also help control perennial weeds as it removes leaves, which reduces photosynthesis, and causes the plant to use stored resources to regrow, which depletes the energy available for production of reproductive plant parts. Additional methods of weed control are listed in **Table 3**. As wildflowers mature, plants become more vigorous and are able to outcompete weeds. Once the plant community is well established, and weed pressure is low, transition to a rotational management plan.

What to Expect During the Establishment Period

Wildflower mixes planted from seed are slow to establish. In the first growing season, perennial wildflowers devote most of their energy to root growth and do not grow much aboveground. Many species will not bloom until **Year 2** or **3**. Newly planted sites, often look patchy or weedy and the presence of annual or biennial weeds is common in **Year 1** (e.g., foxtail, crabgrass, wild mustards). During this time, weeds will grow faster and taller than the slow-growing wildflowers. If left unmanaged, weeds can choke—or shade—out wildflower seedlings resulting in poor wildflower establishment.

Figure 10: Annual weeds creating excessive shade on Illinois bundleflower (*Desmanthus illinoensis*) seedlings in a first year planting.

Figure 11: ***Short Term (2015):*** In the first spring after seeding the previous fall (2014), this site is dominated by annual and biennial weeds. Mowing the site periodically during the first year (ideally as high as mower settings allow) will prevent these short-lived weeds from producing more seed, and allow sunlight to reach the slower-growing natives (outlined), which are generally unharmed by the occasional mowing. ***Long Term (2016):*** Flourishing wildflowers and pollinator habitat in the second year after planting.

Weed Management During Establishment

Use weed management methods described below in combination with **high-mowing for weed control** (or as an alternative, where appropriate) to control noxious and invasive species. An integrated approach to weed management is often more effective than mowing alone, as some weeds may not respond to mowing and require more effective methods. These methods can also be used on a targeted, or spot-treatment basis beyond the establishment period as part of a long-term plan. Follow restrictions during wildlife nesting periods (consult with NRCS biologists). **Always clean equipment to ensure it is free of weed seed before entering planting area.**

Table 3: Integrated Weed Management Methods

PRIMARY METHOD: High-Mowing for Weed Control ⓘ (Figure 12)

Where to Use

- In perennial wildflower plantings established from seed in early stages of establishment and in adjacent areas that have weedy vegetation.

Timing

- **TOTAL TIME:** 2+ years
- **BEGIN:** Immediately after seeding site

Basic Instructions:

1. Monitor growth and begin follow-up weed management immediately. Perennial wildflowers are slow to establish and are usually not harmed by incidental mowing, but since young wildflower and weed seedlings may look alike care should be taken to properly identify weeds before removal (especially in **Year 2**). Use other weed control strategies along with high-mowing to remove problem weeds.
   I. **In Year 1 after planting:** Each time plant cover reaches a height of 12–18", trim vegetation back to a height of 8". Do not let weeds growing in the planting area and in adjacent areas produce and disperse seed. Mowing should cease by mid-September, unless additional late-season mowing is needed to prevent weed seed production and dispersal.
   II. **In Year 2 after planting:** Monitor weed pressure. Repeat high mowing in spring as needed, raising mower blade to 10" if necessary to avoid damage to wildflowers (i.e., if wildflower growth is taller than 8"). Cease mowing after spring if weed pressure is low and wildflowers are dominant cover. Continue to prevent weeds from going to seed with more targeted methods such as hand-pulling/clipping weeds, string-trimming, or targeted herbicide spot-treatment.

ⓘ **NOTE:** Requires a mower that can be adjusted to at least 8" height (e.g., rotary brush mower, flail mower). A lawn mower/finishing mower will not be effective. Clean equipment to ensure it is free of weed seed before entering planting area.

Figure 12: High-mowing in the first year of this new planting removed the shade canopy created by annual weeds and increased sunlight to slower-growing perennial wildflowers like wild bergamot and black-eyed Susan (circled, right).

METHOD: String-Trimming (Figure 13)

Where to Use

- Smaller plantings, areas not accessible to mowers, to remove small weed patches within a larger planting (i.e., alternative to spot-mowing/spot-herbicide application), and to manage weeds around woody transplants or plugs.

Basic Instructions:

- Use string-trimming to keep weedy species from shading out wildflower seedlings and to prevent annual and biennial weeds from flowering and producing seed (similar to high-mowing). Like high-mowing, raise string-trimmer so that vegetation is clipped no shorter than 6-8" to avoid seedling damage (establishment period). Adjust to appropriate height if using to control weeds in mature plantings.

Figure 13: String-trimming can be used to control small patches of weeds mixed with desirable plants in larger plantings that may take longer to establish. A tri-blade is most effective at cutting thick stemmed weeds or small woody stems—e.g., invasive thistles or multiflora rose—while string is best for thin-stemmed weeds like annual grasses and mustard.

Continued on next page ···→

Table 3: Integrated Weed Management Methods

METHOD: Hand-Weeding (Figure 14)

Where to Use

- Hand-weeding is effective in small areas to remove individual plants before they produce seed or spread, or for weedy species that do not respond to mowing or whose growth is encouraged by mowing.

Basic Instructions:

- Use hand-pulling or hand tools to eliminate weeds from the planting area. When pulling or digging out perennial weeds, it is important to remove the entire root (for some plants even the smallest piece of root may be capable of producing a new plant). Hand-weeding is easiest when the soil is damp (e.g., after a rain event). Remove weedy plant material from the site. If weeds being pulled have set seed, carefully remove the plant and put it in a bag to prevent seed dispersal and properly dispose of or destroy seed heads.

Figure 14: Hand-weeding is often the most effective way to remove weeds without harming desirable species, although it can be time-consuming in large sites.

METHOD: Spot-Spraying* (Figure 15)

Where to Use

- Spot-spraying is usually performed with backpack spraying, or with rope-wick implements (when weed growth is substantially taller than newly established wildflowers).

* *All recommendations for chemical herbicide products and application must be made by a Certified Pesticide Applicator or other certified specialist and applied per label instructions as required by law.*

Basic Instructions:

- For weed control after planting, herbicide is to be applied on a spot-treatment basis to protect desirable plants, pollinators, and other wildlife. Do not allow herbicide to drift or drip onto wildflowers or grasses planted in the mix. Targeted herbicides can be spot-sprayed to treat herbicide resistant weeds. Grass-selective herbicides can be especially helpful to control weedy grasses, which are common invaders wildflower plantings. If large areas need to be sprayed, reseed or replant any resulting bare patches.

Figure 15: An after market spray wand extension was added to a backpack sprayer to minimize overspray on adjacent wildflowers when spot-spraying herbicide on Canada thistle (circled) in this two-year-old planting.

METHOD: Managing Irrigation (Figure 16)

Where to Use

- In perennial wildflower plantings established from seed or transplant and in adjacent areas that have weedy vegetation.

Basic Instructions:

- Most wildflowers established from seed thrive with little or no supplemental irrigation. Consult with NRCS to determine if irrigating habitat planted from seed is necessary based on site-specific conditions. Keeping irrigation to a minimum helps native wildflowers out-compete non-native weedy species that sometimes have higher soil moisture requirements.
- Similarly, when irrigation is needed for transplants, it should be supplied at the base of the transplant whenever possible—through drip irrigation, for example—to avoid watering nearby weeds. See *Transplanting Forbs and Woody Plants* in Table 2 (page 9) for more information.

Figure 16: In some cases (e.g., drought) irrigation may be necessary to establish new wildflower plantings from seed and should be included in the planning and installation phases of a project.

Operations and Maintenance (Long-Term)

Early Successional Habitat Management: Wildflower plantings generally need to be managed over time to maintain open, early successional characteristics. The actual management will depend on the size and location of the habitat. Possible management tools/ techniques include mowing or burning. Be sure all equipment is clean and free of weed seed. Do not mow or burn during critical wildlife nesting seasons (consult your state wildlife biologist for specific guidance).

- After establishment, mow or burn only ⅓ of the total area in any one year to ensure sufficient and undisturbed cover for pollinators and other wildlife remains standing. Mow at 8-10 inch height in late fall after wildflowers are done blooming for the season. Adjust timing (e.g., late summer/early fall when most wildflowers are done blooming) if site is prone to wet fall conditions that prohibit management activities.
- The remaining patches are mowed, burned, etc. in subsequent years per annual rotation schedule with no patch being disturbed in consecutive years unless there is a specified need to control weeds or woody encroachment at greater frequency or over a larger portion of the planting. If burning, consult with a Certified Prescribed Burn Manager/ Specialist on permitting and proper implementation of controlled burns.
- Occasional thatch removal (using a chain or tine harrow or rake) after mowing can be beneficial to facilitate regeneration/reseeding of wildflowers and reduce build-up of thatch that can inhibit seedling growth or movement of wildlife (e.g., dense thatch layers can inhibit movement of birds foraging for insects).
- Pollinators meadows that have loss of plant diversity over time can benefit from interseeding or transplanting wildflower plugs.

Figure 17: Newly-planted areas should be clearly marked to protect them from herbicides or other disturbances.

NOTE: *using signs such as the one above can be a useful tool to designate protected pollinator habitat. Due to wildlife safety concerns, we recommend attaching habitat signs to the top hole of the fence post or plugging the top hole with a bolt and nut. Alternatively, posts which do not have holes—such as solid wood stakes—should be used.*

Protection From Animal Damage: Control herbivores as needed, but remove tree guards or other materials that could impede plant growth as soon as possible after plants are established.

Invasive Species Management: Targeted herbicide use (spot-treatment), occasional hand-weeding, and other weed control techniques may be necessary to control noxious weeds. Plantings must monitored for invasive species presence. Early detections will allow for timely management/treatment and prevent invasion levels that can reduce native plant diversity, have negative impacts to plant structure, and maintains habitat value and functions.

Protection From Pesticide Risk: Some common farm management practices can cause harm to bees and other beneficial insects. Insecticides are especially problematic, including some insecticides approved for organic farms. Therefore, if insecticide spraying is to occur on the farm, it is critical that the habitat planting area is outside of the sprayed area and/ or protected from application and drift. Continue to protect habitat from insecticide and fungicide drift and unintended herbicide drift. Use pesticide set-backs and prevent drift from all pesticide applications occurring on or adjacent to the site (see References and Resources).

Figure 18: Grow tubes or trunk protectors may help during establishment to reduce browsing by herbivores and trunk damage from mowers or weeding operations, but should be removed as soon as possible to avoid impeding plant growth.

Figure 19: Most transplants will benefit from 1" of water per week during the first two years of establishment, either from natural rainfall or irrigation, such as drip-irrigation.

Appendix: Seed Mixes, Plant Lists, and References

Seed Mix Specifications

NRCS will provide seed mixes approved by Biologists or Specialists to ensure seed mix specifications and seeding rates meet **NRCS–PA Practice Standards and Implementation Requirements** and that species in the mix are appropriately matched to site-specific conditions.

Standard seed mixes for pollinator meadows, specialized mixes for monarch butterfly habitat (including options that meet criteria for Greater Appalachian Mountain Region monarch initiative focus area), and wildflower mix add-in options to increase pollinator value of CREP grass mixes have been developed for NRCS–PA, each with options for dry, mesic, and wet conditions. Consult with your NRCS conservation planner to select an appropriate mix. A custom mix can be developed for unique conditions or ecoregions. Species substitutions or any other modifications to the seed mixes provided, including adjustments to the mix or recommendations for pre-packaged mixes made by seed suppliers, must be approved for NRCS practices before planting.

Due to different seed sizes, seeding rates for wildflower mixes are calculated for each mix based on seed/ft^2. The recommended rate for wildflower mixes is 40–60 seeds/ft^2 per acre total, depending on site conditions and seeding equipment being used. Rates for individual species within a mix will vary based on species composition (percent of each species in the mix). Depending on the species in the mix the seeding rate in lb/acre will be different, therefore there is no standard lb/acre rate for wildflower mixes and seeding rates will be provided based on the specific mix recommended for your site.

Figure 20: This pollinator meadow demonstrates a high diversity of bloom with numerous native (and non-native pollinator-attractive) wildflower species that have overlapping bloom times throughout the year.

Seed Mix Considerations

Pure Live Seed (PLS)

Seed must meet certification standards for purity, germination, weed seed, and noxious weed seed. Most seed companies advertise and sell wildflower seed in bulk pounds per acre. NRCS recommendations are in pure live seed (PLS). Make sure to specify PLS when ordering seed. ***Do not accept unlabeled seed or seed that has not been tested.***

Native Plants

Focus plant selection on native perennial plants that provide pollen- and nectar-rich forage for pollinators and beneficial insects and larval food plants for butterflies and moths. Include non-competitive native bunch grasses at a low rate; less than 25% of the mix based on a pure live seed (PLS) per square foot.

Bloom Requirements

Select individual species that, in combination, provide consistent and adequate floral resources throughout the seasons. Seed or plant mixes must include a minimum of three species from each bloom period (early, mid, and late season). A more diverse mix is encouraged.

Locally Sourced Seed or Plants

Select plant materials from local or regional sources that are adapted to your ecoregion. If transplanting plugs or potted plants, focus on straight species and avoid cultivated varieties.

Ordering Seed

Obtain quotes based on PLS before purchasing the seed mix. Seed companies may adjust specifications or recommend species substitutions on your quote based on inventory. Modifications to the mix or recommended alternative species must be approved. Wildflower seeds range in size and texture. Using equipment that can accommodate different seed types will result in better distribution across the planting area. Requesting seed be packaged separately by species (i.e., not pre-mixed) is also helpful, as similar seed can be sown in batches making it easier to calibrate seeders for consistent flow. ***If planting with a native seed drill, ordering seed packed separately is required to fill seed boxes with appropriate seed type (e.g., fine vs. fluffy seed box).**

Planting Size and Configuration

Bigger or connected habitat areas are ideal for supporting abundant and diverse populations of pollinators and beneficial insects, but habitat can be created in smaller patches or strips and still provide benefits. If planning for CRP, minimum size field is 0.5 acre and, if planted in strips, minimum width is 20'. Consider expanding or adding to existing habitat.

Many native wildflowers are adapted to a wide range of environmental conditions, but establish best when matched with appropriate conditions. Wildflowers tolerate poor pH and nutrient conditions and typically do not require soil amendments. Nitrogen applications are not needed, and not recommended, as it will only promote weed growth. If soil pH is extremely low, lime can be applied to bring pH to optimal range of 5.5 to 6.5. Most species on the Master Plant Lists (pages 15–16) are considered native to Pennsylvania, and those that are not are naturalized in the state or region. To determine county-level distribution of these species visit USDA–PLANTS (https://plants.usda.gov) or The Biota of North America Program Maps by States and Provinces (http://bonap.net/fieldmaps).

Master Plant Lists

Recommended Native Wildflowers for Pollinators

Bloom time for species can vary depending on ecotypes, location, and environmental conditions. The bloom times for each species are approximate. **Seed mixes shall contain a minimum of 9 species of pollinator-friendly flowering plants with at least 3 species from each bloom period.** For several species, the duration of flowering may overlap several bloom periods.

	COMMON NAME	SCIENTIFIC NAME					PLANT COMMENTS
[1]Early	Golden Alexanders	*Zizia aurea*	P	3'	M	WD–SPD	Adapted to disturbance
	Wild blue indigo	*Baptisia australis*	P	5'	D–M	WD–MWD	Slow to establish
	Wild columbine	*Aquilegia canadensis*	P	2'	D–M	WD	Tolerates shade
	Wild lupine	*Lupinus perennis*	P	2'	D	ED–MWD	Prefers sandy soil
[2]Early–Mid	Hairy beardtongue	*Penstemon hirsutus*	P	2'	D	WD–MWD	
	Lanceleaf coreopsis	*Coreopsis lanceolata*	P	2'	D–M	WD–MWD	Low-cost seed
	Spiderwort	*Tradescantia* spp.	P	2'	D–M	WD–SPD	Multiple species available
	Tall white beardtongue	*Penstemon digitalis*	P	2'	D–M	WD–MWD	Establishes quickly
[3]Mid	Black-eyed Susan	*Rudbeckia hirta*	B, P	2–3'	D–M	WD–SPD	Short-lived
	Butterfly milkweed	*Asclepias tuberosa*	P	3'	D–M	WD–MWD	Prefers sandy soil
	Common milkweed	*Asclepias syriaca*	P	6'	D–M	WD–MWD	
	Culver's root	*Veronicastrum virginicum*	P	5'	M–W	WD–SPD	
	Dotted mint	*Monarda punctata*	A, B, P	3'	D	WD	Prefers sandy soil; establishes quickly
	Great blue lobelia	*Lobelia siphilitica*	P	3'	M–W	SPD–PD	Prefers part-shade and fertile soil
	Lavender hyssop	*Agastache foeniculum*	P	5'	D–M	WD-MW	Establishes quickly
	Oxeye sunflower	*Heliopsis helianthoides*	P	5'	D–M	EWD–MWD	
	Partridge pea	*Chamaecrista fasciculata*	A	2'	D	WD–MWD	Favors disturbed sites
	Purple coneflower	*Echinacea purpurea*	P	4'	D–M	WD–MWD	Establishes quickly
	Swamp milkweed	*Asclepias incarnata*	P	5'	W	SPD–PD	
	Virginia mountain mint	*Pycnanthemum virginianum*	P	3'	M	WD–MWD	
	Wild bergamot	*Monarda fistulosa*	P	4'	D–M	WD–MWD	Establishes quickly
	Wild senna	*Senna hebecarpa*	P	6'	M–W	WD–SPD	
[4]Mid–Late	Blue mistflower	*Conoclinium coelestinum*	P	2'	D	WD	
	Blue vervain	*Verbena hastata*	P	5'	M–W	SPD–PD	
	Boneset	*Eupatorium perfoliatum*	P	5'	M–W	SPD–PD	Prefers fertile soil
	Cutleaf coneflower	*Rudbeckia laciniata*	P	7'	M	WD–MWD	Rhizomatous; tolerates occasional flooding
	Joe Pye weed	*Eutrochium fistulosum*	P	7'	M–W	SPD–WD	Prefers part-shade and fertile soil
	Marsh blazing star	*Liatris spicata*	P	4'	M–W	WD–MWD	Prefers sandy soils
	Purple giant hyssop	*Agastache scrophulariifolia*	P	5'	M	WD–MWD	
	Sneezeweed	*Helenium autumnale*	P	2–5'	M–W	WD–SPD	Prefers moist, fertile soil
	Wingstem	*Verbesina alternifolia*	P	6'	M–W	PD–SPD	Prefers moist soils

KEY: BLOOM TIME | LIFE CYCLE—perennial (P), annual (A), biennial (B) | MAX HEIGHT | WATER NEEDS—dry (D), mesic (M), wet (W) | SOIL DRAINAGE CLASS

(Continued on next page.)

PLANT COMMENTS

- **Attracts beneficial insects**
- **Bumble bee plant**
- **Monarch nectar plant**
- **Legume**—rich in nitrogen and attractive to a wide variety of wildlife
- **Nest plant**—provides nesting materials or sites for solitary bees.
- **Support birds/wildlife** with fruit, seeds, or nuts, ***AND/OR*** nesting materials/sites.
- **Lepidoptera (butterfly/moth)** ***AND/OR*** **specialist bee host plant**. ***NOTE:*** indicate one or more species supported are listed as species of conservation concern by the Pennsylvania Natural Heritage Program, see: www.naturalheritage.state.pa.us/Species.aspx
- **Monarch host plant**—milkweed (*Asclepias* spp.) attract and support an incredible range of pollinators and beneficial insects; most species tolerate clay soils and wet or dry conditions.

Recommended Native Wildflowers for Pollinators *continued*

	COMMON NAME	SCIENTIFIC NAME					PLANT COMMENTS
[5]Late	Calico aster	*Symphyotrichum lateriflorum*	P	3'	D–M	MWD–PD	Prefers part-shade
	Grassleaf goldenrod	*Euthamia graminifolia*	P	3'	D–M	MWD–SPD	Drought tolerant
	Gray goldenrod	*Solidago nemoralis*	P	2'	D	WD–MWD	Tolerates a variety of soil conditions; smaller and less aggressive than other *Solidago* spp.
	New England aster	*Symphyotrichum novae-angliae*	P	6'	M–W	WD–MWD	Can be aggressive
	New York ironweed	*Vernonia noveboracensis*	P	7'	M	MWD–SPD	Tolerates a variety of soil conditions; prefers moist soils but will tolerate regular to dry sites
	Showy goldenrod	*Solidago speciosa*	P	5'	D–M	WD–MWD	Prefers part-shade; can be aggressive in moist soils
	Smooth blue aster	*Symphyotrichum laeve*	P	2–5'	D–M	WD–MWD	
	Wrinkleleaf goldenrod	*Solidago rugosa*	P	4'	D–M	WD–MWD	Highly variable in appearance
KEY	BLOOM TIME	LIFE CYCLE—perennial (P), annual (A), biennial (B)	MAX HEIGHT	WATER NEEDS—dry (D), mesic (M), wet (W)	SOIL DRAINAGE CLASS		

Native Grasses and Sedges for Pollinator Seed Mixes

NOTE: Grasses and sedges should ideally comprise no more than 25% of seed mixes on pollinator sites. Ecotypes below are recommended for PA/Northeast region for wildlife habitat restoration. Avoid varieties developed for biomass production.

COMMON NAME	SCIENTIFIC NAME	ECOTYPE				PLANT COMMENTS ⓘ
Big bluestem	*Andropogon gerardii*	'Niagara'-NY	8'	D–M	WD–MWD	
Canada wildrye	*Elymus canadensis*	—	5'	D–M	WD–MWD	Cool season grass, short-lived
Fox sedge	*Carex vulpinoidea*	PA ecotype	3'	W	PD	Tolerates occasional flooding
Indiangrass	*Sorghastrum nutans*	PA ecotype	7'	D–M	EWD–MWD	
Little bluestem	*Schizachyrium scoparium*	Fort Indiantown Gap-PA	3'	D–M	EWD–MWD	
Pennsylvania sedge	*Carex pensylvanica*	PA ecotype	1.5'	D–M	WD–MWD	Prefers part-shade
Switchgrass	*Panicum virgatum*	'Shelter'-NY/WV	4–7'	D–M	WD–PD	Tolerates poorly drained soils and has good drought tolerance
Tussock sedge	*Carex stricta*	PA ecotype	4'	W	PD	Tolerates occasional flooding
Virginia wildrye	*Elymus virginicus*	PA ecotype	5'	M–W	MWD–PD	Cool season grass, short-lived
KEY	MAX HEIGHT	WATER NEEDS—dry (D), mesic (M), wet (W)	SOIL DRAINAGE CLASS	CAN BE AGGRESSIVE AT HIGH SEEDING RATES		

Non-Native Annual Plants for Insectary Meadows and Cover Crops

	COMMON NAME	SCIENTIFIC NAME				PLANT COMMENTS ⓘ
Early	Alsike clover	*Trifolium hybridum*	A	2'	W	
	Crimson clover	*Trifolium incarnatum*	A	1.5'	M	Not freeze-tolerant, spring-seeded in cold climates
	Hairy vetch	*Vicia villosa*	A	1.5'	M	Fall-seeded; aggressive at high seeding rates
	Lacy phacelia	*Phacelia tanacetifolia*	A	2'	D	Not freeze-tolerant, spring-seeded in cold climates
Early–Mid	Blue flax	*Linum perenne*	P	2'	M	—
	Red clover	*Trifolium pratense*	P	1'	M	Aggressive at high seeding rates
Mid	Alfalfa	*Medicago sativa*	P	2'	M	Susceptible to frost heaving
	Blanketflower	*Gaillardia aristata*	P	2'	D	Low cost seed; thrives in disturbed sites
	Borage	*Borago officinalis*	A	1.5'	M	Not freeze-tolerant, spring-seeded in cold climates
	Buckwheat	*Fagopyrum esculentum*	A	2'	M	
	Mexican hat	*Ratibida columnifera*	P	3'	M	
Mid–Late	Common sunflower	*Helianthus annuus*	A	9'	M	Attracts pollinators, **avoid use of sunflower with insecticide seed treatments
	Cosmos	*Cosmos bipinnatus*	A	5'	M	Select single-petal varieties for pollinators
KEY	BLOOM TIME	LIFE CYCLE—perennial (P), annual (A), biennial (B)	MAX HEIGHT	WATER NEEDS—dry (D), mesic (M), wet (W)		

ⓘ **PLANT COMMENTS**—*see previous page.*

Regional Native Seed Vendors and Native Plant Nurseries

Inclusion on this list does not constitute an endorsement. Other vendors not listed below may also have suitable plant materials. **Before ordering, ensure that all plants or seeds purchased for pollinator habitat have NOT been treated with systemic insecticides.**

Aquascapes Unlimited Inc. (🪴) • Pipersville, PA
215-766-8986 • www.aquascapesunlimited.com

Arch(E)Wild (🪴) • Quakertown, PA
855-752-6862 • http://archewild.com

Bowman's Hill Wildflower Preserve (🌱 & 🪴) • New Hope, PA
215-862-1846 • www.bhwp.org

Edge of the Woods Native Plant Nursery (🪴) • Orefield, PA
610-395-2570 • www.edgeofthewoodsnursery.com

Ernst Conservation Seed (🌱 & 🪴) • Meadville, PA
800-873-3321 • www.ernstseed.com

Green Light Plants, *Organic Nursery* (🪴) • Landenberg, PA
610-633-7637 • www.greenlightplants.com

Mid Atlantic Natives (🪴) • New Freedom, PA
717-227-0924 • www.midatlanticnatives.com

North Creek Nurseries (🪴) • Landenberg, PA
610-255-0100 • www.northcreeknurseries.com

Northeast Natives & Perennials (🪴) • Quakertown, PA
215-901-5552 • www.nenativesandperennials.com

Octoraro Native Plant Nursery (🪴) • Kirkwood, PA
717-529-3160 • www.octoraro.com

Pinelands Nursery (🌱 & 🪴)* • Columbus, NJ
609-291-9486 • www.pinelandsnursery.com

Redbud Native Plant Nursery (🪴) • Glen Mills, PA
610-358-4300 • www.redbudnativeplantnursery.com

Sugarbush Nursery (🪴) • Mohnton, PA
610-856-0998 • www.sugarbushnursery.com

Sylva Native Nursery and Seed (🌱 & 🪴) • Glen Rock, PA
717-227-0486 • www.sylvanative.com

Wetland Supply Company (🌱 & 🪴) • Apollo, PA
724-727-3772 • http://wetlandsupply.com

Yellow Springs Farm Native Plant Nursery (🪴) • Chester Springs, PA
610-827-2014 • www.yellowspringsfarm.com

NOTES: Transplants Only (🪴), Seeds & Transplants (🌱 & 🪴), **Wholesale only*

References & Resources

SEED MIX CALCULATOR & ADDITIONAL RESOURCES

Xerces Society Seed Mix Calculator
xerces.org/pollinators-northeast-region/xerces-seed-mix-calculator/

Pollinator Conservation Resource Center
xerces.org/pollinator-resource-center

Attracting Native Pollinators: Protecting North America's Bees and Butterflies
xerces.org/announcing-the-publication-of-attracting-native-pollinators/

NRCS Monarch Butterflies: Greater Appalachian Mountains Region Resources
www.nrcs.usda.gov/wps/portal/nrcs/detail/national/plantsanimals/pollinate/?cid=nrcseprd402207

Seed Quality, Seed Technology, and Drill Calibration
www.plant-materials.nrcs.usda.gov/pubs/wapmctn6331.pdf

SEEDLING IDENTIFICATION

USDA-NRCS Central Region Seedling Identification Guide for Native Prairie Plants
www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mopmcpu6313.pdf

Bonestroo Prairie Seedling and Seeding Evaluation Guide
www.prairiemoon.com/books/identification-guides/prairie-seedling-and-seeding-evaluation-guide.html

WEED IDENTIFICATION & CONTROL

Weeds of the Northeast
www.plants.usda.gov/java/invasiveOne?pubID=NEAST

Directory for Invasive Weeds of the Northeast
http://extension.psu.edu/pests/weeds/invasive-plants

SITE PREPARATION & PLANTING GUIDELINES

Organic Site Preparation for Wildflower Establishment
xerces.org/guidelines-organic-site-preparation/

Farming for Bees
xerces.org/guidelines-farming-for-bees/

Habitat Planning for Beneficial Insects
xerces.org/habitat-planning-for-beneficial-insects/

SITE ESTABLISHMENT GUIDELINES & RESOURCES

Maintaining Diverse Stands of Wildflowers Planted for Pollinators
xerces.org/guidelines-maintaining-diverse-stands/

Guidance to Protect Habitat from Pesticide Contamination
xerces.org/guidance-to-protect-habitat-from-pesticide-contamination/

Protecting Pollinators from Pesticides: Fungicide Impacts on Pollinators
xerces.org/fact-sheets/fact-sheet-fungicide-impacts-on-pollinators/

Figure 21: Numerous green sweat bees forage on butterfly milkweed (*Asclepias tuberosa*).

Aerial Sketch or Map of Farm Conservation Plan:

Notes:

Implementation Requirements/ Job Sheet

Client:	Farm #:	Date:
Field(s):	Tract #:	Planned by:
Client Conservation Objectives:		

Purpose

These Implementation Requirements/ Job Sheet documents the process of establishing nectar and pollen habitat for bees in the form of wildflower meadow plantings. Other natural resources may also benefit, depending on your conservation objectives and the integration of this habitat with other conservation practices. Installation shall be in accordance with these requirements and any attached drawings. **No changes are to be made without prior approval from the technical specialist who approved the installation plan.** For detailed instructions on each step in this Job Sheet, please see the *Conservation Cover (327) for Pollinators Installation Guide: Pennsylvania*.

Key Site Characteristics

Risk of pesticide drift on site? ☐ Low to high ☐ Very low to none

Weed pressure? ☐ High weed pressure ☐ Low weed pressure

Primary weed species of concern:

↳ _____

Site history—*historic and current plant cover, past use of land, pre-emergent herbicide use, compaction, etc.*:

↳ _____

Soils and habitat—*soil texture (coarse to fine), drainage, and moisture level:*

↳ _____

Irrigation—*availability and method (necessary if transplants are to be used):*

↳ _____

Other concerns or conservation goals that may affect plant choice or site preparation and planting:

↳ _____

Plant Selection: Wildflower Seed Mix

See the Appendix in the Installation Guide: ☐ Dry Site Pollinator Seed Mix ☐ Wetland Pollinator Seed Mix ☐ Custom Seed Mix

Note any species substitutions here or attach copy of custom seed mix:

↳ _____

Recommended seeding rate based on weed pressure: ☐ 60 seeds/ft^2 (high) ☐ 40 seeds/ft^2 (low)

Plant Selection: Transplants

Transplants may be preferred when seed is not available, weed pressure is high, or when a particular species is difficult to establish by seed. Transplanting can be most cost-effective when using plug plants. Conservation Cover can also include woody plants. See *Habitat Installation Guide—Pennsylvania: Hedgerow Planting (422) for Pollinators & Beneficial Insects* for suggested woody plants.

Note any woody or herbaceous species established from transplants here:

↳ _____

(Continued on next page.)

Site Preparation Method

Choose all options that apply and note any adjustments.

☐ Herbicide ☐ Solarization ☐ Mechanical ☐ Mechanical + smother crop

Severe weed pressure? (If so, an additional year of site prep, possibly combined with a smother crop, or the use of transplants should be considered. See Table 1: Site Preparation Methods in the Installation Guide for information on assessing weed pressure.)

Adjustments:

↳ _____

Planting Method

Choose all options that apply and note any adjustments.

☐ Broadcasting (machine or hand) ☐ Drop-seeding ☐ Native seed drill ☐ Transplants

Adjustments:

↳ _____

Maintenance During Establishment

Choose all options that apply and note any adjustments.

☐ High-mowing ☐ Spot-spraying herbicide ☐ Hand-weeding and/or -hoeing ☐ Other:_____

☐ String-trimming ☐ Grass- or other selective herbicide ☐ Managing irrigation

Adjustments:

↳ _____

Long Term Site Operations and Maintenance

Control herbivores as needed, but remove plant guards or other materials that could impede plant growth as soon as possible after establishment. In most cases, irrigation of transplants is no longer required by the end of the second growing season after planting. Maintain the long-term plant diversity of pollinator habitat by re-seeding or re-planting as necessary.

Finally, after establishment, no more than 30% of the habitat area should be mowed, grazed, or burned in any one year to ensure sufficient undisturbed areas for pollinators and other wildlife. Do not mow or burn during critical wildlife nesting seasons (consult your state wildlife biologist for specific guidance). Continue to protect habitat from pesticide applications and drift (especially insecticides and bee-toxic fungicides). Herbicide spot-treatments and hand-weeding may be used to control noxious or invasive plants.

Check Out and Certification Requirements

I certify that the above Design and Installation requirements (circle one) **HAVE / HAVE NOT** been met in accordance with the criteria of the Conservation Practices 327 or 420. The _____ acres of this practice installed on the locations covered by this job sheet were installed on the date(s) of _____ .

_____ _____

Signature of Designated Conservationist or Technical Service Provider ***Date***