



Meadows & Buffers for Bees:

Creating Mid-Atlantic Pollinator Habitats

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*Front cover: (top) Bumblebee (*Bombus ternarius*) on green-headed coneflower (*Rudbeckia laciniata*), photo by Matt Sarver;
(bottom) suburban meadow planting, photo by Iowa Natural Resources Conservation Service.
Back cover: (top) "Wet bee", photo by Sean McCann; (bottom) native buffer planting, photo by Roger Hill,
USDA Natural Resources Conservation Service*

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Why Plant for Native Bees?

The term “native bee” refers to any of a large and diverse group of wild bees that are indigenous to North America. There are some 4,000 species of native bees north of Mexico, around 200 of which have been found in Delaware. Native bees are a vital component of natural ecosystems, providing pollination services to wild trees, shrubs and flowers.

In addition to wild plants, bees pollinate over 100 crop species in North America. Populations of managed, non-native, European honey bees have declined in recent years due to mites and diseases. While honey bees are still very important pollinators for many crops, native bees can provide “pollination insurance” during times when honey bees are not available. Recent studies in New Jersey and Pennsylvania have shown that native bees alone can provide sufficient pollination for most watermelon farms. Native bees are extremely efficient pollinators of pumpkins, tomatoes, apples, berries, and many other crops.

Bees benefit from patches of native flowering plants on farms, in home gardens, and in public spaces.



PHOTO: JEFF GORDON

A bee meadow will also attract butterflies (such as this black swallowtail, *Papilio polyxenes*) and other beneficial insects.

Adult bees drink nectar and gather pollen to provide food for their young. A supply of pollen- and nectar-rich plants available throughout the growing season will help maintain large, healthy native bee populations. Farmers, gardeners and land managers can help by establishing native meadows and buffer plantings using plant mixes and practices

favorable to native bees.

In addition to supporting native bee populations, these plantings can also provide food for natural enemies of crop pests (such as predatory bugs and beetles, and parasitic wasps). Meadows also provide valuable cover and food for other types of wildlife, including butterflies, dragonflies, game birds, song birds, and mammals. Permanent native plantings can also stabilize soil and help prevent erosion.

To Plant or Not to Plant?

Before establishing a native meadow or buffer planting for bees, consider your long-term goals for the site and your level of commitment to maintaining an area specifically for bees and other wildlife. Native plant seed can be expensive, and a native meadow community can be relatively slow to establish. You should be willing to set the area aside for many years. Once the meadow is established, it will need relatively little maintenance, but will require monitoring and periodic maintenance including mowing, burning, and spot spraying to control weeds and woody growth and promote a healthy wildflower population.



PHOTO: JIM WHITE

Many species of bees will benefit from a meadow planting. Here, a native carpenter bee (*Xylocopa* sp.) and a European honeybee (*Apis mellifera*) nectar on swamp milkweed (*Asclepias incarnata*).

Site Assessment

LOCATION

Bee forage plantings should ideally be located near nesting habitat provided by wood edges, thickets, hedgerows, fallow fields, or lawns. Ground-nesting bees may nest within the new planting itself if there is a sufficient amount of exposed soil surface. If the site is on a farm, locate plantings within flight distance (several hundred feet) of crops requiring insect pollination. While small plantings are beneficial, larger areas of forage habitat will support larger populations of native bees. However, larger plantings are more expensive to establish and require more work to maintain, so plan the size of your planting based on your budget and available time and equipment. Most bee flowers and native warm-season grasses do best in full sun (a minimum of 8 hrs per day) but some will tolerate partial shade. If your area is partly shaded, it will be worth designing a special seed mix that includes species that will tolerate the lower light conditions.

EXISTING PHYSICAL CONDITIONS

It is important to know your soil characteristics. Have the soil in your planting area tested for organic content and pH, and be sure you are familiar with the general type of soil and degree of soil moisture. Your plant selection for a very sandy site will be quite different than for a site with heavy clay soils. Analyze the planting site, taking into account the degree of sun exposure, and any tendency for the site to flood or become excessively dry. Measure your planting area and draw a plan to aid in calculating the right amount of seed. If you will be planting rooted plugs or adding woody plants, calculate plant spacing and estimate the number of plugs or seedlings needed.



Clockwise from top left : Crop residue, bare or tilled soils, cool season grass pastures, and old fields all require different techniques.

EXISTING VEGETATION

Currently cropped sites that will be taken out of production or sites with little existing vegetation are ideal for establishing a bee planting. Existing cool season grass turf is also relatively easy to prepare. Most difficult are old fields, which typically have many aggressive native species like goldenrods, and often invasive non-native forbs and grasses. In all cases, the planting site should be surveyed for the presence of invasive species, since special efforts may be needed to control these species prior to planting the site. In some cases the weed control process may take more than one growing season.

If you have an old field or marginal area with a number of desirable native species present that you don't wish to eliminate, it might be possible to selectively control invasives, then add more wildflower species to this existing community. This can be accomplished by burning or mowing the area to reduce competition, then overseeding with the desired species, or planting rooted plugs.

Knowing what species currently occupy your planting site is critical to choosing a method of weed control and seeding. Take note of natural changes in vegetation that may indicate underlying changes in soils, moisture, and aspect.

PHOTO: MATT SARVER

Choosing Plants and Designing the Planting

CHOOSING THE RIGHT FLOWERS:

There are several important factors to consider when selecting wildflowers for a bee planting. Some plants are excellent pollen sources, while others are used primarily for their nectar. Many species provide both pollen and nectar, and some are also hostplants for butterfly and moth caterpillars. It is important to select native species that feature a variety of colors, shapes, and bloom times.

In some areas, deer can cause significant problems. Many native perennials

are unpalatable to deer, but depending on local conditions, even these species may be browsed. If deer are a problem in your area, keep this in mind when designing your species mix.

While it is useful to read about native plants, there is no substitute for getting out into the fields and woods to study them in person. As you learn more about each plant, its habitats, and its pollinators and other insect associates, you will be able to apply that knowledge to your own native plantings.



PHOTO: MATT SARVER

Matching plant species to site conditions is important. This great blue lobelia (*Lobelia siphilitica*) will only thrive in moist soils.

FACTORS TO CONSIDER WHEN CHOOSING WILDFLOWERS

- **Bloom Period:** Choose a variety of species that bloom *at different times of the year*, so that pollinators have access to a source of food from early in the spring to late in the fall.
- **Origin:** Select *native* plants whenever possible, and definitely avoid invasive alien species.
- **Ecotype:** Whenever possible, buy seed or plants from a nursery that sells *local ecotypes* (plants propagated from seed or stock originally collected in the area you plan to plant, rather than in another region of the country). This helps ensure that the plants you use are adapted to the local climate and growing conditions. Any reputable native plant nursery should be able to tell you the geographic source of their material.
- **Flower Shape and Color:** Choose plants with a *variety of floral shapes and colors* to appeal to many different species of both short-tongued and long-tongued bees.
- **Annual vs. Perennial:** Plant native perennials. They are less likely than annuals to become weedy, and they are easier to maintain, since they don't need to be reseeded. Some annuals, especially those that reseed freely, may be useful during the first year or two of establishment of a planting to provide color or serve as nurse plantings, but they lack the staying power necessary to become part of the long-term composition of the meadow.
- **Hybrids:** *Avoid planting hybrid flower varieties* or those that have been bred for showy or "double" blossoms, as these often lack the pollen and nectar rewards of the parent species.
- **Aggressiveness / Longevity:** Select a mix that includes some species that establish rapidly in large numbers but do not persist in mature meadows (pioneer species) as well as those that are slower to establish, but long-lived (conservative species).

Choosing Plants and Designing the Planting

SEEDS OR PLUGS?

Many native herbaceous plants are available as seed. A commercial seed mix containing desirable species may be used, or better yet, a custom seed mix can be designed to include any number of species. An easy way to establish a native meadow is to plant a mix of native warm-season grasses and bee-friendly wildflowers.

Herbaceous plants can also be grown from rooted plugs, and these will flower more quickly (within 1-2 years versus 3-5 years from seeds). Establishing a new planting from plugs requires significantly more labor than establishing from seed, since plugs need to be individually planted. Nevertheless, plugs may be a good alternative in certain situations. When the area to be planted is wet or frequently flooded, planting plugs by hand avoids the impacts of driving equipment into a wetland area. Plugs are also good for adding new species to existing plantings or remnant natural habitats. Some species that are difficult to establish from seed because of low germination rates, for instance, can be successfully established using plugs. Plugs are also a practical alternative for small backyard or garden meadows, or for establishing small plantings in odd areas around a farm.

USEFUL CONVERSION FACTORS:

43,560 square feet / acre
453.59 grams / pound
28.35 grams / ounce

SEED MIX DESIGN

Some commercial native meadow seed mixes are appropriate for pollinator meadow establishment, but often these mixes do not contain the diversity of flowering forbs needed to ensure bee forage throughout the season. Also, the ratio of grasses to forbs is often too high in mixes that are designed for wildlife cover rather than pollinator habitat. This eventually leads to a dense stand of grasses with relatively few forbs. An appropriate

grass to forb ratio for a pollinator meadow seed mix should be less than 50:50 but at least 30:70. A minimum of 30% grasses is necessary in order for the planting to carry a prescribed burn. (If not enough grass is present, there will not be sufficient fuel for the fire).

In order to provide forb diversity for bee forage, the mix should contain at least 14 or 15 species of forbs, and ideally 18 or more species. Native grasses should be represented by at least 3 species.

SEED MIX DESIGN STEPS

1. Determine the desired number of total seeds per square foot for your planting (40-60 seeds / sq. ft. is generally good)
2. Choose a unit of area as a basis for calculating the seed mix. For small plantings, you can use the total area to be planted in square feet. For larger plantings, it may be convenient to use 1 acre here and calculate a per acre mix that you can later multiply to arrive at your total order.
3. Using your unit of area and the desired number of seeds per square foot from step 1, calculate the total number of seeds needed for the unit area.
4. Determine the desired grass to forb ratio (50:50 to 30:70 for bee plantings).
5. Choose a list of appropriate forb and grass species. Try to match the species to the local site conditions in order to avoid wasting seed.
6. Using the grass to forb ratio, and keeping in mind the characteristics of each plant on your list, determine the desired percentage of each species in the mix. (Of course, check to be sure that all of your percentages add up to 100%).
7. Multiply each percentage by the total number of seeds needed from step 3 to get the number of seeds required for each species.
8. Divide the number of seeds needed for each species by the seeds per unit weight for that species (seeds/lb will be available from your seed supplier). The result will be a list of the weight of viable seed per unit area (e.g. 1 acre) that you will need for each component in the mix. These weights take into account the differences in seed size between species.
9. Multiply by the number of area units (acres) in the planting to find the total weight of seed you need for your planting. If you're using the total square footage of a small planting, you've already done this step.
10. In order to ensure that you get the proper amount of viable seed, order the seed in PLS Pounds. Each pound of PLS (Pure Live Seed) seed may actually weigh more than a pound in bulk, but will be certified to contain a pound of viable seed.

Choosing Plants and Designing the Planting

The most difficult part of the seed mix design process is choosing the relative percentages of species in the mix. While each individual site may warrant a slightly different mix, a few guidelines are useful. When using a no-till drill, it is a good idea to increase the percentages of the very small-seeded species in the mix to compensate for incorrect depth of machine-planted small seeds. Also consider how the plant community will change through time. If cost is an issue, increase the seeding rate of the less expensive and easily established forbs like common milkweed (*Asclepias syriaca*), black-eyed susan (*Rudbeckia hirta*), bee balms (*Monarda fistulosa* and *M. punctata*) penstemons (*Penstemon digitalis*), partridge pea (*Chamaecrista fasciculata*), smooth oxeye (*Heliopsis helianthoides*), blue vervain (*Verbena hastata*), etc. and reduce the rate of the more expensive species. When meeting a budget, reducing diversity like this is preferable to reducing the overall forb seeding rate. More species diversity may be added later by interseeding.

In planting sites that contain a range of moisture regimes (wet swales, drier ridges, etc.), a technique called sculptured seeding or mosaic seeding may be used. Sculptured seeding is simply the seeding of two or more different mixes in different parts of the planting, following the natural lay of the land. For example, a low, wetter area in a meadow would receive a different mix than the rest of the planting. This saves on seed cost by sowing only the species most likely to survive in those microhabitat conditions. In practice, there should also be a zone of overlap where two different mixes are sown, which will help create a natural ecotone between the two plant communities.

NATIVE GRASSES FOR USE IN MEADOW PLANTINGS

Warm-season:

Big Bluestem (*Andropogon gerardii*) is a tall grass that will grow in a variety of soil and moisture conditions. It is often planted more densely than necessary and will outcompete wildflowers at high seeding rates unless disturbed by fire or disking. For this reason it is best to include it in only small amounts, if at all, in a pollinator mix.

Switchgrass (*Panicum virgatum*) is a tall grass that does well in a variety of sites, including poorly-drained, acidic and infertile soils. Like Big Bluestem, it can easily dominate a planting and should be planted in moderation, if at all, in pollinator meadows.

Indian Grass (*Sorghastrum nutans*) is another tall species, but it has less tendency to dominate a planting than Big Bluestem or Switchgrass, making it a good choice for pollinator plantings,

Eastern Gamagrass (*Tripsacum dactyloides*) is a tall species that is well-adapted to moist sites. It is generally less abundant in many natural habitats than the previous three species.

Little Bluestem (*Schizachyrium scoparium*) is a warm-season grass that works well in pollinator meadows because its shorter stature and less dense growth habit allow space for forb establishment. It does best in drier sites.

Cool Season:

Canada Wild Rye (*Elymus canadensis*) is a short-lived perennial grass that is often planted along with the slower-growing warm-season grasses as a cover crop.

Virginia Wild Rye (*Elymus virginicus*) is similar to the previous species, but adapted to wet areas, floodplains, and stream banks.



Warm-season grasses are critical to a successful meadow. For bee meadows, the smaller species like little bluestem (left) should be favored over large and aggressive species like switchgrass (right).

Partial List of Species for Bee Meadows: Mid-Atlantic Coastal Plain / Piedmont

Scientific Name	Common Name	Best Planting Time	Seeds / lb.
<i>Asclepias incarnata</i>	Swamp Milkweed	Late Spring	70,000
<i>Asclepias syriaca</i>	Common Milkweed	Late Spring	70,000
<i>Baptisia tinctoria</i>	Yellow Wild Indigo	Fall	300,000
<i>Chamaecrista fasciculata</i>	Partridge Pea	Spring	65,000
<i>Desmodium canadense</i>	Showy Tick Trefoil	Either	80,000
<i>Eupatorium dubium</i>	Three-nerved Joe-Pye Weed	Fall	
<i>Eupatorium perfoliatum</i>	Common Boneset	Fall	2,880,000
<i>Eupatorium purpureum</i>	Purple Node Joe-Pye Weed	Fall	672,000
<i>Helianthus giganteus</i>	Giant Sunflower	Fall	
<i>Heliopsis helianthoides</i>	Ox-eye Sunflower	Either	102,000
<i>Lespedeza capitata</i>	Round-head Bush-Clover	Late Spring	275,000
<i>Liatris spicata</i>	Dense Blazing-star	Fall	173,000
<i>Liatris graminifolia</i>	Shaggy Blazing-star	Fall	290,000
<i>Lobelia siphilitica</i>	Great Blue Lobelia	Fall	7,760,000
<i>Lupinus perennis</i>	Wild Blue Lupine	Fall	19,000
<i>Monarda fistulosa</i>	Wild Bergamot	Either	1,272,500
<i>Monarda punctata</i>	Spotted Horsemint	Either	1,472,000
<i>Penstemon digitalis</i>	Beardtongue	Fall	400,000
<i>Pycnanthemum muticum</i>	Bigleaf Mountain Mint	Fall	
<i>Pycnanthemum virginianum</i>	Common Mountain Mint	Fall	3,872,000
<i>Rudbeckia hirta</i>	Black-Eyed Susan	Either	1,576,000
<i>Solidago canadensis</i>	Canada Goldenrod	Either	4,600,000
<i>Solidago juncea</i>	Early Goldenrod	Either	2,538,000
<i>Symphyotrichum novae-angliae</i>	New England Aster	Fall	1,100,000
<i>Symphyotrichum pilosum</i>	Hairy Heath Aster	Fall	700,000
<i>Tradescantia virginiana</i>	Spiderworts	Late Spring	1,750,000
<i>Verbena hastata</i>	Blue Vervain	Late Spring	<1,500,000
<i>Vernonia noveboracensis</i>	New York Ironweed	Fall	360,000
<i>Zizia aurea</i>	Golden Alexanders	Fall	172,000
<i>Andropogon gerardii</i>	Big Bluestem	Late Spring	144,000
<i>Panicum virgatum</i>	Switch Grass	Late Spring	259,000
<i>Schizachyrium scoparium</i>	Little Bluestem	Late Spring	200,000
<i>Sorghastrum nutans</i>	Indian Grass	Late Spring	175,000
<i>Tripsacum dactyloides</i>	Eastern Gamagrass	Late Spring	7,000
<i>Elymus canadensis</i>	Canada Wild-rye	Either	114,000
<i>Elymus virginicus</i>	Virginia Wild-rye	Either	73,000

	Soil Moisture	Soil Type	Soil pH	Color	Bloom
	Mesic to Wet	Clay, Loam	5.0-8.0	Pink	Jun -Aug
	Dry	Loam, Sand	5.1-7.5	Pale Purple	Jun-Jul
	Dry	Loam, Sand	5.8-7.0	Yellow	Jun-Jul
	Dry	Sand	5.5-7.5	Yellow	Jul-Sep
	Mesic to Wet	Clay, Loam, Sand	5.5-6.5	Pink	Jul-Aug
	Mesic to Wet	Sand	4.5-6.5	Whitish Purple	Aug-Sep
	Mesic to Wet	Clay, Loam, Sand	6.5-7.0	White	Aug-Sep
	Mesic	Clay, Loam, Sand	6.1-7.8	Pink	Jul-Aug
	Mesic to Wet	Clay, Loam, Sand	5.5-7.5	Yellow	Aug-Sep
	Dry to Mesic	Loam, Sand	6.0-7.5	Yellow	Jul-Sep
	Dry	Loam, Sand	6.0-8.0	White	Aug-Sep
	Dry to Mesic	Clay-Loam, Sand	5.6-7.5	Purple	Aug-Sep
	Dry	Sand	5.8-6.8	Purple	Sep-Oct
	Mesic to Wet	Clay, Loam, Sand	6.5-7.0	Blue	Aug-Sep
	Dry	Sand	6.1-7.5	Purple	May-Jun
	Dry to Mesic	Clay, Loam	6.0-8.0	Pale Pink	Aug-Sep
	Dry	Sand	5.0-7.5	Yellow/Pink	Jul-Aug
	Dry to Mesic	Clay, Loam, Sand	5.5-7.0	White	Jun
	Mesic to Wet	Clay, Loam, Sand		White	Jul-Sep
	Mesic to Wet	Clay, Loam, Sand	5.5-6.5	White	Jul-Sep
	Dry to Mesic	Clay, Loam	5.0-7.5	Yellow	Jun-Jul
	Dry to Mesic	Clay, Loam, Sand	4.8-7.5	Yellow	Sep-Oct
	Dry to Mesic	Sand	5.0-7.5	Yellow	Jul-Sep
	Mesic	Loam	5.5-7.0	Purple	Aug-Sep
	Dry to Mesic	Clay, Loam, Sand	5.4-7.0	White	Sep-Oct
	Mesic to Wet	Loam	4.0-8.0	Purple	May-Jun
	Mesic to Wet	Clay, Loam, Sand	6.0-7.0	Purple	Jun-Aug
	Mesic to Wet	Loam	4.5-8.0	Purple	Aug-Sep
	Dry to Mesic	Clay, Loam, Sand	4.0-6.5	Yellow	Apr-Jun
	Dry to Mesic	Clay, Loam, Sand	6.0-7.5	N/A	Aug-Oct
	Mesic	Clay, Loam, Sand	4.5-7.5	N/A	Jul-Sep
	Dry to Mesic	Sand, Loam	5.8-6.8	N/A	Jul-Oct
	Mesic	Clay, Loam, Sand	5.0-7.8	N/A	Aug-Oct
	Mesic to Wet	Clay, Loam, Sand	5.0-7.5	N/A	Jun
	Mesic	Clay, Loam, Sand	5.0-7.9	N/A	Jun-Aug
	Mesic to Wet	Clay, Loam, Sand	5.0-7.4	N/A	Jun-Oct

Establishing a Planting

WEED CONTROL

The first and most important step in planting a successful bee meadow is weed control. There are a number of different methods to eliminate competing vegetation on your site, depending on the site conditions. Mowing, burning, cultivating, and herbicide application are all useful tools. See the Decision Table on page 13 for some possible approaches. The choice of how best to prepare a given site can be complex, and advice should be sought from knowledgeable restoration ecologists, other conservation landowners, and seed suppliers before making a decision. Factors such as slope, soil type, and land use history may make some methods impractical or even harmful.

In all cases, first scout the site for invasive perennial weeds and spot treat these species using appropriate spe-

SAFE HERBICIDE USE

Herbicides must be mixed and applied according to the product's label guidelines. It is essential for anyone wishing to apply pesticides to be aware of the state laws and regulations that govern pesticide applicator licensing and pesticide use. All applicators should keep abreast of changes to the law and to chemical formulations. More significantly, it is important to understand the ecological impacts of pesticides and their long-term effects on public health and safety. County Extension agents are available to recommend the best management practices for your site.

USE PESTICIDES WISELY: ALWAYS READ THE ENTIRE PESTICIDE LABEL CAREFULLY, FOLLOW ALL MIXING AND APPLICATION INSTRUCTIONS, AND WEAR ALL RECOMMENDED PERSONAL PROTECTIVE GEAR AND CLOTHING. CONTACT YOUR STATE DEPARTMENT OF AGRICULTURE FOR ANY ADDITIONAL PESTICIDE USE REQUIREMENTS, RESTRICTIONS OR RECOMMENDATIONS.

cies-specific methods. Careful attention to controlling invasives is critical. If these species are not brought under control before spraying or cultivating the entire site, they may spread

throughout the site due to reduced competition from cool-season grasses and other vegetation. Species listed under state noxious weed laws should be controlled according to the regula-



PHOTO: MATT SARVER

On disturbed grassy sites, seedlings of invasive species, like this Tree-of-Heaven (*Ailanthus altissima*), can be released from the seedbank when the initial spray kills the grass sod, allowing light to reach the dormant seeds. A second round of spraying is often necessary to control this sudden flush of weed seedlings.

Establishing a Planting

tions set forth by state law (Delaware's noxious weed designations may be found in Title 3, Section 801 of the Delaware Administrative Code).

When spraying a site, it is often helpful to burn first (or mow and rake) to remove standing dead plant material, litter, and thatch. This will allow herbicide to reach the actively growing vegetation. A typical herbicide mix for weed control in old fields with perennial weeds is a 2% glyphosate solution, often with the addition of a broad-leaf-specific herbicide such as 2,4-D. Glyphosate alone usually does a poor job of controlling perennial weeds. Repeated treatments may be necessary to bring weeds under control. Spraying may be combined with shallow disking, which will promote further germination of weeds from the seed bank, exposing the newly emerged seedlings to the next spray. The most effective herbicide treatment time varies with the species that is being targeted. Fall treatments, applied while plants are still actively growing, are generally most effective, because at that time of year perennial weeds are storing carbohydrates in the root system and they will readily translocate herbicide to the roots. It may take a full growing season or more to bring especially tenacious weeds like Canada Thistle, Smooth Brome or Crown Vetch under control. Patience is critical, because once planting has occurred, weed problems are much more difficult to eliminate.

Cultivating to eliminate weeds is an alternative to spraying, particularly if a crop has been growing on the site or the soil has been recently disturbed. Cultivation may be performed alone, in or in combination with herbicide applications. If cultivation is the sole method of weed control, it often takes longer to achieve a clean site, and the control of perennial weeds may not be complete. One drawback to cultivation is the possibility of bringing dormant weed seeds from deeper soil profiles to the surface, where they will germinate.



PHOTO: MATT SARVER

Low areas with standing water or saturated soils should be avoided during herbicide application unless applying a product approved for use in wetlands. Here, wet areas are cordoned off to avoid herbicide contamination during site preparation. These areas can be treated later with an appropriate product.

Cultivate to a depth of 6", then disc twice in perpendicular passes to further break up the soil. Repeat the disking at intervals of a few weeks until the weed problem is eliminated.

Various cultural methods of site preparation are also possible, using a rotation of smother crops and/or in-crop weed control (e.g. Roundup-ready crops) to help prepare a site for meadow planting. On particularly weedy or degraded upland sites, it may be worth putting the planned meadow area into row crops or cover crops for a few seasons to help control the weed problem before proceeding with site preparation and planting. A landowner who does not farm the site could even con-

sider leasing the acreage to accomplish this.

For weed control in wetlands and wetland edges, special care is required. To avoid toxicity to aquatic life and contamination of ground water, be sure to use only those herbicides specifically approved for wetland use. To minimize soil compaction, avoid driving equipment through areas that are too wet.

Establishing a Planting

SEEDBED PREPARATION

If seeding is to be done with a no-till drill directly into dead grass turf or crop residue, no further preparation of the seedbed is needed so long as there is good light penetration to the soil and the site is even enough to allow good contact of the drill coulters with the soil.

Uneven bare soil sites or sites that have been cultivated for weed control should be disced and harrowed to break up soil clods and smooth out the surface. To ensure good seed to soil contact, the site should be firmed by cultipacking, either before planting when using a no-till drill, or after seeding when using a broadcaster.

If soil nitrogen levels are especially high, methods of decreasing available nitrogen before planting might be helpful in controlling weed competition. Most native species will outcompete weeds in soils with limited nitrogen. Incorporating sufficient high-carbon organic matter like sawdust will improve the soil and tie up nitrogen temporarily while the organic material is decaying. Planting a non-legume green manure crop with a high C:N ratio and tilling it in before it goes to seed is another option for less extreme cases. If the soil is sandy and sterile, a legume green manure crop will add nitrogen. In most cases, however, increasing the fertility of the soil is not necessary and it is better to adapt the plant mix to the soil conditions than to try to add nutrients to the soil.

SEEDING TIMING

Seeding should take place either in late fall or from late spring to early summer. Both times have advantages and drawbacks. Spring seeding is the preferred method when establishing warm-season grasses. Many forbs, however, require a cold stratification period before germination, so a larger percentage of seed of most forb species will germinate when planted in the fall. However, fall planting risks loss of seed to wildlife during the winter, possible erosion issues on some sites, and increased competition from cool-season grasses and weeds in spring. A hybrid method is to plant warm-season grasses along with seed of some forb species (particularly milkweeds, many composites, legumes, and verbenas) in the spring, followed by a second seeding of the remaining mix of forbs in the fall. Ultimately the decision on the best planting time should be made on a site-specific basis, depending on conditions, desired species mix, and status of weed control efforts.

SEEDING METHOD

No-till seeding requires access to a special no-till drill designed for planting warm-season grasses. Such a drill can often be borrowed (or rented for a nominal fee) from local conservation districts or local chapters of organizations such as Quail Unlimited or Pheasants Forever. Proper seed depth should be ½ inch

for clay and loam soils, and ¾ inch for sand.

Broadcast seeding requires significantly more seed than drilling, but allows the use of locally-collected seed that has not been cleaned of stems and debris (this type of seed would clog the tubes of a seed drill). Broadcasting may be done by hand, with a crank-operated broadcaster, or with a broadcaster mounted to a tractor. After broadcast seeding, lightly rake or harrow the site, then roll or cultipack to ensure good seed-to-soil contact. The harrow incorporates the seed into the top of the soil, and then the packing ensures good seed-to-soil contact and eliminates air spaces in the seedbed.

SEEDING TECHNIQUES

Hand

- mix seed with sand, perlite, or vermiculite
- two passes at right angles
- scatter by hand or with hand-cranked broadcaster

Broadcast

- mix seed with sand, cracked grain, or vermiculite and put in seed hopper
- two passes at right angles

No-till Drilling

- put clean seed in proper hoppers of drill
- single pass

Fertilizers are not needed for native meadow plantings and tend to favor rapid growth of non-native weeds, rather than successful establishment of the native planting. Avoid mulching plantings with wood, hay, or weedy composts. Only a thin mulch of clean, chopped straw or clean sawdust may be used for spring plantings. Fall plantings may benefit from hydromulch or a planting of annual rye grass as a winter cover crop.



PHOTO: DAVID PRO

For large sites, a no-till drill is often the easiest and best way to plant seeds of meadow species.

Establishment Decision Table

Use this table to select appropriate strategies for establishing a meadow planting at your site.

START HERE Select the existing vegetation type to the right and follow the column down:	Cool season grass sod (pasture, hay, or lawn, mostly free of perennial invasive weeds)	Perennial Weeds, Wildflowers, and/or Grasses (old fields, meadows, waste areas)	Cropped or recently fallow field with annual weeds present	Crop Residue (soybean, corn, etc)	Bare Soil
1. Is there a recent history of residual broadleaf herbicide (atrazine, trifluralin, picloram, etc.) use on the site?	Yes: Strategy A	N/A: Go to #2 Below	Yes: Strategy B	Yes: Strategy B	Yes: Strategy B
	No: Go to # 2 Below		No: Strategy C or D	No: Strategy E	No: Strategy F
2. Are there desirable native species already present?	Yes: Strategy I or J	No: Strategy G, H or I	Yes: Go to #3 Below	No: Go to #3 Below	
3. Are there persistent perennial, invasive weeds such as Canada Thistle or Japanese Honeysuckle?		Yes: Strategy I	No: Strategy J	Yes: Strategy H or I	No: Strategy G, H, or I

Example Establishment Strategies (These strategies may need to be modified for specific sites)

Strategy A. Grassy sites with Residual Herbicides

1. Wait to plant until the herbicide breaks down. In the meantime, spot treat any problematic invasive weed species with non-residual post-emergence herbicides, spot mowing, or spot cultivating.

2. Once the residual effects of broadleaf herbicides have worn off, proceed with one of the other applicable strategies.

Strategy B. Crop or Bare Soil Sites with Residual Herbicides

1. Plant a cover crop or a smother crop (such as corn or sorghum) to help control weeds until the herbicide breaks down. Legumes should not be used, as they add nitrogen to the soil, which will increase weed growth.

2. Once the residual effects of broadleaf herbicides have worn off, proceed with one of the other applicable strategies.

Strategy C. Sites with Annual Weeds (Non-chemical Approach)

1. Disc first to a depth of 4-5" to break up weed roots.

2. Drag roots to the surface with an aggressive harrow.

3. Repeat the discing every 2-3 weeks until existing weed roots are dead

4. Disc to a depth of 2" every 2-3 weeks to remove weeds that germinate from the seed bed without bringing more weed seed to the surface.

5. Just before planting, disc shallowly once more and then harrow or drag to smooth the soil.

6. Cultipack or roll the soil before seeding if using a drill, or after seeding if broadcasting.

Strategy D. Sites with Annual Weeds (Mechanical / Chemical Approach)

1. Burn or mow and rake to remove litter and thatch.

2. Spray the annual weeds with a glyphosate herbicide.

3. Allow remaining weed seeds to germinate.

4. Disc to a depth of 2" every 2-3 weeks until weeds are controlled

5. Spot spray any persistent weeds if needed.

6. Just before planting, disc shallowly once more and then harrow or drag to smooth the soil.

7. Cultipack or roll the soil before seeding if using a drill, or after seeding if broadcasting.



Incomplete weed control prior to planting can cause problems later.

PHOTO: MATT SARVER

Example Establishment Strategies (These strategies may need to be modified for specific sites)

Strategy E. Annual Crop Residues

1. If crop residue is too thick to allow good light penetration to the soil surface, the site will need to be either burned or mowed and raked to remove the heavy litter and allow sunlight to reach the soil surface.
2. Appropriate herbicide treatment may be necessary to control any annual weeds
3. Soil disturbance should be avoided in order to avoid bringing new weed seed to the surface.
4. Use a no-till drill to seed directly into crop residue.

Strategy F. Bare Soil

1. Prepare the seedbed by shallow discing at 90 degree angles, followed by harrowing to even the surface.
2. Cultipack to create a firm seed bed for drilling, or alternatively broadcast seed, then rake/harrow seed in before cultipacking.

Strategy G. Grass Sod or Old Field (No-till Weed Control followed by Seedbed Preparation)

1. Mow closely and rake (or burn if possible) in early spring to remove thatch accumulation.
2. Allow weeds and grasses to regrow to about 8 inches.
3. Spray with a mixture of glyphosate and 2,4-D

4. Allow time for the inevitable sprouting of weeds from the soil seed bank
5. Spray again with herbicide
6. Repeat steps 4 and 5 until weed control is accomplished.
7. Burn, or mow and rake, again late in the season to remove standing plant material and litter.
8. Till to a depth of 6", to break up rhizomatous weeds.
9. Allow weeds to regrow for about 3 weeks.
10. Disc to a depth of 4"
- 11 Allow weeds to regrow for 2-3 weeks.
- 12 Repeat steps 3 and 4 until weed control is accomplished.
13. Just before planting, disc shallowly once more and then harrow or drag to smooth the soil.
14. Cultipack or roll the soil before seeding if using a drill, or after seeding if broadcasting.
15. If planting in the fall, mulch or plant a cover crop to help stabilize the soil and protect the seed over the winter.

Strategy H. Grass Sod or Old Field (No-till Weed Control)

1. Mow closely and rake (or burn if possible) in early spring to remove thatch accumulation.

2. Allow weeds and grasses to regrow to about 8 inches.
3. Spray with a mixture of glyphosate and 2,4-D
4. Allow time for the inevitable sprouting of weeds from the soil seed bank
5. Spray again with herbicide
6. Repeat steps 4 and 5 until weed control is accomplished.
7. Mow and rake (or burn) again before planting (either late fall or early spring) to remove remaining dead vegetation.
8. A final spray prior to planting will remove any newly germinated weeds
9. Prepare the seedbed by raking off any litter.
10. Seed with a no-till drill.

Strategy I. Grass Sod or Old Field (Live Sod Interseeding)

1. Mow closely and rake (or burn if possible) in early spring to remove thatch accumulation.
2. Spot treat any invasive perennial weeds using broadleaf-selective herbicides, spot spraying, spot mowing, or other appropriate techniques. This may require multiple treatments over one or more seasons.
3. After problem weeds have been controlled, repeat step 1, and then seed directly into the cool-season grass turf. This makes for a slower establishment of natives, but will help keep weed problems under control.
4. Mow to 6" or so for the first two years to keep cool-season grasses and weeds under control. After the first two years, burn or spring mow for several seasons to reduce competition from cool-season grasses and promote natives.

Strategy J. High Quality Old Field or Meadow (Interseeding without Weed Control)

1. For a site that already consists of mostly desirable species, implementing a burning or mowing rotation may be sufficient to help control weeds and maintain the plant community.
2. Interseeding after a burn or mow can be used to introduce new species to the site.
3. Broadcast seeding or drill seeding may be used for interseeding.



PHOTO: MATT SARVER

Prescribed burning is an excellent tool for establishing and maintaining meadows. The effects of a burn can be mimicked by mowing followed by raking off of the mowed material and accumulated thatch.

Maintaining a Planting

FIRST YEAR MAINTENANCE

If plantings are properly established in the fall, watering should not be necessary during the subsequent growing season. Spring plantings can be susceptible to drought however, and may need to be watered regularly (every 1-2 weeks) during the first year until the plants are well established. It is necessary to mow herbaceous plantings to a height of 6-8" several times during the first growing season to remove the tops of the weeds that will inevitably grow faster than the desired perennials. Mow before the weeds reach 12" to avoid smothering the native seedlings with the cut thatch. A flail mower works best, since it chops the cut material and doesn't leave the windrows and clumps that a rotary mower leaves behind. A rotary mower can be used if a flail mower is not available.



PHOTO: MATT SARVER

A flail mower or a rotary mower (shown here) may be used during the first year or two after planting to cut the tops off of fast-growing weeds without harming the slower-growing native seedlings. Be sure to set the mower to the proper height.

PRESCRIBED FIRE

Periodic prescribed burns are one of the best ways to manage bee meadows.

The most common time for conducting prescribed burns in the northeast is in spring. Burns are easier to control then, because weather and moisture conditions are often favorable, and because cool-season weeds and grasses are greening up. However, mid or late spring burns tend to favor the growth of warm-season grasses over forbs, and can damage early-blooming forbs. Dormant-season (fall) burns are more challenging to conduct, but provide better control of woody plant invasion and tend to promote forb dominance within the plant community. A disadvantage of fall burns is that they remove winter cover for wildlife. For bee meadows, fall or early spring maintenance burns are typically best in order to encourage forb productivity, and both types of burn can be a useful tool during habitat establishment. Decisions about when and how to conduct a burn should be made in consultation with experienced burn managers and wildlife biologists.

It is important to plan for the protection of insects and other wildlife during a burn. This can be accomplished by dividing a planting into two or three sections, and burning only one of these sections per year.

CAUTION: Prescribed burns should only be conducted by trained fire crews with appropriate equipment. No one should attempt to conduct a prescribed burn until he or she has intensively studied burning and gained burning experience by assisting educated and experienced burn managers. In many states, a permit from the state department of natural resources is required before carrying out a burn. Be sure to inform neighbors, regulatory authorities, and local fire departments of your burn. Before burning on your property, be sure you know how the laws of your state deal with liability issues related to prescribed fire.

Qualified burn managers include some farmers, forestry or wildlife agency personnel, state agricultural extension personnel, Nature Conservancy and Ducks Unlimited land management personnel, Natural Resource Conservation Service (NRCS) personnel, and County Conservation District wildlife or forage specialists.

In Delaware, land managers must obtain approval of prescribed fire plans from DNREC Air Quality Management section before conducting planned burns. Prescribed burns are permitted from Oct. 1st to Apr 30th.

For more information about prescribed burning in Delaware, contact Gerald Mood at 302-739-9402 or gerald.mood@state.de.us, or visit www.awm.delaware.gov/Info/Pages/OpenBurningMain.aspx

Maintaining a Planting

SECOND YEAR

Mowing can be continued into the second growing season if weeds continue to be a problem. To accommodate the larger size of the native seedlings, the mower height should be adjusted to 10-12". One or two summer mowings may be needed to eliminate seed production from biennial weeds. Mow when the weeds are in bloom, but before they have gone to seed. Any remaining perennial weed species may be controlled by spot mowing and/or spot treatment with herbicides during the first 2 to 3 years of establishment.

THIRD YEAR

The third spring is a good time to consider burning your planting for the first time, if there is enough accumulated plant material to carry a fire. The goal is to damage any cool-season weeds once they are actively growing, but before native warm-season species have broken dormancy, or when they are no more than an inch or two in height. A burn at this time removes thatch and exposes the soil to sunlight, giving the warm-season species a head start. If a burn is not possible, a close mow (as close to the ground as possible) followed by raking off of the thatch is the next best technique.

Spot spraying with an ATV mounted sprayer, a wick applicator, or a backpack sprayer (shown here) may be necessary to control any persistent perennial weeds that remain in the planting.

SUBSEQUENT YEARS

Long-term maintenance should consist of rotational prescribed dormant season burns (or mowing and raking) every 3-5 years. This will help encourage forb diversity and keep the planting free of woody plants. If cool season weeds continue to be a problem, spring burns or mows may be conducted every other year to help bring them under control. Only a portion of the planting should be

burned or mowed in a given year, with the remainder left undisturbed to avoid disrupting resource availability or destroying wildlife cover. Scouting for invasive weeds should be conducted regularly, so that any new invasions can be controlled quickly by spot treatments. Once the meadow or buffer is well-established, disturbance should be avoided during the primary bird nesting season (Apr 15 - Aug 15).



PHOTO: TOM PEARSON

Financial Assistance

There are many federal, state, and private programs available that can provide financial assistance to landowners for planting native plant species as part of conservation practices. Most of these practices can be adapted to benefit bees and other pollinators by choosing plant species such as those listed in this booklet. NRCS conservation cost-share programs such as the Environmental Quality Incentives Program (EQIP) and the Wildlife Habitat Incentives Program (WHIP) can help agricultural producers with the establishment of native species plantings.

Some of the NRCS cost-share practices that can be adapted for bees include:

- Conservation cover
- Field border planting
- Filter strip planting
- Hedgerow planting
- Shallow-water wetland creation
- Wetland restoration
- Critical area planting
- Riparian herbaceous cover development
- Early successional habitat development
- Riparian forest buffer planting
- Upland / Wetland wildlife habitat management



PHOTO: RANDOLPH CIURLINO

NRCS cost-share assistance may be available to establish plantings for bees.

Contacts for NRCS are listed at the end of this fact sheet. Ask about how you can incorporate plantings for native bees into NRCS projects. The Delaware DNREC private lands biologist can assist you with finding public and private cost-share assistance for conservation projects. Delaware Department of Agriculture staff members are available to help you design bee habitat enhancements on your farm.



PHOTO: IOWA NRCS

Black-eyed susan (*Rudbeckia hirta*) and partridge pea (*Chamaecrista fasciculata*) dominate a flush of early growth from a newly-planted meadow.

Terminology

BULK SEED

Seed that is sold by the bulk pound, regardless of the purity and viability. The quality of bulk seed may vary widely between lots.

CONSERVATIVE SPECIES

Slow to establish, usually long-lived species that are adapted to stable, late-successional communities

COOL-SEASON GRASS

Grass species that grow best early in spring when temperatures are cooler, then slow or stop growth during summer, before beginning to grow actively again in fall. Many commonly planted cool-season grasses are of Eurasian origin, but there are also a number of species native to North America.

ECOTYPE

An ecotype is a subpopulation of a species which is genetically differentiated so that its survival in a particular habitat or region is enhanced. In the native plant nursery trade, the ecotype is typically listed by state, and represents the original collection locality of the parent seed or stock used to produce a nursery or seed catalog offering. In order to maximize the probability of planting success, local ecotypes are preferred when available.



PHOTO: JIM WHITE

Pioneer species like this wild bergamot (*Monarda fistulosa*) establish quickly during the first season of growth, while more conservative species may not appear for several years.

FORB

A flowering herbaceous plant that is not a graminoid (grass, sedge, or rush).

HYDROSEEDING

The delivery of seed in a jet of water, often mixed with a mulch solution. If native seed is planted using this technique, the seed and water must be delivered first, then the mulch must be delivered in a subsequent application. Otherwise, the native seed is suspended in mulch, and is not in contact with the soil.

INTERSEEDING

Planting seed directly into existing vegetation without tillage. Often used to add species diversity to old fields or to improve species-poor warm-season grass stands.

PURE LIVE SEED (PLS)

A specification of the purity and viability of seed. The bulk weight of seed required to yield a unit of PLS seed depends on the amount of dead seed, inert matter, and weed seed in the bulk seed lot. Specifying PLS weights rather than bulk weights for seed mixes ensures that you receive the proper amount of viable seed each time.

STRATIFICATION

The cold period needed by many native forb seeds before breaking dormancy. This is naturally provided by winter temperatures and freeze/thaw cycles, but seeds may also be artificially stratified by refrigeration.

WARM-SEASON GRASS

Grass species that grow best in the warm temperatures of late spring and summer. Many native grasses are warm-season species.



PHOTO: JEFF GORDON

Warm-season grasses like eastern gamagrass (*Tripsacum dactyloides*), shown here in flower, are important and attractive components of a meadow planting.

More Information

Two booklets, *Delaware Native Plants for Native Bees* and *Farm Management for Native Bees: a Guide for Delaware*, are available from the Delaware Department of Agriculture. Contact them at the address listed below to obtain a copy, or visit the website: dda.delaware.gov/plantind/pollinator.shtml

BEE USE OF NATIVE PLANTS:

Brooklyn Botanic Garden's New York Metropolitan Flora Project, Metropolitan Plant Encyclopedia:
www.bbg.org/research/nymf/

Enhancing Beneficial Insects with Native Plants (MI):
nativeplants.msu.edu

Insect Visitors of Illinois Wildflowers:
flowervisitors.info

Loose, J.L., F.A. Drummond, C. Stubbs, S. Woods and S. Hoffman. 2005. Conservation and management of native bees in cranberry. Maine Agricultural and Forest Experiment Station Technical Bulletin 191. Orono, ME: University of Maine.
www.umaine.edu/mafes/elec_pubs/techbulletins/tb191.pdf

NAPPC Pollinator Conservation Digital Library:
libraryportals.org/PCDL

CHOOSING NATIVE PLANTS:

Lady Bird Johnson Wildflower Center Native Plant Database:
www.wildflower.org/plants/

Missouri Botanical Garden's Kemper Center For Home Gardening Plantfinder:
www.mobot.org/gardeninghelp/plantfinder/

New Jersey NRCS Biology Technical Note: Habitat Development for Pollinators.
www.nj.nrcs.usda.gov/programs/whip/documents/NJ_BIO_TECH_NOTE-Pollinators.pdf

NRCS Plants Database:
plants.usda.gov/

Pollinator Partnership Ecoregional Planting Guides:
www.pollinator.org/guides.htm

REGIONAL RESOURCES:

Delaware Native Plant Society (DNPS):
www.delawarenativeplants.org

Delaware Native Plant Society. 2005. Delaware native plants for landscaping and restoration: recommended species for the property owner and land steward. 2nd ed. DNPS. 21 pp.

McAvoy, W.A. and K.A. Bennett. 2001. The flora of Delaware: an annotated checklist. Dover, DE: Delaware Dept. of Natural Resources and Environmental Control, Division of Fish and Wildlife. 265 pp. Available for purchase at:
www.dnrec.state.de.us/fw/floraform.pdf

University of Delaware Cooperative Extension Plants for a Livable Delaware Publications:
ag.udel.edu/extension/horticulture/index.htm

More Information

REGIONAL RESOURCES CONTINUED:

Maryland Native Plant Society (MNPS):
www.mdflora.org

Adkins Arboretum:
www.adkinsarboretum.org

US Fish and Wildlife Service Bayscapes Program:
www.fws.gov/chesapeakebay/Bayscapes.htm

Native Plant Society of New Jersey:
www.npsnj.org

Pennsylvania Native Plant Society (PNPS):
www.pawildflower.org

Bowman's Hill Wildflower Preserve:
www.bhwp.org

Virginia Native Plant Society (VNPS):
vnps.org

Virginia Natural Heritage Program Native Plant Lists:
www.dcr.virginia.gov/natural_heritage/nativeplants.shtml

PLANTING FOR POLLINATORS:

The Xerces Society provides a wealth of information on pollinator conservation at their website: www.xerces.org

MacCulloch, Bonnie. 2007. Farming for Native Bees in Delaware. Dover, DE: Delaware Department of Agriculture. Available from: dda.delaware.gov/plantind/pollinator.shtml

Vaughan, M., M. Shepherd, C. Kremen and S.H. Black. 2007. Farming for Bees: Guidelines for Providing Native Bee Habitat on Farms. 2nd ed. www.xerces.org/guidelines-farming-for-bees/

Vaughan, M. and S.H. Black. 2006. Agroforestry Note 33: Improving Forage For Native Bee Crop Pollinators. USDA National Agroforestry Center. www.unl.edu/nac/agroforestrynotes/an33g07.pdf

ESTABLISHMENT AND MAINTENANCE OF NATIVE PLANTINGS:

Diboll, Neil. Burn your prairie safely (and have fun, too!) Prairie Nursery. www.prairienursery.com/store/images/Burn%20Your%20Prairie%20Safely%20202-08.pdf

Diboll, Neil. Five steps to successful prairie meadow establishment. Prairie Nursery. www.prairienursery.com/store/images/Five%20Steps%20to%20Successful%20Prairie%20Establishment.pdf

Kurtz, Carl. 2001. A Practical Guide to Prairie Reconstruction. Iowa City, IO: U of Iowa Press.

Michigan State University's Enhancing Beneficial Insects with Native Plants program:
nativeplants.msu.edu/getstarted.htm

Packard, S. and C.F. Mutel, eds. 2005. The Tallgrass Restoration Handbook: for Prairies, Savannas, and Woodlands. Society for Ecological Restoration International The Science and Practice of Ecological Restoration Series. Washington: Island Press.

Planting the Seed: A guide to establishing prairie and meadow communities in southern Ontario
www.on.ec.gc.ca/wildlife/docs/doc-planting-prairie-e.html



PHOTO: DAVID SMITH

White beardtongue (*Penstemon digitalis*) is an excellent and easy-to-grow bee plant that does well in almost any meadow soil.

Some Regional Native Plant Suppliers for Conservation Projects

Note: this list includes primarily wholesale suppliers that can provide large quantities of plants and seed to individuals enrolled in cost-share programs. Many additional retail native plant nurseries and garden centers sell native plants in smaller quantities to homeowners and gardeners. Consult your local native plant society or search the internet to locate additional suppliers.

AMERICAN NATIVE PLANTS

PO Box 158
Perry Hall, MD 21128
(410) 529-0552, wholesale
(410) 529-3883 fax
info@americannativeplants.net
www.americannativeplants.net

CHESAPEAKE NATIVES

www.chesapeake natives.org
sales@chesapeake natives.org

ENVIRONMENTAL CONCERN, INC.

P.O. Box P
201 Boundary Lane
St. Michaels, MD 21663
(410) 745-9620
(410) 745-4066 fax
nursery-sales@wetland.org
www.wetland.org

ERNST CONSERVATION SEEDS

9006 Mercer Pike
Meadville, PA 16335
(800) 873-3321
(814) 336-5191 fax
sales@ernstseed.com
www.ernstseed.com

NORTH CREEK NURSERIES

388 North Creek Rd.
Landenberg, PA 19350
(877) ECO-PLUG
(610) 255-4762 fax
order@northcreeknurseries.com
www.northcreeknurseries.com

NEW MOON NURSERY

975 Barretts Run Rd.
Bridgeton, NJ 08302
(888) 998-1951
(888) 998-1952 fax
info@newmoonnursery.com
www.newmoonnursery.com

OCTORARO NATIVE PLANT NURSERY

6126 Street Rd.
Kirkwood, PA 17536
(717) 529-3160
(717) 529-4099 fax
octoraro@octoraro.com
www.octoraro.com

PINELANDS NURSERY, INC.

323 Island Road
Columbus, NJ 08022
(609) 291-9486
(800) 667-2729
(609) 298-8939 fax
sales@pinelandsnursery.com
www.pinelandsnursery.com

REDBUD NATIVE PLANT NURSERY

1214 North Middletown Road
Glen Mills, PA 19342
(610) 358-4300
(610) 358-3330 fax
info@redbudnativeplantnursery.com
www.redbudnativeplantnursery.com

SYLVA NATIVE NURSERY & SEED Co.

3815 Roser Road
Glen Rock, PA 17327
(717) 227-0486
(717) 227-0484 fax
sylvanat@aol.com
www.sylvanative.com

Contacts for Information on Cost-share and Technical Assistance Programs:

DNREC:

Private Landowner Assistance Contacts:

Bill Jones
Delaware Fish & Wildlife
89 Kings Highway
Dover, DE 19901
302.284.4795
william.jones@state.de.us

Jason Davis
Delaware Fish & Wildlife
McKay House Office
6180 Hay Point Landing
Smyrna, DE 19977
302.735.3606
jason.davis@state.de.us

USDA NRCS:

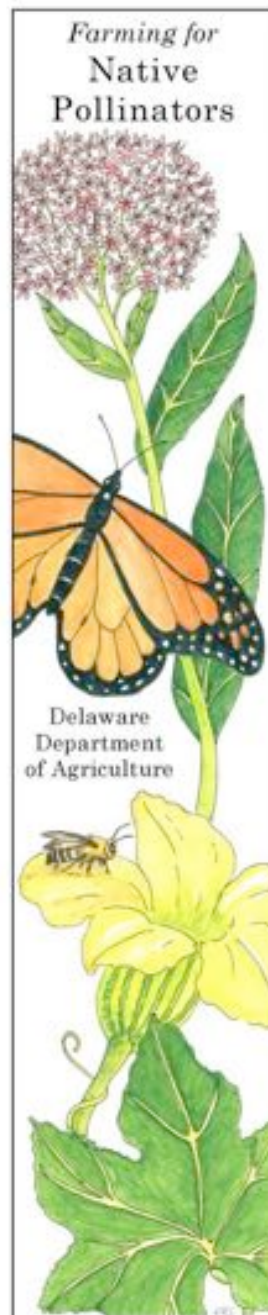
New Castle County Service Center
2430 Old County Road
Newark, DE 19702-4702
Phone: 302-832-3100
Fax: 302-834-0783

Kent County Service Center
800 Bay Road, Suite #2
Dover, DE 19901-4667
Phone: 302-741-2600
Fax: 302-741-0347

Sussex County Service Center
21315 Berlin Road, Unit #3
Georgetown, DE 19947-2144
Phone: 302-856-3990
Fax: 302-856-4381

DELAWARE DEPT. OF AGRICULTURE:

Faith Kuehn
Plant Industries Administrator
Delaware Department of Agriculture
2320 S. DuPont Highway
Dover, DE 19901
Phone: 302-698-4500
Email: Faith.Kuehn@state.de.us



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