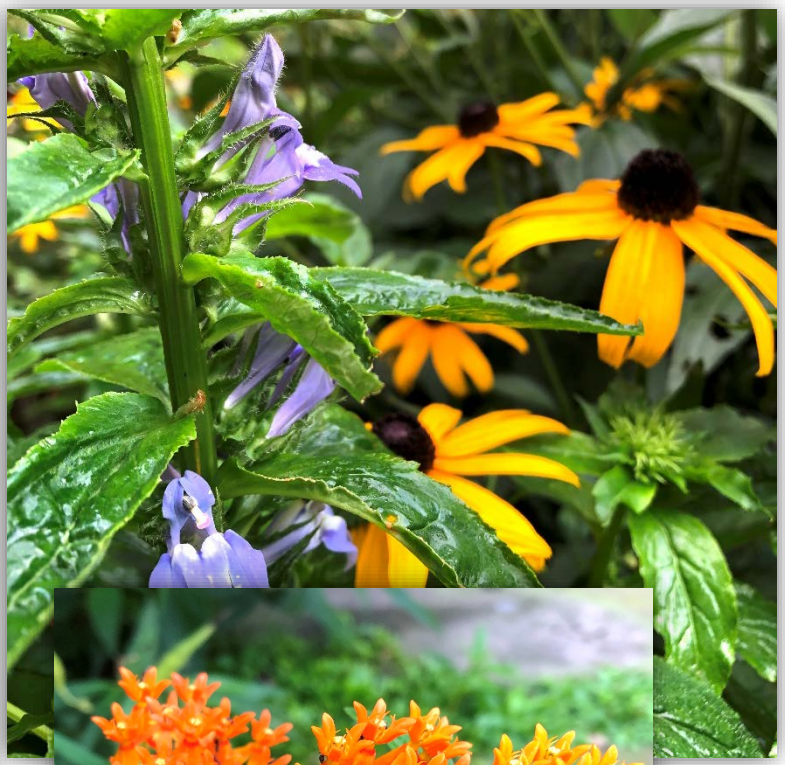
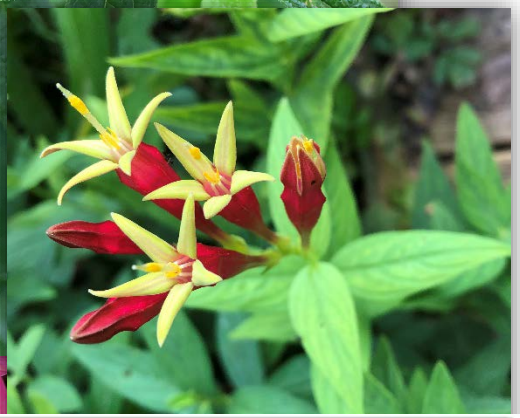
Native Plant Species Selection Guide





CBTRUST

Chesapeake Bay Trust

Updated: October 2021

NATIVE PLANT SPECIES SELECTION GUIDE

I. WHAT ARE NATIVE PLANTS?

A native (indigenous) species is one that occurs in a particular region, ecosystem, and habitat without direct or indirect human actions (Kartesz and Morse 1997; Richards 1998). Species native to North America are generally recognized as those occurring on the continent prior to European settlement. It is becoming generally recognized that in order to preserve individual species, their plant communities must be preserved. This includes the preservation of native plants that are not yet in danger of extinction, but still play an important role in native ecosystems.

II. WHY USE NATIVE PLANTS?

Native plants have formed symbiotic relationships with native wildlife over thousands of years, and therefore offer the most sustainable habitat. A plant is considered native if it has occurred naturally in a particular region, ecosystem, or habitat without human introduction.
Exotic plants that evolved in other parts of the world or were cultivated by humans into forms that don't exist in nature do not support wildlife as well as native plants. Occasionally, they can even escape into the wild and become invasive exotics that destroy natural habitat.
Native plants help the environment the most when planted in places that match their growing requirements. They will thrive in the soils, moisture and weather of your region. That means less supplemental watering, which can be wasteful, and pest problems that require toxic chemicals. Native plants also assist in managing rainwater runoff and maintain healthy soil as their root systems are deep and keep soil from being compacted. Native plants are valued for their economic, ecological, genetic, and aesthetic benefits in addition to the growing societal belief in their intrinsic value as living species.

Using native plants to restore the landscape or as a substitute for exotic ornamental plantings can help to reverse the trend of species loss. Although the methods may differ, native plants require the same level of care in installation and establishment as do ornamental plants. If the environment has been altered significantly through human activities, some work will be necessary to recreate an environment more hospitable to natives. However, in the long run, natives will, in most cases, form self-sustaining plant communities that do not require much maintenance. Because they are adapted to a local region, they tend to resist damage from freezing, drought, common diseases, and herbivores if planted in that same local region.
Native plant species provide the keystone elements for ecosystem restoration. Native plants help to increase the local population of native plant species, providing numerous benefits. There are specific associations of mycorrhizae with plants, invertebrates with woody debris, pollinators with flowers, and birds with structural habitat that can only be rebuilt by planting native plants.

<u>Advantages of native plants:</u>

- add beauty to the landscape and preserve our natural heritage.
- provide food and habitat for native wildlife, including our native pollinators

- serve as an important genetic resource for future food crops and plant-derived products.
- decrease the amount of water needed for landscape maintenance.
- require very little long-term maintenance if they are properly planted and established.
- produce long root systems to hold soil in place, thus protecting water quality by controlling soil erosion and moderating floods and droughts.

III. COMMUNICATING CLEAR PROJECT GOALS AND OUTCOMES

For projects that include native plant selection, setting clear goals and objectives will help in making good decisions as the planning process continues. Clear goals and objectives are also essential for defining a monitoring plan that will quantitatively evaluate the long-term success of the project. Each project objective should relate to some measurable criteria. Some examples of goals, related objectives and measurable criteria include the below which can be combined to meet overall project outcomes:

Goal: increase available wildlife habitat
Objective: plant native plants that can provide food for local wildlife
Measurable Criterion: establish greater than 50% to 70% cover of native plant species that are providing food for wildlife

Goal: attract native pollinators
Objective: plant native plants preferred by our native pollinators that provide nectar sources, pollen sources, nesting sources, and pollinator host plants
Measurable Criterion: establish greater than 50% to 70% cover of high-quality plant species preferred by our native pollinators

Goal: improve water quality
Objective: plant native species that require less fertilizers and pesticides than non-native plants, reducing chemical run-off into local streams
Measurable Criterion: reduce the quantity of commercial fertilizers used on site by 90%

Goal: reduce soil erosion
Objective: plant native species that will develop strong root structures to hold soil in place
Measurable Criterion: reduce soil loss to less than 5 milligrams per hectare per year

IV. PLANT SPECIES SELECTION

Once clear goals and objectives have been set for the project and a thorough site evaluation has been conducted, native plant species that will be appropriate for the site should be chosen. Choose native species that will match restoration site conditions by keeping in mind the three most important variables for plants: water, light, and nutrient availability. For instance, if the site has sandy, well-drained soils and full exposure to the sun, it would not be a good idea to plant species that require moist, shady conditions.

There are a few different ecoregion classifications of the United States that have been developed. One popular classification is Bailey's ecoregions, a product of a cooperative effort among

several federal agencies and The Nature Conservancy. These regions are areas that have been defined as having similar natural communities, geology, and climate.

In developing a plant list, remember that species are typically found together in certain groupings, referred to as plant associations or plant communities. These associations will suggest other plant species that may be appropriate. Planting species together based on their typical associations is a good idea because they will all be adapted to the same site conditions. They may also have symbiotic relationships, a relationship where each helps the other in some way. Some species may also be dependent on the presence of certain other species. If one of the goals of the project is to restore self-supporting native flora and fauna communities, there is a greater chance of success through using typical associations to develop the plant list. This is a much better method as opposed to picking individual species without considering their interactions. Also, keep in mind that the final community desired on site that must be created or restored may not be the one that is initially planted. For example, if the goal is to restore a native hardwood forest community on a site that has been cleared of trees, it would not be appropriate to plant herbaceous understory species that are shade-tolerant or intolerant to high light levels if there is no existing canopy at the site. Until the shady environment is created, those understory species will not survive, and efforts and resources will have been wasted. To help in selecting the most appropriate species, different resources are advantageous and can include the following:

- native species are already on site
- reference sites
- local plant experts
- literature on local plant communities
- historical records of the site

The best indicators of appropriate plant species may be native species that are already growing on the site. An exception would be if the site has been altered enough for new native species adapted to different conditions to grow, rather than the originally present native species. In this case an evaluation of which native plant community is desired at the site is required: the original community or one adapted to the new site conditions. The challenge is to determine the factors keeping native species from growing throughout the entire site.

Another very helpful method of determining what native species to use is to identify a reference community. A reference community is the same type of ecological community as the project plans to have at the restoration site. It is always located in environmental conditions similar to the restoration site and provides an idea about what plant species to use for restoration. If there is enough historical data available, the reference community could be the community that was historically found at the site. However, if it is unclear what native species used to be present at the site, a reference community can also be an intact community of native species located near the restoration site in similar site conditions.

Local native plant experts and literature on local plant communities are two other resources that should be taken advantage of if the restoration team is not familiar with the native plants of the site’s region. Historical records of a site, including include localized floras, local herbaria, and aerial photographs can provide another good source of information. Information resources could

include the local conservation district office, the local office of the NRCS, the botany department of local universities, the county Cooperative Extension office of the state's land grant university, the state's Department of Natural Resources, the Xerces Society for Invertebrate Conservation, or the state's Natural Heritage Program.

V. OVERVIEW OF PLANT GENETICS AND PLANT VOCABULARY

Binomial nomenclature is the system of nomenclature in which two terms are used to denote a species of living organism, the first one indicating the genus and the second the specific epithet (or "species"), both of which are Latin and italicized. This concept was introduced by Carl Linnaeus in 1735. For example, the scientific name for butterflyweed is *Asclepias tuberosa* (butterfly milkweed), where *Asclepias* is the genus and *tuberosa* is the epithet (or species); the family is Asclepiadaceae, the order is Gentianales, the class is Magnoliopsida, the division is Magnoliophyta, and the kingdom Plantae. Arranging scientific plant names in a hierarchical classification allows related organisms to be classified closely together. Please note that plants under the same genus are *not necessarily all considered native to your location*. For example, Asclepias tuberosa is native to Maryland, but *Asclepias nivea* (Caribbean milkweed) is native to Puerto Rico and NOT Maryland.

Taxonomic Hierarchy

Kingdom	Plantae – plantes, Planta, Vegetal, plants
Subkingdom	Viridiplantae – green plants
Infrakingdom	Streptophyta – land plants
Superdivision	Embryophyta
Division	Tracheophyta – vascular plants, tracheophytes
Subdivision	Spermatophytina – spermatophytes, seed plants, phanérogames
Class	Magnoliopsida
Superorder	Asteranae
Order	Gentianales
Family	Apocynaceae – dogbane, apocyns
Genus	Asclepias L. – milkweed
Species	Asclepias tuberosa L. – butterflyweed, butterfly milkweed
	Direct Children:
Subspecies	Asclepias tuberosa ssp. interior Woodson – butterfly milkweed
Subspecies	Asclepias tuberosa ssp. rolfsii (Britton ex Vail) Woodson – Rolfs' milkweed
Subspecies	Asclepias tuberosa ssp. tuberosa L. – butterfly milkweed

Different species are different plants; they are distinct organisms that generally cannot interbreed.

A subspecies (ssp.) is a rank of nomenclature that exists beneath a species. For example, in *Asclepias incarnata* ssp. *incarnata*, the subspecies is *incarnata*. A subspecies describes a collection of **plants** within a specific geographic portion of the overall range of the **species**, with slightly different characteristics compared to the **straight species**.A subspecies designation is applied to a plant that is geographically isolated from other members of its species in habitat and therefore does not interbreed for this reason (although genetically possible) (Mayr and Ashlock 1991). Because of this geographic isolation, subspecies can often take on different physical characteristics from other members of the species. Sometimes the terms subspecies and variety are used interchangeably, though this is not technically taxonomically correct. A ssp. notation is

placed between the species and subspecies names and never capitalized or italicized. Variety is a taxonomic category that ranks below subspecies (where present) or species, its members differing from others of the same subspecies or species in minor but permanent or heritable characteristics. For example, below are examples of varieties of *Asclepias incarnata* ssp. *pulchra*:

Symbol	Scientific Name	Common name
ASINI	*Asclepias incarnata* ssp. *incarnata*	swamp milkweed
ASINP2	*Asclepias incarnata* ssp. *pulchra*	swamp milkweed
ASINN	*Asclepias incarnata* var. *neoscotica*	
ASINP	*Asclepias incarnata* var. *pulchra*	

Different species of milkeed (*Asclepias*):

Asclepias species: D. *Asclepias curassavica*, (Querétaro, Mexico). E. *Asclepias subulata*, (cultivated, seed from Sonora, Mexico). F. *Asclepias glaucescens*, (Michoacán, Mexico). G. *Asclepias viridis*, (cultivated, seed from Mississippi). H. *Asclepias syriaca*, (Virginia). I. *Asclepias oenotheroides*, (Oaxaca, Mexico). J. *Asclepias auriculata*, (Oaxaca, Mexico). K. *Asclepias pedicellata*, (Florida). L. *Asclepias melantha*, (Mexico).

Asclepias incarnata 'Cinderella' (above); straight species *Asclepias incarnata* (below)

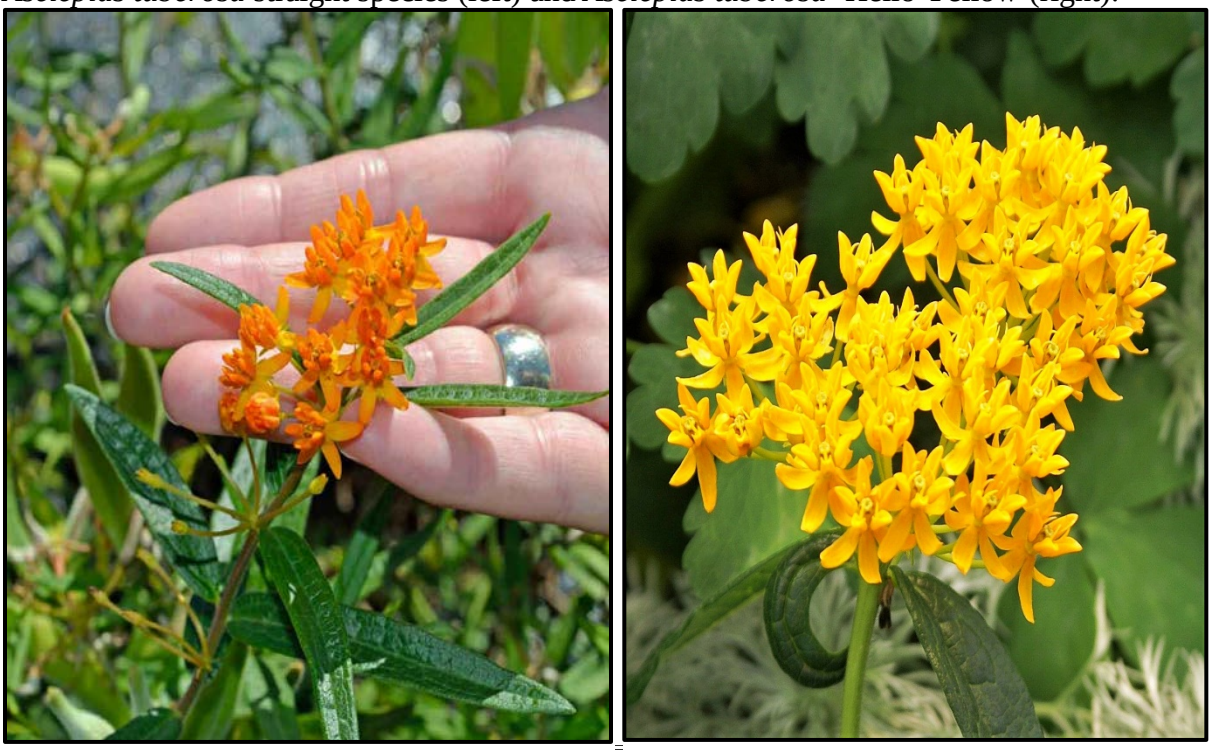
A cultivar is a is a subspecies classification describing plants varieties that are produced through artificial selection that originates from a combination of "*cultivated variety*.". Different forms of the same species are considered varieties. When these varieties are then artificially selected by humans for particular traits, they become a cultivar. In the United States "cultivar" is more or less synonymous with "variety." For example, *Asclepias incarnata* 'Cinderella' is a cultivated form of swamp milkweed named Cinderella, which has been selected to produce brilliant clusters of vanilla

scented, rose-pink flowers. A cultivar of a native species is also considered native.

Cultivar is a term recognized internationally, and more formally defined as certain plants which can be distinguished from others by any characteristic. In reproducing a cultivar either sexually or asexually, these characteristics always remain "true". This mean that the characteristics are controlled by a *homozygous* gene for that cultivar. In this case, the plant can *self-fertilize*, which will produce plants that are also homozygous for particular traits. The alternative is that the line is maintained through *vegetative propagation*, also known as *cloning*. Either way, an established line with defined characteristics becomes a cultivar. A cultivar is narrower than a species, and represents one of the narrowest focuses, genetically speaking. Many cultivars, because they are so closely related, can produce hybrids with other cultivars of the same species. This allows an almost infinite variety of cultivars to be produced from only a few starting cultivars.

Cultivars have been developed for thousands of years, since humans first started artificially selecting plants. The first true cultivars were the first well-established lines of crop plants. These included rice, corn, beans, wheat, and other vegetables. These cultivars survived for millennia and formed the basis of modern civilizations. As such, a well-established, true-breeding cultivar always has a higher value than an unknown seed. Nativar is a word resulting from the combination of the words native and cultivar. Nativar is more concise than stating "cultivar of a native plant" and means a cultivar derived from a native plant species. A nativar represents a tiny sample of a species' genetic diversity. To maintain these atypical traits, most nativars are propagated through cloning, such as by rooting cuttings, which produces genetically identical plants.

Asclepias tuberosa straight species (left) and *Asclepias tuberosa* 'Hello Yellow'(right):



The Xerces Society recommends straight native milkweed species and not "nativars."

VI. QUESTION AND ANSWER: SHOULD WE PLANT NATIVARS?

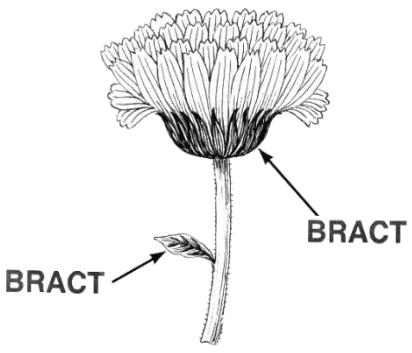
Remember, our native pollinators prefer native plants over non-natives because they have co-evolved together and are thus dependent upon one another. In **Maryland and in the Mid-Atlantic, the most important group of pollinators is bees;** other MD pollinators include butterflies, moths, ants, beetles, flies, wasps and the hummingbird. Moths and butterflies are not as productive at pollinating compared to bees, who are our most productive and efficient pollinators. A single bee colony can pollinate 3 million flowers a day and three-fourths of the world's flowering plants depend on animal pollinators to reproduce. Therefore, in order to support our most productive pollinators (bees), native flowering plants should be planted. Although the majority of pollinator research has focused on bees, other pollinators (such as moths) do play an important role in pollinating plants. Butterflies are also pollinators, although they do not carry as much pollen as bees (consider the long skinny legs of a monarch butterfly compared to the short hairy legs of a bumblebee). There are many resources that provide support to select plants and provide recommendations for plants that will enhance pollinator populations throughout the growing season. These recommendations are detailed in **Section XI: Native Planting Guidelines**, *Planting for Pollinators*. The Pollinator Partnership Ecoregional Plant Guides are excellent resources to find native plants for pollinators in your ecoregion: https://www.pollinator.org/guides_code.

If the plant blooms earlier or later in the year than the original species, will it still be in sync with the life cycles of the insects that pollinate it? If the leaves are purple instead of the regular green, has the chemistry changed enough to turn off insects that use it as a food source? Hello Yellow butterfly weed (*Asclepias tuberosa* 'Hello Yellow'), with bright yellow flowers instead of the normal orange, appeals to gardeners because "it is kind of fun to have another color," but do the insects care? The issue is that we do not yet know whether the insects care or not, says Doug Tallamy.

Doug Tallamy looked at what happens when you make a green leaf, red or purple. What happens when you change that leaf into a variegated form? What happens when you take a tall plant and make it short, or change the habit in some way? When you enhance fall color? When you increase fruit size? This is called the cultivation of a plant species.

The only thing that consistently deterred insect feeding was taking a green leaf and making it red or purple. This changed the leaf chemistry and amount of chlorophyll as well as taste to insects since red leaves have anthocyanins, which are chemical feeding deterrents. So, when you select to make a leaf red, the leaf is being loaded with feeding deterrents, which of course then deters feeding by insects.

Take the example of a hydrangea cultivar known as *Hydrangea arborescens* 'Annabelle.' The cultivar 'Annabelle' instead of a lacecap flower, has been changed into a mophead flower that is loaded with sterile bracts and that is physically what the big mophead is, the white bracts. Compared to the straight species, 'Annabelle' has far fewer fertile flowers, and even the fertile flowers it does have are very low in nectar. The nectar quality is



very poor—it's prettier for humans, but we've taken a native plant that is a really great pollinator plant when it's the straight species, and we've created a cultivar that's almost useless to pollinators.

Straight *Hydrangea arborescens* species


Hydrangea arborescens 'Annabelle.'

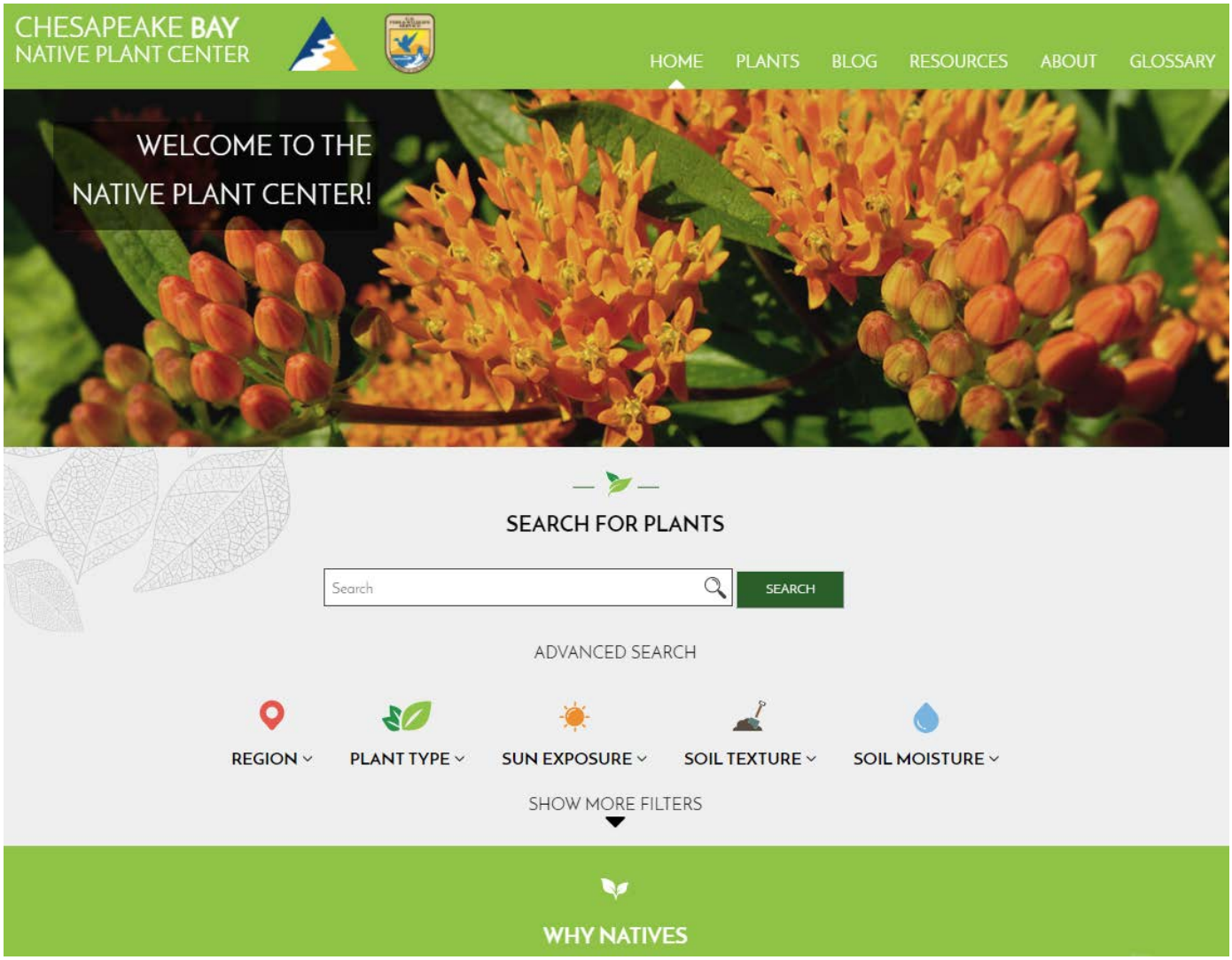
If possible, the solution is to GENERALLY AVOID using ornamental or cultivated varieties of native species. The ornamental varieties have been bred for aesthetic values, not to be adapted to certain environmental conditions. It is best to avoid using them if at all possible. Many plants that are for sale at a nursery are the genetic variant of a straight species. There are lots of reasons that cultivars are created, most of them do focus on aesthetics, but any genetic variant that is disease-resistant is also a cultivar, like the Dutch-elm-disease-resistant American elm cultivar! Sometimes the only native plants readily available are native cultivars, not open-pollinated, "straight species" natives. These native cultivars (or nativars) are perfectly fine to be planted in garden settings like pollinator gardens and bioretention, but should be avoided in larger restoration projects, if possible. ***The Trust recommends using the "straight species" natives instead of the cultivar, whenever possible***. It can be difficult to find native plants at plant nurseries. It is suggested to seek out a local nursery or non-profit organization that specializes in native plants. The following links list local and online retailers where you can purchase native plants:

- Maryland Native Plant Society https://mdflora.org/nurseries.html
- Pennsylvania Native Plant Society http://www.panativeplantsociety.org/plant-sale-vendors-and-plant-list.html
- Virginia Native Plant Society https://vnps.org/native-plant-nursery-list/
- West Virginia Department of Natural Resources http://www.wvdnr.gov/Wildlife/NativeVegetation.shtm

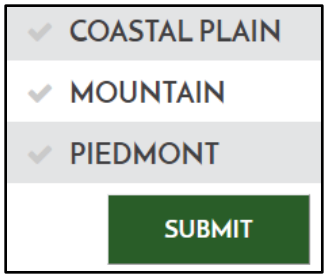
VII. CHOOSING NATIVE PLANTS

It is much EASIER to go to websites that help you choose native plants at the beginning of your project, compared to researching if a plant is native. Steps to choosing native plants:

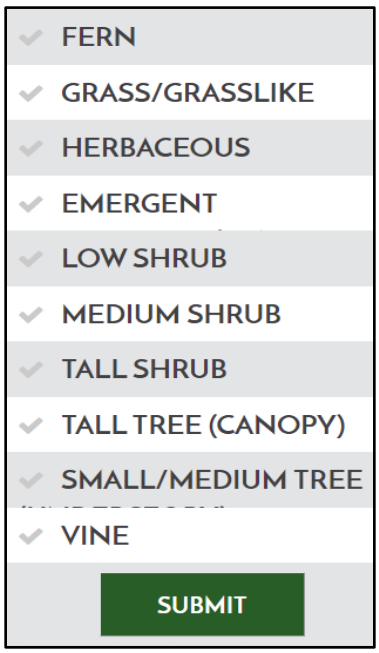
1. First, navigate to the Chesapeake Bay Native Plant Center, sponsored by the USFWS and the Alliance for the Chesapeake Bay at http://www.nativeplantcenter.net/:



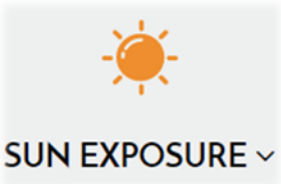
2. Choose the **Region** for the location of your project based upon the Physiographic Regions of the Chesapeake Bay Watershed:

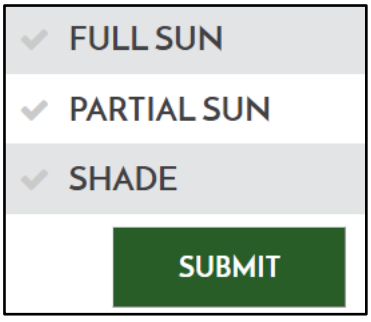


3. Choose your **Plant Type** based upon mature size and plant hierarchy:

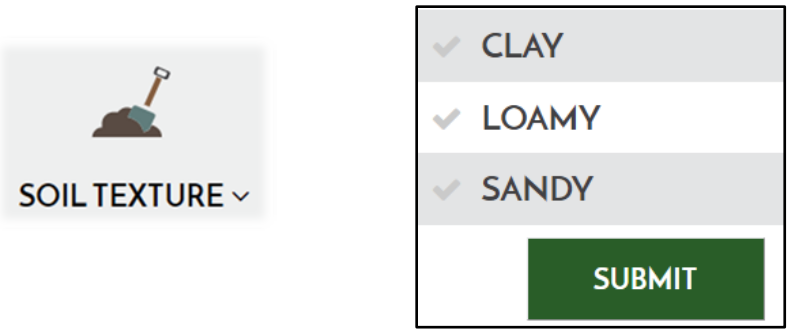


4. Choose the amount of **Sun Exposure** at your project site:

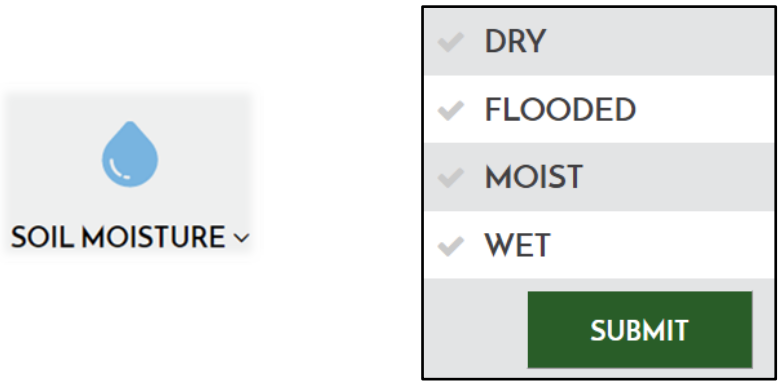




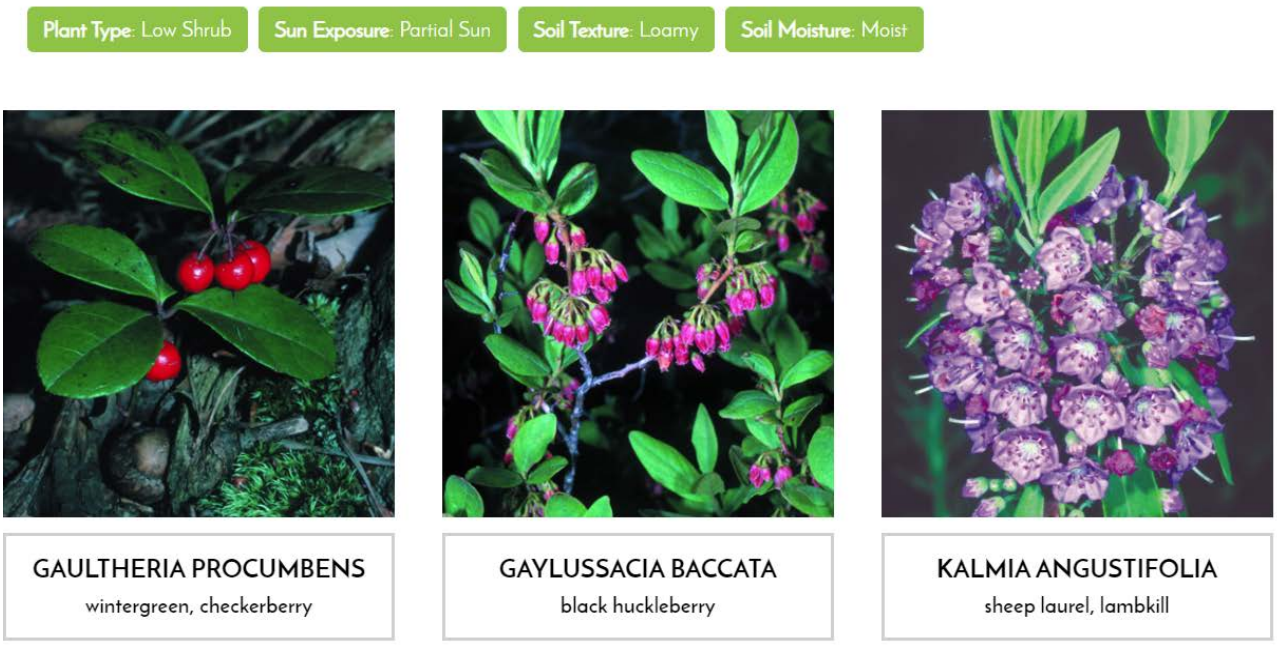
5. Choose the type of **Soil Texture** at your project site:



6. Choose the expected Soil Moisture at your project site:



7. Once the submit key is clicked, the output includes photographs of matching plant species with links to further information for your selected parameters. This output can be used to create a plant list and planting plan for your project site.

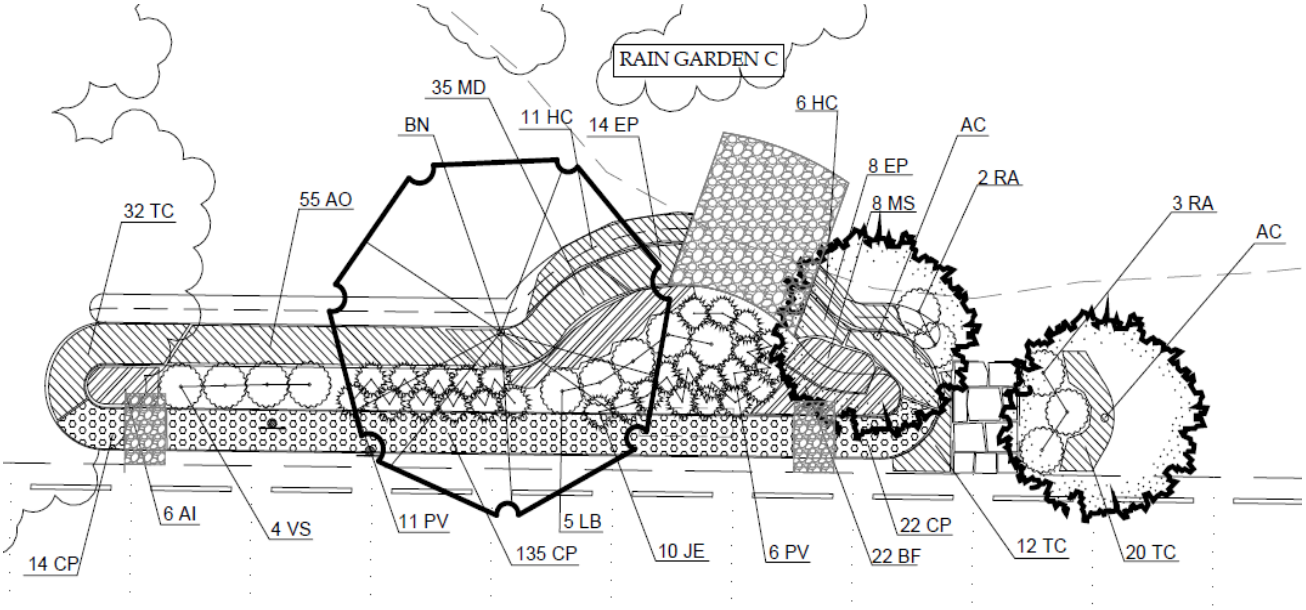


VIII. IS THIS PLANT A NATIVE SPECIES?

The U.S. Department of Agriculture (USDA) provides information on whether a species is native to a particular state or county (https://plants.usda.gov/home). As stated above in section VII, it is much EASIER to go to websites that help you choose native plants, compared to researching if a plant is native. Steps to determine if a previously selected plant is native:

1. Request and review the proposed planting List, which can be an itemized invoice from a nursey, the planting schedule, and/or the planting plans. Planting plans are usually the last page of the design plans and normally have a planting schedule included that is a table in the oversized sheets of common name, scientific name, and number proposed.

Example Planting Plans from Design Plans:



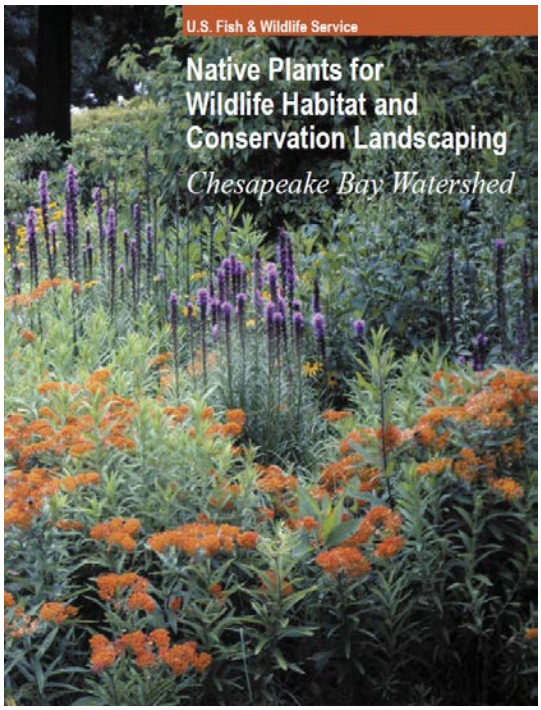
Example Planting Schedule from Design Plans:

KEY	QUA	BOTANICAL NAME	COMMON NAME	SIZE	NATIVE
	Canopy Trees				
BN	2	Betula nigra'Heritage'	Heritage Birch Tree	1 - 1 ½" Cal. B&B	Y
	Understory Trees				
AC	2	Amelanchier canadensis'Autumnalis'	Autumnalis Serviceberry	1 - 1 ½" Cal. B&B	Y
MV	1	Magnolia virginiana	Sweetbay Magnolia	1 - 1 ½" Cal. B&B	Y
	Shrubs				
CA	3	Clethra alnifolia'Hummingbird'	Hummingbird Sweet Pepperbush	18 - 24" Cont.	Y
JD	1	Ilex verticillata'Jim Dandy'	Jim Dandy Winterberry	18 - 24" Cont.	Y
BP	3	Ilex verticillata'FarrowBPop'	Berry Poppins Winterberry	18 - 24" Cont.	Y
VS	9	Itea virginica'Henry's Garnet'	Henrys Garnet Virginia Sweetspire	18 - 24" Cont.	Y
LB	5	Lindera benzoin	Spicebush	18 - 24" Cont.	Y
RA	8	Rhus aromatica'Gro-Low'	Gro Low Sumac	18 - 24" Cont.	Y
	Perennials				
AI	39	Asclepias incarnata'Ice Ballet'	Ice Ballet Swamp Milkweed	1 Qt. Cont.	Y
AO	95	Aster oblongifolius'Raydon's Favorite'	Raydon's Favorite Aster	1 Qt. Cont.	Y
CV	36	Coreopsis verticillata'Zagreb'	Tickseed	1 Qt. Cont.	Y
EP	22	Echinanea purpurea'Kims Knee High'	Kims Knee High Coneflower	1 Qt. Cont.	Y
HC	17	Hypericum calycinum'Aaron's Beard'	Aarons Beard St John's Wort	1 Qt. Cont.	Y
BF	85	Iris versicolor	Blue Flag	1 Qt. Cont.	Y

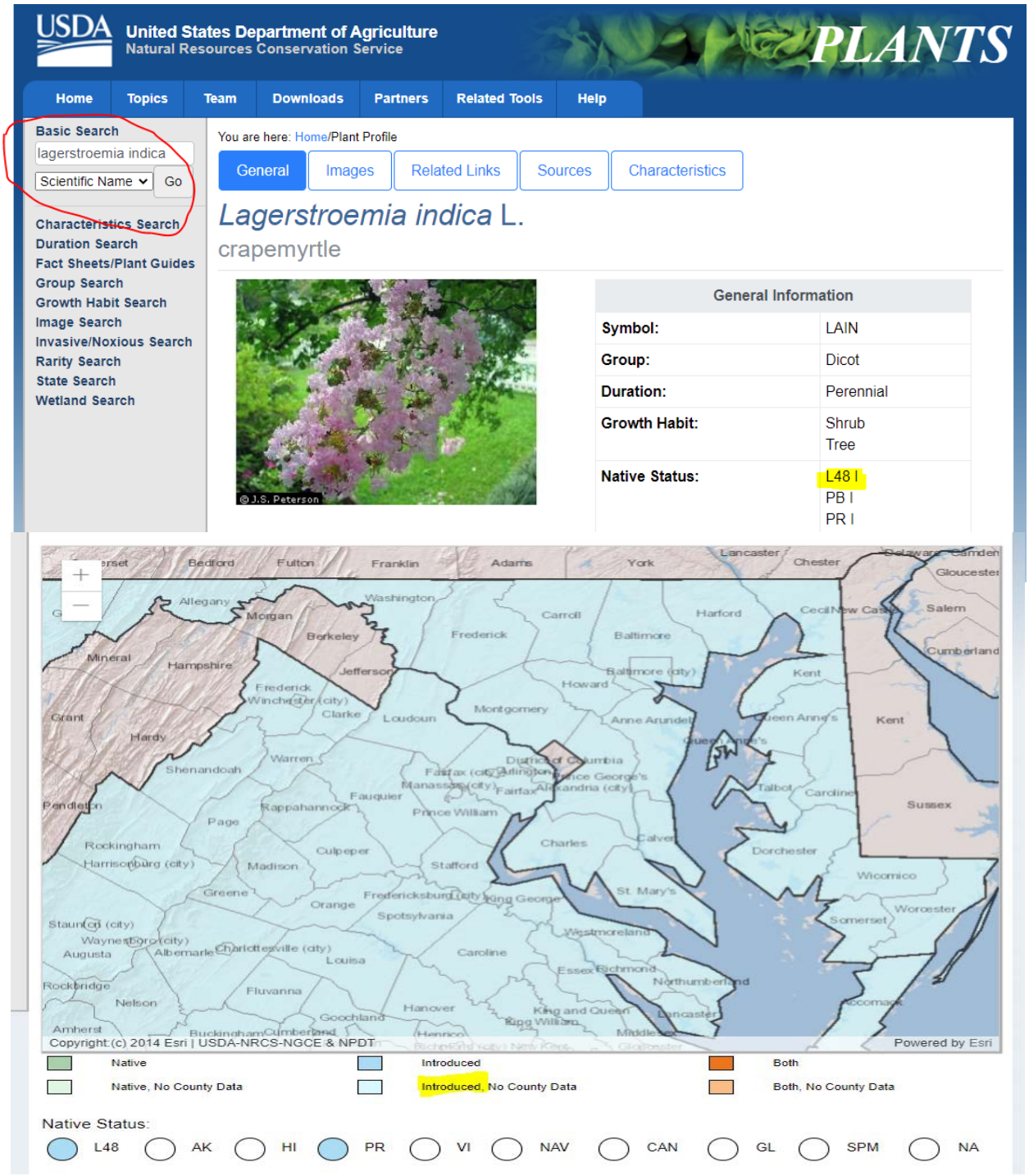
Example invoice that shows proposed plants for design: the yellow highlight indicates a species that is not in this USFWS guide and may be a non-native, plant species:

ITEM	DESCRIPTION	QTY	RATE
grplant	- Supply and install 40 yards of compost amended topsoil in the planting beds that have trees - Supply and install the following compost amended plant material: CANOPY TREES (10) Acrer rubrum (Red Maple) .75/1" caliper (2) Liquidambar styraciflua 'Rotundiloba' (Seedless Sweet Gum) 2/2.5" caliper (6) Platanus acerifolia 'Bloodgood' (Bloodgood Planetree) 1/1.5" caliper (5) Quercus alba (White Oak) 2.5-3" caliper (3) Quercus phellos (Willow Oak) 1.75/2" caliper (4) Ulmus americana 'New Harmony' (New Harmony Elm) 2/2.5" caliper ORNAMENTAL TREES (2) Cercis canadensis 'Forest Pansy' (Forest Pansy Redbud) 12' (8) Lagerstroemia indica 'Natchez' (Natchez Crape Myrtle) 10/12' (3) Quercus palustris (Pin Oak) .5"/1" caliper		

2. Next, navigate to the Chesapeake Bay Native Plant Center, sponsored by the USFWS and the Alliance for the Chesapeake Bay at http://www.nativeplantcenter.net/ guide to ensure if all proposed plants below are native to the Chesapeake Bay Region. This website pulls data from the plant guide available as a pdf document: https://www.fws.gov/Chesapeakebay/pdf/NativePlantsforWildlifeHabitatandConservationLandscaping.pdf:



3. Search for the plants that are NOT on the USFWS website or in the USFWS guide (and/or if you are unsure of the native status). Use the USDA Plants Database here: https://plants.usda.gov/home. Type in the scientific name in the red circle and then look under "General Information" **I = Introduced (same as non-native)**; N = Native; L48 = lower 48 states (not HI or AK). So, you can quickly see that the invoice requests funds to pay for 8 non-native Crape Myrtle trees. The map below shows that Crape Myrtle is introduced to Maryland = not native. Suggest another, similar tree from Chesapeake Bay Native Plant Center at http://www.nativeplantcenter.net/. The Chesapeake Bay Native Plant Center (USFWS and ACB) has an excellent search filter that can be used to find a similar species that is native.



IX. NATIVE PLANTING GUIDELINES

Planting for Pollinators:

The numbers of both native pollinators and native bee populations are declining. They are threatened by habitat loss, disease, parasites, and environmental contaminants (the excessive and inappropriate use of pesticides). Every native plant food source and habitat provided can help pollinators rebound and overcome these challenging threats. You can provide food and habitat through your project to support and attract pollinators. Additionally, you can increase the number of pollinators in your area by making conscious choices to include plants that provide essential food and habitat for bees, butterflies, moths, beetles, hummingbirds and other pollinators. Below are some ways to make your project attractive to pollinators:

- Use pollinator-friendly plants in your landscape. Focus on native perennials, with the understanding that native shrubs and trees such as dogwood, blueberry, cherry, plum, willow, and poplar also provide pollen or nectar, or both, early in spring when food is scarce. **Use the Pollinator Partnership Ecoregional Plant Guides to find native plants for pollinators in your ecoregion: https://www.pollinator.org/guides_code**
- Choose a layering of native plants, including groundcovers, perennials, shrubs, and trees as well as a mixture of plants for spring, summer, and fall bloom times; different flower colors, shapes, and scents will attract a wide variety of pollinators.
- Reduce or eliminate pesticide use in your landscape or incorporate plants that attract beneficial insects for pest control.
- Accept some plant damage on plants meant to provide habitat for butterfly and moth larvae.
- Provide clean water for pollinators with a shallow dish, bowl, or birdbath with half-submerged stones for perches.
- Leave dead tree trunks (snags) in your landscape for wood-nesting bees and beetles.
- Leave hollow-stemmed perennials in your landscape (can trim to 18 inches) from fall to early spring for overwintering nesting pollinators.
- Support land conservation in your community by helping to create and maintain community gardens and green spaces to ensure that pollinators have appropriate habitat.

Planting Spacing

Proper spacing for landscape plants often seems to create confusion. There is no uniform recommendation for exactly how far apart plants should be placed since actual spacing depends on the following:

- Project Goals (what effect is to be achieved?)
- The ultimate mature size of a plant, and
- How the site and plants will be pruned and maintained in the future.

In addition to the way plants are used for landscape effect, plant spacing may vary with the gardening budget. We want to get the maximum effect from the minimum number of plants. On the other hand, we want to place trees and specimen shrubs so they may develop fully without crowding each other, the house, or other structures.

Use this simple formula as a general guide to calculate the number of plants needed for your design:

A = Area to be planted (total square feet)
D = Distance plants are spaced apart in feet
N = Number of plants needed

Distance plants are to be spaced apart guidelines:
• For perennials, use D = 1 foot (for faster spreading)
• For shrubs, use D = 5 feet to 7 feet (based on mature size)
• For a mixture of trees and shrubs, use D = 10 feet for a naturalistic planting
• For ornamental trees, use D = crown spread

Formula: A ÷ D2 = N For example: If you decide to plant an entire 100 square foot area with perennials that are spaced 1 foot apart, then you will need 100 plants, or 100 feet ÷ 1 (1 foot squared) = 100.

Herbaceous plants may be spaced in regard to how fast a complete cover is wanted. Remember that 100 plants at 12-inch spacing will cover about 100 square feet of bed area.

The Use of Seeds vs. Propagated Plants

For native plantings and restoration projects seeding or planting can be specified. Seeds are less expensive than plants and are easier to distribute at a large site. However, seeds are more susceptible to predation from birds or rodents and seeds can take several years to establish especially if they are tree or shrub seeds. They are more likely than planted plants to be overcome by weedy species. The use of seeds through a temporary seed mix for erosion control or "cover crop" is often specified using the seeds of non-persistent annuals such as weedfree barley or cultivated oats.

Sometimes it may be useful to use a cover crop to help protect the site from soil erosion as well as provide safe sites for seedling germination until the native plants that were seeded are able to establish. Cover crops are usually some type of sterile annual weed-free grain that will grow rapidly, establish for the first year, and then fade out as the natives become established. Oats, barley or REGREEN are recommended over wheat or some types of rye because the wheat and rye have been found to have a more competitive effect on the seeded natives. Consider using a non-persistent annual such as weed-free barley or cultivated oats to act as a soil stabilizer until native plants in the area can recolonize a site. However, early successionals such as Canada Wild Rye, a cool season native grass, are also useable. If possible, to help ensure that the grain does not persist at the site, it is recommended that it be mowed before it produces seed.

Propagated plants may be preferred because they establish themselves more rapidly, increasing the chances of success in a project. Using plants will be more expensive than seeds since the material is more costly and it is also more labor intensive to install plants rather than doing a direct seeding. Considerations should also include the time and labor that will be needed to maintain a project due to supplemental irrigation, protective cages, and other measures. Prior to

purchasing plants, consider salvaging plants from a site that is proposed for development. Plant sources also include contracting with a native plant supplier to grow the plant material and/or buying grown plants from a nursery.

X. TYPES OF PLANT MATERIAL

Plant material is available in a variety of forms, each with advantages and disadvantages for native plant project planning. Nursery grown native plants can be grown in a wide assortment of containers, usually dependent on which species is grown, its growth habit (tree, woody shrub, annual, perennial, etc.) and its natural habitat. The following is a list of commonly available nursery stock types:

BALLED-IN-BURLAP or "B&B" The plant is grown in the field, dug up with its roots and surrounding soil and wrapped in a protective material such as burlap.
BARE-ROOT The plant is sold without any soil around its roots.
CONTAINERS The plant is sold in a container of soil with drainage holes. Sizes and shapes of containers vary, but they are usually plastic. Examples of common sizes are: 4" pots, 6" pots, and 1, 2 or 5 gallon containers.
CUTTINGS or WHIPS A piece of branch, root or leaf that is separated from a host plant and is used to create a new plant. These may be placed in a rooting medium or stuck directly into the ground for planting.
LINERS A small, grafted plant, rooted cutting or seedling that is ready for transplanting. They are often used for herbaceous plants and grasses.
PLUGS or TUBELINGS These are similar to liners, but they are individual cylindrical or square planting containers that are longer than they are wide. The longer shape provides room for a plant to build root mass for transplanting.

COMPARISON OF PLANT MATERIAL FOR RESTORATION PLANNING		
TYPE	**ADVANTAGES**	**DISADVANTAGES**
BALLED-IN-BURLAP	• Well-developed root systems increase chances of survival on site • Provide shade and earlier establishment of upper canopy on site	• Expensive • Large and heavy to transport
BARE-ROOT	• Less expensive • Easier to transport to site, lightweight to carry around for planting • Roots have not been restricted by containers	• Require care not to let root systems dry out before planting • Difficult to establish in dry sties or sites with warm, sunny spring seasons
CONTAINER	• Well-established root systems with intact soil • Provide "instant" plants on site • Available in a variety of sizes, many are available year-round	• Native soil not used in nursery, transplant shock may occur when roots try to move in to native soil • Can be expensive • Can be difficult to transport to and around site if large amount is used • Can be difficult to provide irrigation until established, may actually require more maintenance than plugs
LINERS/ PLUGS/ SEEDLINGS	• Well-established root systems with intact soil • Easy to transplant, plant material pops out of containers easily	• Same as above • Smaller plants may take longer to establish, require more initial maintenance
CUTTINGS	• Inexpensive to produce • Cuttings may easily be taken on site or from nearby site • Easy and light to transport • Known to work well in rocky areas or areas difficult to access	• No established root systems • Timing of taking cuttings and planting them is important, varies among species
SEED	• Inexpensive compared to plant material • Variety of seed available commercially • Easier handling than plant material	• Seeds of different species have different germination and storage requirements • Potential losses from birds, small mammals, etc. eating seeds on site • Slower establishment on site
SALVAGE*	• Can use plant material that would otherwise be destroyed • Plant material could be local to site • Relatively inexpensive • Small or young salvage plants often adapt more readily to transplant than do mature specimens	• Different native plants respond differently to being dug up, some loss could be expected • Requires fairly intensive measures to protect plants and ensure they have adequate irrigation

XI. REFERENCES

Bailey's Ecoregions & Other Ecoregions
- http://www.epa.gov/bioindicators/html/usecoregions.html
- http://www.fs.fed.us/institute/ecolink.html
- http://www.fs.fed.us/land/ecosysmgmt/ecoreg1_home.html
- http://www.ngdc.noaa.gov/seg/eco/cdroms/gedii_b/datasets/b03/bec.htm

National Climactic Data Center
- http://lwf.ncdc.noaa.gov/oa/climate/onlineprod/tfsod/climvis/main.html

Natural Heritage Programs
- http://www.natureserve.org/nhp/us_programs.htm

Other Restoration, Revegetation & Native Plant Websites
- Society for Ecological Restoration (http://www.ser.org)
- Plant Conservation Alliance (http://www.nps.gov/plants/)

Other Books and Websites:

Chesapeake Conservation Landscaping Council (CCLC) Eight Essential Elements of Conservation Landscaping, 2013 https://chesapeakelandscape.org/wp-content/uploads/2014/04/8_elements_2013.pdf

Mayr, E. and Ashlock, P.D. 1991. Principles of Systemic Biology. New York: McGraw-Hill.

National Public Radio (NPR). Robin Hood Radio in Sharon, CT and A Way to Garden, by Margaret Roach, head gardener: "how effective are nativars? with Doug Tallamy" https://awaytogarden.com/nativars-with-doug-tallamy/

Native Plant Finder Website through NWF: https://www.nwf.org/NativePlantFinder/Plants

Plant Finder Documents: for the Chesapeake Bay: https://www.fws.gov/chesapeakebay/pdf/NativePlantsforWildlifeHabitatandConservationLandscaping.pdf

Tallamy, Doug. 2009. Bringing Nature Home: How You Can Sustain Wildlife with Native Plants, April 1, 2009.

The Pollinator Partnership Ecoregional Planting Guides: https://www.pollinator.org/guides_code