The Nature Conservancy

Protecting nature. Preserving life.


# Native Plant Installation and Maintenance for Solar Sites

*Written by Kim Steinberger, Restoration Project Manager*

*The Nature Conservancy in Michigan*

May 2021

**Summary:**
This document is intended to direct and guide landowners who would like to install a solar array on their property while also providing habitat for Michigan's native pollinators and wildlife. The purpose is to provide guidance recommended by The Nature Conservancy to landowners and solar developers who wish to establish native plantings around solar sites and how to best maintain those native plantings to help native pollinators and wildlife coexist at solar sites. Advice in this document is focused towards solar sites and native plant management that are installed on previously degraded lands such as former agricultural fields or fallow fields that are suitable for a solar array installation.

The Nature Conservancy discourages removing or altering landscapes with well-established natural areas that are already providing habitat for native pollinators or wildlife in order to install a solar array. All necessary precautions, assessments, and research needs to be conducted by the landowner or solar developer before any solar arrays are installed to prevent installation on lands that provide valuable ecosystems services (I.e., wetlands or floodplains) or have established native vegetation and habitat for native pollinators and wildlife.

Landowners looking to install solar arrays on their property should consider 'smart solar siting' to help determine where the best location for a solar site should be installed. The Nature Conservancy has developed a Resilient Land Mapping tool to show the locations of connected and resilient lands in the face of climate change. All efforts to avoid siting in well-established natural areas or in connected and resilient landscapes should be considered by landowners or solar developers prior to solar array installation.

Recommended Citation: Steinberger, K.J. (May 2021). Native Plant Installation and Maintenance for Solar Sites. The Nature Conservancy in Michigan.

In Michigan and across the Midwest, solar energy generation is on the rise.[1] Due to the SunShot initiative created by the Department of Energy, which aims to have solar energy meet 14% of U.S. energy needs by 2030 and 27% by 2050, large-scale solar plants are becoming more cost-competitive with other forms of energy.[2] The Midwest is suited to solar array investments due to falling solar technology costs and the availability of agricultural land. With recent changes to Michigan's the Farmland and Open Space Preservation program, solar developers and farmers have a new opportunity to utilize farmland that is currently not in agricultural production. This allows farmers to diversify their revenue options while supporting economic development and supporting job growth in an up and coming industry in Michigan.[3]

Most solar installations are designed for ease of maintenance, meaning groundcover around the installations is typically turfgrass. However, an opportunity exists for solar installations to utilize vegetation around solar sites that provide ecological benefits as well. Using native plantings as an alternative groundcover provides habitat to pollinators while also generating long-term cost savings. Increasingly, solar developers are turning to native plantings for groundcover for these reasons.[4]

This guide is meant to inform Michigan solar developers and landowners about the multiple benefits of using native plant species around solar arrays, and key considerations for successful implementation.

**Why Native Plantings?**

There is a mutually beneficial relationship that can occur between solar sites and native plants by creating pollinator-friendly environments. One important benefit of native plantings to solar projects is reduced long-term maintenance costs. Monotypic turfgrass requires significant maintenance throughout the lifespan of the solar site. Though native plants have higher maintenance costs within the first 3 years of establishment, the cost is much less after that, generating savings that continue to grow over time.[5] The savings accrued just by reducing regular mowing and maintenance, means the additional costs of native planting can be recovered in the first five to ten years of operation and maintenance.

Native plantings also support the efficiency of the solar panels. While gravel under solar arrays promotes "low-maintenance" of land around solar sites, it can create a "heat island" effect which could potentially reduce the effectiveness and lifetime of the solar panels. Using native vegetation under the solar array helps to reduce the ambient air temperature by creating a cooler microclimate, enabling the photovoltaic panels to be more efficient (Macknick et al., 2013).

Native vegetation also has vital ecological benefits, providing habitat for native pollinators and wildlife in the area. Native pollinators face a variety of significant threats including habitat loss and fragmentation, which happens when large, intact areas of habitat are broken up by different uses into smaller, isolated patches (Jules, 1993). Land that is used in agriculture not only contributes extensively to this fragmentation in southern Michigan, but also does not provide

[1] Numerous large-scale solar projects are growing across the Midwest according to PV Magazine.

[2] The initiative aims to reduce the total costs of solar energy by 75% by the end of the decade.

[3] Governor Whitmer's press release in June 2019 granting farmers to convert land enrolled in PA 116 to solar development.

[4] Rural Solar Stories a project by Environmental Law & Policy Center notes that after the first 3 years of prairie solar development, lower maintenance costs should occur once the native species and less mowing is needed.

[5] Based on a cost comparison completed by Troy Anderson, Director of Construction for Applied Ecological Services out of Brodhead, Wisconsin (Tiller, 2013).

necessary, long-term food sources for pollinators. (Aizen et al., 2019) Restoring pollinator friendly habitat within these areas helps to re-establish lost habitat and connectivity, which is important to pollinator persistence.

Groundcover is not the only ecological consideration for solar projects—environmental impacts must be considered throughout the process to ensure maximum ecological benefits. Potential negative impacts from solar installation can be mitigated or eliminated through careful site selection and assessment, while the success of the native planting can be ensured through thoughtful site design, preparation, planting, and maintenance.

**Site Assessment**

Before a solar site is established, a thorough evaluation of the proposed site should be conducted. The potential site of a solar facility should be evaluated for any potential environmental impacts, including those that could affect wildlife and their habitat (Gagnon et al., 2018). Former agricultural lands (or any other previously altered/degraded land) are ideal for ecological reasons because they allow for minimum ground disturbance during installation. This helps prevent avoidable impacts such as soil erosion, which can adversely impact the groundwater supply or disrupt the existing seed bank.

By utilizing fallow fields or former agricultural lands instead of new greenspaces provides solar developers the opportunity to utilize already degraded land that could benefit significantly from a solar installation site that is planted with a native prairie throughout. Developing solar sites on unused, previously degraded land provides value to solar developers through reduced land costs and high potential for profit and can provide generally close proximity to grid interconnection points. Using undisturbed land to develop a solar site instead of building on an already degraded land can be costly in comparison (Bruce, 2019).

Although some agricultural crops are pollinator dependent and provide food for pollinators for a brief amount of time, typical monotypic crops are only a viable food source for a short amount of time, and do not provide a sustainable nesting habitat for many pollinators. (Aizen et al., 2019) An evaluation from an ecologist or wildlife biologist ensures that any disturbances that may occur during site construction are minimal. It is important to help identify any potentially threatened plants and animals that may be impacted during site design and construction (Bruce, 2019).

If a solar site is being developed on fallow land, a vegetation assessment should be completed to determine what native vegetation is already at the site and the type of native vegetation should be there. This assessment process should begin up to 2 years in advance, to provide enough time to decrease the invasive or noxious plant seed bank that could reside in the soil, which would reduce the success of a native prairie planting. If non-native or invasive species are present, they will need to be removed before planting (see Site Preparation below). There is no "one size fits all" approach to native plantings and each site should be evaluated properly.

**Site Design**

By creating a smart design for a solar site, it benefits not only pollinators but wildlife too, by helping to conserve and promote native biodiversity by providing habitat for plants and animals at the solar facility by providing a diverse array of food sources and providing habitat that will remain undisturbed. Native plant species established under solar arrays promote new habitats and sources of food for a wide array of insects and wildlife (Sinha, Hoffman, Sakers, & Althouse, 2018).

An important factor when designing a solar site is that the site should not be developed in areas that will directly impact bodies of water or create erosion and runoff issues. Buffer strips around the site should be installed to prevent erosion or stormwater runoff from the site. Buffer strips can be created by installing additional grassland species or even native shrubs or trees planted around the perimeter of the site.

Developers should also aim to protect any natural features in the area to prevent damage to any habitats that are most likely already inhabited by local wildlife. These areas include wetlands, floodplains, or even forested areas. These areas provide natural ecosystem services and are most likely already inhabited by local wildlife. This is why using developed or already degraded land – such as agricultural land – is an ideal solar site. By providing additional forms of habitat features like bird boxes, bat boxes, down wood or even bird perches, a site design will help to mitigate any negative impact a solar site development might have on the local wildlife in the surrounding area (Kalies and Hartung, 2019).

## Fencing

Most solar sites install fencing around the perimeter of the facility. This is done for security purposes and to prevent damage to the site. This ensures that the parcel of land set aside for solar generation will remain relatively undisturbed during the lifespan of the solar site. However, installing a fence around the facility could also create a barrier that prevents the movement of wildlife through the site (Bruce, 2019).

To allow wildlife to move freely through the site, the use of wildlife-friendly fencing is encouraged. Wildlife-friendly fencing has larger holes at the bottom that will allow small to mid-size creatures (i.e., rabbits, foxes, and raccoons) to pass through. Wildlife friendly fencing around solar sites encourages the advancement of renewable energy while also minimizing impact on wildlife movement. Even if the native planting at the solar site is not in an area that has wildlife species of conservation concern, it allows other species of wildlife to inhabit the area, which is beneficial for the native prairie planting (Coastal Review Online, 2019).

## Species Selection

The goal of planting native species at solar sites is to provide a mix of grasses and forbs that will provide enough diversity for pollinators, but not interfere with the functionality of the solar panels. When determining the species that should be planted as part of a solar site plan, several important factors should be considered.

- **Native species:** Choose a seed mix that reflects the historical pre-settlement vegetation for the county where the solar project is located.
- **Plant height:** Choose species that will not exceed a height of 2-3', so as not to interfere with the solar panels at the plant maximum height. There are some prairie species like Tall Coreopsis (*Coreopsis tripteris*), Prairie blazing star (*Liatris pycnostachya*), and Prairie dock (*Silphium terebinthinaceum*) that should not be planted at solar sites due to their height, except around the perimeter or between panel rows.
- **Soil type:** Consider the soil type and moisture level – whether sandy, clay, loam, or organic soil – to determine the species that will be able to grow at that location.
- **Species diversity:** Having a diversity of seeds is an important factor in a planting's success. By having a diverse planting there is more likelihood for long-term health and self-sustainability, which means lower management costs (Minnesota Department of Natural Resources, 2016).
- **Varied blooming times:** Plantings around solar sites should also have species that bloom from early spring into late fall, to maximize benefits to pollinators.

Below is an example of a seed mix that has been used at prairie plantings located at solar sites previously. It has been developed by Native Connections, a company based in Three Rivers, Michigan that specializes in designing and developing native seed mixes focused on Michigan's native landscaping.

Recommended species for a solar site:[6]

| **Grasses, Sedges, Rushes, etc.** | **Common Name** |
|---|---|
| *Bouteloua curtipendula* | Side-oats Grama |
| *Juncus tenuis* | Path Rush |
| *Koeleria cristata* | June Grass |
| *Schizachyrium scoparium* | Little Bluestem |
| *Sporobolus heterolepis* | Prairie Dropseed |
| **Forbs** | **Common Name** |
| *Achillea millefolium* | Yarrow |
| *Allium cernuum* | Nodding Wild Onion |
| *Aquilegia canadensis* | Wild Columbine |
| *Asclepias tuberosa* | Butterfly Milkweed |
| *Aster ericoides* | Heath Aster |
| *Cassia fasciculata* | Partridge Pea |
| *Coreopsis tinctoria* | Plains Coreopsis |
| *Heuchera richardsonii* | Prairie Alum Root |
| *Liatris punctate* | Dotted Blazingstar |
| *Lupinus perennis* | Lupine |
| *Petalostemum purpureum* | Purple Prairie Clover |
| *Potentilla arguta* | Prairie Cinquefoil |
| *Rudbeckia hirta* | Black-eyed susan |
| *Solidago nemoralis* | Old-field Goldenrod |
| *Zizia aptera* | Prairie Golden Alexander |

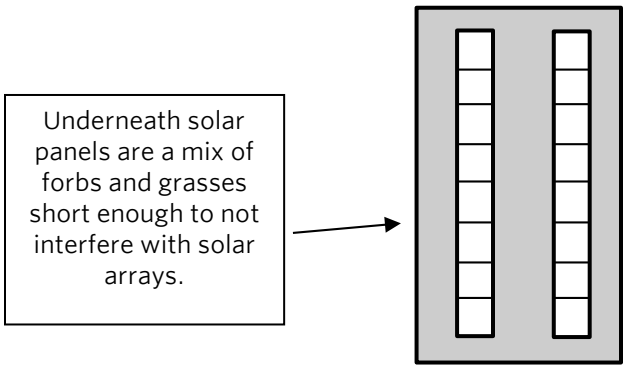
The Michigan State University Department of Entomology developed a scorecard to guide vegetation management at solar installations to support native pollinators (see Appendix). This guide provides guidance to different aspects that will help guide solar developers in creating pollinator-friendly solar sites.

Planting Configurations

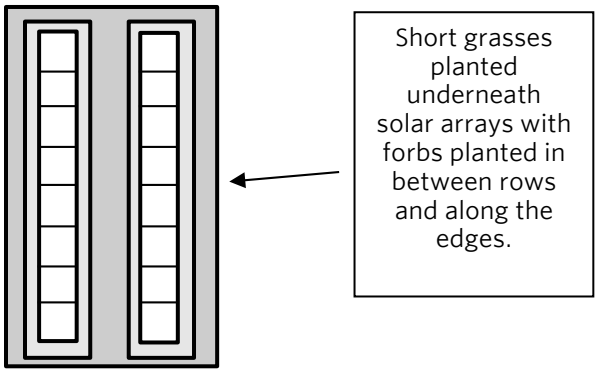
There are multiple ways to complete prairie plantings around solar arrays. It is important that the species in the prairie plantings should not exceed a growth height of 36 inches when planting under the arrays (assuming the lowest edge of the solar panels is 3 feet high). Species above 3 feet can be used around the perimeter or in between panel rows—these will not impact solar panels by creating shade because most of the plant material in these taller species is in the lower portion of the plant, while the height is only in the flower stalk. Below are some landscaping suggestions for native plantings that have been developed by Minnesota's Department of Natural Resources (2016).

[6] We recommend working with a professional ecologist or botanist to determine the best seed mix for each site.

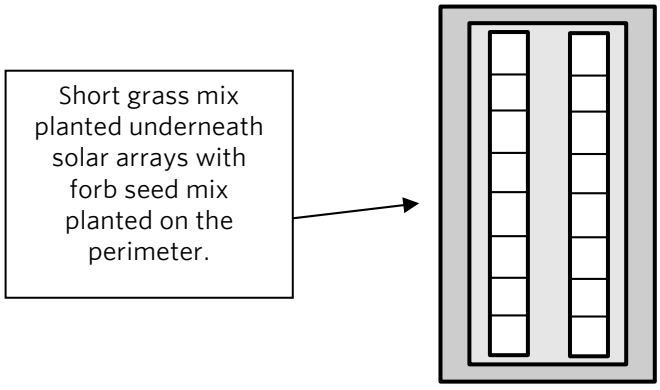
1. Whole site pollinator seed mix with grasses and forbs.




2. Grass only mixes planted under solar panels. In between the solar arrays and along the perimeter a pollinator mix is planted.




3. Grass only mix planted underneath and between solar panels while perimeter is planted to a pollinator mix.



**Site Preparation**

Preparing a site for a native prairie planting takes time and consideration to determine when and where to have a native planting. Proper and thorough preparation of the site to remove invasive species prior to planting will determine the success of your native planting. If restoring to a native prairie from a fallow field, it is best to treat with non-selective herbicide for 2-3 years prior to native prairie installation.

One of the first steps that should be considered is eradicating all vegetation if there is no beneficial vegetation at the site. By eradicating all existing vegetation, it helps to create a clean slate and give the native species a head start. If desired, all vegetation can be removed by broadcast spraying a broad spectrum, non-persistent glyphosate herbicide. Using a broad-spectrum herbicide will remove all vegetation at the site, and, if it is non-persistent, any excess herbicide will not reside in the area for long. If there are unwanted woody shrubs or trees, these can be removed mechanically or by brush cutting and applying herbicide to the cut stump with a 1:1 ratio glyphosate solution to make sure the woody plant is dead. If spraying the woody vegetation is necessary, use of the herbicide 2,4, D is recommended. Before using any herbicide, it is imperative to read and understand the label of the chemical being used, and users should also understand how the herbicide could have the potential to impact the native species they are planting. If there is already well-established native vegetation, spot-spraying to remove individual plants by an expert who can properly identify native and non-native plant species should take place.

When converting an agricultural field to a native planting there will only need to be a few herbicide treatments before completing a native prairie planting. Since farmers treat their crops regularly with specific herbicides to eliminate any noxious plants that would interfere with the success of their crops the noxious seed bank is low.

**Site Planting**

Prairie plantings should be completed after the solar arrays have been installed at any site. This is to avoid the loss of native seeds that will be installed around the solar arrays during construction. If native seeds are installed before a solar array installation, equipment use over the site will create poor contact between seeds and the soil from the site or damage any existing native plants. Recommended planting times should be in the spring from mid-April to mid-June or in the dormant season. Planting in the dormant season should occur between mid-October to mid-February before the first snowfall and before the ground freezes. A dormant season planting will allow seeds to germinate the following spring and is typically more favorable for forbs than grass species. A spring planting will be initially beneficial to warm season grasses over forbs for the first year; forbs will begin to show in the second year.

**Site Maintenance**

The first three years will require the most maintenance of the native prairie planting. The biggest priority for the first few years as the prairie is being established will be removing non-native or invasive weeds that show up. Native plants will begin to grow in the first few years but will spend most of their time developing roots before seeing significant growth above ground. Spot spraying non-native plants with herbicide throughout the growing season will help reduce the amount of noxious and invasive weeds that occur. Managing undesirable species will allow the desirable, native species to thrive.

Controlling noxious or invasive species can be implemented by mechanical removal (pulling or mowing before plants go to seed) or by foliar herbicide application by backpack sprayer. People

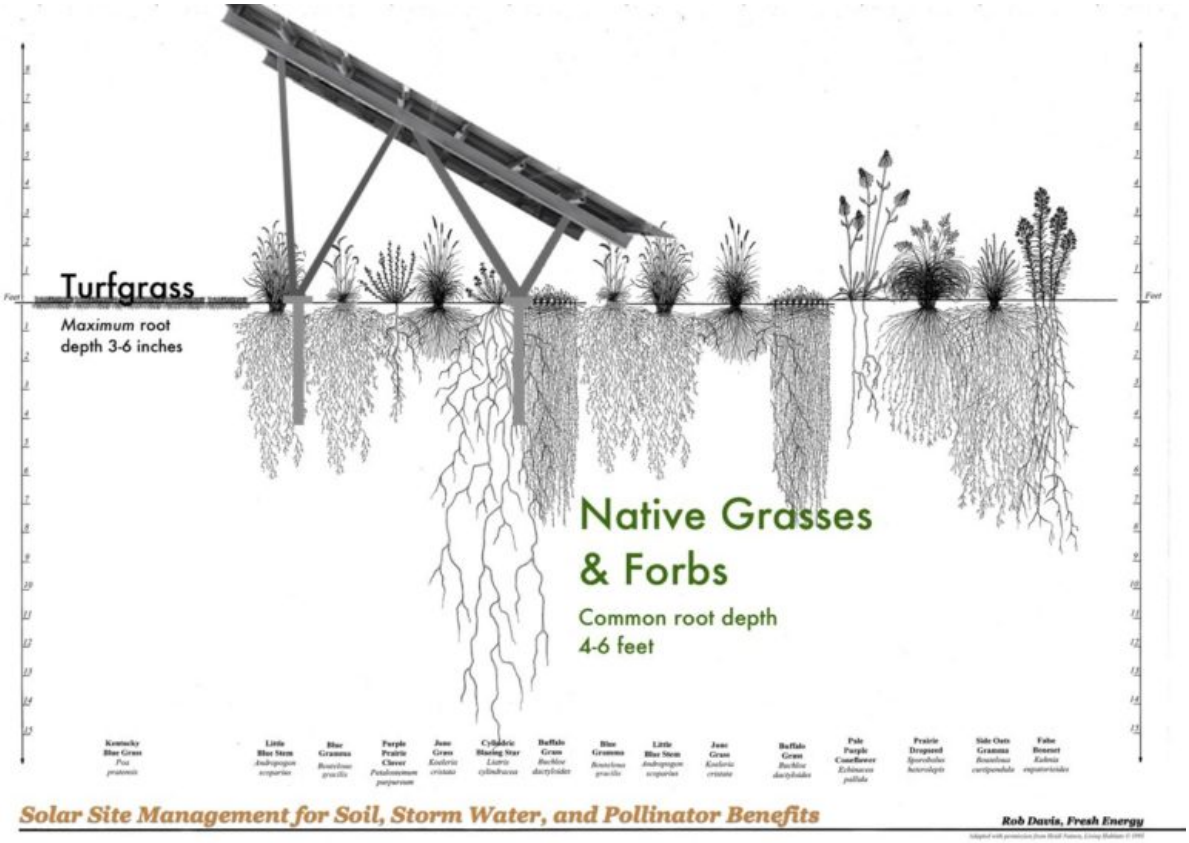
maintaining the planting should be able to identify native and non-native species when applying herbicide. Spot spraying should occur throughout the growing season and before invasive species go to seed. After the native plants have established themselves, they will begin to overgrow the weeds that appear. As with many native prairie plantings, natural disturbances are an important part of native vegetation management to help keep the ecosystem healthy and allow it to thrive.

Within the first-year, mowing or spot spraying with non-selective herbicide can be the main control methods of invasive or noxious plant species. An expert who can successfully identify plant species should comb through the native planting to conduct spot spraying treatments to keep invasive, noxious plants at bay. If mowing is conducted, the plants should be cut to around 4-6 inches to prevent undesirable species from going to seed. (Native Connections, 2015)

For the second- and third-year weeds will still dominate the native planting. It is imperative to continue to mow or spot spray with non-selective herbicide once the vegetation gets above 10 inches. Vegetation should be mowed back down to 4-6 inches to keep the weeds at bay or sprayed with herbicide while the noxious plant is in early stages of growth. If the native vegetation is flowering it is acceptable to mow over them during the first year as they will not die if they are mowed at that point. For the long-term health of the native planting, mowing over native species in early stages will be beneficial for the future of the planting.

Since prescribed fire is not a management tool that can be used in managing native prairie systems surrounding solar sites, mowing is a good substitute for long-term management (starting the 4$^{th}$ year after planting). For years when fire would typically be introduced (e.g., every 3-5 years), mowing the vegetation down to 6 inches will suffice. Mowing should take place from February to early spring. It is important to mow before wildlife begin to build nests or dens in prairies in the springtime. Herbicide application to noxious weeds is a practice that can be continued throughout the lifetime of the native prairie planting.

| **Mowing Schedule at Native Prairie Plantings at Solar Sites** | |
|---|---|
| **Within First Year** | Mow 4 - 6 inches once noxious/invasive plants begin to grow |
| | Spot spray with non-selective herbicide to reduce establishment of noxious/invasive plants |
| **Year 2 - 3** | Mow once plants grow to 10 inches to prevent undesirable species from going to seed. |
| | Spot spray with non-selective herbicide to reduce population of noxious/invasive plants |
| **After Year 4** | Every 3 - 5 years mowing vegetation down to 6 inches from February to early Spring. |
| | Mowing should take place before wildlife build nests or dens in prairies in the springtime. |
| | Continue spot spraying throughout the prairie to remove noxious and invasive plants. |


Turfgrass
Maximum root depth 3-6 inches
Native Grasses & Forbs
Common root depth 4-6 feet
Kentucky Blue Grass
Little Blue Stem
Blue Grama
Purple Prairie Clover
Junc Grass
Cylindric Blazing Star
Buffalo Grass
Blue Grama
Little Blue Stem
Junc Grass
Buffalo Grass
Pale Purple Coneflower
Prairie Dropseed
Side Oats Grama
False Boneset
Solar Site Management for Soil, Storm Water, and Pollinator Benefits
Rob Davis, Fresh Energy

(Davis, 2016)

## Appendix

**Pictures:**


A prairie planting next to an agricultural field. The prairie was established after being in agricultural production for some time. © Rodolfo Zuniga-Villegas

A native planting in bloom a few seasons after it was planted in the fall at a former agricultural field. © Rodolfo Zuniga-Villegas

A solar array that has native plants surrounding the site but is mowed around and sprayed underneath the panels to prevent vegetation. If the solar arrays were higher off the ground, a native seed mix with a growing height of no more than 36 inches can be planted underneath. © Kim Steinberger/TNC


© Kim Steinberger/TNC

## Native species that can be used around solar sites:


Butterfly milkweed
*(Ascelpias tuberosa)*


Spiderwort
(*Tradescantia ohiensis)*


Yarrow
(*Achillea millefolium)*


Wild Columbine
(*Aquilegia canadensis*)


Hairy Beardtongue
(*Penstemon hirsutus*)


Lance-leaf Coreopsis
(*Coreopsis lanceolata*)


Wild Lupine
(*Lupinus perennis*)


Black-eyed Susan
(*Rudbeckia hirta*)


Hoary Vervain
(*Verbena stricta*)

**Michigan Pollinator Habitat Planning Scorecard for Solar Sites created by Michigan State University Department of Entomology:**

# Michigan Pollinator Habitat Planning Scorecard for Solar Sites

This form was developed by the MSU Department of Entomology to guide vegetation management at solar installations to make them more supportive for native pollinators. Check the boxes and add up the points to determine whether the plans meet or exceed the minimum requirements. For more local information on pollinators and habitat: www.pollinators.msu.edu

## PROJECT DETAILS

**Solar developer:**_____

**Vegetation consultant:** _____

**Project location:** _____

**Project size (acres):**_____

## SITE SCORES

1. SITE PLANNING AND MANAGEMENT
   - ☐ Detailed plant establishment and vegetation management plan developed +10 pts
   - ☐ Site plan developed with a vegetation management company + 5 pts
   - ☐ Signage legible at forty or more feet stating pollinator friendly solar habitat +3 pts

2. HABITAT SITE PREPARATION PRIOR TO IMPLEMENTATION
   - ☐ Measures taken to control weeds during season prior to seeding +10 pts
   - ☐ No weed control -20 pts

3. INSECTICIDE RISK
   - ☐ Planned on-site use of insecticide or pre-planting seed/plant treatment (excluding buildings/electrical boxes, etc) -40 pts
   - ☐ Communication with local chemical applicators and site registered on https://mi.driftwatch.org/map +20 pts

4. AVAILABLE HABITAT COMPONENTS WITHIN 0.25 MILES (check/add all that apply)
   - ☐ Native bunch grass for bee nesting +1 pt
   - ☐ Open sandy soil areas for bee nesting +1 pt
   - ☐ Trees/shrubs for bee nesting +1 pt
   - ☐ Clean, perennial water sources +1 pt

## FLOWERING PLANT SCORES

5. FLOWERING PLANT SPECIES SEEDED IN PERIMETER AREA (species with more than 1% cover)
   - ☐ 5-10 species +1 pts
   - ☐ 10-15 species +3 pts
   - ☐ 16-20 species +8 pts
   - ☐ >20 species +10 pts

   *Exclude invasive plant species from total*

6. PLANT DIVERSITY UNDER SOLAR ARRAY*
   - ☐ Grass only +2 pts
   - ☐ Clover/grass mix +8 pts
   - ☐ Low-growing wildflower mix +10 pts

7. PERCENT OF SITE PLANNED TO BE DOMINATED BY WILDFLOWERS**
   - ☐ 0 - 25% 0 pts
   - ☐ 26- 50 % +3 pts
   - ☐ 51-75 % +8 pts
   - ☐ More than 75% +15 pts

   *Projects may have different species mixes under the solar array panels and in the perimeter. Flower cover should be averaged across the entire site.*

8. SEEDS USED FOR WILDFLOWER AREAS
   - ☐ Mixes are seeded using at least 40 seeds/square foot +5 pts
   - ☐ All wildflower seeds are from a source within 150 miles of the site +5 pts

9. SEASONS WITH AT LEAST THREE BLOOMING FORB SPECIES PRESENT (check all that apply)
   - ☐ Spring (April-May) +5 pts
   - ☐ Summer (June-August) +5 pts
   - ☐ Fall (September-October) +5 pts

** For seeding in the panel array, these can be a short-stature wildflower mix or clovers and other non-native species beneficial to pollinators. If clovers are used, these should be seeded in locations separate from the native wildflowers in the perimeter locations.*

*** Wildflowers in Question 7 refer to forbs which are flowering plants that are not woody, and are not grasses, sedges, etc. Measurements of percent cover should be based on the percent of the ground surface covered by foliage as viewed from above.*

*Refer to www.nativeplants.msu.edu or a local native wildflower supplier for advice on plants that are attractive to pollinators and will work in various Michigan settings.*

*For more on pollinator habitat: www.pollinators.msu.edu*

| | |
|---|---|
| **Total points:** | ☐ |
| **Provides exceptional habitat** | **90+ points** |
| **Meets pollinator standards** | **76 – 89 points** |
| **Does not meet standards** | **below 75 points** |

MICHIGAN POLLINATOR INITIATIVE

MICHIGAN STATE UNIVERSITY | Extension

## Native Plant Distributor Contact Information:

**Native Connections**
3815 N Westnedge Ave
Kalamazoo, MI 49004
269.459.6900
nativeconnections.net
email: info@nativeconnections.net

**Wildtype Native Plant Nursery**
900 N Every Road
Mason, MI 48854
517.244.1140
wildtypes.com
email: info@wildtypeplants.com

**Michigan Wildflower Farm**
11770 Cutler Road
Portland, MI 48875
514.647.6010
michiganwildflowerfarm.com
email: michiganwildflowerfarm@gmail.com

**Hidden Savanna Nursery**
18 N Van Kal Street
Kalamazoo, MI 49009
269.352.3876
hiddensavanna.com
email: info@hiddensavanna.com

## References


Aizen, M. A., Aguiar, S., Biesmeijer, J. C., Garibaldi, L. A., Inouye, D. W., Jung, C., … Seymour, C. L. (2019). Global agricultural productivity is threatened by increasing pollinator dependence without a parallel increase in crop diversification. *Global Change Biology*, *25*(10), 3516–3527. https://doi.org/10.1111/gcb.14736

Beneath Solar Panels, the Seeds of Opportunity Sprout | News | NREL. (n.d.). Retrieved January 25, 2021, from https://www.nrel.gov/news/features/2019/beneath-solar-panels-the-seeds-of-opportunity-sprout.html

Bruce, B. (2019). Utility-scale solar sites provide surprising opportunity for wildlife stewardship. Retrieved January 3, 2020, from Solar Power World website: https://www.solarpowerworldonline.com/2019/03/utility-scale-solar-wildlife-stewardship/

Davis, R. (2016). Soil, Crop, & Storm Water Benefits of Solar Sites. Retrieved January 25, 2021, from Fresh Energy website: https://fresh-energy.org/soil-crop-storm-water-benefits-of-solar-sites/

Department of Natural Resources, M. (2019). *Prairie Establishment & Maintenance Technical Guidance for Solar Projects Minnesota Department of Natural Resources*.

Evans, S., & Gabbatiss, J. (2020). Solar is now 'cheapest electricity in history', confirms IEA. Retrieved November 15,2020, from Carbon Brief website: https://www.carbonbrief.org/solar-is-now-cheapest-electricity-in-history-confirms-iea

Gagnon, P., Margolis, R., Melius, J., Phillips, C., Elmore, R., Kennedy, J. R., … Kiesecker, L. (2018). *Rooftop Solar Photovoltaic Technical Potential in the United States: A Detailed Assessment*. Retrieved from http://conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/ED_TNCNCPrinciplesofSolarSitingandDesignJan2019.pdf

Jordan Macknick, Laura Caspari, Rob Davis (2017). Solar Agriculture Co-location Webinar-final.pdf - Google Drive. Retrieved April 9, 2020, from National Renewable Energy Labratory website: https://drive.google.com/file/d/0B7dSsLGeEeCXWXVvai01MHBqd2c/view

Jules, E. (January 1993). *Habitat fragmentation and pollinator interactions Ecology of the Bald Hills and Little Bald Hills of Redwood National Park: An assessment of vegetation change View project*. Retrieved from https://www.researchgate.net/publication/202000327

Kalies, Liz, Hartung, T. (2019). Principles of Low Impact Solar Siting and Design. Retrieved December 11, 2019, from The Nature Conservancy in North Carolina website: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/ED_TNCNCPrinciplesofSolarSitingandDesignJan2019.pdf

Macknick, J., Beatty, B., & Hill, G. (2013). *Overview of Opportunities for Co-Location of Solar Energy Technologies and Vegetation*. Retrieved from https://www.nrel.gov/docs/fy14osti/60240.pdf

*MDARD 2019*, Michigan Department of Agriculture and Rural Development. *Commercial Solar Facilities on PA 116 Enrolled Land*. http://169.62.82.226/documents/mdard/Commercial_Solar_Facilities_on_PA_116_Enrolled_Lands_656804_7.pdf

MDARD. *Michigan Department of Agriculture and Rural Development Policy for Allowing Commercial Solar Panel Development on PA 116 Lands*. Retrieved from https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263169.pdf

*Michigan Department of Agriculture and Rural Development*
MDARD. (September 2014). *Michigan Department of Agriculture and Rural Development Policy for Allowing Commercial Solar Panel Development on PA 116 Lands*. Retrieved from https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263169.pdf

Michigan State University. (June 3rd, 2018). Michigan Pollinator Habitat Planning Scorecard for Solar Sites now available - Pollinators and Pollination. Retrieved November 5, 2019, from https://www.canr.msu.edu/news/michigan-pollinator-habitat-planning-scorecard-for-solar-sites

Native Connections. (2015). *Guidelines for Establishing a Native Planting by Seed*. Retrieved from www.nativeconnections.net

PhD, Rogers Tiller, E. (2013). Native Plants vs. Turf Lawn: Sustainability Made Profitable. Retrieved January 22, 2020, from American Public Works Association website: https://www.apwa.net/Library/Reporter/201304_ReporterOnline.pdf

ROSELUND, C. (April 9th, 2019). Supersized solar in the Midwest – PV magazine USA. Retrieved October 14th, 2020, from PV Magazine website: https://pv-magazine-usa.com/2019/04/09/supersized-solar-in-the-midwest/

Rural Solar Champions » Prairie Solar. (n.d.). Retrieved January 18, 2021, from http://ruralsolarstories.org/farm-friendly/prairie-solar/

Sinha, P., Hoffman, B., Sakers, J., & Althouse, L. (2018). Best Practices in Responsible Land Use for Improving Biodiversity at a Utility-Scale Solar Facility. *Case Studies in the Environment*, *2*(1), 1–12. https://doi.org/10.1525/cse.2018.001123

Soil, Crop, & Storm Water Benefits of Solar Sites | Fresh Energy. (March 22nd, 2016). Retrieved April 25th, 2020, from https://fresh-energy.org/soil-crop-storm-water-benefits-of-solar-sites/

Solar Firm Tests Wildlife-Friendly Fencing. (2019). Retrieved January 22, 2020, from Coastal Review Online website: https://www.coastalreview.org/2019/02/35317/

*SunShot initiative created by the Department of Energy*
Energy, U. S. D. of E. & R. (February 4th, 2011.). The SunShot Initiative | Department of Energy. Retrieved April 9, 2020, from https://www.energy.gov/eere/solar/sunshot-initiative

Walston, L. J., Mishra, S. K., Hartmann, H. M., Hlohowskyj, I., McCall, J., & Macknick, J. (2018). Examining the Potential for Agricultural Benefits from Pollinator Habitat at Solar Facilities in the United States. *Environmental Science and Technology*, *52*(13), 7566–7576. https://doi.org/10.1021/acs.est.8b00020

Whitmer - Gov. Whitmer, MDARD to allow commercial solar panels on Michigan Farmland. (June 3rd, 2019). Retrieved April 06, 2020, from https://www.michigan.gov/whitmer/0,9309,7-387-90499_90640-498861--,00.html

The Nature Conservancy
Protecting nature. Preserving life.

The Nature Conservancy
in Michigan

101 E. Cesar E. Chavez Avenue
Lansing, MI 48906