

# Commercial Solar Siting Guidance

Minnesota Department of Natural Resources



Photo courtesy of MNL Grazing

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## Introduction

Increasing demands for renewable energy, along with efficiencies in technologies and costs, have accelerated commercial solar development in Minnesota. Thoughtful project siting and construction are necessary to meet renewable energy needs while minimizing environmental impacts. This document is intended to guide commercial solar facility siting and development to minimize natural resources impacts. For this document, “commercial solar” is defined as ground mounted photovoltaic solar facilities that create electricity that is sold to other users.

Commercial solar facilities require differing types of permitting, depending on their energy generating capacity:

1. Facilities that generate 50 megawatts (MW) or greater require a site permit from the Public Utilities Commission (PUC) as provided by Minnesota Statutes, chapter 216E. These facilities are often referred to as “utility-scale.”
2. Facilities with less than 50 MW generation capacity typically require a Conditional Use Permit (CUP) from the Local Government Unit (LGU).
3. Facilities such as community solar gardens that generate up to 1 MW (with up to 5 co-located with 5 MW) are permitted at the county, township, or city level through local land use ordinances, which typically require a CUP.

The Minnesota Department of Natural Resources (DNR) provides comments and guidance to the PUC and LGUs regarding natural resource concerns. During site selection and project planning, proposers should consider DNR jurisdictional and natural resources including state-listed threatened or endangered species, native plant communities, public land and water crossings, work in public waters, wetland impacts, and other potential natural resource impacts.

## Project Site Assessment

### Initial Site Review

The project proposer is responsible for reviewing available public data to identify high value natural resources during the site selection process. To ensure avoidance of sensitive resources, all potential disturbance areas should be evaluated including the solar array area, substation location, laydown yard, associated transmission line routes, and all construction limits.

Most high value resources described in this guidance document can be identified using [Minnesota Conservation Explorer](#) (MCE). This online tool allows users to view and explore spatial information useful for desktop site assessments, project planning, or conservation planning. The spatial information consists of publicly available layers relevant to Minnesota’s Natural Heritage, as well as several reference layers. MCE can be used for several purposes, including general exploration of an area where users can define an area of interest and then create maps or conservation planning reports for that area. This conservation planning service is free and does not require the user to register or log in. MCE is also used to provide the Natural Heritage Review, an essential step in agency coordination, as described below.

Geographic information system (GIS) shapefiles that identify high value natural resources can also be downloaded at no cost from the [Minnesota Geospatial Commons](#) (MGC). Relevant data layers are provided in the *High Value Natural Resources* section.

### State Agency Coordination

The project proposer should identify the preliminary project boundary, disturbance areas, and high value natural resources prior to initiating early coordination with the DNR. Early coordination with our agency benefits proposers by identifying potential issues for resolution early in the process. The DNR provides insight on where high value habitat is within a project area so the project proposer can consider these important resources as they develop the project. There are two steps in early coordination with the DNR: 1) Natural Heritage Review, and 2) Coordination with the [Regional Environmental Assessment Ecologist](#) (REAE) in the relevant DNR Region.

Step 1: A critical aspect of agency coordination is the Natural Heritage Review request. This review request, which is an additional function that occurs via MCE, is required as part of Minnesota's environmental review process. A Natural Heritage Review is strongly encouraged for all projects, regardless of environmental review requirements, as part of the due diligence process to ensure that state laws are followed and impacts to Minnesota's Natural Heritage have been appropriately considered and avoided. To request a Natural Heritage review, users must create an account and log in to MCE. Users can then submit a proposed project and request an automated assessment of potential impacts to Minnesota's rare features. This review informs project proposers of any required actions to follow state law, recommended measures to avoid or minimize disturbance to ecologically significant areas or state-listed species, and, if needed, additional steps needed to complete the review. A "final" Natural Heritage Review should be requested before filing a permit application with the PUC. There is a fee for this service.

The Natural Heritage Review identifies state-listed species, Minnesota Biological Survey (MBS) Sites of Biodiversity Significance, DNR Native Plant Communities, and other rare features. If specific high value resources are present within or near the project area, targeted surveys or studies may be necessary to further understand potential resource impacts. The DNR maintains a list of surveyors who are considered qualified to perform rare plant and animal species surveys in Minnesota. Contact the [Natural Heritage Review Team](#) for information about surveyors, survey protocol, and other requirements before any work is initiated.

Step 2: The DNR recommends providing project information directly to the REAE during preliminary agency coordination. Ideally, the Natural Heritage Review would be requested, completed, and included when submitting project information to the REAE. After the proposed site boundary is identified, the project proposer should email a preliminary review request, including a description of the project and GIS shapefiles of the project boundary, to the REAE. For projects that will undergo the PUC site permitting process, copy the [DNR Energy Projects Reviewer](#) on the review request. The REAE will review the proposed boundary and provide feedback in about 30 days. Any subsequent changes to the project boundary and infrastructure (e.g., transmission and collector lines, access roads, and temporary construction areas) should be submitted to the REAE by email once identified.

Early coordination with the REAE is especially important for community solar projects because LGUs across the state have widely varying processes that may or may not include DNR coordination. To ensure effective early coordination, it is imperative that project proposers contact the REAE with any questions, or to obtain additional information about siting commercial solar projects.

### Federal Agency Coordination

In addition to species protected under state law, there may be requirements pertaining to resources under federal jurisdiction. Coordination with the United States Fish and Wildlife Service (U.S. FWS) concerning federally listed species, eagles, and federal conservation easements is also advised. Regulatory reviews can be conducted using the online tool at the [Information for Planning and Consultation](#) (IPaC) website. For additional information, contact the [U.S. FWS Minnesota-Wisconsin Ecological Services Field Office](#).

### High Value Natural Resources

High value natural resources include native plant communities, wetlands, state-listed species, federally listed species, public lands and waters, and other important resources. The project proposer should identify these resources early in the project siting and development process. Thereafter, DNR staff will review and provide any additional recommendations or concerns to help project proposers pursue sites that avoid natural resource impacts. The project proposer should review and avoid high value natural resources. The *High Value Natural Resources* section includes data layers available in MCE and the Minnesota Geospatial Commons. Although these data layers are not exhaustive, they provide a baseline for identifying high value natural resources.

### State-listed Species

The Natural Heritage Review will identify concerns regarding state-listed species. Surveys for rare species may be required to determine if the proposed project would result in a take. Project planning timelines should consider that some species can only be surveyed at specific times of the year. Project proposers should consider ways to avoid, minimize, and mitigate impacts to listed species and their habitats.

Minnesota endangered species law (Minnesota Statutes, section 84.0895) and associated rules (Minnesota Rules, parts 6212.1800 to 6212.2300 and 6134) prohibit the take of endangered or threatened species without a permit to take. "Take" for animals includes pursuing, capturing, or killing; and for plants includes picking, digging, or destroying. Permit issuance is discretionary and based on the DNR's assessment of all relevant information.

**Data layers available in MCE and MGC:** Listed species are not publicly available data. Issues concerning rare features should be identified and resolved early in the siting process by submitting a Natural Heritage Review request within MCE.

### MBS Sites of Biodiversity Significance and DNR Native Plant Communities

The Natural Heritage Review will identify concerns regarding MBS Sites of Biodiversity Significance and DNR Native Plant Communities. The [Minnesota Biological Survey](#) systematically collects, interprets, monitors, and provides data on plant and animal distribution as well as the ecology of

native plant communities and functional landscapes. MBS sites of biodiversity significance are ranked based on the presence of rare species populations, the size and condition of native plant communities within the site, and the landscape context of the site (for example, whether the site is isolated in a landscape dominated by cropland or developed land, or whether it is connected or close to other areas with intact native plant communities). Biodiversity ranks help guide conservation and management.

There are four MBS [biodiversity significance ranks](#), outstanding, high, moderate, and below. *Outstanding* sites contain the best occurrences of the rarest species, the most outstanding examples of the rarest native plant communities, and/or the largest, most ecologically intact or functional landscapes. *High* sites contain very good quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes. *Moderate* sites contain occurrences of rare species, moderately disturbed native plant communities, and/or landscapes that have strong potential for recovery of native plant communities and characteristic ecological processes. *Below* sites lack occurrences of rare species and natural features or do not meet MBS standards for outstanding, high, or moderate rank. The DNR recommends avoiding outstanding, high, or moderate sites of biodiversity significance.

[Native plant communities](#) are classified and described by considering vegetation, hydrology, landforms, soils, and natural disturbance regimes. Native plant communities with a Conservation Status Rank of S1 through S3 are considered rare in Minnesota and efforts should be made to avoid or minimize disturbance to these ecologically significant areas.

Native prairie, a rare native plant community of particular concern in Minnesota, is a grassland (grass-dominated communities with a diversity of forbs) that has never been broken by a plow (Minnesota Statutes section 84.02, subdivision 5). In the mid-1800s, prairie covered one third of the state's land base. Since then, more than 99 percent of native prairie has been destroyed. Remaining native prairie consists mostly of widely scattered fragments surrounded by agriculture and development. Due to the loss of this once widespread habitat, species found only in prairie communities have become rare. A high percentage of our state's endangered, threatened, and special concern species are dependent on the remaining small fragments of prairie.

Project proposers should identify known locations of native prairie as part of a desktop review of the project area. However, because this information is not based on a comprehensive inventory, there is the potential for native prairie to exist in the project area that is not included in existing data sets. To better understand the potential impacts to native prairie and their associated rare species, state-listed and federally listed species, all grasslands or pasturelands within the project boundary that have not been previously plowed and that could be slated for development, including access roads and utilities, should be assessed by a qualified botanist or ecologist for the existence of remnant prairie. Having a plant surveyor from the DNR's list of surveyors perform the native prairie assessment will ensure that the surveyor will be able to obtain a collection permit if rare plant surveys are also needed. Contact the [Natural Heritage Review Team](#) for a current list of surveyors.

Given the rarity of native prairies, and the potential for state-listed species to occur within native prairie habitat, the DNR recommends avoidance of all native prairie remnants. Rare species surveys may be required to determine if avoidance measures are adequate given the current locations of rare species and will need to be coordinated with the DNR. The U.S. FWS should also be contacted for their recommendations regarding any federally listed species that occur within or adjacent to the project footprint. If avoidance is not possible, minimization and mitigation options should be considered.

**Data layers available in MCE:** MBS Sites of Biodiversity Significance, DNR Native Plant Communities

**Data layers available in MGC:** MBS Sites of Biodiversity Significance, DNR Native Plant Communities, MNDNR Native Prairie, NDSU Potentially Undisturbed Lands (PUDL)

### Shorelands and Floodplains

Statewide and local government shoreland standards provide for the orderly development and protection of Minnesota's shoreland areas (lakes, streams, rivers, and wetlands). Local government floodplain standards promote public health, safety, and general welfare, in accordance with state and federal regulations. The project proposer should contact the LGU regarding local shoreland and floodplain ordinances and their application to a proposed solar development. Local floodplain ordinances do not allow solar structures and related infrastructure within the "floodway" portion of the floodplain. Refer to the DNR's guidance document, [Considerations for Siting Solar Power Facilities near Lakes and Rivers](#), for ways to minimize impacts to land in shoreland and floodplain districts. If your project site is located within the [Lower St. Croix Scenic Riverway](#) or [Mississippi River Corridor Critical Area](#), contact the LGU for requirements associated with these areas.

**Data layers available in MGC:** Public Water Basin and Watercourse Delineations, DNR NextGeneration Hydrography

### Public Waters

Public waters are designated as such to indicate lakes, wetlands, and watercourses over which DNR has regulatory jurisdiction. Minnesota Statutes, section 103G.005, subdivisions 15 and 15a define public waters and public waters wetlands. To minimize impacts from proposed projects, the DNR highly recommends that lakes, streams, rivers, and wetlands be avoided. Avoiding these resources will reduce permitting costs and minimize harm to site infrastructure from flooding and ice damage.

A license must be obtained from the DNR for the passage of any utility crossing over, under, or across any state water (Minnesota Statutes, section 84.415). Refer to the DNR's website for information and details about how to apply for a [Utility Crossing License](#).

As provided by Minnesota Statutes, section 103G.245, subdivision 1, a DNR Public Waters Work Permit is needed to change or diminish the course, current, or cross section of public waters by filling, excavating, or placing materials in or on the bed of public waters. Minnesota Rules, part 6115.0170, subpart 37 defines a structure as any building, footing, foundation, slab, roof, boathouse, deck, wall, dock, bridge, culvert, or any other object extending over or under, anchored

to, or attached to the bed or bank of a public water. A public water work permit is required for the placement of posts or other structures in public waters.

**Data layers available in MCE:** DNR Public Waters Delineations

**Data layers available in MGC:** Public Waters (PW) Basin and Watercourse Delineations

## Wetlands

Wetlands provide many benefits such as erosion control, flood control, groundwater recharge, recreation, and rare species habitat. It is estimated that Minnesota has lost about 50 percent of its original wetland acreage. The practice of surrounding natural wetlands with solar panels is not recommended as it may deter wildlife use of the wetland. For example, some species will avoid the wetlands due to the structures, glare, vehicular traffic, and human disturbance. The DNR also advises against placing solar panels or access roads within farmed wetlands. Even when drained, hydric soils tend to become wetter after agricultural production ceases. Construction in farmed wetlands can result in soil compaction, rutting, construction delays, increased costs of pumping, stuck machinery, and complaints about mud on roads. During operations, areas with hydric soils can flood or pond, thereby limiting access to facilities and hindering maintenance.

The [Minnesota Wetland Conservation Act](#) (WCA) regulates wetland draining and filling and essentially covers all wetlands not listed as public waters. The definition of “fill” under the WCA generally excludes posts and pilings or structures traditionally built on pilings. However, posts and pilings are regulated as fill if they bring the wetland into a nonaquatic use or have the effect of significantly altering the wetland’s function and value. To the extent that solar panels constructed on posts or pilings in a wetland will adversely affect wetland vegetation through shading or maintenance needs or impact wildlife, particularly bird use of wetlands, solar installations may be regulated under the WCA. As a regulated activity, such projects would be required to demonstrate that wetland impacts have been avoided and minimized to the extent practicable and to compensate for any unavoidable impacts by restoring or creating other wetlands or by purchasing banked wetland mitigation credits. Be advised that the LGU must deny a replacement plan for any impacts when a rare natural community is present.

**Data layers available in MCE:** NWI Circular 39 Class

**Data layers available in MGC:** National Wetland Inventory for Minnesota

## Calcareous Fens

Calcareous fens are rare groundwater-fed wetlands that are sensitive to changes in water quality and quantity. Reductions in groundwater discharge or increases in surface water can cause damage to the fen community—both in terms of its condition and size.

Calcareous fens are protected by Minnesota Statutes, section 103G.223, which states that calcareous fens may not be impacted or altered. DNR ensures compliance with this statute by requiring that for any calcareous fens identified within the project footprint, the project proposer will need to demonstrate that impacts will be avoided for the entire wetland containing the



calcareous fen. Prior to construction, project proposers will need to obtain a no effect concurrence decision from the DNR for any calcareous fens within or adjacent to the project footprint. To obtain a no effect concurrence decision, the project proposer will need to demonstrate how they will avoid impacts to calcareous fens.

Calcareous fen surveys may be required in wetlands within the project footprint to determine if unidentified calcareous fens occur. The DNR should be contacted to discuss potential surveyors, survey protocol, and other requirements before any work is initiated. All survey work should follow the [DNR's Calcareous Fen Field Assessment Procedures](#). Please contact the REAE if you have questions or need additional information about avoiding impacts to calcareous fens.

A WCA application may be needed for calcareous fens and other identified wetlands within the project footprint. The DNR recommends coordinating with the [local government unit responsible for administering the WCA](#) to ensure compliance with all its requirements.

**Data layer available in MCE:** Calcareous Fens

**Data layer available in MGC:** Calcareous Fens – Source Feature Points

## Public Lands

Public lands provide a multitude of recreational opportunities such as fishing, hunting, hiking, biking, bird watching, camping, boating, swimming, and educational opportunities. Public lands also provide a wide diversity of habitat that supports hundreds of species including birds, bats, amphibians, insects, and plants. During early project planning, the project proposer should identify federal, state, and local government lands in and within a quarter mile of the project area boundary using existing geographical information from the DNR, U.S. FWS, and local governments.

**Minnesota Outdoor Recreation System Units** (Minnesota Statutes, chapter 86A) include state parks, state recreation areas, state trails, state scientific and natural areas, state wilderness areas, state forests, state wild and scenic rivers, state water access sites, state wildlife management areas, aquatic management areas, as well as state historic sites and should be identified. State water trail campsites, rest areas, and portages should also be identified even though they are not included in Minnesota Statutes, chapter 86A. Project proposers should also identify Federal Waterfowl Production Areas and refuges, national parks, county trails and parks, other public lands, and private conservation lands.

The DNR recommends avoidance of Minnesota Outdoor Recreation System Units. The DNR may provide additional recommendations concerning wildlife or recreational resources near DNR administered lands based on a project-by-project basis. State, federal, and non-profit conservation groups have expended a considerable amount of time and money to acquire and manage these properties for the conservation of natural resources and recreational use by the public.

**School Trust Lands** are set aside to provide a continual source of funding for public education and are managed in a way that generates revenue for the Permanent School Fund (PSF). The DNR manages the trust lands for maximum long-term economic return under sound natural resource

and conservation practices. Potential exists to locate solar projects on trust lands to generate income. The DNR will review school trust lands on a project-by-project basis to determine if solar development is appropriate for the site. The DNR review will include identification of potential impacts to state-listed species, sites of biodiversity, wetlands, and other significant resources that may not be compatible with solar development. The value of mineral resources and other uses of the property will also be considered during the review.

A license must be obtained from the DNR for the passage of any utility crossing over, under, or across any state land (Minnesota Statutes, section 84.415). Refer to the DNR's website for Information and details about how to apply for a [Utility Crossing License](#).

**Data layers available in MCE:** DNR Management Units (includes Aquatic Management Area, Scientific and Natural Area, State Forest, Other Forest Land, State Park, State Recreation Area, State Wayside, Wildlife Management Area), DNR Public Waters Delineations

**Data layers available in MGC:** State Administered Lands – DNR Management Units (includes Aquatic Management Area, Scientific and Natural Area, State Forest, Other Forest Land, State Park, State Recreation Area, State Wayside, Wildlife Management Area), Public Water Basin and Watercourse Delineations

### Large Block and Other Important Habitats

Large blocks of habitat (e.g., prairie or forest) can provide an increased diversity of species, higher species populations, and more resilient and complex ecological communities. A large block of habitat is a function of both acres and shape of the patch. Larger round or square blocks provide interior habitat that is more isolated from noise, pollution, parasitic birds, and predators associated with habitat edges. Locating solar projects in large blocks of forested or grassland habitat causes habitat loss and fragmentation that is detrimental to area-sensitive species. For example, habitat fragmentation is associated with decreases in population size and nesting success for area-sensitive species.

Large blocks (greater than 40 acres) of grassland habitat in the project area should be identified. In many instances, blocks of grassland habitat can include restored prairie, Conservation Reserve Program, Conservation Reserve Enhancement Program, or conservation easements. For land in conservation programs or easements, solar panels may not be allowed depending on the conditions in the contract. The DNR recommends avoiding large blocks of grassland habitat during the solar siting process.

Forest interior habitat should be identified during project development. Forest interior habitat supports nesting and migratory stopover areas for area-sensitive species. Research suggests that area sensitive species tend to use forested areas at least 330 feet from the edge of the patch. The edge of the patch is where a break in the forest canopy occurs. Protecting interior habitat is important due to loss of this resource from habitat conversion for farming, transmission lines, pipelines, roads, other forms of development, and potentially solar projects. Fragmenting forest interior can result in a loss of habitat for area-sensitive species. The deforested area and extended fragmentation effects result in less desirable plant communities, increased levels of invasive

species, changes to avian and predator species composition and populations, nest parasitism, and behavior changes. The DNR recommends avoiding forest interior habitat during the solar siting process.

For both large blocks of grassland and forest habitat, it is also recommended that wildlife corridors, areas that provide a natural corridor for wildlife to travel between habitats, be preserved and avoided. Maintaining wildlife corridors benefits species diversity and reduces fragmentation effects on species. To protect these habitats, our agency generally recommends a buffer distance of at least 300 feet.

**Data layers available in MCE:** DNR Management Units (includes Aquatic Management Area, Scientific and Natural Area, State Forest, Other Forest Land, State Park, State Recreation Area, State Wayside, Wildlife Management Area)

**Data layers available in MGC:** State Administered Lands – DNR Management Units (includes Aquatic Management Area, Scientific and Natural Area, State Forest, Other Forest Land, State Park, State Recreation Area, State Wayside, Wildlife Management Area), Regionally Significant Ecological Areas and Regional Ecological Corridors, State Funded Conservation Easements (RIM Reserve), Designated Wildlife Lakes

**External Geospatial Habitat Resources:** Audubon Important Bird Areas, TNC Site Renewables Right

## Prohibited Sites

Minnesota Rules, part 7850.4400, subpart 1 includes a list of prohibited sites where no large electric power generating plant may be located. Large electric power generating plants are defined as capable of operating at a capacity of 50 MW or greater (Minnesota Rules, part 4400.0200, subpart 10). The prohibited sites include national parks; national historic sites and landmarks; national historic districts; national wildlife refuges; national monuments; national wild, scenic, and recreational rivers and their land use districts; state wild, scenic, and recreational rivers and their land use districts; state parks; nature conservancy preserves; state scientific and natural areas; and state and national wilderness areas. As provided by Minnesota Rules, solar facilities are not allowed in the Lower St. Croix National Scenic Riverway (Minnesota Rules, part 6105.0370, subpart 2) or the six Wild and Scenic River districts (Minnesota Rules, part 6105.0100, subpart 3).

Minnesota Rules, part 7850.4400, subpart 3 includes a list of site exclusions when alternative sites exist. No large electric power generating plant may be constructed in any of the following areas unless there is no feasible and prudent alternative. Economic considerations alone do not justify approval of these areas. The areas include state registered historic sites; state historic districts; state wildlife management areas; county parks; metropolitan parks; designated state and federal recreational trails; designated trout streams; and the rivers identified in Minnesota Statutes, section 85.32, subdivision 1. Additional restrictions to development could also occur due to deed and funding restrictions that apply to certain parcels of DNR administered lands or to areas under easement.

Solar projects are also prohibited in Reinvest in Minnesota (RIM), Minnesota Native Prairie Bank, and Forest Legacy easements. The easement language prohibits the development of new structures within the area under easement. Conservation easements should be identified early in the project development process so they can be avoided. U.S. FWS or private conservation easements may also have prohibitions on structures and should be reviewed with the easement holder. Information about the location of Native Prairie Bank easements, as well as the local Native Prairie Bank contact, are available online.

## Design Considerations and Impact Minimization

### Perimeter Fencing

Fencing requirements for utility-scale photovoltaic solar facilities are defined under Articles 110 and 691 of the National Electrical Code (NEC). Although the code states that a fence shall not be less than 7 feet in height, local jurisdictions may require taller fencing. The North American Electric Reliability Corporation (NERC) standards for project substations are more stringent.

Solar facility fencing has the potential to disrupt wildlife travel corridors and create direct risks to animals. Project sites should be designed in a manner that does not disrupt significant wildlife travel corridors. Wildlife travel corridors are often associated with streams, rivers, wetlands, or other habitats but also provide access to key upland habitats such as for nesting or overwintering. DNR recommendations regarding fencing are project specific, and are developed depending on surrounding habitat, wildlife populations, and presence of sensitive species and their requirements. Fencing placement should be considered as part of the siting process during the project proposer's initial site review. The DNR may provide specific comments during agency coordination and after the facility layout and fencing location have been determined.

The Minnesota White-tailed Deer Management Plan (2019-2028) states that this species is found in all habitats throughout Minnesota, from the intensively farmed southwest to sub-boreal forests of the northeast. In areas with elk populations or moderate to high white-tailed deer populations (which includes much of Minnesota) fencing should be high enough to exclude deer and elk. To completely exclude deer and elk, the DNR's [Fencing Handbook For 10 ft Woven Wire Deer Exclusion Fence](#) recommends an eight-foot, woven wire fence, topped with two strands of smooth, high-tensile wire.

It is important to recognize that deer and elk are protected wild animals as provided by Minnesota Statutes, section 97A.015, subdivisions 3 and 9. Calls to the DNR from concerned members of the public occur when deer or other wildlife appear trapped within fenced areas. Deer are unpredictable and can be challenging to safely remove from solar facilities. Solar operators are solely responsible for safely removing any deer that may enter a solar facility. Conservation officers or DNR wildlife staff will not be deployed to assist a solar operator, and the DNR will not issue a white-tailed deer removal permit for facilities with woven wire fences lower than 10 feet.

Fences pose a risk of entanglement, injuries, or death for birds and other animals. To avoid or reduce injuries and fatalities, barbed wire should never be used at the top of the fence. To increase perceptibility, the DNR may recommend high visibility markers to avoid bird or other wildlife

engagement. Wildlife entanglement, injuries, or fatalities result in poor public relations for the solar operator.

Fencing modifications may be critical to avoiding or minimizing negative impacts to threatened or endangered wildlife species. For example, fences can be modified to allow small openings at the bottom of the fence at intervals so small animals, such as Blanding's turtles, can move in and out of the fenced area. Other modifications can be incorporated to exclude small animals or redirect their travel. Modified fencing for passage of state threatened or endangered wildlife may be required by the DNR for specific sites on an as needed basis.

For site permits issued by the PUC, the DNR may recommend a special permit condition requiring the permittee to develop a fencing plan in consultation with our agency. Fencing plans may contain information about fence height and material or modifications to allow the movement of small animals. Fencing details such visibility markers or "cattle grates" to deter the entry of wildlife when facility gates are open, may also be included.

Fencing that may direct wildlife onto roads, especially high-speed roads, should be avoided because it could result in wildlife fatalities and create a safety issue for the motoring public. The DNR will provide comments during review of individual projects where fence setbacks from roads are warranted. The DNR generally recommends a minimum distance of 50 feet between fencing and the road right of way to provide space for animals to travel around the fence rather than being directed onto the roadway. Setback recommendations will be based on traffic volume and speed, as well as wildlife population levels in the area (primarily deer), and the presence of wildlife travel corridors.

### Wildlife Friendly Erosion Control

Fatalities to snakes, birds, small mammals, and other wildlife occur when they become entangled in erosion control mesh. The DNR recommends using biodegradable erosion control materials for erodible areas. Biodegradable materials tend to break down faster than photodegradable materials, especially when the area is shaded. The netting should be flexible, rectangular shaped mesh (not square). The use of biodegradable mesh is most important in areas where state-listed species occur, and within or near upland habitats, wetlands, rivers, and lakes.

Hydro-mulch products may contain small synthetic (plastic) fibers to aid in its matrix strength. These loose fibers could potentially re-suspend and make their way into water bodies. The DNR recommends mulches that are free from invasive species. Furthermore, malachite green dye is an industrial colorant used in some hydro-mulch that presents an ecotoxicity concern for aquatic species with a potential for bioaccumulation in insects, amphibians, and fish. Our agency recommends that products with malachite green be avoided. The specifications currently used by the DNR, and the Minnesota Department of Transportation (MnDOT), are provided in the Minnesota Department of Transportation Standard Specifications for Construction.

### Facility Lighting

Animals depend on the daily cycle of light and dark for behaviors such as hunting, migrating, sleeping, and protection from predators. Light pollution can affect their sensitivity to the night

environment and alter their activities. The DNR recommends using shielded and downward facing lighting to minimize visual and ecological impacts associated with security lights, substations, and operations and/or maintenance buildings.

In addition to the undesirable effects of upward facing lighting, the hue of lights can also affect wildlife. LED lighting has become increasingly popular due to its efficiency and long lifespan. However, these bright lights tend to emit blue light, which can be harmful to birds, insects, and fish. Color temperature is expressed in kelvins (K). Color temperatures over 5000K and are considered cool colors and are on the upper end of the blue spectrum. The DNR recommends that projects using LED lighting follow [MnDOT's approved products for luminaries](#), which limit the maximum nominal color temperature to 4000K. MnDOT specifications also limit the upright rating to 0 (no light directed upward above the top of the light fixture).

### **Snowmobile Trail Reroutes or Closures**

Snowmobiling is a popular recreational activity during Minnesota's winter months. The Minnesota Legislature has delegated the responsibility of administering a cost-sharing program for the development and maintenance of snowmobile trails to the DNR. The state's grants-in-aid program provides funding for trail maintenance and grooming to a snowmobile trail system that has grown to over 21,000 miles.

If a snowmobile trail route within or near the project boundary will be temporarily or permanently rerouted, the project proposer should coordinate with the local snowmobile club. Coordination with the DNR's Division of Parks and Trails staff will also be necessary for any route changes involving state administered land. Coordination should occur early on to allow time to accommodate any changes to the snowmobile trail route. Snowmobile clubs finalize trail routes by mid-summer and the trails are not normally changed prior to the winter recreation season. Trail users incorporate the route maps as Apps onto mobile devices and any late-determined route changes can cause safety issues. The [DNR's interactive snowmobile trails map](#) is available online.

### **Water Appropriation, Public Waters Work Permits, and Utility Crossing License**

Early coordination work with the DNR should identify the potential need for DNR permits or licenses. Measures to minimize impacts to public waters and lands should also be identified. A water appropriation permit is required for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year. Our agency advises that a water appropriation permit may be needed for construction dewatering or dust control. A public waters work permit may be necessary for any potential changes to the course, current, or cross-section of a public water. A utility crossing license is required for any utility crossings of public lands or waters. These permits/licenses can only be approved after any PUC permitting is complete. Early coordination work to identify any special requirements can help these processes run smoothly.

The project proposer should consider that permits from other agencies may be required. For example, a construction stormwater permit from the Minnesota Pollution Control Agency would be required for projects that would disturb more than one acre of land. Project proposers are

encouraged to coordinate with relevant state and federal agencies to determine all applicable permits.

### Dust Control

Products containing calcium chloride or magnesium chloride are often used for dust control. Chloride products that are released into the environment do not break down and can accumulate to levels that are toxic to plants and wildlife. The DNR recommends the avoidance of chemical dust suppressants containing chloride.

### Avian Flight Diverters

A solar facility may need a high voltage transmission line to connect to the grid and may require a route permit from the PUC. Route permits typically include a condition requiring the permittee to coordinate with the DNR on the placement of flight diverters. Our agency may also recommend flight diverters for above-ground collection lines, if applicable. The DNR's recommendations consider factors such as the surrounding habitat and bird movement in and near the project area.

### Wildlife Interactions with Solar Panels

A limited number of facilities in other states have reported that birds or insects mistake the glare or polarized light reflection as water. Sporadic fatalities may occur to birds attempting to land on or within the panels. A few species of insects have been documented to simultaneously lay eggs on panels resulting in reproductive failure. Impacts can be minimized by using less reflective panels, or non-polarizing white grids between the panels to break up the polarized reflection of light. Another mechanism to reduce the potential for wildlife impacts is to place the panels away from water bodies. Solar operators should report any unusual wildlife events that occur on their site to the permitting authority and the REAE. This information could then be used to determine if a pattern of impacts is occurring that should be addressed.

## Vegetation Management

### Habitat-friendly (Pollinator-Friendly) Vegetation

Prairie establishment and management of habitat-friendly native seed plantings at solar sites can provide the following conservation benefits:

- Provide food and habitat for butterflies, bees, and insects that pollinate flowering forbs and some commercial agricultural crops.
- Provide food, cover, and nesting habitat for some species of wildlife (including mammals, birds, reptiles, and amphibians).
- Significantly reduce wind and surface water erosion.
- Significantly reduce fertilizer, herbicide, and pesticide applications, resulting in improved water quality.
- Increase organic matter and water holding capacity of soils. The result is higher quality soils for farming after the site is decommissioned.
- Improve the aesthetic look of the solar facility.

The DNR's [Prairie Establishment & Maintenance Technical Guidance for Solar Projects](#) provides an overview of the benefits, establishment, and maintenance guidelines for creating pollinator-friendly or habitat-friendly prairie plantings at solar sites. An opportunity is available to manage vegetation at project sites as short-grass prairie, meadows, or other appropriate wildlife habitat. Solar developers are encouraged to plant native seed that contains a diversity of native plants including warm-season grasses, cool-season grass, sedges/rushes, flowering legume and non-legume forbs that are beneficial to wildlife. For example, planting common milkweed (*Asclepias syriaca*) can be especially beneficial to monarch butterflies because their life cycle relies upon milkweed plants for egg laying and larvae development. For additional information on establishing and maintaining habitat to benefit pollinators and other insects, refer to the [Minnesota Pollinator Resources](#) website.

### Vegetation Management Plan

All utility-scale solar projects (50 megawatts or greater) permitted by the PUC require a Vegetation Management Plan (VMP). The Department of Commerce – Energy Environmental Review and Analysis (EERA), in collaboration with the DNR and other state agencies, has developed [Guidance for Developing a Vegetation Establishment and Management Plan for Solar Facilities](#). This guidance document provides the tools and information needed to develop, implement, and monitor long-range vegetation management plans. In addition, the Minnesota Board of Soil and Water Resources (BWSR) website offers extensive information about its [Habitat Friendly Solar Program](#). This website includes links to BWSR's Project Planning Assessment Form and Established Project Assessment Form. These forms are an important tool for solar companies and local governments that aspire to meet BWSR's Habitat Friendly Standards.

### Invasive Species Control

Vehicles and heavy equipment can gather and transport plants and soil that can spread invasive plant seeds from one work site to another. The DNR recommends that all equipment be cleaned prior to transporting it to a new work site. Equipment cleaning will help prevent the spread of unwanted invasive plants that can become established, outcompete native vegetation, decrease habitat quality, and increase invasive/noxious weed control costs. Controlling invasive plants is especially important if the developer intends to seed the site to native grasses and forbs. For additional information, refer to DNR guidance on [Cleaning Heavy Equipment used on Land to Minimize the Introduction and Spread of Invasive Species](#).



## Equal Opportunity Statement

Equal opportunity to participate in and benefit from programs of the DNR is available to all individuals regardless of race, color, creed, religion, national origin, sex, marital status, public assistance status, age, sexual orientation, disability or activity on behalf of a local human rights commission. Discrimination inquiries should be sent to Minnesota DNR, 500 Lafayette Road, St. Paul, MN 55155-4049; or the Equal Opportunity Office, Department of the Interior, Washington, D.C. 20240.

Alternative format available upon request.

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## Hyperlink Resources

**Minnesota Conservation Explorer:** <https://mce.dnr.state.mn.us/>

**Minnesota Geospatial Commons:** <https://gisdata.mn.gov/>

**DNR Regional Environmental Assessment Ecologist (REAE) contact information:**  
[https://www.dnr.state.mn.us/eco/ereview/erp\\_regioncontacts.html](https://www.dnr.state.mn.us/eco/ereview/erp_regioncontacts.html)

**Natural Heritage Review Team:** [Review.NHIS@state.mn.us](mailto:Review.NHIS@state.mn.us)

**DNR Energy Projects Reviewer:** [https://www.dnr.state.mn.us/eco/ereview/erp\\_contacts.html](https://www.dnr.state.mn.us/eco/ereview/erp_contacts.html)

**U.S. FWS IPaC website:** <https://ipac.ecosphere.fws.gov/>

**U.S. FWS Minnesota-Wisconsin Ecological Services Field Office:**  
<https://www.fws.gov/office/minnesota-wisconsin-ecological-services>

**Minnesota Biological Survey:** <https://www.dnr.state.mn.us/mbs/index.html>

**MBS Biodiversity Significance Rank:**  
[https://www.dnr.state.mn.us/eco/mcbs/biodiversity\\_guidelines.html](https://www.dnr.state.mn.us/eco/mcbs/biodiversity_guidelines.html)

**Minnesota's Native Plant Communities:** <https://www.dnr.state.mn.us/npc/index.html>

**DNR Endangered Species Review Coordinator:**  
[https://www.dnr.state.mn.us/eco/ereview/erp\\_contacts.html](https://www.dnr.state.mn.us/eco/ereview/erp_contacts.html)

**Considerations for Siting Solar Power Facilities near Lakes and Rivers:**  
[https://files.dnr.state.mn.us/waters/watermgmt\\_section/shoreland/siting-solar-power.pdf](https://files.dnr.state.mn.us/waters/watermgmt_section/shoreland/siting-solar-power.pdf)

**Lower St. Croix Scenic Riverway:**  
[https://www.dnr.state.mn.us/waters/watermgmt\\_section/wild\\_scenic/wsrivers/stcroix\\_lower.html](https://www.dnr.state.mn.us/waters/watermgmt_section/wild_scenic/wsrivers/stcroix_lower.html)

**Mississippi River Corridor Critical Area:**  
[https://www.dnr.state.mn.us/waters/watermgmt\\_section/critical\\_area/index.html](https://www.dnr.state.mn.us/waters/watermgmt_section/critical_area/index.html)

**Utility Crossing License:** [https://www.dnr.state.mn.us/permits/utility\\_crossing/index.html](https://www.dnr.state.mn.us/permits/utility_crossing/index.html)

**Minnesota Wetland Conservation Act (WCA):**  
<https://bwsr.state.mn.us/wca-program-guidance-and-information>

**Minnesota DNR Calcareous Fen Field Assessment Procedures:**  
[https://files.dnr.state.mn.us/natural\\_resources/water/wetlands/calcareous-fen-field-assessment.pdf](https://files.dnr.state.mn.us/natural_resources/water/wetlands/calcareous-fen-field-assessment.pdf)

**Wetland Conservation Act Contacts:** <https://bwsr.state.mn.us/wetland-conservation-act-contacts>

**Minnesota DNR Fencing Handbook for 10 ft Woven Wire Deer Exclusion Fence:**

[https://files.dnr.state.mn.us/assistance/backyard/privatelandhabitat/woven\\_wire\\_fence\\_handbook\\_deer.pdf](https://files.dnr.state.mn.us/assistance/backyard/privatelandhabitat/woven_wire_fence_handbook_deer.pdf)

**Minnesota Department of Transportation approved products for luminaries:**

<https://www.dot.state.mn.us/products/roadwaylighting/luminaires.html>

**DNR Interactive Snowmobile Trails Map:**

[https://www.dnr.state.mn.us/snowmobiling/interactive\\_map/index.html](https://www.dnr.state.mn.us/snowmobiling/interactive_map/index.html)

**Prairie Establishment & Maintenance – Technical Guide for Solar Projects:**

[https://files.dnr.state.mn.us/publications/ewr/prairie\\_solar\\_tech\\_guidance.pdf](https://files.dnr.state.mn.us/publications/ewr/prairie_solar_tech_guidance.pdf)

**Minnesota Pollinator Resources:** [https://www.dnr.state.mn.us/pollinator\\_resources/index.html](https://www.dnr.state.mn.us/pollinator_resources/index.html)

**Guidance for Developing a Vegetation Establishment and Management Plan for Solar Facilities:**

<https://apps.commerce.state.mn.us/eera/web/project-file/11702>

**Minnesota Habitat Friendly Solar Program:**

<https://bwsr.state.mn.us/minnesota-habitat-friendly-solar-program>

**Equipment Cleaning to Minimize Invasives:**

[http://files.dnr.state.mn.us/natural\\_resources/invasives/terrestrialplants/equipment\\_cleaning\\_to\\_minimize.pdf](http://files.dnr.state.mn.us/natural_resources/invasives/terrestrialplants/equipment_cleaning_to_minimize.pdf)