

Guidelines for Municipalities: Developing Bird-Friendly and Environmentally Responsible Utility-Scale Solar

**Pennsylvania Audubon Council
Renewable Energy Committee**

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The Pennsylvania Audubon Council Renewable Energy Committee aims to provide information to Pennsylvania Audubon Chapters and others on a) proper siting criteria for renewable energy projects to ensure that critical bird areas, migration routes and important wildlife habitats are protected, and b) methods to minimize and mitigate the impact of renewable energy projects on birds and other wildlife.

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Introduction

Climate change is one of the biggest threats to birds, both now and in the future. The National Audubon Society's report "Survival by Degrees" identifies 389 species of North American birds facing extinction if global warming advances beyond 1.5 degrees Celsius above pre-industrial levels.¹ Counteracting this threat means not only dramatically reducing carbon emissions but doing so in a way that does not cause further harm to birds and their habitats.

Many bird species have suffered serious declines over the past 50 years. Habitat loss and habitat degradation are the main causes. The study published in 2019 in the journal *Science* by Kenneth Rosenberg and others, shows that 2.9 million breeding birds have been lost since 1970 from the U.S. and Canada: "[Decline of the North American avifauna](#)."²

Other threats to birds are not insignificant. These include outdoor cats; invasive species; building lights at nighttime; collisions with glass, transmission lines, wind turbines and communication towers; and pesticides and other toxins.³

Renewable Energy

A guideline for appropriate development comes from the white paper "[Beyond Carbon-Free: A Framework for Purpose-Led Renewable Energy Procurement and Development](#)" was launched by the National Audubon Society, the Nature Conservancy and Level Ten Energy, to move the renewable energy industry toward a sustainable and equitable clean energy transition.⁴

Beyond Carbon Free emphasizes the principles of Community, Conservation and Climate:

Community: Engage local communities early and often to build a trusting dialogue around the project and community goals, avoid negative community and cultural impacts, and support community needs and benefits. Support local workforce development and diversity, equity, and inclusion goals.

Conservation: Avoid and minimize impacts to wildlife, habitat, and natural areas. Conduct appropriate consultation with relevant agencies about potential environmental impacts and mitigation planning.

¹ "Survival by Degrees", The National Audubon Society, <https://www.audubon.org/climate/survivalbydegrees>

² Kenneth V. Rosenberg, et al., "Decline of the North American avifauna," *Science*, Vol 366, Issue 6461, (Sep 19, 2019): 120-124, <https://www.science.org/doi/10.1126/science.aaw1313>.

³ "Threats," American Bird Conservancy, <https://abcbirds.org/threats/>.

⁴ Zach Starisia and Nathan Cummins, et al., "Beyond Carbon Free: A Framework for Purpose-Led Renewable Energy Procurement and Development," Level Ten Energy, The Nature Conservancy, The National Audubon Society, Nov. 15, 2021, <https://www.nature.org/content/dam/tnc/nature/en/documents/BeyondCarbonFreeFinal.pdf>.

Climate: Support the highest relative reduction of greenhouse gas emissions for the project. Avoid development that releases carbon stored in natural areas, such as forests, wetlands, and grasslands. [See Details Appendix A.](#)

Following are additional recommendations for proper siting of renewable energy projects and associated infrastructure (pipelines, transmission lines):

- Forests should not be cut down for renewable energy projects.
- Avoid migratory flyways including ridgetops and stopovers such as wetlands, grasslands, forests, conservation areas and lakes.
- Prevention of habitat fragmentation.
- Reduce degradation of habitat from construction of roads, soil compaction and erosion, and road dust.
- Prevent introduction of invasive plants from vehicles, mower blades, tires and clothing and by not immediately replanting areas that have been cleared.^{5 6}

Transmission Lines

Any renewable energy source should be sited as close to users as possible, both to minimize the bird deaths from collisions with transmission lines and to avoid the energy losses that occur during transmission and distribution. Transmission lines kill millions of birds each year. According to the National Audubon Society:

The problem stems from the fact that most electric lines are built around the average bird flight level but are hard for birds to see. Raptors are at risk as their large wingspan can bridge between components of the power line, resulting in electrocutions. Not only do power line collisions and electrocutions cause bird deaths, but they can also cause power outages, which can put a strain on our most vulnerable populations. Power lines can also cause harm when they cut across particularly sensitive habitat, or through an important migratory pathway or stopover site.⁷

High-voltage lines should be placed underground whenever feasible to eliminate impacts to birds. This also protects power lines from storms and wildfires. Additional information on

⁵ “Guidelines for Conservation Siting of Energy Infrastructure in Missouri”, Missouri Energy Infrastructure Conservation Siting Work Group, <https://moguidelines.net/> April 2022, v 1.0.

⁶ “Invasive Plants in Pennsylvania”, PA Department of Conservation and Natural Resources, <https://www.dcnr.pa.gov/Conservation/WildPlants/InvasivePlants/Pages/default.aspx>

⁷ “Transmission Lines and Birds”, the National Audubon Society, <https://www.audubon.org/news/transmission-lines-and-birds>.

protecting birds from power line collisions is available in [Reducing Avian Collisions from Power Lines](#)⁸ from APLIC (the Avian Power Line Interaction Committee)⁹.

Types of Solar Power

There are two main types of Solar Power, photovoltaics (PV) and concentrated solar-thermal power (CSP). The flat solar panels that we see on rooftops use photovoltaic technology. PV cells in the panels absorb the light, creating charges within the cells which are converted into electricity.

Concentrated Solar, in which a beam of light is concentrated should be avoided, due to its deadly effect on birds and insects. Examples include the concentrating of sunlight by mirrors into a beam which is directed to a tower. Birds and insects are attracted to this beam because of the light and are incinerated by the beam.¹⁰

Document Goal

The goal of this document is to provide information and resources for Pennsylvania Audubon Chapters and others to work with municipalities in developing environmentally responsible guidelines for Utility-Scale Photovoltaic Solar, which will effectively avoid, minimize, and mitigate impacts to birds, wildlife, habitat, and the community.

Utility-Scale Solar Permitting in Pennsylvania

Priority for siting of solar facilities should be given to rooftops, parking lots, warehouses and distribution centers, industrial facilities, malls, schools, and other public buildings, as well as brownfields and degraded lands. Three major entities regulate Utility-Scale Solar in Pennsylvania: The Pennsylvania, New Jersey, Maryland Interconnect ([PJM](#))¹¹; the PA Department of Environmental Protection ([DEP](#)); and local municipalities.

Solar development is ramping up in Pennsylvania and is expected to keep increasing in the coming years. Most, if not all of the proposed utility scale solar projects are in rural areas of the state. As of early 2022, over 700 large-scale solar projects have been submitted for approval to PJM. These projects typically range from 400 to 1000 acres and can be aggregates of many properties.

⁸ "Reducing Avian Collisions from Power Lines," 2012, the Avian Power Line Interaction Committee, <https://www.resolutionmineeis.us/sites/default/files/references/avian-power-line-2012.pdf>

⁹ APLIC, www.aplic.org

¹⁰ "Solar Power and Birds", the National Audubon Society, <https://www.audubon.org/news/solar-power-and-birds>

¹¹ PJM, <https://www.pjm.com/>.

Properties may be purchased, but in most cases, developers sign long-term leases with property owners, pending project approvals. Extensive Information on Utility-Scale Solar energy, land use policy, and landowner leasing information is available from Penn State, both in articles and webinars.¹² [See Appendix B.](#)

Once the land for a project is leased or purchased, developers submit the project to **PJM** for approval to generate electricity. **PJM** is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of 13 states including Pennsylvania, and the District of Columbia).

Due to the lengthy permitting process, a developer will often apply to **PJM**, the municipality, and the Pennsylvania Department of Environmental Protection (DEP) concurrently. If the municipality conducts hearings before PJM or DEP approves the project, the municipality may state that their approval is subject to approval from other state and federal agencies.

The DEP is charged with applying and implementing the National Pollutant Discharge Elimination System (NPDES) permits for stormwater discharges associated with construction activities, including erosion and sediment control (E&S) plans and post-construction stormwater management (PCSM) for solar projects. [PA DEP Solar Panel Farms FAQ.](#)¹³ [See Details Appendix C.](#)

Municipal Authority and Solar Development

The Pennsylvania Municipalities Planning Code (MPC) gives authorization to Pennsylvania municipalities to enact zoning or subdivision and land development ordinances to regulate the placement, construction, operation, and maintenance of alternative energy projects.¹⁴

A municipality can develop an ordinance with regulations and permitting requirements to ensure that solar development is consistent with the planning goals of the municipality, conserves natural resources and habitat, and provides assurances for the health and economic interests of the community.

Municipalities have broad authority over development as Pennsylvania is a Home Rule State, and under state law, municipalities are given authority to regulate all forms of development in their jurisdiction, including industrial solar.

¹² “Renewable and Alternative Energy, Solar,” Penn State Extension <https://extension.psu.edu/catalogsearch/result/?q=solar+energy>

¹³ “Chapter 102, Permitting for Solar Panel Farms, Frequently Asked Questions (FAQ),” Pennsylvania Department of Environmental Protection, Bureau of Clean Water, Version 1.1, January 2, 2019 Revised April 30, 2021, https://files.dep.state.pa.us/Water/BNPNSM/StormwaterManagement/ConstructionStormwater/Solar_Panel_Farms_FAQ.pdf.

¹⁴ *Pennsylvania Municipalities Planning Code*, <https://dced.pa.gov/download/pennsylvania-municipalities-planning-code-act-247-of-1968/>.

Community leaders looking to promote solar ordinances should expect their solicitors will not likely have expertise with respect to development of a new and/or amended solar ordinance. In fact, such work can be cost prohibitive to the municipality. Leaders may have to organize a local group to hire and pay for an attorney to prepare a draft of a solar ordinance and/or amendment to an existing ordinance. Having an attorney draft such a document will save costs for the municipality, ensure the legality of the ordinance, and ensure that the legal rights of both the developer and property owners are protected.

Information about Community Benefit Agreements (CBAs) is available from the US Department of Energy in its publication: “Guide to Advancing Opportunities for Community Benefits through Energy Development Opportunities.”¹⁵ CBAs are negotiated between community group leaders and a developer. State and local governments may or may not be involved in the negotiation. The agreements ensure that measurable, local benefits of a development will be given to a community. They are enforceable, legally binding contracts for all parties that stipulate community benefits and are the direct result of substantial community input.

The US EPA has extensive information on renewable energy resources for state and local governments on their website: <https://www.epa.gov/statelocalenergy>, including: a Toolbox for Project Development; Solar Power Purchase Agreements; A Guide to Community Solar; Solar Power FAQ; a Local Government Guide for Solar Power Deployment and a Renewable Energy Project Development Resource Directory.¹⁶

Municipalities with Zoning

If a municipality has zoning, a solar application may be considered as a:

1. Special Exception, in which case the municipality’s Zoning Hearing Board will decide if the application meets the zoning requirements, or
2. Conditional Use, in which case the township supervisors will rule on the application. A municipality with zoning may also designate an overlay on the Zoning map where solar projects will be permitted if they meet the Special Exception or Conditional Use requirements as specified in the ordinance.

Municipalities without Zoning

If a municipality does not have zoning, it is recommended that Utility-Scale Solar regulations be amended into the municipality’s Subdivision and Land Development Ordinance or approved as a stand-alone ordinance.

¹⁵ *Guide to Advancing Opportunities for Community Benefits through Energy Project Development*, <https://www.energy.gov/sites/default/files/2017/09/f36/CBA%20Resource%20Guide.pdf>.

¹⁶ “Energy Resources for State, Local, and Tribal Governments”, U.S. EPA, <https://www.epa.gov/statelocalenerg>.

Recommendations for Utility-Scale Solar Ordinances

In this section, the natural, tourism, recreational, agricultural, and historical assets of a municipality are noted, and the need to protect them from potentially negative impacts of solar energy development is emphasized.

The following parameters should be included in a solar ordinance for a Utility-Scale Solar project:

1. Specification of the Applicable Governing Body of the municipality that will have authority over development of a Solar Energy Facility.
2. The basic rights of the people under the Pennsylvania Constitution to clean air, pure water, preservation of the environment and to the public natural resources that are the common property of the Commonwealth are contained in the Pennsylvania Environmental Rights Amendment, Article 1, Section 27 of the Pennsylvania Constitution¹⁷. Since the adoption of the amendment in 1971, Commonwealth Court rulings have clarified the role of the municipality and state agencies in applying this amendment. [See Details Appendix D.](#)
3. The permitting, design, construction, operation and decommissioning of a Solar Energy Facility.
4. A statement in the ordinance that it is in the best interest of a municipality to protect all stakeholder interests with respect to both health and finances.
5. If applicable, a location where Solar Energy Facilities could be permitted. If the municipality has zoning, then designate if permitting is by special exception or conditional use. A district overlay for solar may also be developed.

Responsible Siting and Design

1. For Utility-Scale Solar projects, we recommend site preparation prior to the installation of solar panels including the use of native grasses and pollinator plantings under and around solar panels, native plant buffers, wildlife friendly fencing, creation of wildlife corridors, minimization of wildlife deaths from transmission lines, and decommissioning plans. Tree cutting and forested land clearing should be discouraged and if necessary, compensated for by acquisition and preservation of forested parcels elsewhere.
2. Low-impact solar development is recommended. Unlike traditional solar development which uses land solely for energy generation, low-impact solar can include native

¹⁷ Pennsylvania Environmental Rights Amendment, Article 1, Section 27 of the Pennsylvania Constitution <https://www.legis.state.pa.us/WU01/LI/LI/CT/HTM/00/00.001..HTM>

Responsible Siting and Design, continued

vegetation and pollinator habitat, solar-integrated greenhouses, co-location of agriculture and solar, sheep grazing, and beekeeping.¹⁸

Additional up-front planning and expenditure is needed, but—according to the data gathered by InSPIRE researchers so far—offers surprisingly robust benefits over time.¹⁹ There are many benefits to low-impact solar development, including improving soil health and water retention, and reduction of stormwater runoff. Existing vegetation is left intact or replaced with native vegetation or crops, topsoil is left in place and minimal, if any, land grading is required. Decommissioning costs are greatly reduced, and the land can be easily returned to farming or a natural area. Low-impact solar developments can be responsive to community priorities and are often more acceptable by local communities. [See Details Appendix E.](#)

3. Many of the PA DEP recommendations for Erosion and Sedimentation Control Best Management Practices for ground level solar projects of one acre or more, are similar to those for low-impact solar. [See Details Appendix C.](#)

The goal is to minimize environmental impacts to the maximum extent practicable. *“Project proponents should (1) minimize the extent and duration of the earth disturbance activity, (2) maximize protection of the existing drainage features and vegetation, (3) avoid soil compaction, and (4) utilize any other measures or controls to prevent or minimize the generation of increased stormwater runoff.”*²⁰

Earth disturbance and grading activities should be minimized, and natural vegetative cover should be preserved or restored. The utilization of low impact construction techniques should be used to the maximum extent practicable. Existing slopes on the project site should ideally be 10% or less.

The DEP FAQ document also discusses arrangement of photovoltaic panels; minimum and maximum height; % vegetative cover and the use of native vegetation, including under and between solar panels as well as buffers around the panel array; site sloping and grading; and agrivoltaics (the use of land for both solar power generation and agriculture). [See Details Appendix C.](#)

¹⁸ “InSPIRE, Innovative Solar Practices Integrated with Rural Economies and Ecosystems”, US DOE, NREL, <https://openei.org/wiki/InSPIRE>.

¹⁹ Harrison Dreves “Beneath the Solar Panels, Seeds of Opportunity Sprout, Low-impact Development of Solar Installations Could be Win-Win-Win for Food, Water and Renewable Energy”, *NREL news*, National Renewable Energy Laboratory, April 1, 2019, <https://www.nrel.gov/news/features/2019/beneath-solar-panels-the-seeds-of-opportunity-sprout.html>.

²⁰ “Chapter 102, Permitting for Solar Panel Farms, Frequently Asked Questions, FAQ,” PA DEP https://files.dep.state.pa.us/Water/BPNPSM/StormwaterManagement/ConstructionStormwater/Solar_Panel_Farms_FAQ.pdf.

Responsible Siting and Design, continued

4. The PA Department of Conservation Resources (DCNR) issued a guidance document in September 2022: [Conservation Considerations for Siting, Planning, and Maintaining Grid-Scale Solar Systems in Pennsylvania \(PDF\)](https://elibrary.dcnr.pa.gov/GetDocument?docId=4659215&DocName=Conservation_Considerations_for_Grid-Scale_Solar_Systems_Pennsylvania_Sept2022.pdf)²¹, outlines considerations for siting best practices and sustainable design. The Guidance Document also provides valuable reference information. “Recommendations include:
 - Prioritize the conservation and protection of nature forests, recreational lands, plants and wildlife habitat, and vital ecosystems
 - Prioritize siting on already disturbed lands to make these sites viable alternatives for hosting grid-scale solar development compared to greenfield areas such as agricultural and forested lands.
 - Avoid the conversion of contiguous forest lands, wetlands, and native grasslands as they provide important ecosystem services, including flood and storm water mitigation, erosion and sedimentation controls, carbon sequestration, and nutrient management.
 - Respect local decision making on the siting of projects within parameters established in existing and informed community-based comprehensive planning efforts.
 - Avoid siting near recreational, historic, and environmental areas where gridscale solar could have an impact on scenic byways and viewsheds, historic sites, recreational amenities, and other high-valued natural resources.
 - Co-locate near existing energy infrastructure
 - Avoid areas inhabited by endangered, threatened, and other species of concern. Developers should use the [Pennsylvania Conservation Explorer Tool](https://conservationexplorer.dcnr.pa.gov/)²² during the siting and planning phases to screen a project area for potential impacts to species that are threatened, endangered, and of special concern.
 - Consider minimizing impacts to Species of Greatest Conservation Need listed in the [Pennsylvania State Wildlife Action Plan](https://www.pgc.pa.gov/Wildlife/WildlifeActionPlan/Pages/default.aspx)²³. Many of these species are not yet listed as rare, threatened or endangered; however, the state has highlighted them as conservation concerns because they are in decline. Landowners can

²¹ “CONSERVATION CONSIDERATIONS FOR SITING, PLANNING, AND MAINTAINING GRID-SCALE SOLAR SYSTEMS IN PENNSYLVANIA,” PA DCNR, https://elibrary.dcnr.pa.gov/GetDocument?docId=4659215&DocName=Conservation_Considerations_for_Grid-Scale_Solar_Systems_Pennsylvania_Sept2022.pdf.

²² “Pennsylvania Conservation Explorer”, PA Department of Conservation and Natural Resources, Pennsylvania Natural Heritage Program, <https://conservationexplorer.dcnr.pa.gov/>.

²³ “2015 – 2025 Pennsylvania Wildlife Action Plan”, PA DCNR, <https://www.pgc.pa.gov/Wildlife/WildlifeActionPlan/Pages/default.aspx>.

Responsible Siting and Design, continued

use the [Conservation Opportunities Area Tool](#)²⁴ to identify potential at risk species on their property.

- Avoid fragmenting habitat and/or migratory corridors. Grid-scale solar development could significantly impede the movement of terrestrial-based plant and animal species, which rely on continuous habitat to move whether for migration, breeding, or feeding. The best method for allowing movement of terrestrial species is to omit structural barriers, retain unfenced passageways, or utilize wildlife-friendly fencing.
 - Design and implement a Beneficial Vegetation Plan for the project (within the footprint of the facility and along right of ways) that utilizes deep-rooted native plants that will prevent the spread of invasive species (see [DCNR list of invasive plants](#)²⁵), improve soil health, improve water retention and infiltration, and provide habitat for native fauna, especially pollinators that can benefit yield of local farms.
 - Include plans for decommissioning that restores the land to the same condition as it was before.”
5. Most Utility-Scale Solar development to date in Pennsylvania has been on rural farmlands and it is anticipated that this trend will continue. Location of Utility-Scale Solar on Prime Farmland should be avoided. [See Appendix F](#). There are many options for making Utility-Scale Solar more environmentally friendly. These include the use of pollinator plantings, agrivoltaics and sheep grazing. Excellent information about these topics and utility scale solar is also available from the Penn State Extension webinars.²⁶ [See Details Appendix B](#).
 6. Proximity to existing substation and transmission lines are encouraged. Transmission lines shall be located underground to the extent possible.
 7. Areas previously used for industry and mining, such as brownfields or landfills, could be noted as being potentially appropriate for development. Such locations could be compromised by existing environment liability issues at such sites, however there are advantages including state and federal monies that may be available.

The [EPA re-Powering America's website](#) contains extensive information including location maps and data on available contaminated properties, tools, and contacts to assist with evaluating contaminated sites for energy development.²⁷

²⁴ “Conservation Opportunity Area Tool”, Pennsylvania Wildlife Action Plan, PA DCNR, <https://wildlifeactionmap.pa.gov/>.

²⁵ “Invasive Plants in Pennsylvania”, PA DCNR, <https://www.dcnr.pa.gov/Conservation/WildPlants/InvasivePlants/Pages/default.aspx>.

²⁶ “Solar Energy and Agrivoltaics,” Penn State Extension webinar, <https://extension.psu.edu/solar-energy-and-agrivoltaics>.

²⁷ “RE-Powering America's Land,” US EPA, <https://www.epa.gov/re-powering>.

Responsible Siting and Design, continued

Potentially contaminated land, landfills, and mine sites can offer significant advantages over other sites, such as open space, for renewable energy development. Some of these sites have unique attributes that can lower development costs and shorten development time frames. Many of these properties can offer developers a unique value proposition for renewable energy deployment and the ability to:

- Leverage existing infrastructure
- Reduce project cycle times through streamlined permitting and zoning
- Improve project economics with reduced land costs and tax incentives
- Gain community support through land revitalization efforts
- Protect open space.

Areas where grassland habitat has been developed on reclaimed strip mine land would not be a suitable location for solar energy development in that grassland bird species are often among the most endangered and/or threatened bird species in Pennsylvania. Any incentives that encourage development on Brownfields or Landfills, or the inclusion of native pollinator plantings should be noted.

8. Road construction on the site shall be kept to a minimum, to reduce compaction of the soil on the site.

Protected Areas

The following resources, which may be found in municipal, county, or regional planning documents, should be listed as being protected from development of Utility-Scale Solar Energy Facilities:

1. Public and protected lands, designated on the local, state, and federal levels (Note: This is not meant to exclude accessory solar projects, e.g.: rooftop panels to run park facilities). Conserved land in Pennsylvania can be found at the [We Conserve PA Conserved Land Database](https://weconservepa.org/gis/).²⁸
2. Historical Places listed, or eligible to be listed in the National Park Service's National Register of Historic Places
3. Historical structures as recognized by other entities

²⁸ "Conserved Land Database," WeConservePA, <https://weconservepa.org/gis/>.

4. [Areas included in the Pennsylvania Natural Heritage Program](#)²⁹
5. [Audubon Important Bird Areas in Pennsylvania](#)³⁰
6. Forested Lands: Forested lands and designated forest zones should be protected from use for solar development. Development on forested lands makes habitat loss worse due to forest fragmentation and increased soil erosion and can result in local temperature increases. Forests play very important roles in the fight against climate change as they absorb carbon dioxide out of the atmosphere and sequester the carbon in the trees. Loss of this carbon sequestration contributes to climate change.

When a forest is logged, the benefit achieved by electricity creation from the solar panels is reduced by the loss of carbon sequestration. This must be factored in any calculations of energy yield. The loss of carbon sequestration is not a one-time loss but must be accounted for every year the solar farm is in operation and in future uses of the site. According to Penn State Extension, most forest species in Pennsylvania mature between ages 60 and 120 years, with 80 years used as the average age for forest maturity.³¹ While protecting habitat elsewhere is an important compensation for forest loss, it may not adequately take the place of a mature forest.

7. Tree cutting on the solar site should be minimized with existing tree/shrub areas and edges maintained as much as possible. If tree and shrub cutting is necessary, habitat should be compensated for with protection of other non-protected areas.
8. Ridgetop development, since these areas provide opportunities for community recreation and viewsheds that promote tourism; critical habitat for wildlife; source waters; carbon sequestration and storage in the forests; and migration corridors and stopover sites for birds and bats.
9. Conserved lands are valuable for many reasons and should be protected from solar development. Conservation easements protect forested areas, grasslands and other important bird and wildlife habitats, while protecting soils and watersheds. A tax penalty applies if conserved land is developed. The need for renewable energy does not compensate for the value of conserved lands.
10. Lands having a slope greater than 10%. [See Details Appendix C.](#)
11. Areas of special value for culture, archeology, recreation, tourism, or natural resources, including viewsheds or areas of natural beauty.

²⁹ "County Natural Heritage Inventories," Pennsylvania Natural Heritage Program (PHNP), <https://www.naturalheritage.state.pa.us/inventories.aspx>.

³⁰ "Pennsylvania Important Bird Areas", <https://www.audubon.org/important-bird-areas/state/pennsylvania>.

³¹ "Forest Finance 4: Understanding Forest Property Tax Assessment in Pennsylvania," Penn State Extension, <https://extension.psu.edu/forest-finance-4-understanding-forest-property-tax-assessment-in-pennsylvania>.

12. Areas of agricultural heritage or value, including areas designated as Prime Farmland. Development on prime agricultural lands is highly discouraged, and it is appropriate for a municipality to consider a maximum percentage that could be developed in order to protect rural integrity and character, if applicable. [See Details Appendix F.](#)

13. [Farmlands in Zoning Districts designated as Agricultural Protection Zoning \(APZ\)](#)³²

Agricultural Protection Zoning (APZ) is used by municipalities to preserve the availability of agricultural lands for farming and provide stability to the farming economy. The local government designates areas where agriculture is intended to be the principal use. Regulations are established for these agricultural zoning districts to constrain non-agricultural development and uses. APZ regulations can help to:

- a. reduce conflicts between farm and non-farm uses
- b. maintain a critical mass of farmland that keeps businesses and organizations viable that support farms, such as farm suppliers and granges, and keeps land affordable for farmers
- c. protect prime agricultural soils, which if developed, may be irretrievable
- d. protect the character of the community. Note: APZs can be undone by a simple zoning amendment and conservation easements offer greater protection.
- e. Any areas necessary to maintain and enhance the quality of life for the residents of the municipality not listed above, including lands necessary for residential growth.

Recommendations for Permitting

Permitting requirements are the key opportunity to protect the community, wildlife and natural habitats in a municipality. Suggested requirements are as follows:

1. A statement that as a prerequisite to the application for a construction permit for a Solar Energy Facility, the applicant shall provide written notification to the municipality of application to the PJM Regional Transmission Organization.³³ Such written notification is required within 30 days of the application to PJM and is to include such documentation from PJM, as well as a narrative and documents that provide information regarding the headquarters, legal structure, and ownership of the applicant. A statement and financial information that comments on the financial ability of the applicant to fund the construction of the project and provide for the bonding for subsequent de-commissioning is also required.

³² "Agricultural Protection Zoning", WeConservePA, <https://conservationtools.org/guides/67-agricultural-protection-zoning>.

³³ PJM, <https://www.pjm.com>

Recommendations for Permitting, continued

Within 30 days subsequent to that written notification the applicant shall provide, in writing, the list of federal, state, and all other agency and/or authoritative permits that the applicant anticipates will be needed for the proposed project and a list of consultant studies that they will provide and/or anticipate will be required to secure the listed permits.

2. A statement that a permit application is required, and that no construction is to take place (including logging or any form of site preparation) until such application is approved and a building permit issued by the applicable authority of the municipality, as well as NPDES permits from the PA DEP.³⁴

If the earth disturbance associated with the construction of a solar panel farm, over the life of the project, will be 1 acre or greater, NPDES permit coverage is required pursuant to 25 Pa. Code § 102.5(a). Please refer to FAQ #2 for more information.³⁵ [See Details Appendix C.](#)

A proposed solar panel farm must utilize Erosion and Sedimentation Control Best Management Practices (E&S BMPs) that are applicable to the size and scope of the project, which can be found in DEP's Erosion and Sediment Pollution Control Program Manual (E&S Manual)³⁶ or on [DEP's website \(Alternative E&S and PCSM BMPs\)](#).³⁷

3. A statement that the permit application and all subsequent and supporting submissions shall be submitted in both hard copy and electronic form.
4. A statement on the municipality's fees to be charged with respect to the application and a detailed list of the costs for which reimbursement would be expected. These costs listed shall include reimbursement of all legal, engineering, environment, and other consulting fees applicable to the application, review of submitted assessments and reports, and other conditions to the ordinance. Since an application review is of cost to a

³⁴ "National Pollutant Discharge Elimination System (NPDES) and Water Quality Management (WQM) Permits," PA DEP, <https://www.dep.pa.gov/Business/Water/CleanWater/WastewaterMgmt/Pages/NPDESWQM.aspx>.

³⁵ "Solar Panel Farms, FAQ" #2, PA DEP, https://files.dep.state.pa.us/Water/BPNPSM/StormwaterManagement/ConstructionStormwater/Solar_Panel_Farms_FAQ.pdf.

³⁶ "Erosion and Sedimentation Control Manual" 363-2134-008, PA DEP, March 2012. <https://www.depgreenport.state.pa.us/elibrary/GetFolder?FolderID=4680>.

³⁷ "ALTERNATIVE E&S AND PCSM BMPs," PA DEP, Bureau of Clean Water, Revised, August 16, 2022 Version 2.3,, https://files.dep.state.pa.us/water/bpnpsm/StormwaterManagement/ConstructionStormwater/Reviewed_Alternative_BMPs.pdf.

Recommendations for Permitting, continued

municipality, appropriate fees may be imposed to cover the time requirement on the municipality's zoning officer (if applicable), engineer, solicitor, staff and for those with authority who will be involved in public hearings.

5. A statement by the applicant to acknowledge that they have read the ordinance in full, agree to promptly pay all fees and reimbursements and agree to comply with all of its requirements, and understand that a construction permit will not be issued until all requirements have been met and approved by the applicable governing body of the municipality, as well as state and federal authorities. Any major changes to the application will require a new application to be submitted.
6. A narrative to be provided by the applicant describing the proposed Solar Energy Facility, including: an overview of the project; the project location (including a narrative on other locations that were considered and the criteria that provided for the selection of this location); the approximate generating capacity, and expected capacity factor of the Solar Energy Facility; the approximate number of panels, the dimension of those panels and the resulting area to be covered with solar panels, representative types and height or range of heights of the solar panels to be installed, including their generating capacity and respective manufacturers, and a description of ancillary facilities. Storage capabilities associated with the project shall be included in the narrative.
7. The narrative shall include a statement on any need for additional transmission infrastructure required for the project, and if so, provide details on the location and financing of that development. Safety Data Sheets³⁸ for solar panels, a specific statement as to hazardous materials present with the installation of the Solar Energy Facility, and other pertinent information are to be provided:
 - a. The application shall provide adequate documentation showing that the leachate from the manufacturer's panels is non-toxic. The narrative shall include fire safety and firefighting information, any manufacturer recommendations and/or the industry standards on setback, and on other safety and impact considerations and recommendations.
8. A narrative on other locations that were considered and the criteria that provided for the selection of this location.
9. A narrative to include comments and quantitative analysis on the expected positive impacts to carbon/greenhouse gas emissions of the project's electricity generation, based on both expected capacity factor and nameplate capacity versus the current generation that it can be expected to replace, and narrative and analysis on the negative carbon impacts of the project.

³⁸ "OSHA Brief: Hazard Communication Standard: Safety Data Sheets," US DOL, OSHA, February 2012, <https://www.osha.gov/sites/default/files/publications/OSHA3514.pdf>.

Recommendations for Permitting, continued

Such negative impacts should include those related to the manufacture of the solar panels and storage units, if applicable, the site construction materials, the emissions from the transportation of the solar equipment, the removal of existing trees and other vegetation at the project construction site and for the related placement of transmission infrastructure required to deliver the project's generation to the grid. The narrative shall also comment on any plans for replacing habitat lost in the development of the project.

10. A narrative to include comments and quantitative analysis on the expected cost of electrical generation versus the existing costs available to the customers of the utilities currently serving customers in the municipality, and the expected market for the electricity being generated. If there is an agreement to sell the generated electricity, then such agreement shall be disclosed, and a copy provided, in the application or at the time one is reached.

The narrative shall include information from PJM on the impact to the grid in order to accommodate the generated electricity, and any impact of storage capabilities included in the project.

11. An affidavit or similar evidence of an agreement between the property owner(s) and the Facility Owner or Operator, and that the Facility Owner or Operator has the permission of the property owner to apply for necessary permits for construction and operation of the Solar Energy Facility.
12. Copies of federal and state agency application permits, and all documentation of plan submissions, related required studies and reports related to all such permitting requirements. The Applicant shall submit copies of engagement letters for all permit related reports, and all such engagement letters shall include:
 - a. Any and all copies of all reports shall be submitted directly to the agencies and the municipality at the same time that they are submitted to the applicant and
 - b. Any and all finding of confirming or possible evidence of federal or state threatened or endangered species, or species of special concern, will be provided directly and immediately to the applicable agencies and if appropriate, to the municipality.
13. Identify properties on which the Solar Energy Facility would be located and notify all property owners within 2,500 feet of the Facility's boundary using certified letters.
14. A site plan of the development site and extended setback boundaries, drawn to scale of 1 inch equals 50 feet, to include:
 - a. Location of each pane
 - b. Property Lines and Setback lines

- c. Access roads and turnout locations

Recommendations for Permitting, continued

- d. Substation(s)
 - e. Electrical cabling from the Solar Energy Facility to the Substation
 - f. Ancillary equipment, including inverters and battery storage structures
 - g. Both temporary and permanent buildings and structures
 - h. Location of transmission lines (Transmission lines shall be located underground to the extent possible.)
 - i. Roads, existing and to be constructed, to include widths - The width of the cartway should be indicated, as well as any clearing along the sides of the cartway. Road details should be provided for construction access, as well as post-construction.
 - j. Provide weight-bearing capacity and type of surface for all private and public roads to be used by truck and construction equipment to and from the site during construction and for continuing maintenance.
 - k. An analysis of any road improvements needed to accommodate weight and the turning movements related to construction, and the plan for making applicable improvements, including bonding to cover the construction costs of such roads.
 - l. A list of vegetation to be planted and locations.
15. An inventory of environmentally sensitive habitats and conservation areas: to include wetlands, watersheds, bodies of water, riparian buffers, wildlife corridors (for reptiles, amphibians, and mammals), populations of and habitat for endangered or threatened species, Natural Heritage Areas, National Landmark designations, archeological sites, cemeteries, burial grounds, history sites and structures, natural features, scenic viewsheds, existing trails or corridors; including acreage of habitat types (forest/woodlands, grassland, wetland, etc.) that will be impacted by activity, and any replacement of habitat to be done in conjunction with the completion of construction.
16. Statement on requirements for clearance with respect to other permits, if applicable:
- a. Federal Aviation Administration approval, if applicable
 - b. Documentation confirming compliance with the National Pollutant Discharge Elimination System (NPDES) regulations.³⁹ [See Details Appendix C.](#)

³⁹ NPDES and WQM Permits, PA DEP, <https://www.dep.pa.gov/Business/Water/CleanWater/WastewaterMgmt/Pages/NPDESWQM.aspx>.

Recommendations for Permitting, continued

- c. Documentation and/or proof demonstrating compliance with the Pennsylvania Natural Heritage Program (PNHP) to protect biological species listed as endangered, threatened, or rare as listed by the Department of Conservation and Natural Resources (DCNR), PA Game Commission, PA Fish and Boat Commission, U.S. Fish and Wildlife Services, and species recommended for protection by the Pennsylvania Biological Survey.
- d. Analysis of a pre-construction survey of breeding and wintering birds in the proposed project area.
- e. A report(s) by an independent consultant to the municipality that includes wildlife (mammal, bird, reptile, amphibian) risk assessment to include expected mortalities during construction and operations; and to include a plan for the monitoring for mortalities during construction and operation and the mitigation program that will be implemented.
- f. A comprehensive Environmental Stewardship Plan (ESP), that provides a narrative on the responsible use and protection of the project area shall be submitted by a qualified consultant. Such ESP shall address any and all issues raised by agency-supplied studies (to include, among others; protection of endangered plant or animal species, wetland, and watershed issues, NPDES issues, and habitat replacement), and shall include detailed narrative on the requirements for ground and buffer planting and maintenance.

The ESP shall provide a summary narrative on pre-construction assessments and an annual update shall be issued, with such update to include recommended post construction monitoring and mitigation.

- g. With days to be adjusted per the requirement of the Municipal Planning Code and/or per guidance of the Solicitor, a standard list of requirements with respect to notice to the public by the municipality to include:
 - i. Notify the township residents of the applicant's permit application – 30 days
 - ii. Provide a completeness notification to the Applicant – 45 days
 - iii. Following the completeness determination by the municipality, the applicant shall schedule at least two open meetings to introduce the public to the project.
 - iv. A public hearing shall be held to provide the opportunity for the Applicant to present the project to the public and municipal officials and to answer questions about the project; and to afford the public a full and fair

Recommendations for Permitting, continued

opportunity to provide comment, present information, evidence, and witnesses regarding the project impact – 60 days.⁴⁰

17. It should be noted that any modifications after construction, such as changing the size, type, number of panels, the area covered in panels, or other equipment, would require a new permit.
18. Any state or local law that includes a mandate to protect property value or secure “quiet enjoyment” should be included. If no law exists, then a property value guarantee should be included.

A property value impact study prepared by an independent appraiser having appropriate qualifications, including a Pennsylvania appraiser license, should be completed and paid for by the applicant. This is a critical issue for community protection. The appraiser must include an estimated pre-project value of the real estate market value of all holdings within the impacted area.

Approval of an application should include a written Real Property Value Protection Agreement as a condition of permit approval for the area impacted per the study, and such Agreement is to be secured by a bond to cover a projected loss if indicated in the study.

Other Items to be Included in a Utility-Scale Solar Ordinance

1. Applicant to notify municipality and submit any changes in the information contained in the permit application.
2. Provide for an annual report, with such cost to be paid by the facility owner, on the inspection of the facility and solar panels that is to be conducted by municipality’s engineering and/or consulting engineering, legal and administrative departments or hired professionals; with such inspection to determine and report on the compliance with the requirements included in the approved permit. (Standard)
3. Additional suggested requirements to include in the independent reporting on:
 - a. Maintenance of natural habitat and management of invasive species
 - b. Watershed and erosion management
 - c. A Glare Impact Study shall be conducted and any other applicable safety issues

⁴⁰ Pennsylvania Municipal Planning Code, <https://dced.pa.gov/download/pennsylvania-municipalities-planning-code-act-247-of-1968/>

- d. A Property Value Impacts Study shall be completed

Other Items to be Included in a Utility-Scale Solar Ordinance, cont'd

- e. Height of solar panels: Height limits should be established based on current best practices and/or to manage visual impacts. Example: Ground-mounted solar energy systems shall not exceed 15 feet.
 - f. Scenic Viewshed Impacts and protection
 - g. Appropriate provisions should be included to protect viewsheds with a requirement on the Applicant to provide a before and after visual impact study. Standard inclusions will include 360-degree and three-dimensional computer-generated surface models, along with appropriate photos (including drone photos if needed) to document the impact to the area, and with special attention to key sites and scenic by-ways that would be impacted.
4. Setbacks should be established from:
- a. Property lines
 - b. Public roads
 - c. Waterways and wetlands
 - d. Historic structures and district
 - e. [Audubon's Important Bird Areas in Pennsylvania](#)⁴¹
 - f. [Pennsylvania Natural Heritage Areas](#)⁴²
5. Environmental Impact Statement - An environment impact study with an exhaustive list of protections from potential impacts to the area that could be impacted by the Solar Facility to and/or to include:
- a. Comments and concerns raised by citizens and all governmental agencies
 - b. Human, livestock, and wildlife health
 - c. Water assets
 - d. Vegetation, including invasive plant impacts
 - e. Wildlife habitat and corridors, including migration pathways and flyways
 - f. Endangered habitat, plants, and animals

⁴¹ Pennsylvania IBAs, <https://www.audubon.org/important-bird-areas/state/pennsylvania>.

⁴² Pennsylvania Natural Heritage Program (PNHP), <https://www.naturalheritage.state.pa.us/CNHI.aspx>.

Other Items to be Included in a Utility-Scale Solar Ordinance, cont'd

- g. Areas of special designation, including both for historical and conservation significance
 - h. Hydrogeologic study, to include impacts to groundwater supplies, wetlands, and streams.
 - i. Geological study, to include impacts on stability and analysis of hazardous minerals that could be exposed during excavation.
6. Emergency Response Plan - The Applicant should be required to have a documented emergency response plan that will be shared and commented on by the Municipality and all applicable first responders. Among the many issues to be covered are fires, solar panel collapse, fluid spills, access and sufficiency of equipment and manpower for anticipated emergencies. Fire safety and other issues regarding panel components and hazards are addressed in "[The Health and Safety Impacts of Solar Photovoltaics](#)" a White Paper from NC State University.⁴³ [See Details Appendix D.](#)
7. Public Complaints and Inquiries - Appropriate provisions shall be included to provide for communication platforms for public inquiries and complaints; and reporting of such to the Municipalities.
8. Glare and other safety and health-related impact studies, requirements, and testing - All studies and plans (including with respect to glare and emergency response) needed to provide for the safety of adjacent property owners and of all residents of the Municipality shall be conducted. Remedies to replace any disruption in reception that is caused by the Solar Energy Facility shall be designated. Studies with respect to weather hazards and protocols for shutdown for preventative actions during times of hazardous weather conditions.
9. Noise Impact Assessment - Like any other energy-generating or industrial facility, solar projects must be designed and operated to be compliant with state and municipal noise codes. Noise criteria and regulations should be established at the property line, which is in accordance with standard practice for zoning or a municipality's subdivision and land development ordinance.

A Noise Impact Assessment should be conducted to assess the predicted environmental noise impact from the proposed operations on the surrounding environment. The predicted levels of noise should be compared to the permissible noise level limits determined by the municipality. [Example of a Noise Impact Assessment for a Solar](#)

⁴³ *Health and Safety Impacts of Solar Photovoltaics*, White Paper, NC State University, NC Clean Energy Technology Center, May 2017, https://nccleantech.ncsu.edu/wp-content/uploads/2018/10/Health-and-Safety-Impacts-of-Solar-Photovoltaics-2017_white-paper.pdf.

Other Items to be Included in a Utility-Scale Solar Ordinance, cont'd

[Project](#).⁴⁴ Acoustician Robert Rand's Noise Impact Assessment Overview on Solar Facility Inverters and Transformers is contained in [Appendix G](#).

10. Economic Impact Study - Such study shall include projected impacts on tourism and recreation, businesses, agricultural production operations, property devaluations and housing market; all in context with any long-term goals established by Municipality and/or regional planning commissions.

11. Traffic Impact Study and Use of Public Roads:

- a. A traffic impact study by a qualifying consultant should be required.
- b. Pre and post construction evaluation of the road conditions should be done by a qualified consultant and requirements for repairs at the cost of the Applicant are to be included. Bonding and/or such appropriate assurance for payment to be included.

12. Design and Installation:

- a. If any recent studies favor a solar panel that would reduce hazards to birds, bats or other wildlife, then such study suggestions should be adopted.
- b. On-site transmission and power lines between Solar Panels shall be placed underground.
- c. A resident shall be provided with an alternative method of receiving signals if there is significant interference or disruption resulting from the installation of the Solar Energy Facility.
- d. If applicable, require a Forest Plan prepared by a Professional Forester and/or consultation with a state forester from the Pennsylvania Department of Conservation and Natural Resources.
- e. Require that clearance of woods is held to a reasonable minimum and in no case shall there be clearance of more than 10 percent of the total woodland area for the use of the project.

⁴⁴ *Noise Impact Assessment SR North Stonington Solar Project New London County, CT*, Urban Solution Group, Prepared for: Silicon Ranch Corporation (2020, December 2), https://portal.ct.gov/-/media/CSC/3_Petitions-medialibrary/Petitions_MediaLibrary/MediaPetitionNos1441-1450/PE1443/PetitionerSubmissions/Petition/Exhibit-N---Noise-Impact-Assessment.pdf.

- f. Require that all invasive plant and animal species be removed before installation and that native ground cover be established before construction begins. The native vegetated ground cover that is Pollinator-Friendly shall be planted under

Other Items to be Included in a Utility-Scale Solar Ordinance, cont'd

- g. and around solar panels and in buffer areas, established, and maintained over the life of the project.

Such planting to be made under the most recent guidance by the National Audubon Society, the Penn State Extension, and/or by any other authority as deemed suitable by the Municipality. [See Details Appendix H.](#)

If sheep grazing is considered, native vegetation shall be planted. Information about sheep grazing on solar installations is available from the [American Solar Grazing Association](#).⁴⁵

- h. A written maintenance plan is to be included that notes no insecticide or fertilizer use and provides for timing of any mowing that will not interfere with the breeding of grassland bird species. The property owner shall be given the right of first refusal for the property maintenance contract for the solar project.

It is important that maintenance personnel receive training so that they can identify native vegetation and prevent its removal, and to know and anticipate any wildlife that may be found on site if wildlife friendly fencing is utilized.

If a Pollinator Habitat Planning Scorecard is available, such is to be completed and if the project does not qualify as pollinator friendly, then the applicant will submit a landscaping plan detailing the site conditions that prevent the site from being qualified and state the alternative means of meeting the water quality and habitat goals of the habitat-friendly standard. [See Details Appendix H.](#)

- i. Traditional fencing does not allow the movement of wildlife and is a cause of bird and wildlife deaths, from entanglement with wires, razor or blunt point cuts and impalement.

Wildlife-friendly standards prohibit the use of barbed wire, razor or blunt points or woven wire designs and include smooth wires. This type of fencing is often more pleasant to look at and more acceptable to communities. A recommended style for a wildlife-friendly solar installation is upside-down deer fencing. [See Details Appendix I.](#)

- j. Wildlife Corridors - A perimeter fence is a barrier to wildlife movement, while fencing around but not in between solar panel bays creates open areas through which animals can continue to travel. The arrangement of panels within a project

⁴⁵ American Solar Grazing Association, <https://solargrazing.org/>.

site is also important to maintain areas conducive to wildlife travel through the site.

Other Items to be Included in a Utility-Scale Solar Ordinance, cont'd

In addition to mitigating the visual impact of Utility-Scale Solar facilities, substantial buffers can act as wildlife corridors along project perimeters. Existing trees, wetlands, or other vegetation that link open areas should be preserved as

wildlife cover. Such sensitivity to the land's environmental features also breaks up the panel bay groups and will make the eventual restoration of the land to its previous state that much easier and more effective.

Any other recommendations to provide for wildlife corridors from the National Audubon Society, the Penn State Extension, and/or by any other authority as deemed suitable by the Municipality can also be included. [See Details Appendix I.](#)

- k. The use of gravel under the solar panels is not recommended. Gravel increases stormwater flow, compacts the soil, and is difficult to remove during decommissioning. The widespread use of gravel beneath solar panels requires stormwater analysis, additional post-construction stormwater management and best management practices in accordance with 25 Pa. Code §§ 102.8(g)(2) & 102.8(g)(3)⁴⁶.
- 13. Liability Insurance - Evidence of appropriate insurance policies for property, injury and/or death, with the Municipality designated as an Additional Insured, to be obtained by the Applicant/Facility Owner and/or Operator to include General Liability, Workers Compensation, and Umbrella Liability.
- 14. Maintenance, Repair, and Replacement - Once in operation there shall be requirements to maintain and operate the Solar Energy Facility in a manner consistent with best practices of the industry, and there shall be a regular inspection requirement to be conducted by an outside consultant. A modification or expansion to the Facility shall require a new permit.
- 15. Decommissioning - All solar panels and associated structures (including concrete footings, metal pilings and mounting structures, wiring, transmission lines, and site improvements (roadways) must be removed within twelve months upon expiration of the permit and/or after cessation of operation. The landowner has the option of keeping the roadways.

⁴⁶ "Chapter 102, FAQ 6," January 2, 2019 Revised, April 30, 2021 Version 1.1: https://files.dep.state.pa.us/Water/BPNPSM/StormwaterManagement/ConstructionStormwater/Solar_Panel_Farms_FAQ.pdf.

A Decommissioning Plan shall be a requirement of the Application. Such a plan will include a cost estimate and financial security, generally expected to be a performance bond to be put in place to cover that cost; and will detail the improvements to be removed and the post removal condition to be required on the site.

The plan will set a timeline for such work following expiration of the permit or cessation of operations. The ordinance language should include appropriate provisions that all applicable governmental agency requirements will be met and will provide the Municipality with appropriate rights and authority to assure the performance of the Plan, and that the costs will all be borne by the Facility Owner and/or Operator. Additional information about hazardous materials in Solar Panels and decommissioning is found in [“The Health and Safety Impacts of Solar Photovoltaics”](#) NC State University.⁴⁷ [See Details Appendix J.](#)

⁴⁷ “Health and Safety Impacts”, NC State University, May 2017, https://nccleantech.ncsu.edu/wp-content/uploads/2018/10/Health-and-Safety-Impacts-of-Solar-Photovoltaics-2017_white-paper.pdf.

Appendices

Appendix A: Beyond Carbon Free

Beyond Carbon Free: A Framework for Purpose-Led Renewable Energy Procurement and Development, The Nature Conservancy, Level Ten Energy, and The National Audubon Society.

<https://www.nature.org/content/dam/tnc/nature/en/documents/BeyondCarbonFreeFinal.pdf>.

Supporting a sustainable and equitable clean energy transition starts with embracing the 3 Cs in clean energy development and procurement: Communities, Conservation, and Climate:

Community:

1. Please describe perspectives in the host community on the project, including any favorable or unfavorable feedback.
2. What is your community engagement plan? Will there be a Community Benefit Agreement in place between the project and the host community? If so, at what stage are these discussions currently?
3. Who benefits from ownership in the project? Do mechanisms exist for re-investing profits in the community? If so, please share.
4. Will the project provide targeted investments for local communities that have been disproportionately impacted by climate change, industrial waste and pollution?
5. Has the project completed an archaeological and cultural resources survey in consultation with relevant tribal governments? If so, please share.
6. What percentage of the project's workforce will be graduates of a state or federally approved apprenticeship program? What percentage of the project's workforce will be under collective bargaining? Of the total jobs the project will create, what percentage will be filled by local community members?
7. If there will be a project-sponsored job training program, will it include specific diversity, equity, and inclusion targets? If there will not be, why not?
8. Will the percentage of supplier diversity for sourcing and/or subcontracting be tracked for this project? Have these suppliers been screened for supply chain protocols, such as anti-forced labor provisions?

Conservation:

- a. Will the project be located in an area specifically designated as a preferred renewable energy development zone?

- b. Will the project be located on previously impacted land, such as brownfield, built structure, landfill, or mine lands?
- c. Will the project be located on agricultural land? Is the agricultural land categorized as “prime” or “important” agricultural land?
- d. Will the project have a moderate-to-high probability of significant adverse impacts to species of concern or their habitat such as federally or state-listed candidate species or their habitat, or “species of greatest conservation need” identified in State Wildlife Action Plans?
- e. Did state and federal wildlife agencies concur with the conclusions to Question 4? Will a mitigation plan be developed to address these impacts (first avoid, then minimize, and as a last resort, offset impacts)?
- f. Will the project be located entirely on, partially on, or adjacent to important natural habitats as identified by the wildlife layer of The Nature Conservancy’s Site Renewables Right Map?
- g. Will the project be located entirely on, partially on, or adjacent to Important Bird Areas as identified by The National Audubon Society?
- h. Does your project have any environmental impact minimization and/or enhancement characteristics (i.e., pollinator-friendly plantings, wildlife-permeable fencing, bat-and-bird-deterrent technologies)? If yes, please describe.

Climate:

- 1. Is the project offering “additional” electricity generation in displacement of conventional generation technologies?
- 2. Are you tracking the sourcing practices and GHG footprint of major equipment components required for the project?
- 3. Is there tree clearing required for project development? If so, have you estimated the projected payback period from lost carbon storage?
- 4. How will your project decommissioning plan reflect the community’s priorities? Does the project have a decommissioning plan that includes recycling components and returning land to original values?

Appendix B: Penn State Extension Utility-Scale Solar in Pennsylvania

Pennsylvania Landowners Guide to Utility-Scale Solar Leasing

<https://extension.psu.edu/pennsylvania-landowners-guide-to-utility-scale-solar-leasing>

This guide is intended to inform landowners on terminology, background information, and considerations to make when approached to lease their land for Utility-Scale Solar.

Webinars: <https://extension.psu.edu/catalogsearch/result/?q=solar+energy+webinar>

Penn State Extension webinars are an excellent source of information regarding solar energy development in Pennsylvania. A sampling of available recordings is listed here. Additional webinars on solar are available and include solar development for landowners, leasing, and economics of solar development.

- **Solar Energy and Land Use – Designing a Sustainable Outcome:**
<https://extension.psu.edu/solar-energy-and-land-use-designing-a-sustainable-outcome>
- **Environmental Aspects of Solar Power**, Recorded Mar 2, 2021:
<https://extension.psu.edu/environmental-aspects-of-solar-power>
- **Solar Energy and Agrivoltaics:**
<https://extension.psu.edu/solar-energy-and-agrivoltaics>
- **Utility Scale Solar: Land Use, Policy and Emerging Ordinances - An Interactive Q and A:** <https://extension.psu.edu/utility-scale-solar-land-use-policy-and-emerging-ordinances-an-interactive-q-and-a>
- **Sheep Grazing to Maintain Solar Energy Sites in Pennsylvania:**
<https://extension.psu.edu/sheep-grazing-to-maintain-solar-energy-sites-in-pennsylvania>

Sheep grazing has proven to be a successful way to maintain solar energy sites in many states. Furthermore, grazing sheep has been found to be more cost-effective than a more traditional approach.

- **Utility Scale Solar and Siting Considerations: Stormwater, Vegetation, Fencing, and Ag Use:** <https://extension.psu.edu/utility-scale-solar-and-siting-considerations-stormwater-vegetation-fencing-and-ag-use>

This webinar focuses on key siting issues associated with utility scale solar development. The presentation will look at how stormwater is managed at a large solar facility and include a discussion on impervious surfaces, control structures, and protection of environmentally sensitive areas.

Appendix C: PA DEP Permitting for Solar Panel Farms

Chapter 102 Permitting for Solar Panel Farms Frequently Asked Questions (FAQ),
January 2, 2019, Revised, April 30, 2021, Version 1.1⁴⁸

The following information is from the PA DEP FAQ:

“This FAQ document was developed to clarify the Department of Environmental Protection’s (DEP’s) interpretations concerning applicability and implementation of National Pollutant Discharge Elimination System (NPDES) permits for stormwater discharges associated with construction activities, including erosion and sediment control (E&S) and post-construction stormwater management (PCSM) for solar panel farms.

Project proponents should (1) minimize the extent and duration of the earth disturbance activity, (2) maximize protection of the existing drainage features and vegetation, (3) avoid soil compaction, and (4) utilize any other measures or controls to prevent or minimize the generation of increased stormwater runoff.

Minimize the lowest vertical clearance of the solar array (when at resting position during storm events) while retaining sufficient height to sustain perennial deep-rooted vegetation and optimizing infiltration below the array.

Limiting the vertical clearance of the solar array will minimize the potential for accelerated erosion to occur along the drip line of the solar array. Additional controls such as turf reinforcement/energy dissipation may be needed to address erosion and scour along the dripline – particularly in cases where the lowest vertical clearance of solar panels from the ground exceeds 10 feet. Meeting these conditions will minimize the potential for accelerated erosion.

Surface slope is a contributing factor to runoff, particularly projects proposing earth disturbance on slopes greater than 10%. Existing slopes on the project site should ideally be 10% or less.”

Slopes of 10% or less reduce erosion and sedimentation.

The DEP document should be thoroughly studied by municipalities and solar developers to understand state and federal parameters for solar development.

The use of gravel leads to larger volumes of stormwater runoff to manage as well as compaction of soil and adds to costs for decommissioning. See FAQ #6.

The DEP FAQ document also provides recommendations for agrivoltaics. See FAQ #12.

⁴⁸ PA DEP Chapter 102 Permitting for Solar Panel Farms Frequently Asked Questions (FAQ)
https://files.dep.state.pa.us/Water/BNPNSM/StormwaterManagement/ConstructionStormwater/Solar_Panel_Farms_FAQ.pdf,

The PA DEP Erosion and Sediment Control Frequently Asked Questions (FAQ), June 15, 2021, Version 1.1

https://files.dep.state.pa.us/Water/BNPNSM/StormwaterManagement/ConstructionStormwater/E%26S_FAQ.pdf

The PA DEP Erosion and Sediment Pollution Control Program Manual

<http://www.depgreenport.state.pa.us/elibrary/GetFolder?FolderID=4680>

“A proposed solar panel farm must utilize Erosion and Sedimentation Control Best Management Practices (E&S BMPs) that are applicable to the size and scope of the project, which can be found in DEP’s Erosion and Sediment Pollution Control Program Manual (E&S Manual) or on DEP’s website (Alternative E&S and PCSM BMPs).”

The PA DEP ALTERNATIVE E&S AND PCSM BMPs

https://files.dep.state.pa.us/water/bpnpsm/StormwaterManagement/ConstructionStormwater/Reviewed_Alternative_BMPs.pdf.

PA DEP NPDES and WQM Permits

<https://www.dep.pa.gov/Business/Water/CleanWater/WastewaterMgmt/Pages/NPDESWQM.aspx>.

Appendix D: Environmental Rights Amendment

The Environmental Rights Amendment to the PA Constitution was approved by voters on May 18, 1971: “The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic, and esthetic values of the environment. Pennsylvania’s public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.” This amendment is codified in Article 1, Section 27 of the Pennsylvania Constitution: <https://www.legis.state.pa.us/WU01/LI/LI/CT/HTM/00/00.001..HTM>

Pennsylvania’s Environmental Rights Amendment, Conservation Advocate, Pennsylvania Land Trust Association, Frank L. Kury

<https://conservationadvocate.org/pennsylvanias-environmental-rights-amendment>

PENNSYLVANIA CONSTITUTION Article I, § 27 Resources, ENVIRONMENTAL LAW AND SUSTAINABILITY CENTER, Widener University Commonwealth Law School

<https://widenerenvironment.com/environmental-law/art-1-sec-27-resources/>

A Citizen’s Guide to Article I, § 27 of the Pennsylvania Constitution, Prepared by The Widener School of Law’s Environmental & Natural Resources Law Clinic, Summer 2010

https://blogs.law.widener.edu/envirolawcenter/files/2010/03/PA_Citizens_Guide_to_Art_I_Sect_27.pdf

Applying the Environmental Rights Amendment in 2019, January 14, 2019, Thomas M. Duncan, Esq., MGKF Special Alert - Pennsylvania Forecast 2019

<https://www.mankogold.com/publications-ERA-PEDF-Coalfield-Justice-PA-Supreme-Court.html>

Health and Safety Impacts of Solar Photovoltaics, NC State University, 2017

http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2017/10/Health-and-Safety-Impacts-of-Solar-Photovoltaics-2017_white-paper-1.pdf

This white paper, produced by NC State University, details the health and safety impacts of solar development. Concerns over hazardous materials, electromagnetic fields, electric shock, and fire safety are addressed in this study.

Appendix E: Low-impact Solar Development

National Renewable Energy Laboratory, Beneath Solar Panels, the Seeds of Opportunity Sprout

<https://www.nrel.gov/news/features/2019/beneath-solar-panels-the-seeds-of-opportunity-sprout.html>

“Low-impact solar development improves soil health, retains water, nurtures native species, produces food, and reduces energy costs for local communities. It’s unlike traditional solar development, which uses land solely for energy production.”

The Inspire Project designed the Low-Impact Solar Development Strategies Guidebook and Primer “to provide insights and best practices associated with low-impact solar development. It (They) can assist solar developers, state agencies, and other interested parties in siting, designing, installing, and operating low-impact solar development projects.”

Low-Impact Solar Development Strategies Guidebook

<https://openei.org/wiki/InSPIRE/Guidebook>

Low-Impact Solar Development Strategies Primer

<https://openei.org/wiki/InSPIRE/Primer>

“Industry identified best practices include Avoid environmentally sensitive areas (wetlands, endangered species habitat, etc.) as much as possible. Work with local landowners/environmental groups to identify cultural sites and sites of local significance to identify areas to avoid.”

“Potential benefits to landowners include self-generation of electricity and reduced energy bills; Additional income stream and increased revenue security; Control of wind and soil erosion; Compatible with grazing activities, provides shade and cover for livestock; New market opportunities for shade tolerant crops; Protection of natural habitat; Safeguarding soil health, (and) Improved habitat for pollinator species.”

“Potential benefits to solar developers include reductions in site preparation and installation costs; reductions in O&M costs; reduced need for dust suppression; reduction in litigation vulnerability; decreased permitting time; increased solar energy production from cooler air zone created under modules, and reduction in environmental mitigation investments.”

The following table from the Inspire Low-Impact Solar Development Primer Website shows some general principles for low-impact solar:

Conventional Site Preparation:	Low-Impact Site Preparation:
Clearing and grubbing of soil and roots	Existing vegetation is left intact or is replaced with low-growing native vegetation species or crops
Topsoil stripping and stockpiling	Existing topsoil is left in place to allow for the successful growth of native vegetation and to promote soil health post-decommissioning of the solar project
Land grading and leveling utilizing heavy machinery	Natural contours of land are worked into the design and configuration of the solar project, with minimal if any land grading required
Soil compaction utilizing heavy machinery	Soil and vegetation are left intact to facilitate the growth of native vegetation, improved stormwater management through less runoff and erosion, and soil health
Land footprint for the foundations of vertical support structures, often including concrete	Lower land footprint for foundations of vertical support structures, often driven piles
Vegetation that supports habitat is discouraged and removed	Vegetation that supports habitat (e.g., pollinator species, other native fauna) is encouraged
O&M activities include herbicide spraying, mowing of weeds and other vegetation	Minimal O&M activities due to low-growing native vegetation species, could involve livestock grazing”

Principles of Low Impact Solar Siting and Design, The Nature Conservancy in North Carolina

https://www.nature.org/content/dam/tnc/nature/en/documents/ED_TNCNCPinciplesofSolarSitingandDesignJan2019.pdf

The following recommendations are from the “Summary of Principles and Practices” in the above document:

1. Avoid areas of high native biodiversity and high-quality natural communities. Avoid siting in resilient areas. Resilient areas are identified as areas that contain high levels of landscape diversity and local connectedness that increase resilience to climate change. These areas are likely to have the highest levels of species biodiversity now and in the future and should remain undeveloped. We do not recommend mitigating biodiversity loss by moving sensitive species from a solar site to natural habitat, due to the low success rates associated with these efforts.
2. Allow for wildlife connectivity, now and in the face of climate change. Avoid siting in and fragmenting wildlife corridors. Where appropriate, use wildlife-friendly fencing or unfenced wildlife passageways.
3. Preferentially use disturbed or degraded lands. Preferentially site on degraded lands with little vegetation and/or poor soil quality. Retain or plant vegetation/trees in buffers or outside of a perimeter fence.
4. Protect water quality and avoid erosion. Do not site in floodplains. Buffer streams and wetlands.
5. Restore native vegetation and grasslands. Integrate the planting of native and/or pollinator vegetation where appropriate.
6. Provide wildlife habitat. Protect and restore on-site wildlife habitat features (e.g., wetlands, vegetated buffers). Provide supplemental habitat as appropriate.

EPA’s RE-Powering America’s Land Initiative

<https://www.epa.gov/re-powering>

RE-Powering America’s Land is an EPA initiative that encourages renewable energy development on current and formerly contaminated lands, landfills, and mine sites when such development is aligned with the community’s vision for the site.

Appendix F: Prime Farmland

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban or built-up land or water areas. The soil quality, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields

of crops when proper management, including water management, and acceptable farming methods are applied.

Prime farmland is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. The water supply is dependable and of adequate quality. Prime farmland is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. Slope ranges mainly from 0 to 6 percent.

More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service, located in each county.

<https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/pennsylvania>

The Natural Resources Conservation Service (NRCS) provides a table for each Pennsylvania County that lists the Soils Map Unit, the Map Unit Name, and the class of soil. For example, in Adams County, Soil Map Unit ArB, which stands for Arendtsville gravelly loam, 3 to 8 percent slopes is classified as Prime Farmland.

NRCS Welcome to Web Soil Survey (WSS)

<https://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>

The above site offers a simple yet powerful way to access and use soil data.

Title 4 Chapter 7 4Pa.Code 7/303 Protected agricultural lands

<http://www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/data/004/chapter7/s7.303.html&d=reduce>

“7.303. Protected agricultural lands.

- (a) The prime agricultural land to be protected under this subchapter includes lands:
 - (1) In active agricultural use (not including the growing of timber).
 - (2) Devoted to active agricultural use the preceding 3 years.
 - (3) Which fall into at least one of the categories of agricultural land in subsection (b).
- (b) State agencies shall provide protection to prime agricultural land under this subchapter based upon the following levels of priority:
 - (1) *Preserved farmland (highest priority)*. Preserved farmland includes lands that fit into one of the following categories:
 - (i) Farmland that is restricted to agricultural use by an agricultural conservation

easement that has been recorded in the appropriate county land records office. These easements include:

- (A) Easements owned by the Commonwealth or county, and township under the authority of the Agricultural Area Security Law (3 P.S. § § 901—915).
 - (B) Easements owned by any other “qualified conservation organization,” as that term is defined in section 170(h)(3) of the Internal Revenue Code (26 U.S.C.A. § 170(h)(3)). Qualified conservation organizations may include private nonprofit land conservation organizations, in addition to local governments and State governments.
- (ii) Farmland that is restricted to agricultural use by deed restrictions that have been imposed under the authority of the act of January 19, 1968 (1967) (P.L. 992, No. 442) (32 P.S. § § 5001—5013) and that have been recorded in the appropriate county land records office.
- (2) *Farmland in agricultural security areas (second highest priority)*. Farmland approved by local government units after public review and comment according to the procedures in the Agricultural Area Security Law.
 - (3) *Farmland enrolled in the Pennsylvania Farmland and Forest Land Assessment Act of 1974 (Clean and Green) (Act 319) programs or the act of January 13, 1966 (1965) (P.L. 1292, No. 515) (16 P.S. § § 11941—11947) (Act 515) programs (third highest priority)*. Farmland enrolled for preferential tax assessments as land in “agriculture use” (Act 319) or “farmland” (Act 515).
 - (4) *Farmland planned for agricultural use and subject to effective agricultural zoning (Fourth highest priority)*. Farmland designated for agricultural use in a comprehensive plan and zoning ordinance adopted in the Pennsylvania Municipalities Planning Code (53 P.S. § § 10101—70105) that delineates an area of agriculturally valuable soils and existing farms.
 - (5) *Land capability Classes I, II, III and IV farmland and unique farmland (fifth highest priority)*. Land capability Classes I, II, III and IV farmlands are mapped by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (formerly Soil Conservation Service) and published in county soil surveys. “Unique farmland” is defined by the USDA Natural Resources Conservation Service as land other than prime farmland that is used for the production of specific high value food and fiber crops. The USDA Natural Resources Conservation Service has established a mechanism under which unique farmland is identified and mapped by interested county committees.”

Reshaping the Energy Future: Renewable Energy and Land Trusts - Conservation in a Changing Climate, Land Trust Alliance

<https://climatechange.lta.org/reshaping-the-energy-future-renewable-energy-and-land-trusts/>

Appendix G: Noise

Definitions:

dB: Decibels measure sound intensity using a logarithmic scale. This means that a 3 dB increase from 40 dB to 43 dB doubles the sound energy, while an increase of 10dB increases the sound by a factor of ten.

dB(A): A-weighted decibel is an expression of the relative loudness of sounds in air as perceived by our ears.

Ldn or DNL: stands for Day-Night Average Sound Level and describes the cumulative noise level of the A-weighted sound pressure level over a 24-hour period, with a penalty added for noise during the hours of 22:00 to 07:00. 10dB is added to reflect the impact of noise during the nighttime period.

Lden: stands for Day Evening Night Sound Level is the average sound level over a 24-hour period, with a penalty of 5dB added for the evening hours of 19:00 to 22:00, and a penalty of 10 dB added for the nighttime hours of 22:00 to 07:00. It is very similar to Ldn, but with the added penalty for the evening period.

Leq: stands for Equivalent Continuous sound level, which is the steady sound pressure level which, over a given period of time, has the same total energy as the actual fluctuating noise.

The following document is an overview of noise emissions, control and recommended noise design guidelines for grid-scale solar facilities:

<http://iiccusa.org/solar/rob-rand-noise-impact-assessment-overview/>

“Robert W. Rand, ASA, INCE (Member Emeritus)
RAND ACOUSTICS, LLC
65 Mere Point Road Brunswick, ME 04011
E-mail: rrand@randacoustics.com
Telephone: 207-632-1215

I respectfully submit this general overview of noise emissions, control, and recommended noise design guidelines for grid-scale solar facilities which contain inverters and transformers.

Design basis

INCE Rules of Practice require approving only noise control engineering studies, reports, or work which, to the best of the reviewer's knowledge and belief, is safe for public health, property, and welfare and in conformance with accepted practice. From years of work in power generation noise control including ten years at Stone & Webster Engineering Corporation, accepted practice includes planning to protect communities from unwanted sound and assuring facilities comply with regulatory requirements with an adequate margin of safety. Noise complaints indicate developers, regulators, and consultants failed to protect from unwanted sound.

Background: Solar Facility Noise Overview

1. Noise is unwanted sound; sound that is annoying, interfering with activities such as sleep, degrading of amenity. Zoning and regulations establish noise limit standards on the predicate to protect people from unwanted sound and prevent high annoyance.
2. Grid-scale solar facilities contain inverters and transformers. Solar inverters convert DC voltage from panels to AC voltage. Transformers step that voltage up to grid voltages. Inverters and transformers emit tonal noise due to magnetostriction and emit broadband fan noise where components are fan-cooled. Typical A-weighted noise levels for each grid-connect system component are in the range of 65-68 dBA at 10 meters.
3. Transformer noise consists of primary tonal components at 120, 240, 360 and 480 Hz. Additional harmonics continue at higher frequencies but are generally not considered in noise control planning. Fan noise is broadband in nature and is generally not objectionable with sufficient distance provided the fans do not emit significant tonal noise themselves. Quiet transformers (Best Available Technology) can be purchased at up to 15 to 20 dB below normal NEMA ratings. If a quieter transformer is incorporated in a facility design, the lowered sound level rating should be used in place of the regular NEMA rating during noise impact estimates.
4. Inverter noise emissions include unfamiliar-sounding chopped tonal noise components at approximately 3000, 6000 and 9000 Hz [video for inverter SMA Type TCS 1600 MV-2F at https://www.youtube.com/watch?v=H_G2p0y31I accessed 10 Nov 2020] (SMA Solar Technology AG, SC2200-3000-EV-DS-en-59.pdf, 1 April 2020).
5. Cost-effective noise controls for transformer and inverter noise are readily available and used worldwide for decades. These include full building enclosures, industrial site noise barriers, acoustic slotted masonry block barriers, and reactive barrier panels.
6. Facility components: An example system diagram is shown from SMA, a world-around solar component supplier headquartered in Germany. The SMA design overview below shows the components used in a large facility (inverter and transformer components are outlined with ovals).

Review of Noise Criteria

1. Regulations should state a permitting predicate to prevent annoyance by prohibiting audible excessive tonal sounds from solar components within residential property lines. "A prohibition on producing any audible prominent tones, as defined by using the constant level differences listed under ANSI S12.9-2005/Part 4 Annex C (sounds with tonal content), at the outside of any existing nonparticipating residence or at any point on residential property where audible tonal sound would result in activity interference." Regulations should require that audible prominent tones shall be flagged and reduced in level with noise control implemented as required to drop below prominent tone thresholds.
2. ANSI Standards provide a neutral consensus-body reference for noise guidelines for compatibility with land use. Environmental noise compatibility for land use can be formally assessed using ANSI S12.9 Parts 4 & 5 which establish guidelines for

compatibility of a new intrusive noise source for various land uses including rural residential land use. See this letter's Supplement A.

3. ANSI S12.9 establishes by tabular computation that daytime and night-time intrusive noise levels are compatible with quiet rural residential land use when total intrusive long-term average sound levels do not exceed 40 and 30 dBA, respectively.
4. Tonal noise is assigned a 5-dB penalty in many jurisdictions to account for its highly objectionable noise character. However, when evaluating compatibility to land use with ANSI S12.9 Part 5, pure tone/impulse corrections should be ignored, since this factor is already incorporated into the present standard.
5. Noise criteria and regulations should be established at the property line, which is in accordance with standard practice for zoning.
6. Individual noise producing components should be assessed for contribution to a total noise level using a noise "budget" to assign noise controls as required to meet noise criteria with an adequate margin of safety. Decades of best practices established margins of safety for power generation noise in the range of 2-5 decibels depending on site specifics including the fluctuations in facility noise, effects of site layout, topography, and atmospheric conditions on noise propagation to nearby residential properties, and factoring sound meter tolerances.
7. Appropriate noise criteria then fall in the range of 35 to 38 dBA daytime and 25 to 28 dBA at night. These criteria are consistent with ANSI Standards for land use compatibility in quiet rural residential properties and prevent unwanted sound from intrusive tonal noise with an adequate margin of safety.
8. Regulations should require use of Best Available Technology to ensure the lowest practical noise emissions. Facility applicants should be required to show their equipment is Best Available Technology and that facility designs shall not impact people with unwanted sound and shall not create high annoyance.
9. Given the many readily available and time-proven noise control options for transformers and inverters, there should be no objection to applying these criteria and safety margins to protect people from unwanted sound.

Thank you for your consideration of this letter. If you have any questions, please contact me.
Respectfully Submitted, Robert W. Rand, ASA, INCE (Member Emeritus)

Attached: Supplement A:

ANSI Siting Criteria for Compatibility, Rural Residential Land Use

ANSI S12.9 Parts 4 & 5 provides methods for determining noise level thresholds for compatibility with land use. Part 5 Annex A provides that "compatibility of a land use with the outdoor noise environment is assessed by comparing the predicted or measured annual average of the total day-night adjusted sound exposure or the annual average of the adjusted day-night average sound level at a site with the guidance criteria given in Figure A.1."

ANSI S12.9 Part 5 Figure A.1, with markups. Lists a range of land uses, including at the top, "Residential- Urban/suburban, Single Family, Extensive Outdoor Use". This category was selected as a basis for evaluation of compatibility for rural residential land use.

This analysis evaluates compatibility for rural residential land use (homes), similar to the top category in Figure A.1, and does not evaluate for compatibility in farm fields proper (agricultural use). Part 5 Annex A Figure A.1 includes a footnote, "For residences in quiet rural areas (e.g., not near busy roads, busy railroads, grain elevators, etc.), the +10-dB adjustment in ANSI S12.9 Part 4 clause F.3.4.2 should be used." This adjustment was applied in this analysis to be conservative for homes away from busy roads and rail.

For each category a range of acceptable annual average day-night sound levels are listed for Compatible, Marginally Compatible, Compatible with Sound Insulation, and Incompatible. For the Residential-Urban/suburban, Single Family category, "Compatible" ranges up to 55 Ldn*, and "Marginally Compatible" extends to 60 Ldn. Intrusive noise levels above 60 Ldn are "Incompatible". *See notes at end of Appendix

Compatible land use is defined in ANSI S12.9 Part 5:

3.1 compatible land use. *Land use consistent with the outdoor noise environment such that the annual average of the total day-night adjusted sound exposure or the annual average of the adjusted day-night average sound level at a site is not greater than the compatibility limit designated for that land use.*

3.2 land use. *Existing or intended use of a specifically delineated land area or parcel.*

3.3 land use category. *A logical grouping of a set of related land uses.*

The ANSI S12.9 Part 4 adjustment from urban to quiet rural local conditions is a reduction of 15 dBA, including 10 dB for "quiet rural settings" (ANSI S12.9 Part 4 Section F.3.4.2) and 5 dB for unfamiliar intrusive noise (ANSI S12.9 Part 4 Section F.3.4.1). These two factors are additive (ANSI S12.9 Part 4 Section F.3.4.3). In practice, these factors may be used to either 1) adjust measured or predicted levels upward to assess against ANSI land use compatibility ratings, or 2) adjust ANSI land use compatibility ratings downward to assess measured or predicted sound levels. The comparative result is the same. For this calculation, the compatibility noise ratings were adjusted downward *for direct comparison to facility long term average (Leq) noise predictions.*

The tables below summarize the calculation utilized to determine land use compatibility noise criteria for rural residential land use, using ANSI S12.9 Parts 4&5 assuming a quiet rural area. "Criteria" means the level that should not be exceeded- the highest allowable long-term average (Leq) noise level. The more stringent "Night" criteria are highlighted.

Criteria for "Compatibility" per ANSI S12.9:

Factor	Day-Night Sound Level (DNL)	Day Sound Level	Night Sound Level	Average Level (Leq*)
Part 5 Figure A.1 Residential Urban/suburban, Single Family Compatible, at the edge of Marginal Compatibility:	55	55	45	49
Adjust: 10 dB for quiet rural settings (Part 4 F.3.4.1):	-10	-10	-10	-10
Adjust: 5 dB for unfamiliar intrusive noise (Part 4 F.3.4.3):	-5	-5	-5	-5
Criteria for "Compatibility", dBA:	40	40	30	34

Criteria for "Marginal Compatibility" per ANSI S12.9:

Factor	Day-Night Sound Level (DNL)	Day Sound Level	Night Sound Level	Average Level (Leq*)
Part 5 Figure A.1 Residential Urban/suburban, Single Family Marginal Compatibility, at edge of Incompatible:	60	60	50	54

Adjust: 10 dB for quiet rural settings (Part 4 F.3.4.1):	-10	-10	-10	-10
Adjust: 5 dB for unfamiliar intrusive noise (Part 4 F.3.4.3):	-5	-5	-5	-5
Criteria for "Marginal Compatibility", dBA:	45	45	35	39

* The energy-equivalent average level (Leq) equivalent to a 24-hour day-night level (DNL) is computed as 6.4 dB less than the day-night level due to level weighting of -10 dB from 10 pm to 7 am.

The ANSI S12.9 calculation concludes that for unfamiliar intrusive noise in quiet rural areas, long-term average (Leq) noise levels lower than 30 dBA are “compatible”; long-term Leq noise levels between 30 and 35 dBA are “marginally compatible”; long-term Leq noise levels exceeding 35 dBA at night are “incompatible”.

Appendix H: Pollinator Plantings and Agrivoltaics

Much research is currently being done on Best Management Practices (BMPs) and the economics of pollinator plantings and agrivoltaics, and BMPs are expected to evolve.

**Chapter 102 Permitting for Solar Panel Farms Frequently Asked Questions (FAQ),
January 2, 2019, Revised, April 30, 2021, Version 1.1**

https://files.dep.state.pa.us/Water/BPNPSM/StormwaterManagement/ConstructionStormwater/Solar_Panel_Farms_FAQ.pdf

FAQ4 has relevant information on native vegetation and planting for pollinators and contains useful language: "To achieve a native deep-rooted vegetative cover, a mixture of perennial grasses and wildflowers is recommended with a diversity of forbs or flowering plants that bloom throughout the growing season. Blooming shrubs may also be used in buffer areas as appropriate for visual screening. Perennial vegetation (grasses and forbs) should be native to Pennsylvania ."

FAQ 12 addresses “agrivoltaics”, the co-development of the same area of land for both solar photovoltaic power and conventional agriculture. “Agrivoltaic projects can have the added benefit of capture and reuse of stormwater runoff to support crop production.”

“Conventional agricultural activities that can be performed beneath and around solar arrays include crop production, grazing, pollinator habitat and apiaries.” Recommendations and erosion/sedimentation control requirements are listed below:

- a. Shade tolerant crops should be used beneath panels.
- b. Crops should be planted using no till practices where practicable.
- c. Moldboard plowing is not recommended.
- d. A written erosion and sediment control plan must be developed for agricultural activities, or a portion of the overall farm conservation plan must identify BMPs used, in accordance with the requirements of 25 Pa. Code §102.4(a), for the field(s) where the solar panel farm is located.
- e. Hand-harvested or small machine-harvested crops are recommended. Any cutting or mechanized mowing should be limited to a height of no less than 4 inches.
- f. Sustainable grazing practices are recommended that maintain vegetative cover.
- g. Application of chemical fertilization or herbicides/pesticides is limited to the agronomic needs to the crop(s).
- h. Additional BMPs may be needed depending on site conditions, slopes, and soil types, which should be evaluated by the licensed professional.
- i. If the lowest vertical clearance of the solar panels exceeds 10 feet (to allow for farm machinery or personnel to access the area), additional controls to address erosion and scour along the dripline will likely be necessary (e.g., splash pad). Please refer to FAQ #6 for more information.”

The Center for Pollinators in Energy, Fresh Energy

<https://fresh-energy.org/beeslovesolar>

- a. Sample Ordinance and Procurement Language:
<https://fresh-energy.org/beeslovesolar/sample-ordinance-and-procurement-language>

Asking for pollinator-friendly solar—whether at the procurement/RFP stage or in local ordinances—is a reliable way to maximize benefits and ensure solar projects are built and managed in line with expectations.

- b. Pollinator-Friendly Solar Scorecards:
<https://fresh-energy.org/beeslovesolar/pollinator-friendly-solar-scorecards>

States across the country are establishing standards that set fair, flexible, and science-based standards for what constitutes “beneficial to pollinators” in the managed landscape of a solar farm. Many states have adopted their own Pollinator-Friendly Solar Scorecards.

- c. Best Practices and Training:

<https://fresh-energy.org/beeslovesolar/best-practices-and-training>

This website contains links to webinars regarding best practices for zoning and planning, how-to-seminars on pollinator friendly solar and agrivoltaics, and best practices for apiaries.

Creating Low-Impact, Pollinator-Friendly Solar Energy Sites with Native Seeds by Rachel Sohmer, Jul 9, 2021, From the Blog, Pollinators, Solar Energy, Ernst Seeds:
<https://www.ernstseed.com/low-impact-pollinator-friendly-solar-energy-sites/>

Native Plant Installation and Maintenance for Solar Sites, written by Kim Steinberger, Restoration Project Manager The Nature Conservancy in Michigan:
<https://www.nature.org/content/dam/tnc/nature/en/documents/Native-Plant-Management-at-Solar-Sites.pdf>

Pollinator Conservation on Solar Farms: The Entomology Perspective, Entomology Today, June 3, 2001:
<https://entomologytoday.org/2021/06/03/pollinator-conservation-solar-energy-farms-entomology-perspective/>

Virginia's Pollinator-Smart Program
<https://www.dcr.virginia.gov/natural-heritage/pollinator-smart>

Virginia's Pollinator-Smart program is designed to provide incentives and tools for the solar industry to adopt a native plant strategy to meet soil and water control regulations, community needs, and the needs of our biosphere. Below are links to supporting documents for creating pollinator-friendly habitat on a solar facility and meeting the criteria of the Pollinator-Smart certification program.

Developed with input from many stakeholders, natural resource scientists, and environmental policy experts, the materials presented here provide detailed guidance for planning, designing, installing, and maintaining a Pollinator-Smart habitat at a solar facility.

- a. Pollinator-Smart Comprehensive Manual (PDF), Version 1.1, December 2019
<https://www.dcr.virginia.gov/natural-heritage/document/solar-site-comprehensive-manual.pdf>
- b. Pollinator-Smart Monitoring Plan (PDF) Version 1.0, October 2019, On-site Monitoring Guidance for Pollinator-Smart/Bird Habitat Solar Facilities in Virginia
<https://www.dcr.virginia.gov/natural-heritage/document/solar-site-monitoring.pdf>
- c. Pollinator-smart Business Plan (PDF) Version 1.0, October 2019
<https://www.dcr.virginia.gov/natural-heritage/document/solar-site-business-plan.pdf>
- d. Pollinator-Smart Scorecards, New or retrofitted site, Virginia Pollinator-Smart Bird Habitat Scorecard, Version 2.0a
<https://www.dcr.virginia.gov/natural-heritage/document/solar-site-pollinator-bird-habitat-scorecard-a-new.pdf>

- e. Established site, Virginia Pollinator-Smart Bird Habitat Scorecard, Version 2.0b
<https://www.dcr.virginia.gov/natural-heritage/document/solar-site-pollinator-bird-habitat-scorecard-b-established.pdf>

State Pollinator-Friendly Solar Initiatives, Clean Energy States Alliance, January 2020
<https://www.cesa.org/wp-content/uploads/State-Pollinator-Friendly-Solar-Initiatives.pdf>

“Seven states – Illinois, Maryland, Michigan, Minnesota, New York, South Carolina, and Vermont – have enacted legislation to promote pollinator-friendly solar ...”

Pollinator-Friendly Solar Resources, The University of Vermont
<https://www.uvm.edu/extension/agriculture/pollinator-friendly-solar>

Land under and around solar arrays can be planted with pollinator-friendly vegetation: a benefit to agriculture, clean energy, bees and birds.

Pollinator-Friendly Solar with Bird-Friendly Buffers, Audubon Vermont
<https://vt.audubon.org/conservation/pollinator-friendly-solar-bird-friendly-buffers>

Flowering Solar Farms “Agrivoltaics”: A Powerful Sweet Synergy, by John Jacob, with contributions from Rob Davis, American Bee Journal, April 2019, pp. 451 - 456 <https://fresh-energy.org/wp-content/uploads/2019/03/Jacobs-Flowering-Solar-Farms.pdf>

Includes Minnesota’s pollinator-friendly solar scorecard. Best Practices suggest that the beekeeper ask the developer to fill out a version of this before placing hives on the project. Also includes Best Practices for Solar Farm Apiaries.

Co-Location of Agriculture and Solar: Opportunities to Improve Energy, Food and Water Resources, OSTI.GOV
<https://www.osti.gov/biblio/1512073>
<https://www.nrel.gov/docs/fy19osti/73696.pdf>

“The common site preparation practice of removing vegetation can be avoided in certain circumstances, and there have been successful examples where solar facilities have been co-located with agricultural operations or have native vegetation growing beneath the panels. In this study we outline some of the impacts that large-scale solar facilities can have on the local environment, provide examples of installations where impacts have been minimized through co-location with vegetation, characterize the types of co-location, and give an overview of the potential benefits from co-location of solar energy projects and vegetation.”

Jack’s Solar Farm
<https://www.jackssolargarden.com/>

“Jack’s Solar Garden is the largest commercially active research site for agrivoltaics in the USA. Researchers are partnering with Jack’s Solar Garden to study growing crops underneath and around our solar panels. [Audubon Rockies](https://rockies.audubon.org/)⁴⁹ has established a large pollinator habitat around

⁴⁹ “Audubon Rockies,” The regional office of the National Audubon Society for Colorado, Wyoming, and Utah, <https://rockies.audubon.org/>.

our solar array while [Sprout City Farms](https://sproutcityfarms.org/)⁵⁰ is cultivating crops under our solar panels. The [Colorado Agrivoltaic Learning Center](https://www.coagrivoltaic.org/)⁵¹ hosts local high schools, community members, and private groups at our farm to showcase the future of solar + agriculture.”

The American Solar Grazing Association

<https://solargrazing.org/>

In addition to information on sheep grazing on solar installations, the website includes webinars, resources, sample grazing contract, seed mixes and a sample beekeeping contract.

Agricultural Integration Plan: Managed Sheep Grazing & Beekeeping, EDF Renewables (edf-re.com) Consultant’s Report, 2020

https://www.edf-re.com/wp-content/uploads/004C_Appendix-04-B.-Agricultural-Integration-Plan-and-Grazing-Plan.pdf

Balancing Agricultural Productivity with Ground-Based Solar Photovoltaic (PV) Development, White Paper, Tommy Cleveland and David Sarkisian, May 2019, NC State University, NC Clean Energy Technology <https://nccleantech.ncsu.edu/wp-content/uploads/2019/10/Balancing-Agricultural-Productivity-with-Ground-Based-Solar-Photovoltaic-PV-Development-1.pdf>

A very good review of solar site development. Includes information about leaching of toxic materials and soil testing when growing crops.

Capital Costs for Dual Use Photovoltaic Installations: 2020 Benchmark for Ground-Mounted PV Systems with Pollinator-Friendly Vegetation, Grazing, and Crops, Kelsey Horowitz, Vignesh Ramasamy, Jordan Macknick and Robert Margolis, National Renewable Energy Laboratory <https://www.nrel.gov/docs/fy21osti/77811.pdf>

Appendix I: Fencing and Wildlife Corridors

Recommended fencing is 12.5-gauge fixed knot galvanized wire deer fence that is 8 feet high. It should be installed upside down so the bottom openings are 7 1/4 in. x 6 in. to allow small animals like turtles, rabbits, and foxes to pass through. The top openings are smaller: 2 3/4 in. x 6 in. Alternatively, gaps can be created along the fence, allowing smaller animals to enter. If wildlife-friendly fencing is used, vegetation and cover must be provided for the animals.

It is very important that training be provided to maintenance personnel, covering the types of animals expected and appropriate behavior, and how to recognize and care for native vegetation that is planted.

A solar project is an energy producing site and must comply with the electric security requirements. Some facilities have installed wildlife-friendly fencing around the exterior of the project, with the concrete pad holding the electrical transmission equipment fenced according to the requirements for electricity generation. If this is done, it is important to check on the site to ensure that animals are not trapped inside the security fencing.

⁵⁰ “Sprout City Farms,” <https://sproutcityfarms.org/>.

⁵¹ “Colorado Agrivoltaic Learning Center,” <https://www.coagrivoltaic.org/>.

An example of a solar project using an upside-down deer fence is shown here:

<https://pv-magazine-usa.com/2019/12/16/the-quick-gray-fox-jumped-through-the-upside-down-solar-fence-a-photo-essay/>.

This type of fencing is available from DeerBusters:

<https://www.deerbusters.com/metal-deer-fencing/fixe-d-knot-deer-fence/fixe-d-knot-fence-rolls/8-x-330-fixe-d-knot-12-5-ga-20-96-12/>.

“Planning for Utility-Scale Solar Energy Facilities” American Planning Association, PAS Memo — September/October 2019, Darren Coffey, AICP:
<https://www.planning.org/pas/memo/2019/sep/>

Figure 6 in the document, copied below, shows a conceptual site plan for a 1,491-acre Utility-Scale Solar facility showing wildlife corridors throughout the site, courtesy Dominion Energy:

“Making Solar Wildlife-Friendly, Creating solutions to maximize conservation benefit from solar production,” The Nature Conservancy, North Carolina, October 04, 2019:
<https://www.nature.org/en-us/about-us/where-we-work/united-states/north-carolina/stories-in-north-carolina/making-solar-wildlife-friendly/>

“Utility-Scale Solar facilities must comply with the National Electric and National Fire Protection Codes, which require fencing that is at least seven feet high—occasionally with the top foot consisting of barbed wire. However, blocking off 20 to 35 acres of land in the middle of an ecosystem—especially forest habitat—can be detrimental to wildlife.”

Working with solar developers in North Carolina, The Nature Conservancy has had success with wildlife-permeable fencing—with holes large enough for raccoons, rabbits, and squirrels to fit through.

Principles of Low Impact Solar Siting and Design, The Nature Conservancy in North Carolina

https://www.nature.org/content/dam/tnc/nature/en/documents/ED_TNCNCPrinciplesofSolarSitingandDesignJan2019.pdf

“Where appropriate, use wildlife-friendly fencing or unfenced wildlife corridors: Wildlife connectivity and movement may be of greatest concern where there is adjacent habitat disrupted by the presence of the solar facility (e.g., intact forestland on two or more sides). Solar facilities generally use fencing that may act as a barrier to larger, ground-based wildlife movement.”

“While best management practices for wildlife-friendly fencing are still under research, we recommend using fencing that allows small-to-medium sized animals (e.g., turtles, racoons, birds) to pass through. Another approach is to provide wildlife passages (8” diameter HDPE pipe) roughly 500’ apart around the site. When implementing wildlife-permeable fencing, equally important is providing on-site vegetation that provides cover for animals when moving through the site.

The best method for allowing movement of both large and small animals, and particularly appropriate in large solar installations (i.e., >50 acres), is to retain unfenced wildlife passageways through the solar facility. Solar developers typically avoid development near

rivers, streams and their associated riparian areas and wetlands, and these areas can then serve as wildlife passageways.”

Appendix J: Decommissioning

Planning for Utility-Scale Solar Energy Facilities:

<https://www.planning.org/pas/memo/2019/sep/>

For decommissioning, the industry usually stipulates removal of anything within 36 inches below the ground surface. Unless all equipment is specified for complete removal and this is properly enforced during decommissioning, future agricultural operations would be planting crops over anything left in the ground below that depth, such as metal poles, concrete footers, or wires.

“Providing for adequate security to ensure that financial resources are available to remove the equipment is a significant challenge. Cash escrow is the most reliable security for a locality but is the most expensive for the industry and potentially a financial deal breaker. Insurance bonds or letters of credit seem to be the most acceptable forms of security but can be difficult to enforce as a practical matter. The impact of inflation over decades is difficult to calculate; therefore, the posted financial security to ensure a proper decommissioning should be reevaluated periodically — usually every five years or so. The worst possible outcome for a community (and a farmer or landowner) would be an abandoned Utility-Scale Solar facility with no resources available to pay for its removal.”

Health and Safety Impacts of Solar Photovoltaics, NC Clean Energy Technology Center, NC State University, 2017

https://nccleantech.ncsu.edu/wp-content/uploads/2018/10/Health-and-Safety-Impacts-of-Solar-Photovoltaics-2017_white-paper.pdf

This document provides information on photovoltaic (PV) technologies and hazardous materials present in solar panels, wiring and infrastructure; maintenance and end-of-life management; emf, electric shock and arc flash, and fire safety. The Fire Safety section contains links to fire codes, firefighting guidelines, and fire fighter training.

Appendix K: Additional Resources

Solar Guidebook for Local Governments

<https://www.nysed.gov/All-Programs/NY-Sun/Communities-and-Local-Governments/Solar-Guidebook-for-Local-Governments>

The New York Solar Guidebook for Local Governments is an excellent resource that explains many basic facets of solar energy development.

Solar@Scale: A Local Government Guidebook for Improving Large-Scale Solar Development Outcomes, Alexandra Gomez, David Morley, AICP

<https://www.planning.org/publications/document/9222548/>

A guidebook developed by Solar@Scale, a partnership between the International City/County Management Association (ICMA) and the American Planning Association (APA) aims to help local government practitioners.