pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Clean Water

Chapter 102 Permitting for Solar Panel Farms

Frequently Asked Questions (FAQ)
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Background

With renewed interest in the development of clean, renewable energy in Pennsylvania, the development of solar photovoltaic installations is increasing in the state. Responsible development of solar farms must balance the growth of this valuable industry with the need to protect our natural resources, including addressing issues related to stormwater runoff. 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. This document provides recommended guidance for ground level solar projects with one acre or greater of earth disturbance.

Nothing in this document affects regulatory requirements. The interpretations herein are not an adjudication or a regulation. There is no intent on the part of DEP to give the interpretations in this document that weight or deference. This document provides a framework within which DEP and delegated county conservation districts (CCDs) will exercise administrative discretion in the future. DEP reserves the discretion to deviate from the interpretations in this document if circumstances warrant.

For additional information on solar energy, visit the Solar Energy Resource Hub on the DEP website.

FAQ #1: Is NPDES permit coverage required for the development of a solar panel farm?

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.

FAQ #2: What earth disturbance is associated with development of a solar panel farm?

The definition of earth disturbance activity per 25 Pa. Code § 102.1 is:

A construction or other human activity which disturbs the surface of the land, including land clearing and grubbing, grading, excavations, embankments, land development, agricultural plowing or tilling, operation of animal heavy use areas, timber harvesting activities, road maintenance activities, oil and gas activities, well drilling, mineral extraction, and the moving, depositing, stockpiling, or storing of soil, rock or earth materials.

Earth disturbance activities necessary to construct solar panel farms will vary depending on the topography, slopes, soils of the proposed location of the solar panel farm, the layout of the solar arrays, and whether the arrays are fixed-tilt or solar tracking. Each project is different and needs to be evaluated independently. In some instances, significant grading, including clearing and grubbing, of the site may be necessary. In other cases, limited disturbance may be necessary to evenly grade the ground to facilitate installation of the solar modules. The total earth disturbance of the project would be the cumulative impacts of all earth disturbances associated with the installation of the support and mounting structures for each module, as well as any associated earthwork which may include, but is not limited to, access roads, support building(s) and temporary staging areas. Please refer to FAQ #3 for more information on E&S BMPs.

Solar panel farms can be challenging on heavily wooded sites as the proposed condition can create a significant change in land cover, necessitating extensive disturbance, and often requiring more detailed analysis or PCSM planning. For those situations where the pre-construction condition is wooded, any pre-timbering that occurs will need to be considered in the project's PCSM evaluation. Please refer to FAQ #4 for PCSM considerations.

FAQ #3: What E&S BMPs are necessary for the installation of a solar panel farm?

The amount of E&S best management practices (BMPs) will be proportional to the amount of earth disturbance. A proposed solar panel farm must utilize 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). Additionally, there is guidance from other sources that may be helpful from either industry or other governmental agencies (e.g., see References). 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.

FAQ #4: What are the PCSM requirements for a solar panel farm?

All solar panel farm projects need to have some consideration of the impact that their project will have on stormwater runoff. The goal is to minimize environmental impacts to the maximum extent practicable.

If the project will meet all of the criteria listed below, stormwater runoff may be considered mitigated through the preservation or restoration of the vegetated ground surface, thereby satisfying the PCSM requirements pursuant to 25 Pa. Code § 102.8(n), and a detailed stormwater analysis will not be required for runoff coming from the panel array area.

If these criteria cannot be achieved, please refer to FAQ #5.

1. 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.

   For more information, refer to BMP 5.6.1: Minimize Total Disturbed Area – Grading, BMP 5.6.2: Minimize Soil Compaction in Disturbed Areas, and BMP 5.6.3: Re-Vegetate and Re-forest Disturbed Areas, Using Native Species in the Pennsylvania Stormwater Best Management Practices Manual (Stormwater BMP Manual). With regards to the actual panels, attention should be given to the concepts in BMP 5.8.1: Rooftop Disconnection, which aims to disconnect, distribute, and decentralize runoff, as well as BMP 6.4.10, which addresses berms and other retentive grading techniques.

2. The post-construction condition should have a minimum uniform 90% perennial vegetative cover with a density capable of resisting accelerated erosion and sedimentation[1]. The 90% standard exceeds the minimum uniform 70% perennial vegetative cover standard identified in 25 Pa. Code § 102.22(a)(i), since the vegetation also functions as the primary PCSM BMP for solar panel farms per 25 Pa. Code § 102.8(n).

   In addition to the vegetative cover density, the following criteria should be met:

   a. A meadow condition is preferable. Ideal vegetation type is native deep-rooted perennial vegetation[2]. Please refer to DEP's Erosion & Sediment Control FAQ (specifically, FAQ #15 and 16) for more information.

   b. Existing slopes on the project site should ideally be 10% or less (see criterion 5 below for slopes between 10-15%).

   c. Solar panels should be configured in a manner such that they disconnect surfaces; and promote sheet flow and natural infiltration into the ground beneath the panels.

   d. If areas beneath the solar panels require mowing, the vegetative cover should not be cut to less than 4 inches in height.

[1] To incentivize a native or pollinator ground cover, which can take longer to establish than basic turf grass, the permittee can submit a Notice of Termination (NOT) upon achieving 70% vegetative cover when a native ground cover is established and there is a clear plan for achieving 90% establishment, or other provisions are employed until the ground cover meets the 90% threshold. If there is a sale of the property and the NOT has been acknowledged, the new owner will assume the responsibility of achieving and maintaining the 90% standard as part of the PCSM Operation and Maintenance Plan.

[2] 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, but where appropriate to the vegetative management plan goals, may also include other naturalized and non-invasive species which provide habitat for pollinators and wildlife and/or other ecosystem services.

e. Vegetated areas will not be subject to chemical fertilization or herbicide/pesticides application, except for those applications necessary to establish the vegetative cover (in accordance with an approved E&S Plan) or to support crop production related to agrivoltaics (see FAQ #12).

f. Compaction of subsoil will be avoided. Vehicular traffic should be kept to designated areas and any incidental traffic over the array field by contractors will be minimized to the maximum extent practicable. Construction vehicles and equipment should avoid areas receiving disconnected runoff during installation of the solar panels. If compaction issues are encountered, the project proponent will be responsible to conduct restorative measures (e.g., subsoil should be tilled and amended to return the soil to its pre-compaction condition). Areas receiving runoff should also be protected from future compaction.

g. The site should be designed to maintain applicable buffer distances from the delineated watercourse or wetland limits in accordance with federal, state, or local regulations (e.g., see 25 Pa. Code § 102.14).

h. The site should not be located directly upslope of areas that are subject to flooding issues – particularly to inhabited structures.

i. Sites with soils having slip potential should be more closely evaluated for any geotechnical issues – especially in areas with moderate to steep slopes.

3. The individual photovoltaic panels should be arranged in a fashion that:

a. Allows and supports the passage of sheet flow between each module, thereby minimizing the production of concentrated runoff.

b. Allows for the growth of vegetation beneath the panel and between "arrays." Shade-tolerant vegetation is encouraged.

c. The length of disconnection (the row gap distance between arrays and the distance beneath the downslope array) is sufficient to infiltrate the runoff from the upslope array. At a minimum, the gap distance between arrays should be equal or be greater than the width of the panel array. See Figure 1 below.

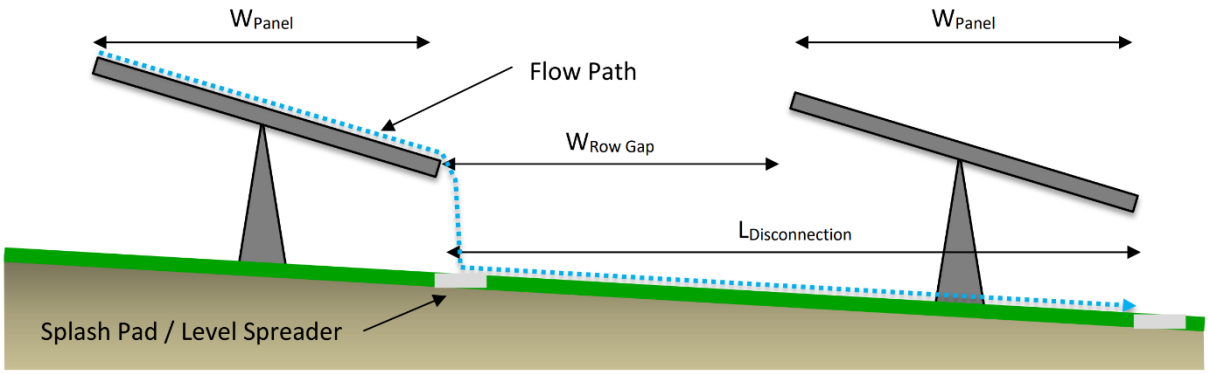

Figure 1: Schematic profile of solar panel array providing impervious area disconnection.

Source: Ohio EPA, October 2019

4. To qualify under 25 Pa. Code § 102.8(n), a licensed professional must conduct an assessment of the proposed solar panel support structures/foundations with regards to increases in earth disturbance and impervious cover as compared to the existing condition. The assessment should demonstrate no greater than a 5% increase in impervious cover compared to the total site area (excluding access drives and service buildings). Please refer to FAQ #8 if proposed work associated with solar panel support structures/foundations will result in excessive earth disturbance.

5. Projects that need grading within array areas with slopes between 10 to 15%, may be acceptable upon site/project evaluation and certification by a qualified professional engineer and the addition of slope protection, as deemed necessary. At a minimum, projects with slopes exceeding 10% should consider options for maintaining sheet flow and dissipating energy at the drip edge of each row of panels. Sloped areas of greater than 10% and any stormwater management features should also be closely monitored for at least one full growing season after project completion or until vegetation is 90% established. This would be in addition to routine inspections conducted during operation and maintenance throughout the life of the project. Vegetation reinforcement or additional BMPs should be provided accordingly.

6. 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 (by creating a stable flow condition under and around the solar panels) and provide for an uninterrupted hydrologic cycle (by sustaining vegetated cover under the solar panels).

FAQ #5: What if I cannot meet the criteria outlined above as part of my project for PCSM planning?

If unable to meet all the criteria in FAQ #4, the applicant should have their licensed professional determine the need for additional PCSM BMPs by completing a stormwater analysis to determine how the proposed solar panel farm will impact the rate, volume, and quality of stormwater runoff from the site pursuant to 25 Pa. Code § 102.8. A comparison of pre- versus post-construction runoff conditions is generally necessary to determine the level of PCSM planning to be provided for the project.

Surface slope is a contributing factor to runoff, particularly projects proposing earth disturbance on slopes greater than 10%. Significant topographic variations are one of the most pressing challenges to overcome for ground mounted solar projects. For steeper hill slopes (greater than 10%) and undulating topography, the project proponent should have a professional engineer design a system with non-intrusive mounting options that can work with the slope variance and minimize earth disturbance. See the References at the end of this document for additional guidance.

FAQ #6: What if I propose the use of gravel rather than vegetative cover under the solar panels?

The use of gravel under the solar panels is permissible. However, the use of gravel (aside from localized energy dissipation) would result in a higher curve number in the post-construction condition, i.e., a larger volume of stormwater to manage. Since additional runoff will be generated from the widespread use of gravel beneath the solar panels, PCSM is required and the project proponent will need to provide a stormwater analysis and additional PCSM BMPs in accordance with 25 Pa. Code §§ 102.8(g)(2) & 102.8(g)(3).

If stone/gravel is solely utilized in small discrete areas along the drip edge for erosion control purposes and the overall area occupied by solar panel support structures/foundations and gravel is less than 5% of the total project area, then these gravel areas will be considered disconnected impervious areas and no additional PCSM BMPs will be necessary when the criteria in FAQ #4 are met.

When performing a stormwater analysis, projects that are utilizing a minimum of a 6-inch layer of clean, washed and uniformly graded gravel may utilize the void space as storage for stormwater purposes if the project site (e.g., slopes exceeding 10% are not applicable) and the underlying soil conditions allow for it. Sand layers (or another filter media, as approved by DEP) may also be introduced into the stormwater design to help address water quality issues at the discretion of the licensed professional.

FAQ #7: What are the PCSM requirements for roadways and support buildings associated with the development of the solar panel farm?

All impervious areas associated with roadways and support buildings will need to follow normal

protocols when performing the PCSM stormwater analysis. Sheet flow from upslope areas may need to be incorporated into the analysis when roadways bisect these areas. Preference is given to the use of localized and low impact BMPs that mimic existing drainage patterns and preserve pre-development hydrology during and after the life of the solar farm.

FAQ #8: Are there any additional requirements if I need to re-grade the entire area?

As previously noted, the goal is to minimize earth disturbance to the maximum extent practicable. Projects that are unable to minimize earth disturbance (which includes grading activities) should employ additional E&S BMPs such as those identified in Chapter 11 (Stabilization Methods and Standards) of the E&S Manual, and additional PCSM BMPs such as soil/landscape restoration and soil amendments in accordance with the recommendations of the Stormwater BMP Manual (see BMP 6.7.2: Landscape Restoration and BMP 6.7.3: Soil Amendment and Restoration, respectively). Areas with slopes greater than 10% should be evaluated by a qualified professional engineer and, as necessary, employ additional slope stabilization analysis/slope protection measures. Please refer to FAQ #11 for areas with slopes that exceed 15%.

FAQ #9: Is there a maximum size of solar panel modules that will trigger additional BMPs or design considerations?

If individual solar panels are too large to maintain sheet flow on the ground surface, then an adequate vegetative cover may not be able to be established and maintained. The areal extent of the solar panel(s) will need to be analyzed by the licensed professional to determine whether the permanent vegetative cover is sufficient for anticipated runoff and whether additional BMPs are necessary. Examples from other projects with similar site/project characteristics may be utilized to demonstrate resiliency of the vegetated system once established. When necessary, additional BMPs including, but not limited to, splash pads, infiltration trenches and infiltration berms may be installed downgradient (even when the criteria in FAQ #4 are achieved). Please refer to the Stormwater BMP Manual, specifically BMP 6.4.4: Infiltration Trench and BMP 6.4.10: Infiltration Berm and Retentive Grading for additional guidance. Also see the References at the end of this document.

FAQ #10: If the placement of the solar panel support structure/foundations result in these structures occupying more than 5% of the total project site area, how is the PCSM stormwater analysis addressed?

When greater than 5% of the total project site area is occupied by the solar panel support structure or rock protection and splash pads along the drip edge, the impervious area exceeds criteria for site restoration in FAQ #4, and the applicant will need to conduct a stormwater analysis in accordance with 25 Pa. Code § 102.8(g) and plan for appropriate PCSM BMPs.

FAQ #11: The slope of my solar panel farm project is greater than 15%. Can the project be permitted? What additional BMPs or design considerations are necessary?

Solar panel farm projects completed on slopes exceeding 15% can be permitted, however they would be pushing the threshold of current constructability, especially if any substantial earth disturbance is proposed. These areas may become more viable over time as technology for solar farm installation practices advance. There may be some sites with isolated locations having slopes greater than 15% that may be easier to incorporate into a project design depending on other site conditions. These would need to be evaluated on a case-by-case basis. Currently, sites with slopes exceeding 15% will need to be closely evaluated and will require a detailed stormwater analysis by a qualified professional engineer. At a minimum, additional E&S BMPs such as surface roughening and waterbars should be installed across disturbed areas; and additional PCSM BMPs such as retentive grading, infiltration trenches or infiltration berms should be installed downgradient at a frequency that helps prevent concentrated flow and erosion.

Please refer to the E&S Manual (pages 260 and 292) and Stormwater BMP Manual (specifically BMP 6.4.4: Infiltration Trench and BMP 6.4.10: Infiltration Berm and Retentive Grading) for additional guidance. Other BMPs may also be proposed at the discretion of the qualified professional engineer or may be required by permit reviewers to meet the requirements of Chapter 102 or the conditions of the NPDES permit. DEP also has the discretion to require an Individual NPDES Permit depending on the complexity of the project and if special conditions are warranted.

FAQ #12: Can agricultural crops be grown underneath the solar panels?

Yes, "agrivoltaics", the co-development of the same area of land for both solar photovoltaic power and conventional agriculture, can be pursued provided that:

1. Conventional agricultural activities that can be performed beneath and around solar arrays include: crop production, grazing, pollinator habitat and apiaries. Agrivoltaic projects can have the added benefit of capture and reuse of stormwater runoff to support crop production.

2. Shade tolerant crops should be used beneath panels.

3. Crops should be planted using no till practices where practicable as these practices should have less runoff and erosion potential. Moldboard plowing is not recommended.

4. 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.

5. 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.

6. Sustainable grazing practices are recommended that maintain vegetative cover.

7. Application of chemical fertilization or herbicides/pesticides is limited to the agronomic needs to the crop(s).

8. Additional BMPs may be needed depending on site conditions, slopes and soil types, which should be evaluated by the licensed professional.

9. 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.

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Version History

Date	Version	Revision Reason
4/30/2021	1.1	The FAQ was rewritten in its entirety to reflect the latest knowledge in stormwater management at solar panel farms including recommendations from other states and published research.
1/2/2019	1.0	Original