VIII Topography/ Scenery—Visual impacts can be important for some projects, depending on the topography, surrounding land uses, and the nature of the project. Computer generated imaging is an effective way to demonstrate these effects; please provide if available.

B. Operational phase

9. We will need to know if any glare exists as the panels rotate over the course of the day and during different times of the year.

Response:

Glare from panels is expected to be minimal over the course of the day and throughout the year. Modern PV panels reflect as little as two percent of incoming sunlight, about the same as water and less than soil or even wood shingles. See Exhibit T, "Solar and Glare Fact Sheet".

Witness: Scott Wentzell

a. Please provide any studies or independent data or evaluation that justifies the Applicant position that glare will not impact human activity in the vicinity of the Project.

Response:

"A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic System" in Exhibit E modeled the amount of visible radiation that would be reflected from a PV module every hour between 1998 and 2004 and calculated the hourly retinal irradiance. The results show that the potential for hazardous glare from flat-plate PV systems is similar to that of smooth water and not expected to be a hazard to air navigation.[1]

The 2017 Michigan Technological University study "General Design Procedures for Airport-Based Solar Photovoltaic Systems" in Exhibit F found that the reflection off a solar PV panel from the most near normal angles is less than 3% and represents no risk to air traffic.[2]

Witness: Scott Wentzell

[1] EVAN RILEY AND SCOTT OLSON, A STUDY OF THE HAZARDOUS GLARE POTENTIAL TO AVIATORS FROM UTILITY-SCALE FLAT-PLATE PHOTOVOLTAIC SYSTEM (2011).
[2] ANURAG ANURAG ET AL., GENERAL DESIGN PROCEDURES FOR AIRPORT-BASED SOLAR PHOTOVOLTAIC SYSTEMS (2017).

b. If the Applicant selects panels that do not tilt, we will still need justification about the presence, frequency and intensity of glare.

Response:

See response to sub-part (a).

Witness: Scott Wentzell

c. The SAR says the Applicant "will follow Federal Aviation Administration guidelines for determining glare issues for ingress and egress from the airport." Has the Applicant performed any analyses related to potential glare impacts to traffic, residences, businesses, the airport, or other glare-sensitive structures in the Project area? We would request a copy and interpretation of such a study.

Response:

The 2015 Federal Aviation Administration study "Evaluation of Glare as a Hazard for General Aviation Pilots on Final Approach" in Exhibit S determined that any sources of glare at an airport may be potentially mitigated if the angle of the glare is greater than 25-degrees from the direction that the pilot is looking. The report recommended that the design of any solar installation is placed such that pilots will not have to face glare straight ahead of them or within 25-degrees of straight ahead during final approach.

Lebanon-Springfield Airport has one runway designated 11/29. There will be no solar panels installed within the 2-mile final approach or within 25-degress of the final approach to runway 11. There are no solar panels installed within the 2-mile final approach of runway 29 or 25-degress to the north. Solar panels that are installed south of the approach to runway 29 will be installed at a 30-40-degree tilt, facing 180-degrees south. Aircraft approach runway 29 at a heading of 290-degrees, which is 110-degrees offset from the angle of highest glare and greater than the FAA recommended 25 degree minimum. A detailed glare study is forthcoming, and the Applicant will consult with Lebanon-Springfield Airport and/or Federal Aviation Administration (FAA) officials.

Bobwhite has not performed any studies regarding glare impacts on traffic, residences or businesses, nor are studies planned at this time.

Witness: Scott Wentzell

Supplemental Response (May 10, 2021):

Bobwhite received on May 7, 2021 the Glint and Glare Analysis for the Project prepared by Capitol Airspace Group. A copy of the Glint and Glare Analysis is attached as Exhibit A to this Supplemental Response. The Glint and Glare Analysis evaluated the potential for glare impacts from the Project at Lebanon Springfield Airport - George Hoerter Field and Arnolds Airport and concludes that any glare produced by the Project would be within the levels deemed acceptable to the FAA.

Witness: Scott Wentzell

EXHIBIT A

Northern Bobwhite Solar Project

EDF

Marion County, Kentucky

Glint & Glare Analysis

May 7, 2021

Capitol Airspace Group
capitolairspace.com
(703) 256 - 2485

5400 Shawnee Road, Suite 304
Alexandria, VA 22312

703-256-2485
capitolairspace.com

Summary

EDF is proposing to construct solar arrays near Lebanon in Marion County, Kentucky (***Figure 1***). On behalf of EDF, Capitol Airspace performed a Glint and Glare Analysis utilizing the Solar Glare Hazard Analysis Tool (SGHAT) to identify the potential for glare impacts. Specifically, this analysis considered the potential for glare impacts on Lebanon Springfield Airport-George Hoerter Field (6I2) and Arnolds Airport (36KY) approach paths. Since Lebanon Springfield Airport-George Hoerter Field (6I2) and Arnolds Airport (36KY) do not have an air traffic control tower (ATCT), this analysis did not consider the potential for impact on ATCT personnel.

The results of the analysis predict green glare occurrences for one Lebanon Springfield Airport-George Hoerter Field (6I2) approach path. These occurrences would occur in the morning from February to May and August to October. Furthermore, green glare is associated with a low potential for temporary after-image and is deemed acceptable by the FAA. These results conform to, and are in accordance with, the Federal Aviation Administration's interim policy for *Solar Energy System Projects on Federal Obligated Airports*.

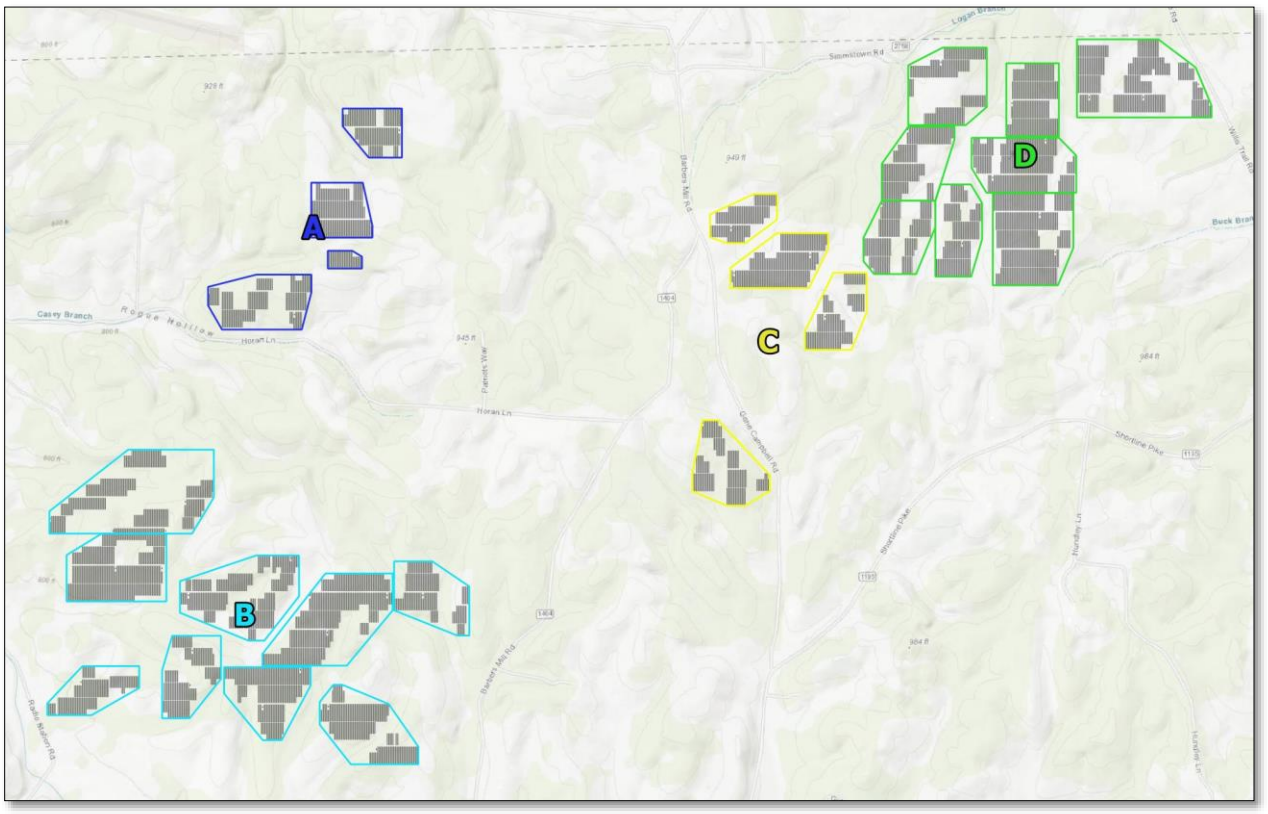

Figure 1: Location and Identification of Northern Bobwhite Solar Project Arrays

Methodology

In cooperation with the Department of Energy (DOE), the Federal Aviation Administration (FAA) developed and validated the Sandia National Laboratories Solar Glare Hazard Analysis Tool (SGHAT), now licensed through ForgeSolar. The FAA requires the use of the SGHAT to enhance safety by providing standards for measuring the ocular impact of proposed solar energy systems on pilots and air traffic controllers. ForgeSolar has enhanced the SGHAT for glare hazard analysis beyond the aviation environment. These enhancements include a route module for analyzing roadways as well as an observation point module for analyzing residences. However, it should be noted that the SGHAT does not account for physical obstructions between reflectors and receptors.

The SGHAT analyzes potential for glare over the entire calendar year in one-minute intervals from when the sun rises above the horizon until the sun sets below the horizon. The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. When glare is found, SGHAT classifies the ocular impact into three categories:

Green: Low potential for temporary after-image
Yellow: Potential for temporary after-image
Red: Potential for permanent eye damage

The FAA interim policy for *Solar Energy System Projects on Federally Obligated Airports* requires the absence of red or yellow predicted glare occurrences in the cockpit. This analysis utilized the FAA approved default SGHAT setting which simulates the pilot's view from the cockpit. No glare occurrences of any category are allowed for ATCT personnel.

Data

Solar array specifications (***Table 1***) as well as location and height information were provided by EDF. Runway end coordinates, elevations, threshold crossing heights (TCH), and visual glidepath angles (VGPA) were obtained from the FAA National Flight Data Center (NFDC) National Airspace System Resource (NASR) dataset. When the NASR dataset did not contain TCH or VGPA data for a runway end, the FAA approved default settings (TCH: 50, VGPA: 3.00 degrees) were used.

Table 1: Northern Bobwhite Solar Project solar array specifications

Parameter	Value
Unit Height	10 feet
Axis Tracking	Single-axis rotation
Tracking Axis Orientation	180°
Tracking Axis Tilt	0°
Max Tracking Angle	60°
Resting Angle	52°
Panel Material	Light textured glass with anti-reflection coating
Reflectivity	Varies with sun
Slope Error	Correlates with material

Results

Lebanon-Springfield Airport-George Hoerter Field (6I2)

Runway 11/29

The SGHAT assessed the potential for glare occurrences for aircraft approach Runway 11 and Runway 29. The SGHAT results do not predict glare occurrences along the Runway 11 approach path. The SGHAT results predict green glare occurrences (solid green lines, *Figure 2*) along the Runway 29 approach path (dashed pink line, *Figure 2*) as a result of sub-array C2 and C3.

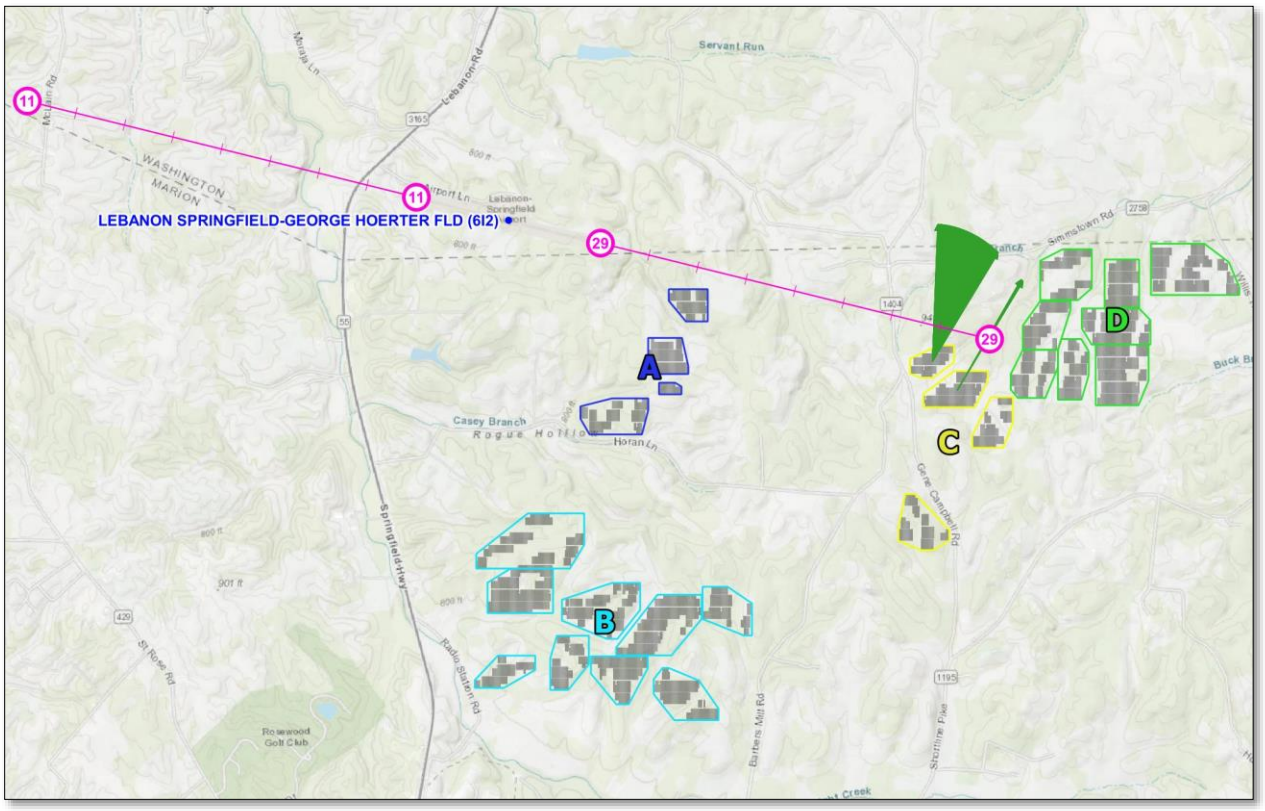

Figure 2: Lebanon-Springfield Airport-George Hoerter Field (6I2) approach paths (dashed pink lines) with generalized glare emanations (solid green lines)

Runway 29

Sub-Array C2

Green glare occurrences lasting less than 35-55 minutes per day are predicted to occur during the morning from February through May and August to October (left, ***Figure 3***). The green glare occurrences would emanate from the northeastern half of sub-array C2 (green area, ***Figure 4***) and could affect aircraft approaching Runway 29 beyond 1.75 statute miles from the Runway 29 threshold. However, green glare is associated with a low potential for temporary after-image that the FAA deems acceptable in the cockpit of aircraft. The SGHAT does not predict yellow glare occurrences for sub-array C2.

Table 2: Monthly predicted glare durations resulting from sub-array C2

C2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Green Glare (min)	0	69	1306	1143	133	0	0	840	1411	417	0	0

Sub-Array C3

Green glare occurrences lasting less than eight minutes per day are predicted to occur during the morning in February and October (right, ***Figure 3***). The green glare occurrences would emanate from the northern corner of sub-array C3 and could affect aircraft approaching Runway 29 approximately two statute miles from the Runway 29 threshold. However, green glare is associated with a low potential for temporary after-image that the FAA deems acceptable in the cockpit of aircraft. Furthermore, none of the proposed photovoltaic solar panels are within the area of predicted glare (green area, ***Figure 4***). The SGHAT does not predict yellow glare occurrences for sub-array C3.

Table 3: Monthly predicted glare durations resulting from Sub-Array C8

C3	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Green Glare (min)	0	31	0	0	0	0	0	0	0	29	0	0

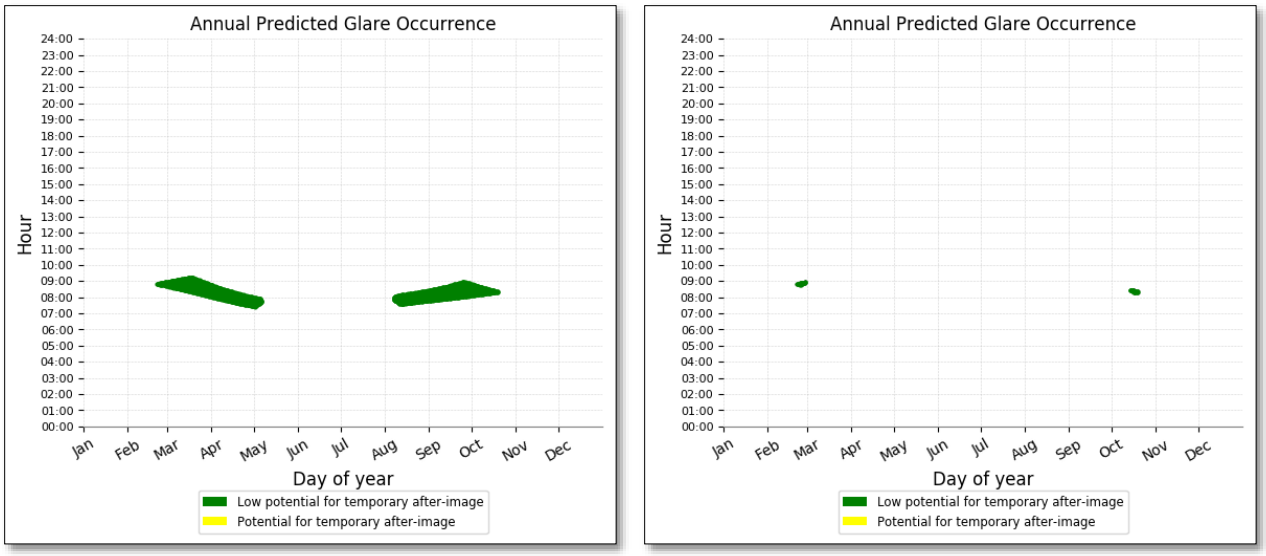

Figure 3: Sub-array C2 (left) and C3 (right) annual predicted glare occurrence plots

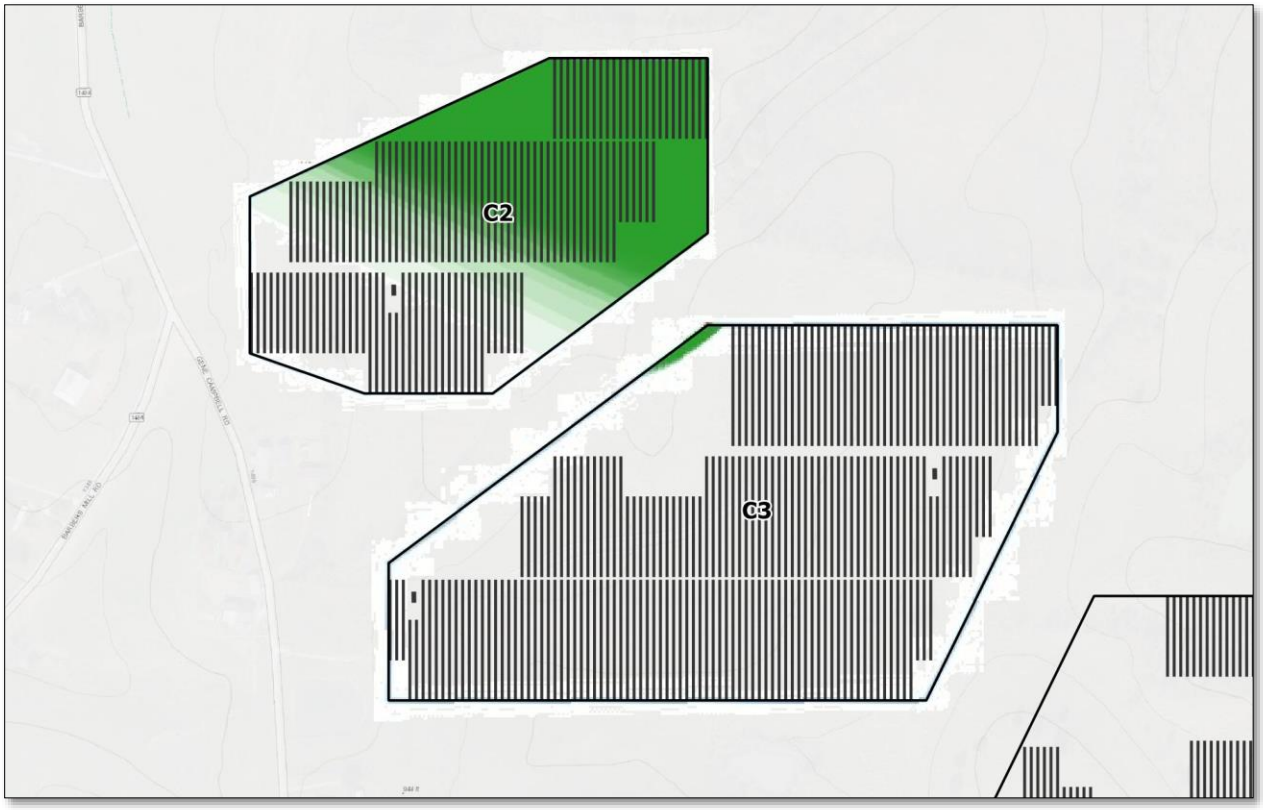

Figure 4: Location of green glare on sub-arrays C2 and C2 that affect Runway 29 approach path

Arnolds Airport (36KY)

Runway 06/24

The SGHAT results do not predict glare occurrences along the Runway 06 or Runway 24 approach paths (*Figure 5*).

Runway 14/32

The SGHAT results do not predict glare occurrences along the Runway 14 or Runway 32 approach paths (*Figure 5*).

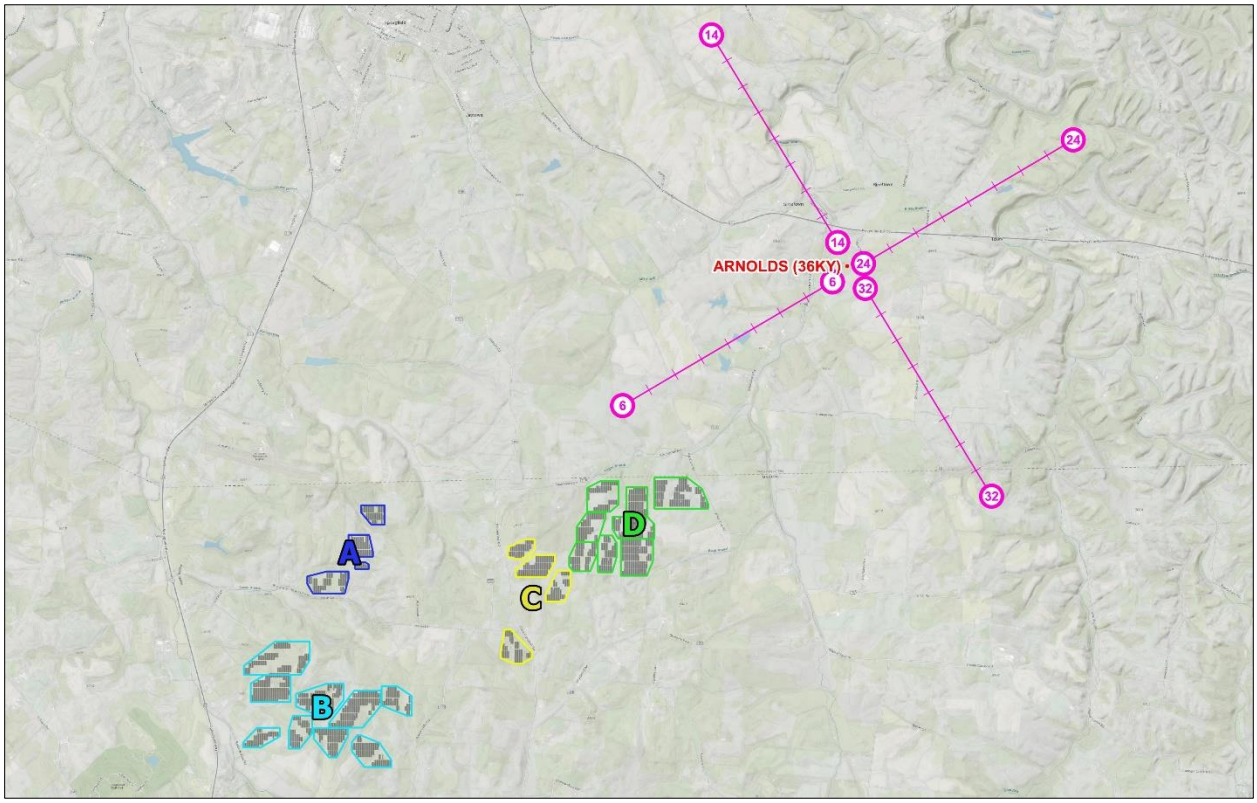

Figure 5: Arnolds Airport (36KY) approach paths (dashed pink lines)

Conclusion

The SGHAT does not predict any glare occurrences for Arnolds Airport (36KY) approaches as a result of the proposed single-axis tracking solar arrays (***Table 4***). However, the SGHAT does predict green glare occurrences for Lebanon Springfield Airport-George Hoerter Field (6I2) Runway 29 approaches. These glare occurrences are the result of sub-arrays C2 and C3 and would occur in the morning from February to May and August to October. However, green glare is associated with a low potential for temporary after-image and is deemed acceptable by the FAA.

These findings are compliant with the FAA interim policy for *Solar Energy System Projects on Federally Obligated Airports*. As noted in the assumptions, the glint and glare analysis does not consider vegetation, fencing, or other natural obstructions. This glint and glare analysis takes the most conservative approach in assessing the possibility of glare occurrences.

Table 4: Annual glare occurrence summary

Receptor	Green Glare (Hours:Minutes)	Yellow Glare (Hours:Minutes)	Red Glare (Hours:Minutes)
6I2 – Runway 11	0:00	0:00	0:00
6I2 – Runway 29	89:39	0:00	0:00
36KY – Runway 06	0:00	0:00	0:00
36KY – Runway 24	0:00	0:00	0:00
36KY – Runway 14	0:00	0:00	0:00
36KY – Runway 32	0:00	0:00	0:00

If you have any questions regarding the findings in this analysis, please contact ***Dan Underwood*** or ***Jason Auger*** at (703) 256-2485.