Keenesburg, CO
Glare Study Results

Photovoltaic (Solar) Project in Keenesburg, Weld County, CO

October 3, 2023 Update

Prepared for:

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Conclusion

Collier's Engineering & Design (CED) performed an analysis on the array areas of the proposed solar project site in Keenesburg, Weld County, CO Findings show that, with appropriate system settings, it is unlikely that glare from the proposed solar project will be problematic in any manner to the surrounding area.

The optimal resting angle of a tracker panel system can be key to reducing the amount of total predicted glare from the project into the surrounding ground scenarios. The resting angle of a solar system can be defined as the angle of rotation of panels when sun is outside tracking range and backtracking rotation has settled.

Resting angles for the tracker panel system were set to 35 degrees as assigned by the owner of the proposed project.

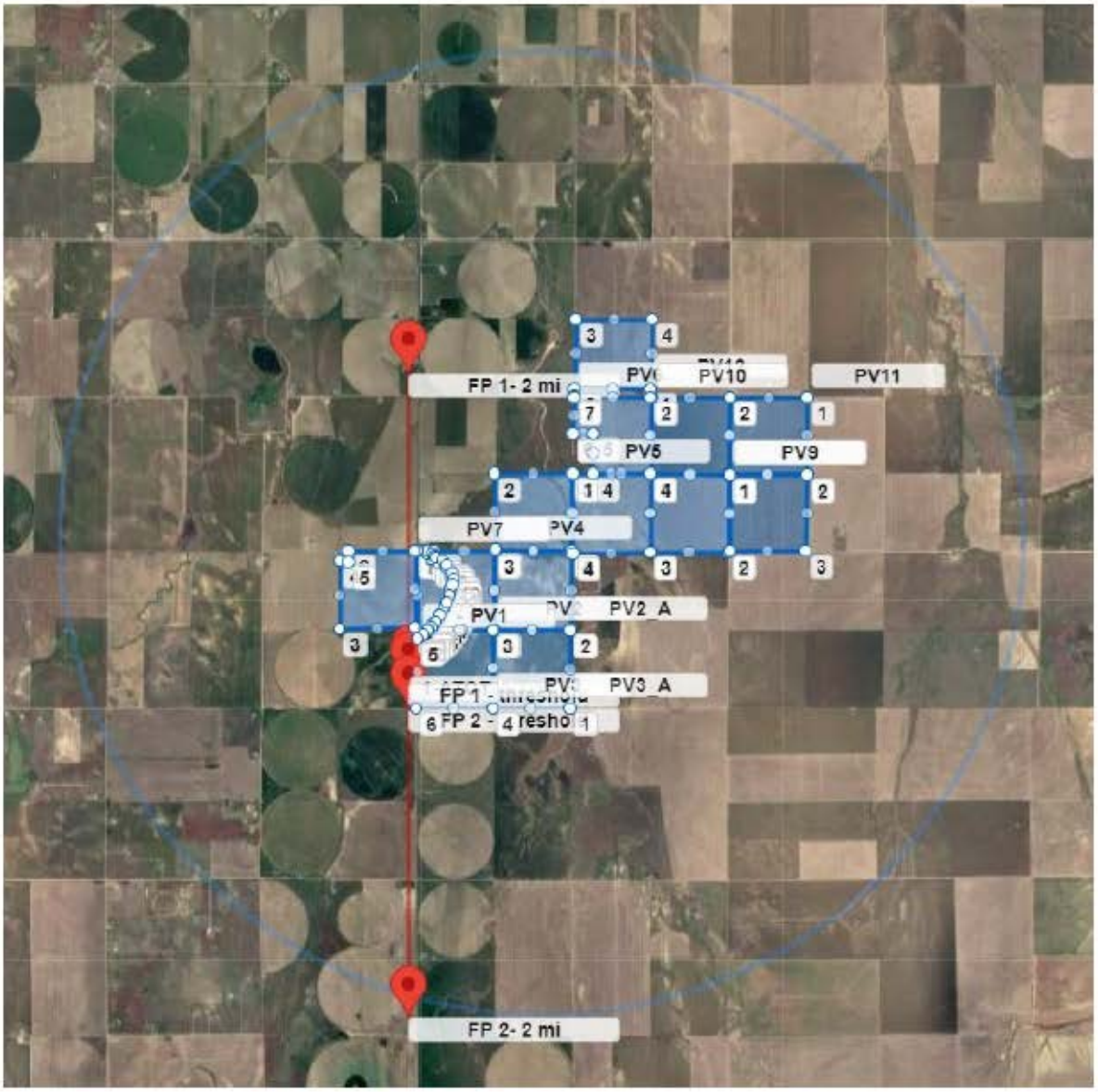
At a 35-degree resting angle no glare is predicted on the OPs and Routes around this proposed project.

In the above graphic, Red Markers represent Observation Points and Turquoise Lines are the roads in and around the proposed project area.

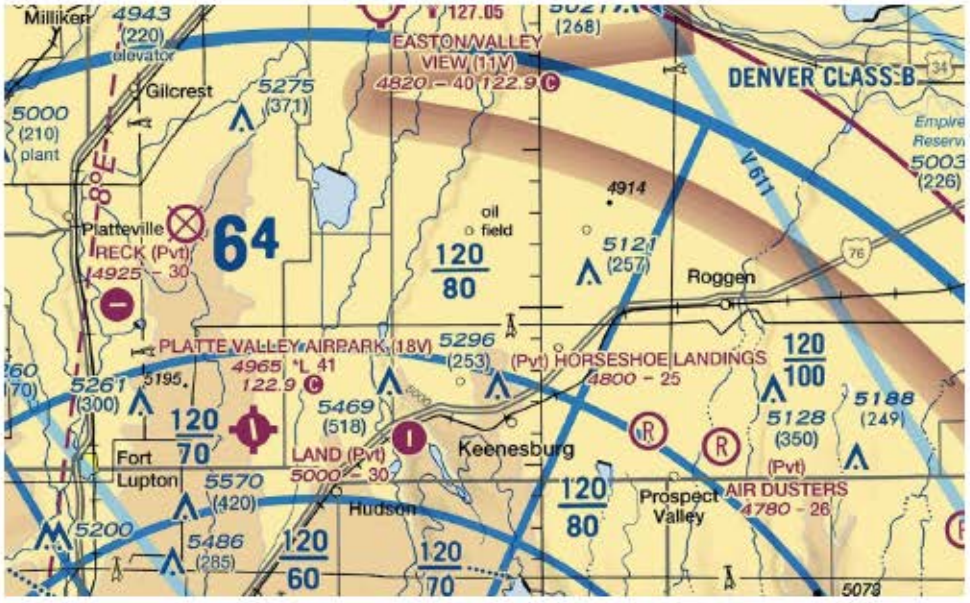
The client also requested a review of how glare might or might not affect a landing strip owned by a resident of the area. Per the FAA regulation standards, a 2-mile flightpath radius was studied.

If this was an FAA regulated airport, the proposed solar project would PASS the 2021 Policy.

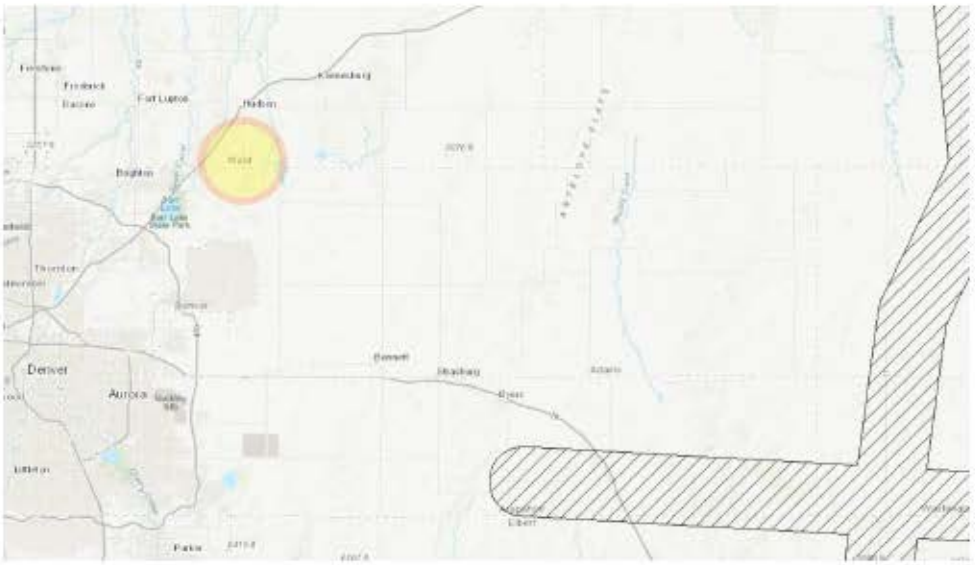
More detail regarding this is included in the Results of this Study Section.



A review of the Federal Aviation Administration's (FAA) Denver area Visual Flight Rules (VFR) charts shows no restricted airspace in or around the proposed project area (Keenesburg, CO).



A review of Military Training Route (MTR) charts was performed utilizing an additional online resource and the proposed project falls entirely **OUTSIDE** of known training route areas.



With appropriate system settings, it is unlikely that glare from the proposed solar project will be problematic in any manner to the surrounding area. An in-depth explanation of the above conclusion and the details of the full parameters of this study are found the pages that follow.

The above conclusion is arrived at by utilizing the worst-case scenario results provided by the *ForgeSolar* software, and then manually layering back into each modeling scenario all real-world factors in the area of the proposed site location.

Full technical reporting output by the *ForgeSolar* program is included in the Appendix of this report.

Sincerely,

Colliers Engineering & Design, Inc.
(DBA Maser Consulting)

Elizabeth Claire Myers, PMP
Project Manager, Electrical Engineering
Certified Glare Analyst through Sims Industries

cc: Lee Hill, PE, Colliers Engineering & Design (via email)

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Resources

Federal Aviation Administration – Publicly Available Visual Flight Rules (VFR) Charts
https://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/vfr/

- Utilized to obtain FAA-approved VFR charts of the project area for inclusion and consideration in this study.

U.S. Military Training Routes (MTRs) and buffers - May 4, 2018 (Last modified Oct 6, 2021)
Uploaded by South Atlantic Blueprint
https://salcc.databasin.org/datasets/4c81852be18444b997f8f860ee568c54/

- Utilized to obtain detail and graphic of US-wide Military Training Routes and location specific data for this study.

Ho, C. K., Ghanbari, C. M., and Diver, R. B., 2011, **Methodology to Assess Potential Glint and Glare Hazards From Concentrating Solar Power Plants: Analytical Models and Experimental Validation**, *ASME J. Sol. Energy Eng., 133*.

Solar Glare Hazard Analysis Tool (SGHAT) Technical Reference Manual

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Details of Glare Study

Methodology

(Source Information: https://forgesolar.com/help/#intro)

Collier's Engineering & Design (CED) offers staff specifically trained on glare analyses utilizing *ForgeSolar*, a web-based interactive software that provides a quantified assessment of (1) when and where glare is predicted to occur throughout the year for a prescribed solar installation, and (2) potential effects on the human eye at locations where glare is predicted to occur. *ForgeSolar* is based on the Solar Glare Hazard Analysis Tool ("SGHAT") licensed from Sandia National Laboratories.

These tools meet the FAA standards for glare analysis.

Determination of glare occurrence requires knowledge of the following: sun position, observer location, and the tilt, orientation, location, extent, and optical properties of the modules in the solar array. Vector algebra is then used to determine if glare is likely to be visible from the prescribed observation points.

If glare is predicted, the software calculates the retinal irradiance and subtended angle (size/distance) of the glare source to predict potential ocular hazards ranging from temporary after-image to more severe possible retinal damage. These results are presented in a simple, easy-to-interpret plot that specifies when glare is predicted to occur throughout the year, with color codes indicating the potential ocular hazard.

Background Information

Glint is typically defined as a momentary flash of bright light, often caused by a reflection off a moving source. A typical example of glint is a momentary solar reflection from a moving car, or "catching" something bright out of the corner of your eye.

Glare is defined as a continuous source of bright light. Glare is generally associated with stationary objects, which, due to the slow relative movement of the sun, reflect sunlight for a longer duration.

The difference between glint and glare is duration. Industry-standard glare analysis tools evaluate the occurrence of glare on a minute-by-minute basis; accordingly, they generally refer to solar hazards as 'glare.'

The ocular impact of solar glare is quantified into three categories (Ho, 2011):

1. Green – Unproblematic shine. Low potential to cause after-image. This type of glare can be compared to noticing something shiny in the distance.

2. Yellow - Potential to cause temporary after-image (flash blindness). This type of glare is much like sunrise and sunset glare for drivers who struggle to find the perfect angle for car visors so they can continue to operate their vehicle safely while traveling through areas of such glare.
   a. Standard levels of yellow glare can, for the most part, be handled with relative ease utilizing slatted fencing or local-foliage landscape mitigation measures.
   b. Only extremely high levels of this type of glare (in the area of the chart to the right labeled as "direct viewing of the sun" which is uncommon to find with PV installations) would be considered an insurmountable hurdle to a PV installation of any size.
   c. High levels/intensities and long durations are different factors.

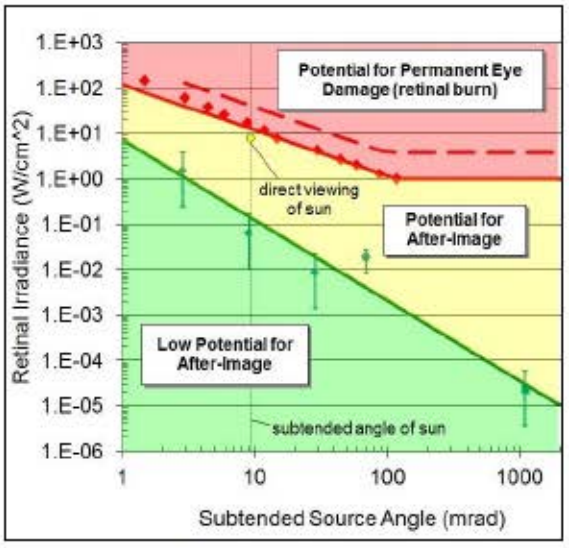

Figure 1 – From *ForgeSolar* website (sample glare hazard plot defining ocular impact as function of retinal irradiance and subtended source angle *(Ho, 2011)*)

3. Red - Potential to cause retinal burn (permanent eye damage). PV modules do not focus reflected sunlight and therefore retinal burn (RED glare) is typically not possible.
   d. This is the ONLY type of glare that would be considered an insurmountable hurdle to a PV installation of any size.

These categories assume a typical blink response in the observer.

Note that retinal burn is typically not possible for PV glare since PV modules do not focus reflected sunlight. They are, in fact, designed to absorb as much sunlight as possible.

To further put glare into perspective, the following is presented.

YELLOW glare such as in the graphic to the right could only be seen when standing directly next to project panels at the perfect angle when the sun is in a perfect place—indeed the point of a photographer standing directly by these panels and waiting for the perfect moment to capture this image. It is also possible that the panels in the picture shown do not have an anti-reflective coating.

Solar panel showing solar glare

GREEN glare, as illustrated directly to the right, is the more common occurrence with solar projects—a noticeable shiny area (in the northwest area) as compared to panels where the sun is not quite in perfect alignment yet.

Even so, the effect of this noticeable shine to certain areas of the project area is still seen from a relatively close up vantage point and at the optimal height this image was captured, possibly by a drone. A similarly sized project in the distance, closer to the horizon of the photo would be unlikely to show even the levels of green glare that the system in the foreground reflects.

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Executive Summary

The purpose of the glare study on the proposed solar project in Keenesburg, Weld County, CO is to provide feedback regarding areas that may warrant closer examination in order to mitigate possible problematic predicted glare to the businesses, residences, and roads surrounding the project area.

Information was provided by Manhard Consulting and their client in order to complete this study. The project's single-axis tracker panels were programmed to a 0-degree tilt axis facing south at 180° with a maximum tracking angle of 60-degrees, a resting angle of 35 degrees, and an assumed midpoint height of 6-feet from the ground. It was further assumed that these panels are constructed of Smooth Glass with an Anti-Reflective coating.

Twenty-eight (28) Observation Points were placed at different points around the site and programmed to an average height of 5 and a half (5.5) feet to model someone standing in these spots, and to a height of 15 feet to model a 5.5-foot person standing on the second floor of a home/business with 8-foot ceilings and a 1.5-foot plenum space.

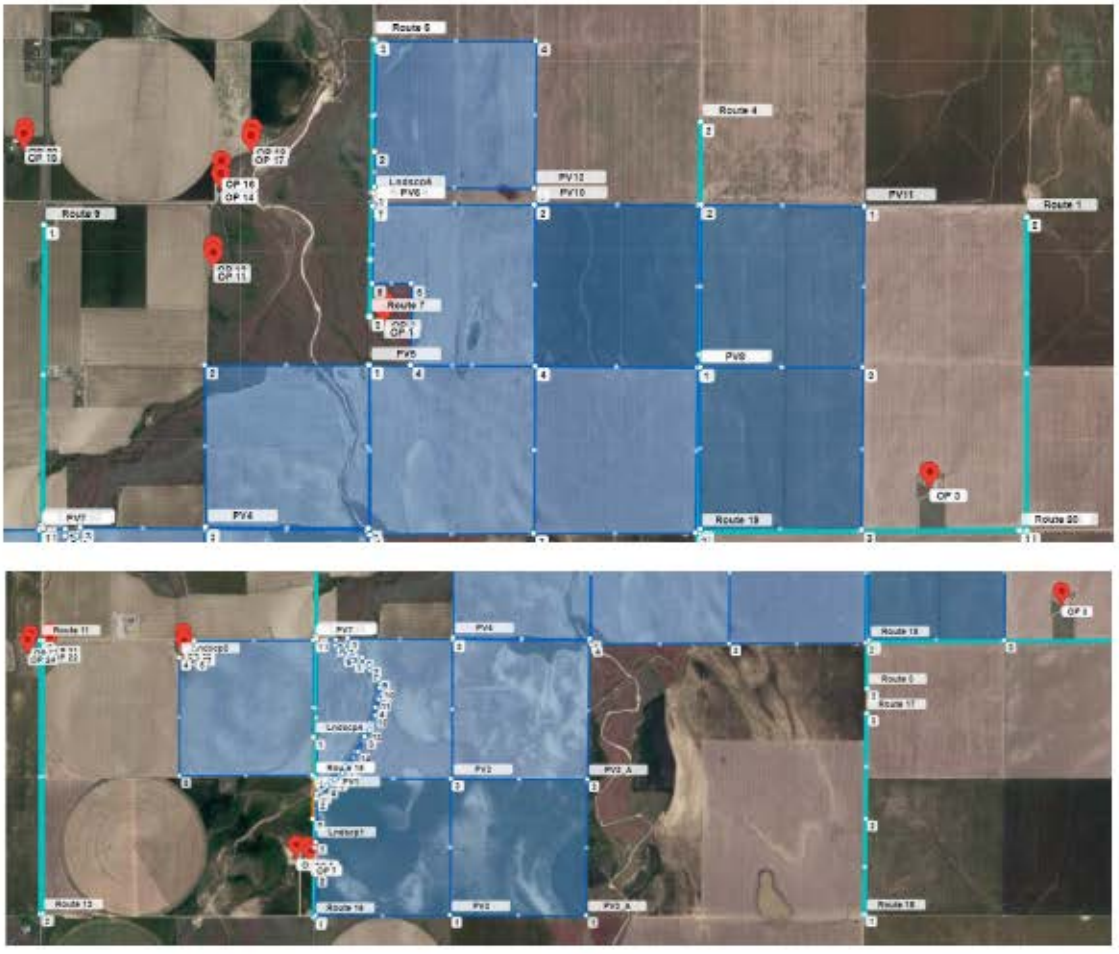
NOTE: Where buildings are obviously identifiable as single-story structures, only the 5.5-foot height is programmed.

Twenty (20) Route Receptors were programmed for two-way traffic to heights of 4.5 feet and 8.5 feet, effectively representing the eyeline of an average person sitting on/in any vehicle from a bike to a motorcycle, a standard car or SUV, through to the approximated seated height in the cab of an 18-wheeler truck.

While it is impossible to study every possible point and/or angle surrounding a photovoltaic (solar) project, Collier's Engineering & Design (CED) has modeled the project and surrounding areas as best as possible with the most likely points of concern.

When PV arrays are spread out over large and/or separated surface areas it may reduce the accuracy of certain calculations. Glare calculations via *ForgeSolar* utilize the PV footprint centroid, rather than the glare-spot location, due to analysis method limitations.

Additional analyses of total array sub-sections can generally provide more accurate information on expected glare. In order to reduce possible flaws to the results of this analysis, CED will run an overall glare map on smaller field sections to find cumulative glare readings and then, where necessary, proceed to break down each area into individual parcels in order to properly estimate the glare of each. In this way, we can ensure the most accurate possible results.



PV modules do not focus reflected sunlight and therefore retinal burn is typically not possible. They are, in fact, designed to absorb as much sunlight as possible. Modern photovoltaic panels actually cause less glare than standard home window glass; and research has shown that they reflect less light than snow, white concrete and energy-efficient white rooftops.

The YELLOW glare we are looking to identified with this study is much like sunrise and sunset glare for drivers who struggle to find the perfect angle for car visors so they can continue to operate their vehicle safely while traveling through areas of such glare. In general, photovoltaic panel systems of any size produce some glare predominately during early sunrise and sunset throughout the Spring through Fall months—although glare is possible throughout each day as well as throughout the entire year.

After examining each point and then factoring in additionally recommended foliage, distance, and elevation changes, points where predicted glare is blocked by natural obstructions were removed from the listing of points to be examined more closely.

Finally, if any glare continues to be predicted in any area, this analyst will address the areas that present the most possibility for likely glare.

ASSUMPTIONS

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.*
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
- Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
- Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.

Results of this Study

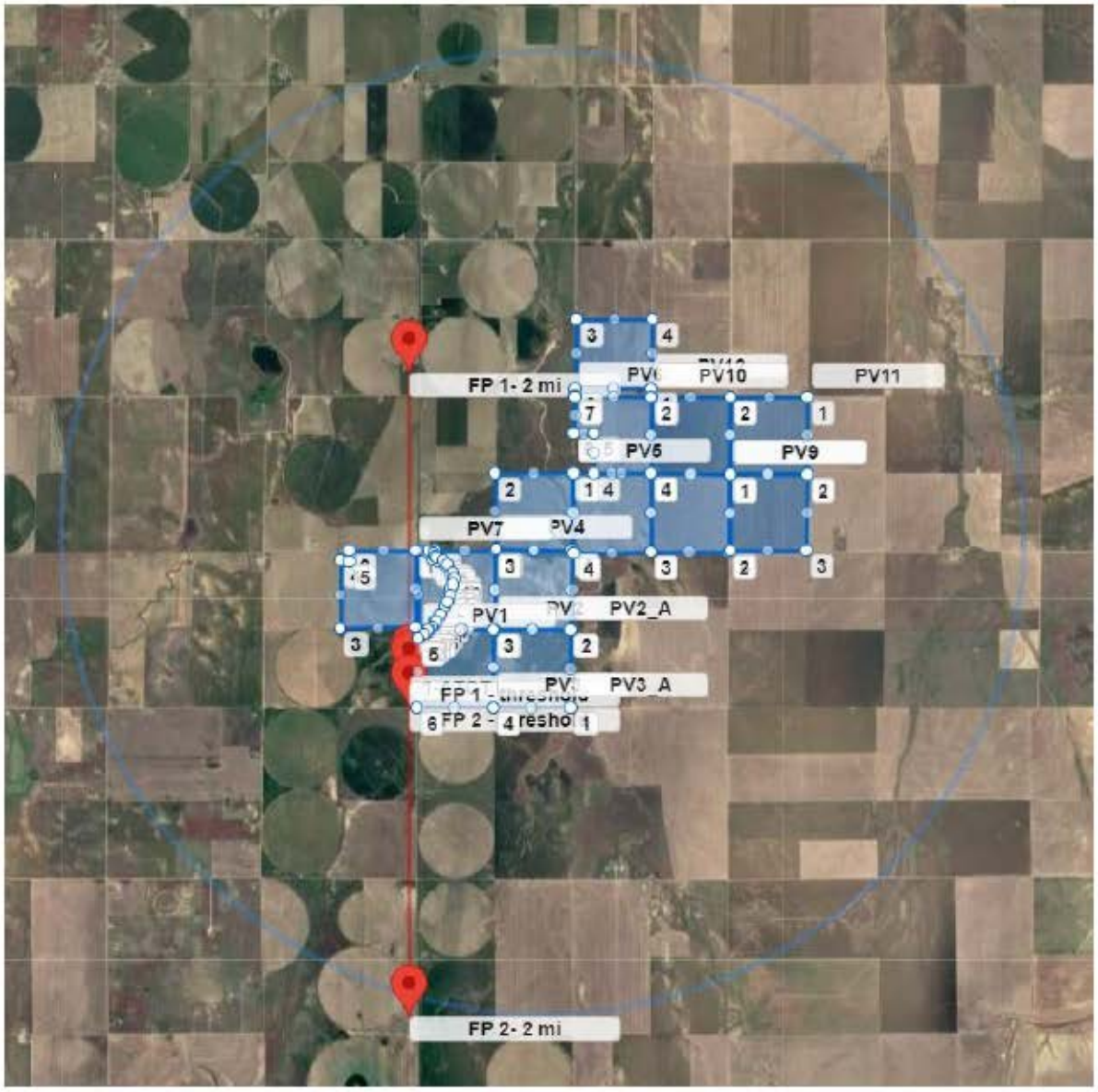
RESULTS at 35 Degree Resting Angle

Tracking panels set to +/- 60 degrees with a mid-point axis of 6-feet high and a resting angle of 35 degrees. There are no noticeable naturally occurring local foliage obstructions.

Results of this scenario shows no glare.

Summary of FAA-Level Flight Path Screening Results

Though there are no FAA local airports in the proposed project area, a local landing strip was reviewed.



FEDERAL AVIATION ADMINISTRATION (FAA) SCREENS

An FAA-level glare analysis was performed and a report specific to this request can be found in Appendix A of this report. Each operational flightpath was programmed with specified alignment, glide path, and threshold crossing height.

Analyses are run from threshold crossings to two miles out taking the pilot's visibility from the cockpit into consideration. These visibility settings were programmed at a 30-degree maximum downward viewing angle and a 50-degree azimuthal viewing angle. Threshold crossing heights of 25 feet were programmed for both approaches.

There is no air traffic control tower at this facility, however a theoretical tower at a height of 25 feet was programmed.

Per the FAA's most recent 2021 policy regarding solar around airports, this project PASSES.

Glare Policy Adherence

The following table estimates the policy adherence of this glare analysis according to the **2021** U.S. Federal Aviation Administration Policy:

Review of Solar Energy System Projects on Federally-Obligated Airports

This policy may require the following criteria be met for solar energy systems on airport property:

- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics, including 1-minute time step.

ForgeSolar is not affiliated with the U.S. FAA and does not represent or speak officially for the U.S. FAA. ForgeSolar cannot approve or deny projects - results are informational only. Contact the relevant airport and FAA district office for information on policy and requirements.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

The complete updated FAA Policy can be read at: https://www.federalregister.gov/d/2021-09862

NOTE: ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

On May 26, 2021, the Federal Aviation Administration updated their policies regarding the installation of solar on and/or near regulated airports/airstrips.

While this policy of the Federal Aviation Administeration does not apply to solar energy systems on airports that do not have an Air Traffic Control Tower (ATCT), airports that are not federally-obligated, or solar energy systems not located on airport property—it does provide a high benchmark to meet to ensure that proposed solar installations do not create glare that poses any sort of safety hazard for pilots.

The brief of this FAA policy update states:

"The Federal Aviation Administration (FAA) published a final policy aimed at ensuring that airport solar projects don't create hazardous glare. The policy requires airports to measure the visual impact of such projects on pilots and air traffic control personnel.

The policy applies to proposed solar energy systems at federally obligated airports with control towers. Federally obligated airports are public airports that have accepted federal assistance either in the form of grants of property conveyances

As more airports invests in this technology for environmental and economic benefits, the FAA wants to make sure that the reflection from the systems' glass surfaces do not create a glare that poses a safety hazard for pilots and air traffic controllers.

Under the final policy, airports are no longer required to submit the results of an ocular analysis to FAA. Instead, the airport must file a Notice of Proposed Construction or Alteration Form 7460-1 that includes a statement that the project will not cause any visual impact. The airport submits the form to the FAA for review and approval.

The FAA relies on the airport to confirm via the form that it has sufficiently analyzed the potential for glint and glare and determined there is no potential for ocular impact to the airport traffic control tower cab. If any impacts are discovered after construction, the airport must mitigate the impact at its expense. The airport may also face compliance action for failure to address visual impacts that create aviation safety hazards. As such, the agency encourages an airport to conduct sufficient analysis before installing a solar energy system.

The FAA is also withdrawing the recommended tool for measuring the ocular impact of potential glint and glare effects on pilots and air traffic controllers."

Additionally:

"Initially, FAA believed that solar energy systems could introduce a novel glint and glare effect to pilots on final approach. FAA has subsequently concluded that in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. However, FAA has continued to receive reports of potential glint and glare from on-airport solar energy systems on personnel working in ATCT cabs. Therefore, FAA has determined the scope of agency policy should be focused on the impact of on-airport solar energy systems to federally-obligated towered airports, specifically the airport's ATCT cab."

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Appendix

Appendix A | Detailed Glare Study Result Reports

The following pages are the full reporting results delivered directly from *ForgeSolar*.

FORGESOLAR GLARE ANALYSIS

Project: **Keenesburg, CO**
Site configuration: **OCT23Edit_FLIGHTPATHS_Keenesburg_35Rest**

Client: Manhard

Created 03 Oct, 2023
Updated 03 Oct, 2023
Time-step 1 minute
Timezone offset UTC-7
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Site ID 102132.17085

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Glare Policy Adherence

The following table estimates the policy adherence of this glare analysis according to the **2021** U.S. Federal Aviation Administration Policy:

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This policy may require the following criteria be met for solar energy systems on airport property:

- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics, including 1-minute time step.

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COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

The referenced policy can be read at https://www.federalregister.gov/d/2021-09862

Component Data

This report includes results for PV arrays and Observation Point ("OP") receptors marked as ATCTs. Components that are not pertinent to the policy, such as routes, flight paths, and vertical surfaces, are excluded.

PV Arrays

Name: PV1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.007212	-104.414198	4952.22	6.00	4958.22
2	40.008543	-104.412460	4947.58	6.00	4953.58
3	40.010121	-104.411151	4944.90	6.00	4950.90
4	40.011666	-104.410421	4938.13	6.00	4944.13
5	40.012734	-104.410099	4949.90	6.00	4955.90
6	40.013622	-104.410807	4933.57	6.00	4939.57
7	40.014147	-104.411945	4933.13	6.00	4939.13
8	40.014460	-104.412696	4930.49	6.00	4936.49
9	40.014969	-104.413168	4932.66	6.00	4938.66
10	40.015250	-104.413132	4930.74	6.00	4936.74
11	40.015242	-104.414402	4936.71	6.00	4942.71
12	40.007146	-104.414455	4952.19	6.00	4958.19

Name: PV10
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.029648	-104.385991	4916.05	6.00	4922.05
2	40.029606	-104.376553	4934.19	6.00	4940.19
3	40.022418	-104.376641	4950.89	6.00	4956.89
4	40.022481	-104.386026	4925.34	6.00	4931.34

Name: PV11
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.029565	-104.367002	4907.89	6.00	4913.89
2	40.029604	-104.376395	4933.60	6.00	4939.60
3	40.022425	-104.376446	4951.02	6.00	4957.02
4	40.022435	-104.367050	4929.22	6.00	4935.22

Name: PV12
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: 0.1
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.030349	-104.386032	4916.76	6.00	4922.76
2	40.030402	-104.395297	4917.15	6.00	4923.15
3	40.036867	-104.395211	4894.34	6.00	4900.34
4	40.036872	-104.385947	4902.25	6.00	4908.25

Name: PV2
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.007894	-104.405144	4943.73	6.00	4949.73
2	40.015265	-104.405116	4935.36	6.00	4941.36
3	40.015309	-104.412293	4934.71	6.00	4940.71
4	40.014947	-104.412508	4932.53	6.00	4938.53
5	40.014701	-104.412401	4933.22	6.00	4939.22
6	40.014536	-104.412208	4933.26	6.00	4939.26
7	40.014290	-104.411328	4941.77	6.00	4947.77
8	40.013912	-104.410791	4946.94	6.00	4952.94
9	40.013172	-104.410191	4949.69	6.00	4955.69
10	40.012679	-104.409912	4954.20	6.00	4960.20
11	40.012104	-104.410148	4944.27	6.00	4950.27
12	40.011233	-104.410405	4941.03	6.00	4947.03
13	40.010460	-104.410791	4943.65	6.00	4949.65
14	40.009326	-104.411585	4946.88	6.00	4952.88
15	40.008669	-104.412186	4946.90	6.00	4952.90
16	40.008176	-104.412658	4949.61	6.00	4955.61
17	40.007929	-104.413066	4951.16	6.00	4957.16

Name: PV2_A
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.007855	-104.395843	4938.48	6.00	4944.48
2	40.015193	-104.395707	4918.02	6.00	4924.02
3	40.015268	-104.405080	4935.29	6.00	4941.29
4	40.007902	-104.405136	4943.73	6.00	4949.73

Name: PV3
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.000708	-104.405275	4961.83	6.00	4967.83
2	40.007880	-104.405246	4943.81	6.00	4949.81
3	40.007911	-104.413171	4950.51	6.00	4956.51
4	40.007520	-104.413745	4952.09	6.00	4958.09
5	40.007081	-104.414442	4954.02	6.00	4960.02
6	40.000695	-104.414528	4969.31	6.00	4975.31

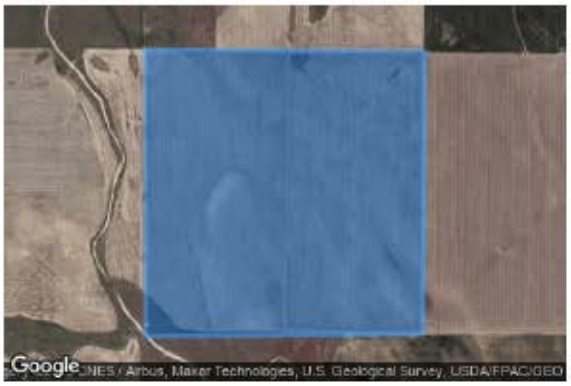
Name: PV3_A
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.000701	-104.395922	4949.33	6.00	4955.33
2	40.007848	-104.395843	4938.48	6.00	4944.48
3	40.007882	-104.405236	4943.80	6.00	4949.80
4	40.000713	-104.405258	4962.00	6.00	4968.00

Name: PV4
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.015348	-104.405030	4934.96	6.00	4940.96
2	40.022529	-104.405116	4924.47	6.00	4930.47
3	40.022511	-104.395629	4911.00	6.00	4917.00
4	40.015276	-104.395664	4918.99	6.00	4924.99

Name: PV5
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

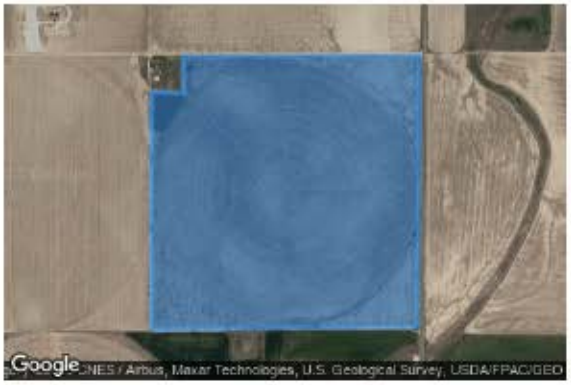


Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.022509	-104.395589	4911.06	6.00	4917.06
2	40.022460	-104.386035	4925.28	6.00	4931.28
3	40.015069	-104.386083	4936.18	6.00	4942.18
4	40.014997	-104.395581	4918.32	6.00	4924.32

Name: PV6
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

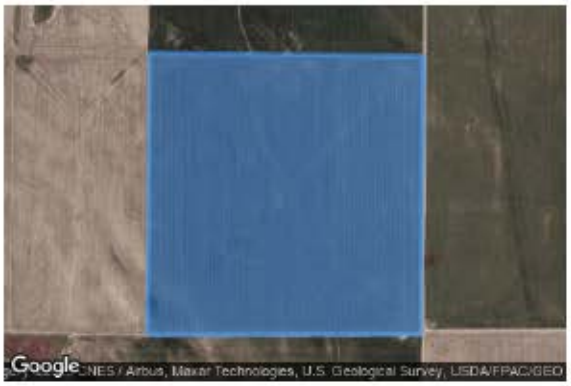
Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.029653	-104.395337	4918.04	6.00	4924.04
2	40.029628	-104.386019	4915.44	6.00	4921.44
3	40.022479	-104.386043	4925.28	6.00	4931.28
4	40.022534	-104.393202	4925.86	6.00	4931.86
5	40.026128	-104.393164	4927.40	6.00	4933.40
6	40.026128	-104.395449	4920.09	6.00	4926.09
7	40.029546	-104.395374	4918.04	6.00	4924.04

Name: PV7
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.015214	-104.414676	4936.99	6.00	4942.99
2	40.008102	-104.414745	4954.02	6.00	4960.02
3	40.008045	-104.423881	4964.68	6.00	4970.68
4	40.014282	-104.423886	4953.78	6.00	4959.78
5	40.014257	-104.422792	4951.11	6.00	4957.11
6	40.015194	-104.422813	4952.21	6.00	4958.21

Name: PV8
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.022375	-104.376618	4951.06	6.00	4957.06
2	40.015084	-104.376712	4951.44	6.00	4957.44
3	40.015067	-104.386074	4936.15	6.00	4942.15
4	40.022457	-104.385997	4925.45	6.00	4931.45

Name: PV9
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 35.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	40.022408	-104.376452	4951.14	6.00	4957.14
2	40.022408	-104.367059	4929.32	6.00	4935.32
3	40.015235	-104.367153	4956.24	6.00	4962.24
4	40.015249	-104.376484	4953.44	6.00	4959.44

Observation Point ATCT Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	40.003647	-104.415400	4980.55	25.00

Map image of 1-ATCT

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV1	SA tracking	SA tracking	0	0.0	0	0.0	-
PV10	SA tracking	SA tracking	0	0.0	0	0.0	-
PV11	SA tracking	SA tracking	0	0.0	0	0.0	-
PV12	SA tracking	SA tracking	0	0.0	0	0.0	-
PV2	SA tracking	SA tracking	0	0.0	0	0.0	-
PV2_A	SA tracking	SA tracking	0	0.0	0	0.0	-
PV3	SA tracking	SA tracking	0	0.0	0	0.0	-
PV3_A	SA tracking	SA tracking	0	0.0	0	0.0	-
PV4	SA tracking	SA tracking	0	0.0	0	0.0	-
PV5	SA tracking	SA tracking	0	0.0	0	0.0	-
PV6	SA tracking	SA tracking	0	0.0	0	0.0	-
PV7	SA tracking	SA tracking	0	0.0	0	0.0	-
PV8	SA tracking	SA tracking	0	0.0	0	0.0	-
PV9	SA tracking	SA tracking	0	0.0	0	0.0	-

Total annual glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV: PV1

1-ATCT	0	0.0	0	0.0

PV1 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV10

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV10 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV11

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV11 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV12

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV12 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV2

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV2 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV2_A

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV2_A and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV3

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV3 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV3_A

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV3_A and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV4

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV4 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV5

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV5 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV6

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV6 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV7

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV7 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV8

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV8 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

PV: PV9

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
1-ATCT	0	0.0	0	0.0

PV9 and 1-ATCT

Receptor type: ATCT Observation Point
No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

ForgeSolar

Keenesburg, CO

OCT23Edit_Keenesburg_35Rest_NoObstrctns

Client: Manhard

Created Oct 02, 2023
Updated Oct 03, 2023
Time-step 1 minute
Timezone offset UTC-7
Minimum sun altitude 0.0 deg
Site ID 102006.17085

Project type Advanced
Project status: active
Category 1 MW to 5 MW

Misc. Analysis Settings

DNI: **varies (1,000.0 W/m^2 peak)**
Ocular transmission coefficient: **0.5**
Pupil diameter: **0.002 m**
Eye focal length: **0.017 m**
Sun subtended angle: **9.3 mrad**

PV Analysis Methodology: **Version 2**
Enhanced subtended angle calculation: **On**

Summary of Results No glare predicted!

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV1	SA tracking	SA tracking	0	0	-
PV10	SA tracking	SA tracking	0	0	-
PV11	SA tracking	SA tracking	0	0	-
PV12	SA tracking	SA tracking	0	0	-
PV2	SA tracking	SA tracking	0	0	-
PV2_A	SA tracking	SA tracking	0	0	-
PV3	SA tracking	SA tracking	0	0	-
PV3_A	SA tracking	SA tracking	0	0	-
PV4	SA tracking	SA tracking	0	0	-
PV5	SA tracking	SA tracking	0	0	-
PV6	SA tracking	SA tracking	0	0	-
PV7	SA tracking	SA tracking	0	0	-
PV8	SA tracking	SA tracking	0	0	-
PV9	SA tracking	SA tracking	0	0	-

Component Data

PV Array(s)

Total PV footprint area: 2,017.7 acres

Name: PV1
Footprint area: 52.6 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.007212	-104.414198	4952.22	6.00	4958.22
2	40.008543	-104.412460	4947.58	6.00	4953.58
3	40.010121	-104.411151	4944.90	6.00	4950.90
4	40.011666	-104.410421	4938.13	6.00	4944.13
5	40.012734	-104.410099	4949.90	6.00	4955.90
6	40.013622	-104.410807	4933.57	6.00	4939.57
7	40.014147	-104.411945	4933.13	6.00	4939.13
8	40.014460	-104.412696	4930.49	6.00	4936.49
9	40.014969	-104.413168	4932.66	6.00	4938.66
10	40.015250	-104.413132	4930.74	6.00	4936.74
11	40.015242	-104.414402	4936.71	6.00	4942.71
12	40.007146	-104.414455	4952.19	6.00	4958.19

Name: PV10
Footprint area: 158.3 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.029648	-104.385991	4916.05	6.00	4922.05
2	40.029606	-104.376553	4934.19	6.00	4940.19
3	40.022418	-104.376641	4950.89	6.00	4956.89
4	40.022481	-104.386026	4925.34	6.00	4931.34

Name: PV11
Footprint area: 157.5 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

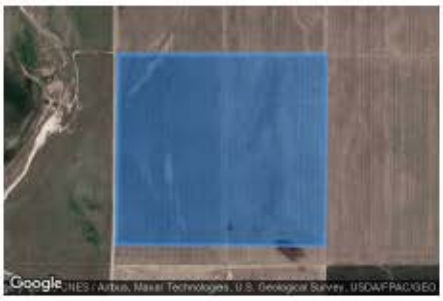
Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.029565	-104.367002	4907.89	6.00	4913.89
2	40.029604	-104.376395	4933.60	6.00	4939.60
3	40.022425	-104.376446	4951.02	6.00	4957.02
4	40.022435	-104.367050	4929.22	6.00	4935.22

Name: PV12
Footprint area: 141.0 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? No
Reflectivity: 0.1
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.030349	-104.386032	4916.76	6.00	4922.76
2	40.030402	-104.395297	4917.15	6.00	4923.15
3	40.036867	-104.395211	4894.34	6.00	4900.34
4	40.036872	-104.385947	4902.25	6.00	4908.25



Name: PV2
Footprint area: 103.0 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.007894	-104.405144	4943.73	6.00	4949.73
2	40.015265	-104.405116	4935.36	6.00	4941.36
3	40.015309	-104.412293	4934.71	6.00	4940.71
4	40.014947	-104.412508	4932.53	6.00	4938.53
5	40.014701	-104.412401	4933.22	6.00	4939.22
6	40.014536	-104.412208	4933.26	6.00	4939.26
7	40.014290	-104.411328	4941.77	6.00	4947.77
8	40.013912	-104.410791	4946.94	6.00	4952.94
9	40.013172	-104.410191	4949.69	6.00	4955.69
10	40.012679	-104.409912	4954.20	6.00	4960.20
11	40.012104	-104.410148	4944.27	6.00	4950.27
12	40.011233	-104.410405	4941.03	6.00	4947.03
13	40.010460	-104.410791	4943.65	6.00	4949.65
14	40.009326	-104.411585	4946.88	6.00	4952.88
15	40.008669	-104.412186	4946.90	6.00	4952.90
16	40.008176	-104.412658	4949.61	6.00	4955.61
17	40.007929	-104.413066	4951.16	6.00	4957.16

Name: PV2_A
Footprint area: 160.8 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.007855	-104.395843	4938.48	6.00	4944.48
2	40.015193	-104.395707	4918.02	6.00	4924.02
3	40.015268	-104.405080	4935.29	6.00	4941.29
4	40.007902	-104.405136	4943.73	6.00	4949.73

Name: PV3
Footprint area: 154.3 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.000708	-104.405275	4961.83	6.00	4967.83
2	40.007880	-104.405246	4943.81	6.00	4949.81
3	40.007911	-104.413171	4950.51	6.00	4956.51
4	40.007520	-104.413745	4952.09	6.00	4958.09
5	40.007081	-104.414442	4954.02	6.00	4960.02
6	40.000695	-104.414528	4969.31	6.00	4975.31

Name: PV3_A
Footprint area: 157.1 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.000701	-104.395922	4949.33	6.00	4955.33
2	40.007848	-104.395843	4938.48	6.00	4944.48
3	40.007882	-104.405236	4943.80	6.00	4949.80
4	40.000713	-104.405258	4962.00	6.00	4968.00

Name: PV4
Footprint area: 159.3 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.015348	-104.405030	4934.96	6.00	4940.96
2	40.022529	-104.405116	4924.47	6.00	4930.47
3	40.022511	-104.395629	4911.00	6.00	4917.00
4	40.015276	-104.395664	4918.99	6.00	4924.99

Name: PV5
Footprint area: 166.4 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.022509	-104.395589	4911.06	6.00	4917.06
2	40.022460	-104.386035	4925.28	6.00	4931.28
3	40.015069	-104.386083	4936.18	6.00	4942.18
4	40.014997	-104.395581	4918.32	6.00	4924.32

Name: PV6
Footprint area: 137.9 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

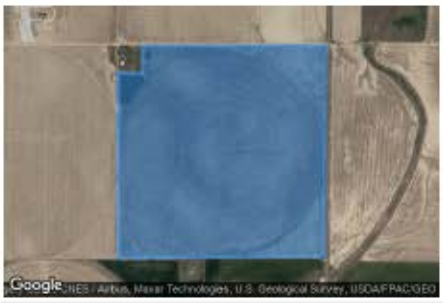
Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.029653	-104.395337	4918.04	6.00	4924.04
2	40.029628	-104.386019	4915.44	6.00	4921.44
3	40.022479	-104.386043	4925.28	6.00	4931.28
4	40.022534	-104.393202	4925.86	6.00	4931.86
5	40.026128	-104.393164	4927.40	6.00	4933.40
6	40.026128	-104.395449	4920.09	6.00	4926.09
7	40.029546	-104.395374	4918.04	6.00	4924.04

Name: PV7
Footprint area: 150.9 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.015214	-104.414676	4936.99	6.00	4942.99
2	40.008102	-104.414745	4954.02	6.00	4960.02
3	40.008045	-104.423881	4964.68	6.00	4970.68
4	40.014282	-104.423886	4953.78	6.00	4959.78
5	40.014257	-104.422792	4951.11	6.00	4957.11
6	40.015194	-104.422813	4952.21	6.00	4958.21



Name: PV8
Footprint area: 161.2 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.022375	-104.376618	4951.06	6.00	4957.06
2	40.015084	-104.376712	4951.44	6.00	4957.44
3	40.015067	-104.386074	4936.15	6.00	4942.15
4	40.022457	-104.385997	4925.45	6.00	4931.45

Name: PV9
Footprint area: 157.2 acres
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 35.0 deg
Ground Coverage Ratio: 0.5

Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.022408	-104.376452	4951.14	6.00	4957.14
2	40.022408	-104.367059	4929.32	6.00	4935.32
3	40.015235	-104.367153	4956.24	6.00	4962.24
4	40.015249	-104.376484	4953.44	6.00	4959.44

Route Receptor(s)

Name: Route 1
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.029098	-104.357657	4885.20	4.50	4889.70
2	40.015191	-104.357658	4921.87	4.50	4926.37

Name: Route 10
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.015402	-104.414474	4936.18	8.50	4944.68
2	40.028728	-104.414335	4925.35	8.50	4933.85

Name: Route 11
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.015217	-104.433454	4965.42	4.50	4969.92
2	40.000753	-104.433454	4988.81	4.50	4993.31

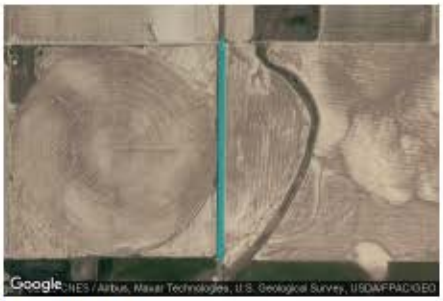
Name: Route 12
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.000803	-104.433303	4989.99	8.50	4998.49
2	40.015233	-104.433260	4965.54	8.50	4974.04

Name: Route 13
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.015301	-104.414538	4936.80	4.50	4941.30
2	40.008014	-104.414605	4954.48	4.50	4958.98

Name: Route 14
Route type Two-way
View angle: 50.0 deg



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.008020	-104.414565	4954.36	8.50	4962.86
2	40.015293	-104.414498	4936.78	8.50	4945.28

Name: Route 15
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.007961	-104.414603	4954.52	4.50	4959.02
2	40.000593	-104.414670	4969.34	4.50	4973.84

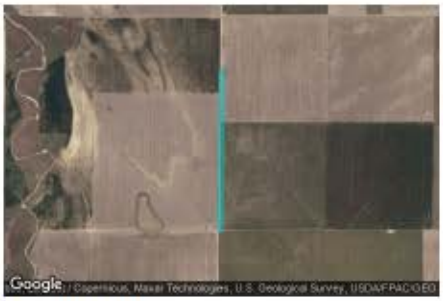
Name: Route 16
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.000601	-104.414630	4969.36	8.50	4977.86
2	40.007957	-104.414563	4954.40	8.50	4962.90

Name: Route 17
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.011347	-104.376667	4953.63	4.50	4958.13
2	40.005786	-104.376713	4957.96	4.50	4962.46
3	40.000746	-104.376847	4972.80	4.50	4977.30

Name: Route 18
Route type Two-way
View angle: 50.0 deg



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.000769	-104.376745	4972.78	8.50	4981.28
2	40.005782	-104.376664	4957.98	8.50	4966.48
3	40.011337	-104.376603	4953.91	8.50	4962.41

Name: Route 19
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.015154	-104.376486	4953.40	4.50	4957.90
2	40.015214	-104.358022	4923.66	4.50	4928.16

Name: Route 2
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.015188	-104.357629	4921.70	8.50	4930.20
2	40.029094	-104.357576	4885.27	8.50	4893.77

Name: Route 20
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.015187	-104.358022	4923.71	8.50	4932.21
2	40.015127	-104.376488	4953.40	8.50	4961.90

Name: Route 3
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.012660	-104.376639	4950.62	4.50	4955.12
2	40.033283	-104.376467	4926.48	4.50	4930.98

Name: Route 4
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.033285	-104.376432	4926.45	8.50	4934.95
2	40.012654	-104.376607	4950.82	8.50	4959.32

Name: Route 5
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.036939	-104.395379	4893.58	4.50	4898.08
2	40.030201	-104.395433	4918.63	4.50	4923.13

Name: Route 6
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.036934	-104.395332	4894.10	8.50	4902.60
2	40.030199	-104.395394	4918.52	8.50	4927.02

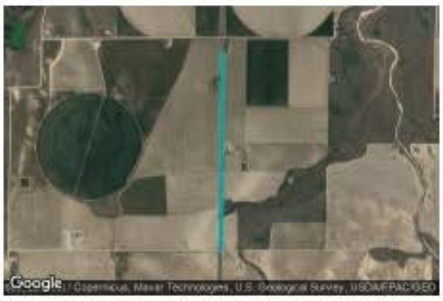
Name: Route 7
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.024656	-104.395618	4921.28	4.50	4925.78
2	40.029697	-104.395475	4918.35	4.50	4922.85

Name: Route 8
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.029694	-104.395443	4918.27	8.50	4926.77
2	40.024664	-104.395569	4921.62	8.50	4930.12

Name: Route 9
Route type Two-way
View angle: 50.0 deg



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	40.028736	-104.414394	4925.21	4.50	4929.71
2	40.015422	-104.414528	4936.00	4.50	4940.50

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	ft	ft	ft
OP 1	40.024283	-104.394779	4926.32	5.50	4931.82
OP 2	40.024554	-104.394693	4930.80	15.00	4945.80
OP 3	40.017019	-104.363212	4941.64	5.50	4947.14
OP 4	40.017058	-104.363247	4940.88	15.00	4955.88
OP 5	40.003611	-104.415044	4981.44	5.50	4986.94
OP 6	40.003668	-104.415032	4980.49	5.50	4985.99
OP 7	40.003364	-104.414855	4980.04	5.50	4985.54
OP 8	40.003409	-104.414855	4981.00	5.50	4986.50
OP 9	40.003664	-104.415869	4977.30	5.50	4982.80
OP 10	40.003707	-104.415850	4977.47	5.50	4982.97
OP 11	40.026765	-104.404619	4923.16	5.50	4928.66
OP 12	40.027052	-104.404623	4925.19	15.00	4940.19
OP 13	40.030281	-104.404182	4917.13	5.50	4922.63
OP 14	40.030244	-104.404192	4918.37	15.00	4933.37
OP 15	40.030842	-104.404165	4914.73	5.50	4920.23
OP 16	40.030821	-104.404168	4915.01	15.00	4930.01
OP 17	40.031932	-104.402436	4902.57	5.50	4908.07
OP 18	40.032250	-104.402356	4911.74	15.00	4926.74
OP 19	40.032015	-104.415559	4922.47	5.50	4927.97
OP 20	40.032288	-104.415538	4924.11	15.00	4939.11
OP 21	40.014959	-104.432832	4967.46	5.50	4972.96
OP 22	40.014627	-104.432807	4964.78	15.00	4979.78
OP 23	40.014837	-104.434144	4967.30	5.50	4972.80
OP 24	40.014503	-104.434346	4962.89	15.00	4977.89
OP 25	40.014881	-104.423613	4954.13	5.00	4959.13
OP 26	40.014940	-104.423614	4954.55	15.00	4969.55
OP 27	40.014441	-104.423582	4952.56	5.50	4958.06
OP 28	40.014633	-104.423582	4953.78	15.00	4968.78

Summary of PV Glare Analysis

PV configuration and total predicted glare

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced	Data File
	deg	deg	min	min	kWh	
PV1	SA tracking	SA tracking	0	0	-	-
PV10	SA tracking	SA tracking	0	0	-	-
PV11	SA tracking	SA tracking	0	0	-	-
PV12	SA tracking	SA tracking	0	0	-	-
PV2	SA tracking	SA tracking	0	0	-	-
PV2_A	SA tracking	SA tracking	0	0	-	-
PV3	SA tracking	SA tracking	0	0	-	-
PV3_A	SA tracking	SA tracking	0	0	-	-
PV4	SA tracking	SA tracking	0	0	-	-
PV5	SA tracking	SA tracking	0	0	-	-
PV6	SA tracking	SA tracking	0	0	-	-
PV7	SA tracking	SA tracking	0	0	-	-
PV8	SA tracking	SA tracking	0	0	-	-
PV9	SA tracking	SA tracking	0	0	-	-

PV & Receptor Analysis Results

Results for each PV array and receptor

PV1 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV10 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV11 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV12 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV2 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV2_A no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV3 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV3_A no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV4 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV5 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV6 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV7 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV8 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV9 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
OP: OP 8	0	0
OP: OP 9	0	0
OP: OP 10	0	0
OP: OP 11	0	0
OP: OP 12	0	0
OP: OP 13	0	0
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	0
OP: OP 20	0	0
OP: OP 21	0	0
OP: OP 22	0	0
OP: OP 23	0	0
OP: OP 24	0	0
OP: OP 25	0	0
OP: OP 26	0	0
OP: OP 27	0	0
OP: OP 28	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 15	0	0
Route: Route 16	0	0
Route: Route 17	0	0
Route: Route 18	0	0
Route: Route 19	0	0
Route: Route 2	0	0
Route: Route 20	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

Assumptions

Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not automatically account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Detailed system geometry is not rigorously simulated.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actua values and results may vary.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combinec area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the **Help page** for detailed assumptions and limitations not listed here.

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