Tillbridge Solar

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PEI Report Volume II Appendix 16-1: Glint and Glare Assessment

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1. EXECUTIVE SUMMARY

1.1. This assessment considers the potential impacts on ground-based receptors such as roads, rail and residential dwellings as well as aviation assets. A 1km study area around the Principal Site is considered adequate for the assessment of ground-based (residential, road, rail and bridleway) receptors, whilst a 30km study area is chosen for aviation receptors. Within the ground-based study areas of the Principal Site, there are 87 residential receptors, 162 road receptors and five bridleway receptors that were considered. No rail receptors were located within the 1km study area. As per the methodology section, where there are several residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for full assessment as the impacts will not vary to any significant degree. Where small groups of receptors have been evident, the receptors on either end of the group have been assessed in detail. Two residential and one road receptor were dismissed as they are located within the no reflection zones(see paragraph 5.5). 14 aerodromes are located within the 30km study area; however, only Sturgate Airfield, RAF Scampton and WIckenby Airfield required a detailed assessment as the Principal Site is located within their respective safeguarding buffer zones. The other 11 aerodromes did not require a detailed assessment due to their size and/or orientation in relation to the Principal Site.

1.2. Geometric analysis was conducted at 85 individual residential receptors, 161 road receptors and three bridleway receptors. Also, geometric analysis was conducted at eight runway approach paths and two Air Traffic Control Towers (ATCT) at Sturgate Airfield and RAF Scampton.

1.3. The assessment concludes that:

- Solar reflections are possible at none of the 85 residential receptors assessed within the 1km study area. Therefore, overall impacts on residential receptors are considered to be **None**.
- Solar reflections are possible at two of the 161 road receptors assessed within the 1km study area. Upon reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** for all road receptors. Therefore, overall impacts are **None**.
- Solar reflections are possible at none of the three bridleway receptors assessed within the 1km study area. Therefore, overall impacts on bridleway receptors are considered to be **None**.
- Eight runway approach paths and two ATCTs were assessed in detailed at Sturgate Airfield, RAF Scampton and Wickenby Airfield**.** Only Green Glare impacts were predicted for Runway 27 at Sturgate Airfield, which is an **acceptable impact** upon runways according to FAA guidance. Overall aviation impacts are **Low** and **Not Significant**.

1.4. **No Mitigation** is required due to the no impacts found for the residential and road receptors.

1.5. The effects of glint and glare and their impact on local receptors has been analysed in detail and there is predicted to be **Low** impacts at one runway approach path, whilst the remaining aviation receptors are predicted to have **No Impacts**. Impacts upon ground-based receptors are predicted to be **None.** Therefore, overall impacts are **Negligible**.

2. INTRODUCTION

BACKGROUND

2.1. Neo Environmental Ltd has been appointed by AECOM Ltd on behalf of Tillbridge Solar Ltd (the "Applicant") to undertake a Glint and Glare Assessment for a proposed solar farm development (the "Scheme") on lands approximately 5km east of Gainsborough.

SCHEME DESCRIPTION

2.2. The Scheme will comprise two distinct sections. The "Principal Site" will consist of the location where rows of solar photovoltaic ('PV') panels, Battery Energy Storage Systems (BESS), and associated development such as maintenance tracks, inverters, and transformers are constructed. The Principal Site is the focus of this assessment, as this will be where the glint and glare impacts will originate from. In addition, the "Cable Route Corridor" will comprise the underground electrical infrastructure required to connect the Principal Site to the national transmission system.

SITE DESCRIPTION

2.3. The Principal Site comprises of approximately 1,400 ha of land contained within approximately 119 fields. The field boundaries consist of hedgerows. Ground levels within the Principal Site vary from approximately 14m Above Ordnance Datum (AOD) along the southwest boundary to 64m AOD at the eastern boundary.

2.4. The Principal Site is centred at approximate grid reference E 490434, N 389180. The wider landscape contains the village of Hemswell, which is located c. 0.8km to the northeast of the Principal Site.

SCOPE OF REPORT

2.5. Although there may be small amounts of glint and glare from the metal structures associated with the solar PV panels, this is not likely to be significant and the main source of glint and glare will be from the solar PV panels themselves and this will be the focus of this assessment. Since the Cable Route Corridor comprises below ground infrastructure and does not comprise of

reflective surfaces, there is no potential for glint and glare effects, therefore this is not considered further in this assessment.

2.6. Solar PV panels are designed to absorb as much light as possible and not to reflect it. However, glint can be produced as a reflection of the sun from the surface of the solar PV panel. This can also be described as a momentary flash. This may be an issue due to visual impact and viewer distraction on ground-based receptors and on aviation.

2.7. Glare is significantly less intense in comparison to glint and can be described as a continuous source of bright light, relative to diffused lighting. This is not a direct reflection of the sun, but a reflection of the sky around the sun.

2.8. This report focusses on the effects of glint and glare and its impact on local receptors and will be supported with the following Figures and Appendices.

- Appendix A: Figures
  - Figure 1: Residential Receptor Map
  - Figure 2: Road Receptor Map
  - Figure 3 – Bridleway Receptor Map
- Appendix B: Residential Receptor Glare Results (1 – 43)
- Appendix C: Residential Receptor Glare Results (44 – 85)
- Appendix D: Road Receptor Glare Results (1 – 81)
- Appendix E: Road Receptor Glare Results (82 – 161)
- Appendix F: Bridleway Receptor Glare Results
- Appendix G: Aviation Receptor Glare Results
- Appendix H: Visibility Assessment Evidence
- Appendix I: Solar Module Glare and Reflectance Technical Memo

STATEMENT OF COMPETENCE

2.9. This Glint and Glare Assessment has been produced by Tom Saddington and Michael McGhee of Neo Environmental. Having completed a civil engineering degree in 2012, Michael has produced Glint and Glare assessments for over 1GW of solar farm developments across the UK and Ireland. Tom has an undergraduate degree in Bioengineering and graduated with an MSc in Environmental and Energy Engineering in January 2020. He has been working on various

technical assessments including glint and glare reports for numerous solar farms in Ireland and the UK.

DEFINITIONS

2.10. This study examined the potential hazard and nuisance effects of glint and glare in relation to ground-based receptors, which includes the occupants of surrounding dwellings as well as road users. The US Federal Aviation Administration (FAA) in their "*Technical Guidance for Evaluating Selected Solar Technologies on Airports*"[1] have defined the terms 'Glint' and 'Glare' as meaning;

- Glint – "*A momentary flash of bright light*"
- Glare – "*A continuous source of bright light*"

2.11. Glint and glare are essentially the unwanted reflection of sunlight from reflective surfaces. This study used a multi-step process of elimination to determine which receptors have the potential to experience the effects of glint and glare. It then examined, using a computer-generated geometric model, the times of the year and the times of the day such effects could occur. This is based on the relative angles between the sun, the panels, and the receptor throughout the year.

2.12. The ocular impact upon a receptor will be assessed and used as the basis of categorising the magnitude of impact at each receptor. For the avoidance of doubt specular impact is a term that refers to the impact produced by the PV panels, whilst ocular impact is the impact observed by the observer.

General Nature of Reflectance from Photovoltaic Panels

2.13. In terms of reflectance, solar PV panels are by no means a highly reflective surface. They are designed to absorb sunlight and not to reflect it. Nonetheless, solar PV panels have a flat polished surface that omit 'specular' reflectance rather than a 'diffuse' reflectance, which would occur from a rough surface. Several studies have shown that solar PV panels (as opposed to Concentrated Solar Power) have similar reflectance characteristics to water, which is much lower than the likes of glass, steel, snow and white concrete by comparison (**See Appendix I**). Similar levels of reflectance can be found in rural environments from the likes of shed roofs and the lines of plastic mulch used in cropping. In terms of the potential for reflectance from solar PV panels to cause hazard and/ or nuisance effects, there have been a number of studies undertaken in respect of schemes in close proximity to airports. The most recent of these was

1 Harris, Miller, Miller & Hanson Inc. (November 2010). Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. Technical Guidance for Evaluating Selected Solar Technologies on Airports. Available at:

https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide.pdf

compiled by the Solar Trade Association (STA) in April 2016 and used a number of case studies and expert opinions, including that from Neo. The summary of this report states that "*the STA does not believe that there is cause for concern in relation to the impact of glint and glare from solar PV on aviation and airports…*"[2].

Time Zones / Datums

2.14. Locations in this report are given in Eastings and Northings using the 'British National Grid' grid reference system unless otherwise stated.

2.15. England uses British Summer Time (BST, UTC + 01:00) in the summer months and Greenwich Mean Time (UTC+0) in the winter period. For the purposes of this report all time references are in GMT.

2 Solar Trade Association. (April 2016). Summary of evidence compiled by the Solar Trade Association to help inform the debate around permitted development for non - domestic solar PV in Scotland. Impact of solar PV on aviation and airports. Available at: http://www.solar-trade.org.uk/wp-content/uploads/2016/04/STA-glint-and-glare-briefing-April-2016-v3.pdf

3. LEGISLATION AND GUIDANCE

3.1. There is no legislation and limited guidance or policy available in the UK at present in relation to the assessment of glint and glare from Scheme developments. Available UK guidance is reviewed below, in addition to references to international guidance where deemed suitable.

NATIONAL PLANNING POLICY GUIDANCE (NPPG) ON RENEWABLE AND LOW CARBON ENERGY (UK) [3]

3.2. Paragraph 013 (Reference ID: 5-013-20150327) sets out planning considerations that relate to large scale ground-mounted solar PV farms. This determines that the deployment of large-scale solar farms can have a negative impact on the rural environment, particularly in undulating landscapes. However, the visual impact of a well-planned and well-screened solar farm can be properly addressed within the landscape if planned sensitively. Considerations to be taken into account by local planning authorities are:

- *"the proposal's visual impact, the effect on landscape of glint and glare and on neighbouring uses and aircraft safety;*
- *the extent to which there may be additional impacts if solar arrays follow the daily movement of the sun."*

NATIONAL POLICY STATEMENT FOR RENEWABLE ENERGY INFRASTRUCTURE (EN-3), ADOPTED 2011

3.3. Section 2.4 of EN-3 provides policy on Criteria for "good design" for energy infrastructure. Paragraph 2.4.1 of this section refers back to the criteria for good design in NPS EN-1. Paragraph 2.4.2 of EN-3 goes on to state that: *"Proposals for renewable energy infrastructure should demonstrate good design in respect of landscape and visual amenity".*

[3] NPPG Renewable and Low Carbon Energy. Available at: http://planningguidance.communities.gov.uk/blog/guidance/renewable-and-low-carbon-energy/particular-planning-considerations-for-hydropower-active-solar-technology-solar-farms-and-wind-turbines/#paragraph_012

DRAFT NATIONAL POLICY STATEMENT FOR RENEWABLE ENERGY INFRASTRUCTURE (DRAFT EN-3)

3.4. Section 2.52 of the Draft EN-3 provides the following commentary in relation to Glint and Glare impacts:

> *"2.52.1 Solar panels may reflect the sun's rays, causing glint and glare. Glint is defined as a momentary flash of light that may be produced as a direct reflection of the sun in the solar panel. Glare is a continuous source of excessive brightness experienced by a stationary observer located in the path of reflected sunlight from the face of the panel. The effect occurs when the solar panel is stationed between or at an angle of the sun and the receptor.*
>
> *2.52.2 In some instances, it may be necessary to seek a glint and glare assessment as part of the application. This may need to account for 'tracking' panels if they are proposed as these may cause differential diurnal and/or seasonal impacts. The potential for solar PV panels, frames and supports to have a combined reflective quality should be assessed. This assessment needs to consider the likely reflective capacity of all of the materials used in the construction of the solar PV farm.*
>
> *2.52.3 Applicants should consider using, and in some cases the Secretary of State may require, solar panels to be of a non-glare/ non-reflective type and the front face of the panels to comprise of (or be covered) with a non-reflective coating for the lifetime of the permission.*
>
> *2.52.4 Solar PV panels are designed to absorb, not reflect, irradiation. However, the Secretary of State should assess the potential impact of glint and glare on nearby homes and motorists.*
>
> *2.52.5 There is no evidence that glint and glare from solar farms interferes in any way with aviation navigation or pilot and aircraft visibility or safety. Therefore, the Secretary of State is unlikely to have to give any weight to claims of aviation interference as a result of glint and glare from solar farms."*

3.5. This Glint and Glare Assessment will be taking account of impacts upon nearby homes, motorists, and aviation receptors.

PLANNING GUIDANCE FOR THE DEVELOPMENT OF LARGE-SCALE GROUND MOUNTED SOLAR PV SYSTEMS

3.6. As outlined within the BRE document 'Planning Guidance for the Development of Large-Scale Ground Mounted Solar PV Systems'[4]:

[4] BRE (2013) *Planning Guidance for the Development of Large Scale Ground Mounted Solar PV Systems*. Available at: https://www.bre.co.uk/filelibrary/pdf/other_pdfs/KN5524_Planning_Guidance_reduced.pdf

"Glint may be produced as a direct reflection of the sun in the surface of the solar PV panel. It may be the source of the visual issues regarding viewer distraction. Glare is a continuous source of brightness, relative to diffused lighting. This is not a direct reflection of the sun, but rather a reflection of the bright sky around the sun. Glare is significantly less intense than glint.

Solar PV panels are designed to absorb, not reflect, irradiation. However, the sensitivities associated with glint and glare, and the landscape/ visual impact and the potential impact on aircraft safety, should be a consideration. In some instances, it may be necessary to seek a glint and glare assessment as part of a planning application. This may be particularly important if 'tracking' panels are proposed as these may cause differential diurnal and/or seasonal impacts.

The potential for solar PV panels, frames and supports to have a combined reflective quality should be assessed. This assessment needs to consider the likely reflective capacity of all of the materials used in the construction of the solar PV farm."

3.7. This Glint and Glare Assessment will assess the overall impact of the Scheme onto the local environment..

INTERIM CAA GUIDANCE – SOLAR PHOTOVOLTAIC SYSTEMS (2010)

3.8. There is little guidance on the assessment of glint and glare from solar farms with regards to aviation safety. The Civil Aviation Authority (CAA) has published interim guidance on 'Solar Photovoltaic Systems[5]', they also intend to undertake a review of the potential impacts of solar PV developments upon aviation, however this is yet to be published.

3.9. The interim guidance identifies the key safety issues with regards to aviation, including *"glare, dazzling pilots leading them to confuse reflections with aeronautical lights."* It is outlined that solar farm developers should be aware of the requirements to comply with the Air Navigation Order (ANO), published in 2016 and amended in 2022. In particular, developers should be cognisant of the following articles of the ANO[6], including:

- ***Article 240*** *– Endangering safety of an aircraft – "A person must not recklessly or negligently act in a manner likely to endanger an aircraft, or any person in an aircraft."*
- ***Article 224*** *- Lights liable to endanger – "A person must not exhibit in the United Kingdom any light which:*

[5] *CAA (2010) Interim CAA Guidance – Solar Photovoltaic Systems. Available at: https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&appid=11&mode=detail&id=4370*

[6] CAA (2016) Air Navigation: The Order and Regulations. Available at: https://www.caa.co.uk/media/1a2cigrq/air-navigation-order-2016-amended-april-2022-version.pdf

- *a) by reason of its glare is liable to endanger aircraft taking off or from landing at an aerodrome; or*
- *b) by reason of its liability to be mistaken for an aeronautical ground light liable to endanger aircraft"*

- ***Article 225** – Lights which dazzle or distract – "A person must not in the United Kingdom direct or shine any light at any aircraft in flight so as to dazzle or distract the pilot of the aircraft."*

3.10. Relevant studies generally agree that there is potential for glint and glare from photovoltaic panels to cause a hazard or nuisance for surrounding receptors, but that the intensity of such reflections is similar to that emanating from still water. This is considerably lower than for other manmade materials such as glass, steel or white concrete (SunPower – 2009).

3.11. These Articles are considered within the assessment of glint and glare for the Scheme.

CAA – CAP738: SAFEGUARDING OF AERODROMES 3RD EDITION[7]

3.12. In 2003, the CAA first introduced the CAP738 document to help provide advice and guidance to ensure aerodrome safeguarding. Subsequently, there have been two updates to this document in 2006 and 2020.

3.13. Within the latest edition of CAP738, it outlines that the purpose of the document is to protect an aerodrome and to ensure safe operation. Specifically stating:

"Its purpose is to protect:

Aircraft from the risk of glint and glare e.g. solar panels."

3.14. Within the section named as "Appendix C – Solar Photovoltaic Cells", the following is stated:

"Policy

1. In 2010 the CAA published interim guidance on Solar Photovoltaic Cells (SPCs). At that time, it was agreed that we would review our policy based on research carried out by the Federal Aviation Authorities (FAA) in the United States, in addition to reviewing guidance issued by other National Aviation Authorities. New information and field experience, particularly with respect to compatibility and glare, has resulted in the FAA reviewing its original document 'Technical Guidance for Evaluating Selected Solar Technologies on Airports', which is likely to be subject to change, see link;

[7] Civil Avaition Authority (2020). CAP738 – Safeguarding of Aerodromes 3rd Edition. Available at: https://publicapps.caa.co.uk/docs/33/CAP738%20Issue%203.pdf

https://www.federalregister.gov/documents/2013/10/23/2013-24729/interimpolicy-faa-review-of-solar-energy-system-projects-on-federally-obligated-airports

2. In the United Kingdom there has been a further increase in SPV cells, including some located close to aerodrome boundaries; to date the CAA has not received any detrimental comments or issues of glare at these established sites. Whilst this early indication is encouraging, those responsible for safeguarding should remain vigilant to the possibility."

3.15. In summary, the above is stating that to date, there has not been any complications on airfields due to glare originating from solar farms across the UK

US FEDERAL AVIATION ADMINISTRATION POLICY

3.16. The US Federal Aviation Administration (FAA) in their Solar Guide (Federal Aviation Authority, 2010)[8] incorporates a chapter on the impact and assessment of glint from solar panels. It concludes that (although subject to revision):

"...evidence suggests that either significant glare is not occurring during times of operation or if glare is occurring, it is not a negative effect and is a minor part of the landscape to which pilots and tower personnel are exposed."

3.17. The interim policy (Federal Register, 2013)[9] demands that an ocular impact assessment must be assessed at 1-minute intervals from when the sun rises above the horizon until the sun sets below the horizon. Specifically, the developer must use the 'Solar Glare Hazard Analysis Tool' (SGHAT) tool specifically and reference its results as this was developed by the FAA and Sandia National Laboratories as a standard and approved methodology for assessing potential impacts on aviation interests, although it notes other assessment methods may be considered. The SGHAT tool has since been licensed to a private organisation who were also involved in its development and it is the software model used in this assessment.

3.18. Crucially, the policy provides a quantitative threshold that is lacking in the English guidance. This outlines that a solar development will not automatically receive an objection on glint grounds if low intensity glint is visible to pilots on final approach. In other words, low intensity glint with a low potential to form a temporary after-image (Green Glare) would be considered acceptable under US guidance. Due to the lack of legislation and guidance within England, this US document has been utilised as guidance for this report, which is accepted as best practice in the UK with the absence of quantitative guidance.

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[8] FAA (2010), Technical Guidance for Evaluating Selected Solar Technologies on Airports. Available at https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide-print.pdf

[9] FAA (2013), Interim Policy, *FAA Review of Solar Energy System Projects on Federally Obligated Airports*. Available at https://www.federalregister.gov/documents/2013/10/23/2013-24729/interim-policy-faa-review-of-solar-energy-system-projects-on-federally-obligated-airports

3.19. The FAA guidance states that for a solar PV development to obtain FAA approval or to receive no objection, the following two criteria must be met:

- No potential for glint or glare in the existing or planned Air Traffic Control Tower (ATCT); and
- No potential for glare (glint) or "low potential for after-image" (Green Glare) along the final approach path for any existing or future runway landing thresholds (including planned or interim phases), as shown by the approved layout plan (ALP). The final approach path is defined as 2 miles from 50 feet above the landing threshold using a standard 3-degree glide path.

3.20. The geometric analysis included later in this report, which defines the extent and time at which glint may occur, is required by the FAA as the methodology to be used when assessing glint and glare impacts on aviation receptors. This report follows the methodology required by the FAA as it offers the most robust assessment method currently available

FAA POLICY: REVIEW OF SOLAR ENERGY SYSTEMS PROJECTS ON FEDERALLY - OBLIGATED AIRPORTS[10]

3.21. The FAA updated their Interim Policy from 2013 as part of their commitment to "*update policies and procedures as part of an iterative process as new information and technologies become available.*" The main development regarding Glint and Glare since the Interim Policy is the following:

> *"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."*

3.22. This is outlining that solar panels are similar to nuisances that are already caused by other existing infrastructure, such as; car parks, glass buildings and water bodies. Furthermore, the ATCT has been outlined as the key receptor to be assessed when determining Glint and Glare impacts from a solar farm.

3.23. Again, in respect of an absence of UK guidance, this is used as the best practice when assessing aviation receptors.

[10] FAA (2021). FAA Policy: Review of Solar Energy Systems Projects on Federally – Obligated Airports. Available at: https://www.federalregister.gov/documents/2021/05/11/2021-09862/federal-aviation-administration-policy-review-of-solar-energy-system-projects-on-federally-obligated

4. METHODOLOGY

4.1. A desk-based assessment was undertaken to identify when and where glint and glare may be visible at receptors within the vicinity of the Scheme, throughout the day and the year.

SUN POSITION AND REFLECTION MODEL

Sun Data Model

4.2. The calculations in the solar position calculator are based on equations from Astronomical Algorithms[11]. The sunrise and sunset results are theoretically accurate to within a minute for locations between +/- 72° latitude, and within 10 minutes outside of those latitudes. However, due to variations in atmospheric composition, temperature, pressure and conditions, observed values may vary from calculations.

Solar Reflection Model

4.3. The position of the sun is calculated at one-minute intervals of a typical year.

4.4. In order to determine if a solar reflection will reach a receptor, the following variables are required:

- Sun position;
- Observer location; and
- Tilt, orientation, and extent of the modules in the solar array.

4.5. The model assumes that the azimuth and horizontal angle of the sun is the same across the whole Principal Site. This is considered acceptable due to the distance of the sun from the Scheme and the miniscule differences in location of the sun over the Principal Site.

4.6. Once the position of the sun is known for each time interval, a vector reflection equation determines the reflected sun vector, based on the normal vector of the solar array panels. This assumes that the angle of reflection is equal to the angle of incidence reflected across a normal plane. In this instance, the plane being the vector which the solar panels are facing.

4.7. On knowing the vector of the solar reflection, the azimuth is calculated and the horizontal reflection from multiple points within the Principal Site. These are then compared with the

[11] Jean Meeus, Astronomical Algorithms (Second Edition), 1999

azimuth and horizontal angle of the receptor from the Principal Site to determine if it is within range to receive solar reflections.

4.8. The solar reflection in the model is considered to be specular as a worst-case scenario. In practice, the light from the sun will not be fully reflected as solar panels are designed to absorb light rather than reflect it. The text above and **Appendix I** outlines the reflective properties of solar glass and compares it to other reflective surfaces. Although the exact figures in this report could contain a margin of error, it is included as a visual guide and it agrees with most other reports, in that solar glass has less reflective properties than other types of glass, bodies of water and snow, and that the amount of reflective energy drops as the angle of incidence decreases.

4.9. Most modern solar PV panels have a slight surface texture which should have a small effect on diffusing the solar radiation further. Although, this has not been modelled to conform with the worst-case scenario assessment.

4.10. The panel reflectivity has been modelled to assume an anti-reflective coating (ARC), which is the industry standard for solar PV panels and further reduces the reflective properties of the solar PV panels.

Determination of Ocular Impact

4.11. The software used for this assessment is based on the Sandia Laboratories Solar Glare Hazard Analysis Tool (SGHAT). This tool is specifically mentioned in the FAA guidance as the software that should be used in this type of assessment. Again, this is following the current best practice available due to the lack of UK guidance.

4.12. Determination of the ocular impact requires knowledge of the direct normal irradiance, solar PV panel reflectance, size and orientation of the array, optical properties of the PV module, and ocular parameters. These values are used to determine the retinal irradiance and subtended source angle used in the ocular hazard plot.

4.13. The ocular impact[12] of viewed glare can be classified into three levels based on the retinal irradiance and subtended source angle: low potential for after-image (green), potential for after-image (yellow), and potential for permanent eye damage (red).

4.14. Green glare can be ignored when looking at ground based and some aviation receptors. Green glare does not cause temporary flash blindness and happens at an instant with very slight disturbance. As per FAA guidelines, mitigation is only required for green glare when affecting an Air Traffic Control Tower, but not for when affecting pilots. Therefore, it can be assumed that green glare is acceptable for ground-based receptors.

[12] Ho, C.K., C.M. Ghanbari, and R.B. Diver, 2011, Methodology to Assess Potential Glint and Glare Hazards From Concentrating Solar Power Plants: Analytical Models and Experimental Validation, Journal of Solar Energy Engineering-Transactions of the Asme, 133(3).

4.15. The subtended source angle represents the size of the glare viewed by an observer, while the retinal irradiance determines the amount of energy impacting the retina of the observer. Larger source angles can result in glare of high intensity, even if the retinal irradiance is low.

4.16. The modelling software outputs a hazard plot for each receptor predicted to be impacted by glare from the PV array. An orange dot is plotted for each minute of glare indicating the irradiance (power density) of the reflected solar light. A yellow dot is plotted to show the irradiance of the Sun when it is viewed directly. The hazard plot shows that the irradiance of the Sun is approximately three orders of magnitude greater than the reflected irradiance, i.e., the power density of solar reflections from photovoltaic panels are approximately 0.1% that of viewing the Sun. Due to the disparity in irradiance, whenever the Sun is observed in the same frame as solar reflections from a PV array, the Sun will be main source of glare impacts upon the observer. In such a case, the impact is deemed to be **Low** as a worst-case scenario.

Relevant Parameters of the Scheme

4.17. The solar PV panels will be oriented in a north to south direction and rotate east-west along a single axis to maximise solar gain throughout the day and during the year (i.e. they will rotate to track the movement of the sun). The panels will have a maximum tracking angle of 60 degrees and the axis tilt will vary throughout the site depending on the lay of the land. For example when the sun is lower on the horizon (dusk/dawn) the panel position will be near vertical, whereas when the sun is high in the sky (midday) the panel position will be near horizontal. For the purposes of this assessment, it has been assumed to be 0 degrees to maintain a worst-case scenario.

4.18. The highest point of the panels will be 3.5m. This will lower through the day as the panels slowly rotate into a horizontal position, ending the day at up to 3.5m.

IDENTIFICATION OF RECEPTORS

Ground Based Receptors

4.19. Glint is most likely to impact upon a ground-based receptor close to dusk and dawn, when the sun is at its lowest in the sky. Therefore, any effect would likely occur early in the day or late in the day, reflected to the west at dawn and east at dusk.

4.20. A 1km study area from the panels was deemed appropriate for the assessment of ground-based receptors as this seemed to contain a good spread of residential and road receptors in most directions from the Proposed Development. The further distance a receptor is from a solar farm, the less chance it has of being affected by glint and glare due to scattering of the reflected beam and atmospheric attenuation, in addition to obstructions from ground sources, such as any intervening vegetation or buildings. This is based on best practice and our experience of completing Glint and Glare Assessments across the UK and Ireland.

4.21. An observer height of 2m was utilised for residential receptors, as this is a typical height for a ground-floor window. With regards to road users, a receptor height of 1.5m was employed as this is typical of eye level. Rail driver's eye level was assumed to be 2.75m above the rail for signal signing purposes and therefore this is the height used for assessment purposes. Horse rider eye level has been assumed to be 2.5m above ground level for bridleway receptors.

4.22. An assessment was undertaken to determine zones where solar reflections will never be directed near ground level.

4.23. Where there are several residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for full assessment as the impacts will not vary to any significant degree. Where small groups of receptors have been evident, the receptors on either end of the group have been analysed in detail with the worst-case impacts attributed to that receptor.

Aviation

4.24. Glint is only considered to be an issue with regards to aviation safety when the solar farm lies within close proximity to a runway, particularly when the aircraft is descending to land. This is outlined within the FAA guidance as being the key aviation receptors to assess ad is considered best practice in the absence of UK guidance.

4.25. Should a solar farm be proposed within the safeguarded zone of an aerodrome, then a full geometric study may be required which would determine if there is potential for glint and glare at key locations, most likely on the descent to land.

4.26. Buffer zones to identify aviation assets vary depending on the safeguarding criteria of that asset. All aerodromes within 30km will be identified, however, generally the detailed assessments are only required within: 20km for large international aerodromes, 10km for military aerodromes and 5km for small aerodromes.

MAGNITUDE OF IMPACT

Static Receptors

4.27. Although there is no specific guidance set out to identify the magnitude of impact from solar reflections, the following criteria has been set out for the purposes of this report:

- **High -** Solar reflections impacts of over 30 hours per year or over 30 minutes per day
- **Medium -** Solar reflections impacts between 20 and 30 hours per year or between 20 minutes and 30 minutes per day
- **Low -** Solar reflections impacts up to 20 hours per year or up to 20 minutes per day

- **None -** Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening

Moving Receptors (Road and Rail)

4.28. Again, no specific guidance is available to identify the magnitude of impact from solar reflections on moving receptors except in aviation, however, it is thought that a similar approach should be applied to moving receptors as aviation, based on the ocular impact and the potential for after-image.

4.29. The FAA guidance states that for a solar PV development to obtain FAA approval or to receive no objection, the following criteria must be met:

- No potential for glare (glint) or "*low potential for after-image*" along the final approach path for any existing or future runway landing thresholds (including planned or interim phases), as shown by the approved layout plan (ALP).

4.30. The FAA produced an evaluation of glare as a hazard and concluded in their report[13] that:

> *"The more forward the glare is and the longer the glare duration, the greater the impairment to the pilots' ability to see their instruments and to fly the aircraft. These results taken together suggest that any sources of glare at an airport may be potentially mitigated if the angle of the glare is greater than 25 deg from the direction that the pilot is looking in. We therefore recommend that the design of any solar installation at an airport consider the approach of pilots and ensure that any solar installation that is developed is placed such that they will not have to face glare that is straight ahead of them or within 25 deg of straight ahead during final approach."*

4.31. It is reasonable to assume that although this report is assessing pilots vision impairment, it can also be applied to drivers of other road and rail vehicles. Therefore, the driver's field of view will also be analysed where required and if the glare is out with 25 degrees either side of their line of sight then any impacts will reduce to **None**.

Moving Receptors (Aviation)

Approach Paths

4.32. Each final approach path which has the potential to receive glint is assessed using the SGHAT model. The model assumes an approach bearing on the runway centreline, a 3-degree glide path with the origin 50ft (15.24m) above the runway threshold.

[13] Federal Aviation Authority, Evaluation of Glare as a Hazard for General Aviation Pilots on Final Approach (2015), Available at https://libraryonline.erau.edu/online-full-text/faa-aviation-medicine-reports/AM15-12.pdf

4.33. The computer model considers the pilots field of view. The azimuthal field of view (AFOV) or horizontal field of view (HFOV) as it is sometimes referred, refers to the extents of the pilot's horizontal field of view measured in degrees left and right from directly in front of the cockpit. The vertical field of view (VFOV) refers to the extents of the pilot's vertical field of view measured in degrees from directly in front of the cockpit. The HFOV is modelled at 50 degrees left and right from the front of the cockpit whilst the VFOV is modelled at 30 degrees.

4.34. The FAA guidance states that there should be no potential for glare or '*low potential for after-image*' at any existing or future planned runway landing thresholds for the Scheme to be acceptable.

Air Traffic Control Tower (ATCT)

4.35. An air traffic controller uses the visual control room to monitor and direct aircraft on the ground, approaching and departing the aerodrome. It is essential that air traffic controllers have a clear unobstructed view of the aviation activity. The key areas on an aerodrome are the views towards the runway thresholds, taxiways and aircraft bays.

4.36. The FAA guidance states that no solar reflection towards the ATCT should be produced by a proposed solar development, however, this should be assessed on a site by site case and will depend on the operations at a particular aerodrome.

4.37. In order to determine the impact on the ATCT, the location and height of the tower will need to be fed into the SGHAT model and where there is a potential for 'low potential for After-Image' or more, then mitigation measures will be required.

Assessment Limitations

4.38. Below is a list of assumptions and limitations of the model and methods used within this report:

- The model does not consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, vegetation, hills, buildings, etc;
- The model 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;
- Due to variations in atmospheric composition, temperature, pressure and conditions, observed values may vary slightly from calculated positions;
- The model does not account for the effects of diffraction; however, buffers are applied as a factor of safety; and

- The model assumes clear skies at all times and does not account for meteorological effects such as cloud cover, fog, or any other weather event which may screen the sun.

4.39. Due to these assumptions and limitations the model overestimates the number of minutes of glint and glare which are possible at each receptor and presents the worst-case scenario. Where glint and glare are predicted a visibility assessment is carried out to determine a more accurate, real-world prediction of the impacts.

5. BASELINE CONDITIONS

GROUND BASED RECEPTORS REFLECTION ZONES

5.1. Based on the relatively flat topography in the area, solar reflections between five degrees below the horizontal plane to five degrees above it are described as near horizontal. Reflections from the Scheme within this arc have the potential to be seen by receptors at or near ground level.

5.2. Further analysis was conducted and it was shown that reflections will only occur between the azimuth of 251.24 degrees and 290.92 degrees in the western direction (late day reflections) and 72.61 degrees and 111.57 degrees in the eastern direction (morning reflections) and therefore any ground-based receptor outside these arcs will not have any impact from solar reflections.

5.3. **Figure 1, 2 and 3 of Appendix A** show the respective study areas whilst also subtracting from this the areas where solar reflections will not impact on ground-based receptors due to the reasons set out in **paragraphs 5.1 to 5.2.** Note that the Principal Site Boundary has been amended slightly since the production of Figures 1, 2 and 3. This report will be updated for the Environmental Statement to reflect the design at that stage.

Residential Receptors

5.4. Residential receptors located within 1km of the Principal Site have been identified (**Table 5-1**). Glint was assumed to be possible if the receptor is located within the ground-based receptor zones as outlined previously.

5.5. There are two residential receptors (Receptors 86 and 87) which are within the no-reflection zones and are clearly identifiable in **Figure 1: Appendix A.** The process of how these are calculated is explained in **paragraphs 5.1 to 5.2** of this report.

5.6. As per the methodology section, where there are a number of residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for detailed analysis as the impacts will not vary to any significant degree. Where small groups of receptors are evident, the receptors on either end of the group have been assessed in detail.

Table 5-1: Residential Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1	487468	389875	Yes

Receptor	Easting	Northing	Glint and Glare Possible
2	487651	389819	Yes
3	487778	389867	Yes
4	487790	389730	Yes
5	487685	389559	Yes
6	487593	389545	Yes
7	488113	389933	Yes
8	489287	390133	Yes
9	489456	390035	Yes
10	487994	389352	Yes
11	487871	389177	Yes
12	487963	389210	Yes
13	487987	389175	Yes
14	487993	389254	Yes
15	488049	389223	Yes
16	488193	388813	Yes
17	488143	388696	Yes
18	488136	388627	Yes
19	488170	388597	Yes
20	488219	388521	Yes
21	488258	388460	Yes
22	488195	388406	Yes
23	489011	388829	Yes
24	489133	388410	Yes
25	489216	388343	Yes
26	489926	388347	Yes
27	489947	388385	Yes

Receptor	Easting	Northing	Glint and Glare Possible
28	490106	388377	Yes
29	488835	387514	Yes
30	488855	387336	Yes
31	488891	387296	Yes
32	489109	387136	Yes
33	489131	387164	Yes
34	490496	387272	Yes
35	490542	386937	Yes
36	491148	388349	Yes
37	491728	387261	Yes
38	492004	387104	Yes
39	492000	387155	Yes
40	492042	387205	Yes
41	492387	387207	Yes
42	492603	387209	Yes
43	494297	387729	Yes
44	493588	388296	Yes
45	494365	388228	Yes
46	494272	388286	Yes
47	494367	388358	Yes
48	494322	388481	Yes
49	494208	388539	Yes
50	492125	388992	Yes
51	493645	389691	Yes
52	493479	389728	Yes
53	493602	389885	Yes

Receptor	Easting	Northing	Glint and Glare Possible
54	493561	389988	Yes
55	493558	390046	Yes
56	493480	390081	Yes
57	493235	389900	Yes
58	493237	389950	Yes
59	493218	389976	Yes
60	493302	390008	Yes
61	493202	390085	Yes
62	492855	390261	Yes
63	492819	390239	Yes
64	492861	390198	Yes
65	492970	390195	Yes
66	492948	390260	Yes
67	493516	390424	Yes
68	492906	391098	Yes
69	492798	390900	Yes
70	493021	390873	Yes
71	493125	390812	Yes
72	493163	390658	Yes
73	493341	390698	Yes
74	493346	390895	Yes
75	493322	391071	Yes
76	493172	391155	Yes
77	492683	391006	Yes
78	492547	391056	Yes
79	491319	390501	Yes

Receptor	Easting	Northing	Glint and Glare Possible
80	491343	390440	Yes
81	491401	390299	Yes
82	490891	390718	Yes
83	490743	390716	Yes
84	490526	390429	Yes
85	489619	390819	Yes
86	488041	391853	No
87	487401	391571	No

Road / Rail Receptors

5.7. There are 11 roads within the 1km study area that requires a detailed Glint and Glare Assessment: the A631, B1398, Common Lane, Coachroad Hill, Gainsborough Road, School lane, Springthorpe Road, Hill Road, Cow Lane, Kexby Road and Northlands Road. There are some minor roads that serve dwellings; however, these have been dismissed as vehicle users of these roads will likely be travelling at low speeds and therefore, there is a negligible risk of safety impacts resulting from glint and glare of the Scheme.

5.8. The ground receptor no-reflection zones are clearly identifiable on **Figure 2: Appendix A** and the process of how these are calculated is explained in **paragraphs 5.1 to 5.2** of this report.

5.9. **Table 5-2** shows a list of receptors points within the study area which are 200m apart.

Table 5-2: Road Based Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1	487125	391012	Yes
2	487320	391014	Yes
3	487527	390993	Yes
4	487726	390949	Yes
5	487923	390911	Yes
6	488303	390802	Yes

Receptor	Easting	Northing	Glint and Glare Possible
7	488498	390761	Yes
8	488707	390757	Yes
9	488903	390771	Yes
10	489105	390786	Yes
11	489304	390799	Yes
12	489505	390797	Yes
13	489706	390787	Yes
14	489904	390778	Yes
15	490103	390755	Yes
16	490299	390727	Yes
17	490496	390703	Yes
18	490689	390665	Yes
19	490885	390678	Yes
20	491071	390636	Yes
21	491262	390604	Yes
22	491461	390592	Yes
23	491654	390574	Yes
24	491847	390567	Yes
25	491999	390443	Yes
26	492187	390399	Yes
27	492385	390373	Yes
28	492572	390304	Yes
29	492760	390242	Yes
30	492900	390158	Yes
31	493094	390161	Yes
32	493292	390130	Yes
33	493481	390097	Yes

Receptor	Easting	Northing	Glint and Glare Possible
34	493671	390055	Yes
35	493855	389985	Yes
36	494042	389916	Yes
37	494228	389842	Yes
38	494416	389774	Yes
39	493397	391126	Yes
40	493404	390922	Yes
41	493416	390713	Yes
42	493508	390539	Yes
43	493604	390364	Yes
44	493701	390189	Yes
45	493801	389935	Yes
46	493896	389754	Yes
47	493966	389565	Yes
48	494071	389401	Yes
49	494154	389220	Yes
50	494266	389053	Yes
51	494410	388913	Yes
52	494558	388779	Yes
53	494685	388625	Yes
54	487357	390821	Yes
55	487357	390624	Yes
56	487367	390414	Yes
57	487375	390212	Yes
58	487414	390009	Yes
59	487454	389791	Yes
60	487575	389676	Yes

Receptor	Easting	Northing	Glint and Glare Possible
61	487667	389543	Yes
62	487667	389363	Yes
63	487620	389789	Yes
64	487806	389829	Yes
65	487994	389868	Yes
66	488188	389908	Yes
67	488382	389950	Yes
68	488576	389992	Yes
69	488773	390034	Yes
70	488968	390076	Yes
71	489162	390117	Yes
72	489356	390160	Yes
73	489452	390266	Yes
74	489424	390462	Yes
75	489394	390657	Yes
76	489851	390861	Yes
77	489915	391046	Yes
78	489981	391237	Yes
79	490044	391423	Yes
80	490175	391563	Yes
81	490334	391676	Yes
82	488168	388378	Yes
83	488355	388433	Yes
84	488542	388394	Yes
85	488743	388379	Yes
86	488944	388372	Yes
87	489143	388368	Yes

Receptor	Easting	Northing	Glint and Glare Possible
88	489342	388366	Yes
89	489542	388363	Yes
90	489741	388360	Yes
91	489942	388357	Yes
92	490141	388354	Yes
93	490342	388348	Yes
94	490514	388298	Yes
95	490655	388196	Yes
96	490842	388268	Yes
97	491021	388351	Yes
98	491170	388470	Yes
99	491325	388596	Yes
100	491494	388689	Yes
101	491669	388768	Yes
102	491824	388888	Yes
103	492008	388967	Yes
104	492193	389043	Yes
105	492378	389112	Yes
106	492477	389228	Yes
107	492498	389369	Yes
108	492681	389447	Yes
109	492868	389515	Yes
110	493058	389586	Yes
111	493251	389618	Yes
112	493443	389678	Yes
113	493573	389797	Yes
114	493550	389986	Yes

Receptor	Easting	Northing	Glint and Glare Possible
115	488648	387290	Yes
116	488843	387311	Yes
117	489041	387352	Yes
118	489229	387388	Yes
119	489426	387395	Yes
120	489626	387410	Yes
121	489817	387450	Yes
122	490009	387470	Yes
123	490038	387261	Yes
124	490064	387055	Yes
125	490099	386851	Yes
126	490271	386845	Yes
127	490459	386901	Yes
128	490648	386932	Yes
129	490846	386966	Yes
130	490919	386816	Yes
131	491114	386850	Yes
132	491310	386885	Yes
133	491499	386920	Yes
134	491689	386932	Yes
135	491884	386975	Yes
136	492045	387040	Yes
137	492157	387132	Yes
138	492349	387157	Yes
139	492541	387175	Yes
140	492738	387196	Yes
141	492929	387215	Yes

Receptor	Easting	Northing	Glint and Glare Possible
142	493122	387259	Yes
143	493301	387320	Yes
144	493479	387391	Yes
145	493661	387470	Yes
146	493846	387545	Yes
147	494038	387594	Yes
148	494222	387667	Yes
149	493383	387562	Yes
150	493295	387738	Yes
151	493218	387925	Yes
152	493203	388088	Yes
153	493385	388170	Yes
154	493564	388256	Yes
155	493749	388319	Yes
156	493939	388349	Yes
157	494114	388444	Yes
158	494273	388507	Yes
159	494398	388348	Yes
160	494424	388536	Yes
161	494586	388656	Yes
162	488121	390871	No

5.10. There are no railway lines within 1km of the Principal Site.

Bridleway Receptors

5.11. All bridleways within 1km of the Scheme have been considered.

5.12. The ground receptor no-reflection zones are clearly identifiable on **Figure 2: Appendix A** and the process of how these are calculated is explained in **paragraphs 5.1 to 5.2** of this report.

5.13. **Table 5-3** shows a list of receptors points within the study area which are 200m apart.

Table 5-3: Bridleway Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1	492260	387135	Yes
2	492272	386923	Yes
3	492287	386723	Yes
4	492333	386526	No
5	492399	386345	No

Aviation Receptors

5.14. Aerodromes within 30km of the Principal Site can be found in **Table 5-4.**

Table 5-4: Airfields within close proximity

Airfield	Distance	Use
Sturgate Airfield	0.67km	Small Unlicensed Aerodrome
Kirkton-in-Lindsay Airfield	6.78km	Small Unlicensed Aerodrome
RAF Scampton	7.25km	Military Aerodrome
West Burton Airfield	10.88km	Small Unlicensed Aerodrome
Hibaldstow Airfield	12.10km	Small Unlicensed Aerodrome
Little Farm Airfield	12.42km	Small Unlicensed Aerodrome
Grove farm Airfield	15.22km	Small Unlicensed Aerodrome
Headon Airfield	17.47km	Small Unlicensed Aerodrome
Wickenby Airfield	17.82km	Licensed Aerodrome
Darlton Airfield	19.30km	Small Unlicensed Aerodrome
Gamston Airfield	21.29km	Licensed Aerodrome
Grange Farm Airfield	22.85km	Small Unlicensed Aerodrome
Doncaster-Sheffield Airport	23.22km	International Airport
RAF Waddington	25.94km	Military Aerodrome

5.15. As shown in **Table 5-4**, there are 14 aerodromes within 30km of the Principal Site. However, only Sturgate, RAF Scampton and Wickenby will require a detailed assessment as the Principal Site is located within their safeguarding buffer zone, outlined in **paragraph 4.24 – 4.26.**

5.16. The other 11 aerodromes do not require detailed assessments due to their location in relation to the Principal Site falling outside of the buffer zones outlined in **paragraph** Error! Reference source not found. **– 4.26.**

RAF Scampton

5.17. RAF Scampton is designated as a Military Airfield. It is located approximately 2 nautical miles (NM) or 7.4km north of the city of Lincoln.

5.18. The elevation of the aerodrome at the Aerodrome Reference Point (ARP) is 202ft (61.6m). It has one blacktop runway, details of which are given in **Table 5-5**.

Table 5-5: Runways at RAF Scampton

Runway Designation	True Bearing (°)	Length (m)	Width (m)
Runway 04	041.08	2739	54
Runway 22	221.09	2739	54

5.19. The threshold locations and heights of the runways at RAF Scampton are given in **Table 5-6**.

Table 5-6: RAF Scampton Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
04	53° 17’ 55.22’’ N	000° 33’ 51.62’’ W	59.84
22	53° 19′ 01.97″ N	000° 32′ 14.25″ W	51.17

5.20. One ATCT at RAF Scamton has been analysed, see **Table 5-7**.

Table 5-7: ATCT at RAF Scampton

	Latitude	Longitude	Height AOD (m)	ATCT Height (m)
ATCT	53° 18′ 22″ N	000° 32′ 54″ W	59.12	10

Sturgate Airfield

5.21. Sturgate Airfield is designated as an unlicensed Airfield. It is located approximately 3.2 nautical miles (NM) or 5.97km southeast of the town of Gainsborough.

5.22. The elevation of the aerodrome at the Aerodrome Reference Point (ARP) is 57ft (17.37m). It has two paved strip runways, details of which are given in **Table 5-8**.

Table 5-8: Sturgate Airfield Runways

Runway Designation	Bearing (°)	Length (m)	Width (m)
09	085.11	820	46
27	085.11	820	46

5.23. The threshold locations and heights of the runways at Sturgate Airfield are given in **Table 5-9**.

Table 5-9: Sturgate Airfield Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
09	53° 22′ 52.00″ N	000° 41′ 24.00″ W	17.00
27	53° 22′ 53.00″ N	000° 40′ 47.00″ W	17.69

5.24. There are no ATCTs present at Sturgate Airfield.

Wickenby Airfield

5.25. Wickenby Airfield is designated as a licensed Airfield. It is located approximately 8 nautical miles (NM) or 14.8km northeast of the city of Lincoln.

5.26. The elevation of the aerodrome at the Aerodrome Reference Point (ARP) is 84ft (25.6m). It has two asphalt runways, details of which are given in **Table 5-10**.

Table 5-10: Runways at Wickenby Airfield

Runway Designation	True Bearing (°)	Length (m)	Width (m)
Runway 03	025.25	530	18
Runway 15	150.23	497	18
Runway 21	205.25	530	18
Runway 33	330.23	497	18

5.27. The threshold locations and heights of the runways at Wickenby Airfield are given in **Table 5-11**.

Table 5-11: Wickenby Airfield Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
03	53° 18' 53.24'' N	000° 21' 01.76'' W	25.29
15	53° 19′ 09.07″ N	000° 21′ 07.44″ W	21.64
21	53° 19′ 08.69″ N	000° 20′ 49.59″ W	22.86
33	53° 18′ 55.19″ N	000° 20′ 54.18″ W	24.08

5.28. One ATCT at Wickenby Airfield has been analysed, see **Table 5-12**.

Table 5-12: ATCT at Wickenby

	Latitude	Longitude	Height AOD (m)	ATCT Height (m)
ATCT	53° 18′ 58″ N	000° 20′ 48″ W	26.69	5

6. IMPACT ASSESSMENT

6.1. Following the methodology outlined earlier in this report, geometrical analysis comparing the azimuth and horizontal angle of the receptors from the Scheme and the solar reflection was conducted. Although this model did not take into account obstructions such as vegetation and buildings, discussion on the potentially impacted receptors is provided where necessary. Such obstructions will be taken into account during the visibility assessment and will be discussed for each relevant receptor.

GROUND BASED RECEPTORS

Residential Receptors

6.2. **Table 6-1** identifies the receptors that will experience solar reflections based on solar reflection modelling and whether the reflections will be experienced in the morning (AM), evening (PM), or both.

6.3. The Nine receptors which were within the no-reflection zones outlined previously have been excluded from the detailed modelling as they will never receive any glint and glare impacts from the Scheme.

6.4. **Appendix B and C** show the analysis with the solar panels modelled as single-axis trackers. **Appendix B** show the analysis for Receptors 1 – 43, whilst **Appendix C** show the analysis for Receptors 44 – 85.

6.5. **Table 6-1** shows the worst-case impact at each receptor, based on a theoretical modelled impact without consideration of local vegetation or other obstacles and assuming no cloud at any point in the year.

Table 6-1: Potential for Glint and Glare impact on Residential Receptors

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact
	AM	PM	Minutes	Hours	
1	No	No	0	0.00	None
2	No	No	0	0.00	None
3	No	No	0	0.00	None
4	No	No	0	0.00	None

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact
	AM	PM	Minutes	Hours	
5	No	No	0	0.00	None
6	No	No	0	0.00	None
7	No	No	0	0.00	None
8	No	No	0	0.00	None
9	No	No	0	0.00	None
10	No	No	0	0.00	None
11	No	No	0	0.00	None
12	No	No	0	0.00	None
13	No	No	0	0.00	None
14	No	No	0	0.00	None
15	No	No	0	0.00	None
16	No	No	0	0.00	None
17	No	No	0	0.00	None
18	No	No	0	0.00	None
19	No	No	0	0.00	None
20	No	No	0	0.00	None
21	No	No	0	0.00	None
22	No	No	0	0.00	None
23	No	No	0	0.00	None
24	No	No	0	0.00	None
25	No	No	0	0.00	None
26	No	No	0	0.00	None
27	No	No	0	0.00	None
28	No	No	0	0.00	None
29	No	No	0	0.00	None

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact
	AM	PM	Minutes	Hours	
30	No	No	0	0.00	None
31	No	No	0	0.00	None
32	No	No	0	0.00	None
33	No	No	0	0.00	None
34	No	No	0	0.00	None
35	No	No	0	0.00	None
36	No	No	0	0.00	None
37	No	No	0	0.00	None
38	No	No	0	0.00	None
39	No	No	0	0.00	None
40	No	No	0	0.00	None
41	No	No	0	0.00	None
42	No	No	0	0.00	None
43	No	No	0	0.00	None
44	No	No	0	0.00	None
45	No	No	0	0.00	None
46	No	No	0	0.00	None
47	No	No	0	0.00	None
48	No	No	0	0.00	None
49	No	No	0	0.00	None
50	No	No	0	0.00	None
51	No	No	0	0.00	None
52	No	No	0	0.00	None
53	No	No	0	0.00	None
54	No	No	0	0.00	None

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact
	AM	PM	Minutes	Hours	
55	No	No	0	0.00	None
56	No	No	0	0.00	None
57	No	No	0	0.00	None
58	No	No	0	0.00	None
59	No	No	0	0.00	None
60	No	No	0	0.00	None
61	No	No	0	0.00	None
62	No	No	0	0.00	None
63	No	No	0	0.00	None
64	No	No	0	0.00	None
65	No	No	0	0.00	None
66	No	No	0	0.00	None
67	No	No	0	0.00	None
68	No	No	0	0.00	None
69	No	No	0	0.00	None
70	No	No	0	0.00	None
71	No	No	0	0.00	None
72	No	No	0	0.00	None
73	No	No	0	0.00	None
74	No	No	0	0.00	None
75	No	No	0	0.00	None
76	No	No	0	0.00	None
77	No	No	0	0.00	None
78	No	No	0	0.00	None
79	No	No	0	0.00	None

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact
	AM	PM	Minutes	Hours	
80	No	No	0	0.00	None
81	No	No	0	0.00	None
82	No	No	0	0.00	None
83	No	No	0	0.00	None
84	No	No	0	0.00	None
85	No	No	0	0.00	None

6.6. As can be seen in **Table 6-1,** there is **No impact** at any of the 85 receptors. Therefore, there are **no glare impacts** at the residential receptors.

Road Receptors

6.7. **Table 6-2** shows a summary of the modelling results for each of the Road Receptor Points whilst the detailed results and ocular impact charts can be viewed in **Appendix D and E**.

6.8. **Appendix D** show the analysis for Receptors 1 – 81, whilst **Appendix E** show the analysis for Receptors 82 - 161.

6.9. The one receptor (162) within the no-reflection zones outlined previously have been excluded from the detailed modelling as they will never receive glint and glare impacts from the Scheme.

Table 6-2: Potential for Glint and Glare impact on Road Based Receptors

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
1	0	0	0	None
2	0	0	0	None
3	0	0	0	None
4	0	0	0	None
5	0	0	0	None
6	0	0	0	None
7	0	0	0	None

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
8	0	0	0	None
9	0	0	0	None
10	12486	0	0	Low
11	8159	0	0	Low
12	0	0	0	None
13	0	0	0	None
14	0	0	0	None
15	0	0	0	None
16	0	0	0	None
17	0	0	0	None
18	0	0	0	None
19	0	0	0	None
20	0	0	0	None
21	0	0	0	None
22	0	0	0	None
23	0	0	0	None
24	0	0	0	None
25	0	0	0	None
26	0	0	0	None
27	0	0	0	None
28	0	0	0	None
29	0	0	0	None
30	0	0	0	None
31	0	0	0	None
32	0	0	0	None
33	0	0	0	None

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
34	0	0	0	None
35	0	0	0	None
36	0	0	0	None
37	0	0	0	None
38	0	0	0	None
39	0	0	0	None
40	0	0	0	None
41	0	0	0	None
42	0	0	0	None
43	0	0	0	None
44	0	0	0	None
45	0	0	0	None
46	0	0	0	None
47	0	0	0	None
48	0	0	0	None
49	0	0	0	None
50	0	0	0	None
51	0	0	0	None
52	0	0	0	None
53	0	0	0	None
54	0	0	0	None
55	0	0	0	None
56	0	0	0	None
57	0	0	0	None
58	0	0	0	None
59	0	0	0	None

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
60	0	0	0	None
61	0	0	0	None
62	0	0	0	None
63	0	0	0	None
64	0	0	0	None
65	0	0	0	None
66	0	0	0	None
67	0	0	0	None
68	0	0	0	None
69	0	0	0	None
70	0	0	0	None
71	0	0	0	None
72	0	0	0	None
73	0	0	0	None
74	0	0	0	None
75	0	0	0	None
76	0	0	0	None
77	0	0	0	None
78	0	0	0	None
79	0	0	0	None
80	0	0	0	None
81	0	0	0	None
82	0	0	0	None
83	0	0	0	None
84	0	0	0	None
85	0	0	0	None

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
86	0	0	0	None
87	0	0	0	None
88	0	0	0	None
89	0	0	0	None
90	0	0	0	None
91	0	0	0	None
92	0	0	0	None
93	0	0	0	None
94	0	0	0	None
95	0	0	0	None
96	0	0	0	None
97	0	0	0	None
98	0	0	0	None
99	0	0	0	None
100	0	0	0	None
101	0	0	0	None
102	0	0	0	None
103	0	0	0	None
104	0	0	0	None
105	0	0	0	None
106	0	0	0	None
107	0	0	0	None
108	0	0	0	None
109	0	0	0	None
110	0	0	0	None
111	0	0	0	None

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
112	0	0	0	None
113	0	0	0	None
114	0	0	0	None
115	0	0	0	None
116	0	0	0	None
117	0	0	0	None
118	0	0	0	None
119	0	0	0	None
120	0	0	0	None
121	0	0	0	None
122	0	0	0	None
123	0	0	0	None
124	0	0	0	None
125	0	0	0	None
126	0	0	0	None
127	0	0	0	None
128	0	0	0	None
129	0	0	0	None
130	0	0	0	None
131	0	0	0	None
132	0	0	0	None
133	0	0	0	None
134	0	0	0	None
135	0	0	0	None
136	0	0	0	None
137	0	0	0	None

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
138	0	0	0	None
139	0	0	0	None
140	0	0	0	None
141	0	0	0	None
142	0	0	0	None
143	0	0	0	None
144	0	0	0	None
145	0	0	0	None
146	0	0	0	None
147	0	0	0	None
148	0	0	0	None
149	0	0	0	None
150	0	0	0	None
151	0	0	0	None
152	0	0	0	None
153	0	0	0	None
154	0	0	0	None
155	0	0	0	None
156	0	0	0	None
157	0	0	0	None
158	0	0	0	None
159	0	0	0	None
160	0	0	0	None
161	0	0	0	None

6.10. As can be seen in **Table 6-2**, there are two receptor points have potential glare impacts with the “low potential for after-image” (Green Glare), which is a **Low** impact. **Appendix D and E**

show detailed analysis of when the glint and glare impacts are possible, whilst also showing from which parts of the Principal Site the solar glint is reflected from.

6.11. **Appendix H** shows two 2021 Google Earth images taken towards the Principal Site location at each of the receptor points where an impact is anticipated. The first image is a ground level terrain view and is based on the height data of the surrounding land showing no intervening vegetation or buildings. The Principal Site has been drawn as a white polygon and can be seen on the images when the Principal Site is theoretically visible. The area of the Principal Site from where reflections may be possible has been drawn as a yellow polygon. The second image is a street view image pointing in the same direction as the terrain image. This gives a good indication as to whether the area of the Principal Site where reflections are theoretically possible will be visible from the receptor point. For some receptors, a field of view (FOV) has been drawn between two red lines, where the glare is situated outside this FOV, and therefore the impact is reduced to **None**.

6.12. As can be seen in **Appendix H**, views of the Principal Site from those with a potential glare impact, are blocked by intervening vegetation. Therefore, impacts upon all road receptors reduce to **None**.

Bridleway Receptors

6.13. **Table 6-3** shows a summary of the modelling results for each of the Bridleway Receptor Points whilst the detailed results and ocular impact charts can be viewed in **Appendix F**.

6.14. The two receptors (4 and 5) within the no-reflection zones outlined previously have been excluded from the detailed modelling as they will never receive glint and glare impacts from the Scheme.

Table 6-3: Summary of Bridleway Glare Results

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
1	0	0	0	None
2	0	0	0	None
3	0	0	0	None

6.15. As can be seen in **Table 6-3**, all receptors are predicted to have **No Impacts**.

River Trent

6.16. The River Trent is approximately 7.2km west of the solar panels within the Scheme. As impacts upon ground-based receptors have been predominantly **None**, except two road receptors

which have a **Low** impact, after modelling, it can be conluded that impacts upon the River Trent will be **Negligible** and **Not Significant.**

Aviation Receptors

6.17. **Table 6-4** shows a summary of the modelling results for each of the runway approach paths and the ATCT's, whilst the detailed results and ocular impact charts can be viewed in **Appendix G.**

Table 6-4: Summary of Aviation Glare Results

Component	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)
RAF Scampton			
Runway 04	0	0	0
Runway 22	0	0	0
ATCT	0	0	0
Sturgate Airfield			
Runway 09	0	0	0
Runway 27	27057	0	0
Wickenby Airfield			
Runway 03	0	0	0
Runway 15	0	0	0
Runway 21	0	0	0
Runway 33	0	0	0
ATCT	0	0	0

6.18. As can be seen in **Table 6-4**, there are no Glare impacts for the receptors at RAF Scampton, Wickenby Airfield or Runway 09 at Sturgate Airfield. There is Green Glare potential for runway 27 at Sturgate, which is an **acceptable impact** upon runways according to FAA guidance.

6.19. Overall impacts on Aviation receptors is **Low** and **Not Significant**.

7. GROUND BASED RECEPTOR MITIGATION

7.1. **No Mitigation** is required due to the no impacts found for the residential and road receptors.

7.2. **Tables 7-1, 7-2, 7-3 and 7-4** show the impacts at each stage of the glint and glare analysis, with the final residual impacts considered once the mitigation is in place.

Table 7-1: Residual Glint and Glare Impacts on Residential Receptors

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
1	None	None	**None**
2	None	None	**None**
3	None	None	**None**
4	None	None	**None**
5	None	None	**None**
6	None	None	**None**
7	None	None	**None**
8	None	None	**None**
9	None	None	**None**
10	None	None	**None**
11	None	None	**None**
12	None	None	**None**
13	None	None	**None**
14	None	None	**None**
15	None	None	**None**
16	None	None	**None**
17	None	None	**None**
18	None	None	**None**

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
19	None	None	None
20	None	None	None
21	None	None	None
22	None	None	None
23	None	None	None
24	None	None	None
25	None	None	None
26	None	None	None
27	None	None	None
28	None	None	None
29	None	None	None
30	None	None	None
31	None	None	None
32	None	None	None
33	None	None	None
34	None	None	None
35	None	None	None
36	None	None	None
37	None	None	None
38	None	None	None
39	None	None	None
40	None	None	None
41	None	None	None
42	None	None	None
43	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
44	None	None	None
45	None	None	None
46	None	None	None
47	None	None	None
48	None	None	None
49	None	None	None
50	None	None	None
51	None	None	None
52	None	None	None
53	None	None	None
54	None	None	None
55	None	None	None
56	None	None	None
57	None	None	None
58	None	None	None
59	None	None	None
60	None	None	None
61	None	None	None
62	None	None	None
63	None	None	None
64	None	None	None
65	None	None	None
66	None	None	None
67	None	None	None
68	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
69	None	None	None
70	None	None	None
71	None	None	None
72	None	None	None
73	None	None	None
74	None	None	None
75	None	None	None
76	None	None	None
77	None	None	None
78	None	None	None
79	None	None	None
80	None	None	None
81	None	None	None
82	None	None	None
83	None	None	None
84	None	None	None
85	None	None	None

Table 7-2: Residual Glint and Glare Impacts on Road Receptors

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
1	None	None	None
2	None	None	None
3	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
4	None	None	None
5	None	None	None
6	None	None	None
7	None	None	None
8	None	None	None
9	None	None	None
10	Low	Low	None
11	Low	Low	None
12	None	None	None
13	None	None	None
14	None	None	None
15	None	None	None
16	None	None	None
17	None	None	None
18	None	None	None
19	None	None	None
20	None	None	None
21	None	None	None
22	None	None	None
23	None	None	None
24	None	None	None
25	None	None	None
26	None	None	None
27	None	None	None
28	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
29	None	None	None
30	None	None	None
31	None	None	None
32	None	None	None
33	None	None	None
34	None	None	None
35	None	None	None
36	None	None	None
37	None	None	None
38	None	None	None
39	None	None	None
40	None	None	None
41	None	None	None
42	None	None	None
43	None	None	None
44	None	None	None
45	None	None	None
46	None	None	None
47	None	None	None
48	None	None	None
49	None	None	None
50	None	None	None
51	None	None	None
52	None	None	None
53	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
54	None	None	None
55	None	None	None
56	None	None	None
57	None	None	None
58	None	None	None
59	None	None	None
60	None	None	None
61	None	None	None
62	None	None	None
63	None	None	None
64	None	None	None
65	None	None	None
66	None	None	None
67	None	None	None
68	None	None	None
69	None	None	None
70	None	None	None
71	None	None	None
72	None	None	None
73	None	None	None
74	None	None	None
75	None	None	None
76	None	None	None
77	None	None	None
78	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
79	None	None	None
80	None	None	None
81	None	None	None
82	None	None	None
83	None	None	None
84	None	None	None
85	None	None	None
86	None	None	None
87	None	None	None
88	None	None	None
89	None	None	None
90	None	None	None
91	None	None	None
92	None	None	None
93	None	None	None
94	None	None	None
95	None	None	None
96	None	None	None
97	None	None	None
98	None	None	None
99	None	None	None
100	None	None	None
101	None	None	None
102	None	None	None
103	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
104	None	None	None
105	None	None	None
106	None	None	None
107	None	None	None
108	None	None	None
109	None	None	None
110	None	None	None
111	None	None	None
112	None	None	None
113	None	None	None
114	None	None	None
115	None	None	None
116	None	None	None
117	None	None	None
118	None	None	None
119	None	None	None
120	None	None	None
121	None	None	None
122	None	None	None
123	None	None	None
124	None	None	None
125	None	None	None
126	None	None	None
127	None	None	None
128	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
129	None	None	None
130	None	None	None
131	None	None	None
132	None	None	None
133	None	None	None
134	None	None	None
135	None	None	None
136	None	None	None
137	None	None	None
138	None	None	None
139	None	None	None
140	None	None	None
141	None	None	None
142	None	None	None
143	None	None	None
144	None	None	None
145	None	None	None
146	None	None	None
147	None	None	None
148	None	None	None
149	None	None	None
150	None	None	None
151	None	None	None
152	None	None	None
153	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
154	None	None	None
155	None	None	None
156	None	None	None
157	None	None	None
158	None	None	None
159	None	None	None
160	None	None	None
161	None	None	None

Table 7-3: Residual Glint and Glare Impacts on Bridleway Receptors

Receptor	Magnitude of Impact		
	After Geometric Analysis	After Visibility Analysis	Residual Impacts
1	None	None	None
2	None	None	None
3	None	None	None

7.3. **Table 7 – 4, 7 – 5 and 7 – 6** show the overall impacts for all residential, road and bridleway receptors.

Table 7-4: Solar Reflection: Residential Receptors

Magnitude	Theoretical Visibility	Actual Visibility (No Mitigation)	Actual Visibility with Mitigation
High	0	0	0
Medium	0	0	0
Low	0	0	0
None	85	85	85

- **High –** Solar reflections impacts of over 30 hours per year or over 30 minutes per day
- **Medium -** Solar reflections impacts between 20 and 30 hours per year or between 20 minutes and 30 minutes per day
- **Low -** Solar reflections impacts between 0 and 20 hours per year or between 0 minutes and 20 minutes per day
- **None -** Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening

Table 7-5: Solar Reflections: Road Receptors

Magnitude	Theoretical Visibility	Actual Visibility (No Mitigation)	Actual Visibility with Mitigation
High	0	0	0
Medium	0	0	0
Low	2	0	0
None	159	161	161

- **High -** Solar reflections impacts of Yellow Glare
- **Low -** Solar reflections impacts of Green Glare
- **None -** Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening

Table 7-6: Solar Reflections: Bridleway Receptors			
High	0	0	0
Medium	0	0	0
Low	0	0	0
None	3	3	3

- **High -** Solar reflections impacts of Yellow Glare
- **Low -** Solar reflections impacts of Green Glare
- **None -** Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening

8. SUMMARY

8.1. This assessment considers the potential impacts on ground-based receptors such as roads, rail and residential dwellings as well as aviation assets. A 1km study area around the Principal Site is considered adequate for the assessment of ground-based (residential, road, rail and bridleway) receptors, whilst a 30km study area is chosen for aviation receptors. Within the ground-based study areas of the Principal Site, there are 87 residential receptors, 162 road receptors and five bridleway receptors that were considered. No rail receptors were located within the 1km study area. As per the methodology section, where there are several residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for full assessment as the impacts will not vary to any significant degree. Where small groups of receptors have been evident, the receptors on either end of the group have been assessed in detail. Two residential and one road receptor were dismissed as they are located within the no reflection zones(see paragraph 5.5). 14 aerodromes are located within the 30km study area; however, only Sturgate Airfield, RAF Scampton and WIckenby Airfield required a detailed assessment as the Principal Site is located within their respective safeguarding buffer zones. The other 11 aerodromes did not require a detailed assessment due to their size and/or orientation in relation to the Principal Site.

8.2. Geometric analysis was conducted at 85 individual residential receptors, 161 road receptors and three bridleway receptors. Also, geometric analysis was conducted at eight runway approach paths and two Air Traffic Control Towers (ATCT) at Sturgate Airfield and RAF Scampton.

8.3. The assessment concludes that:

- Solar reflections are possible at none of the 85 residential receptors assessed within the 1km study area. Therefore, overall impacts on residential receptors are considered to be **None**.
- Solar reflections are possible at two of the 161 road receptors assessed within the 1km study area. Upon reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** for all road receptors. Therefore, overall impacts are **None**.
- Solar reflections are possible at none of the three bridleway receptors assessed within the 1km study area. Therefore, overall impacts on bridleway receptors are considered to be **None**.
- Eight runway approach paths and two ATCTs were assessed in detailed at Sturgate Airfield, RAF Scampton and Wickenby Airfield**.** Only Green Glare impacts were predicted

for Runway 27 at Sturgate Airfield, which is an **acceptable impact** upon runways according to FAA guidance. Overall aviation impacts are **Low** and **Not Significant**.

8.4. **No Mitigation** is required due to the no impacts found for the residential and road receptors.

8.5. The effects of glint and glare and their impact on local receptors has been analysed in detail and there is predicted to be **Low** impacts at one runway approach path, whilst the remaining aviation receptors are predicted to have **No Impacts**. Impacts upon ground-based receptors are predicted to be **None.** Therefore, overall impacts are **Negligible**.

9. APPENDICES

APPENDIX A: FIGURES

- Figure 1: Residential Receptor Map
- Figure 2: Road Receptor Map
- Figure 3: Bridleway receptor Map

Tillbridge Solar Farm
Residential Based Receptors
Figure 1

Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Residential Area
- Non-Reflection Zones

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL

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Date: 09/11/2022
Drawn By: David Thomson
Scale (A3): 1:27,500
Drawing No: NEO01124/001I/A

0 0.5 1 2 Kilometers

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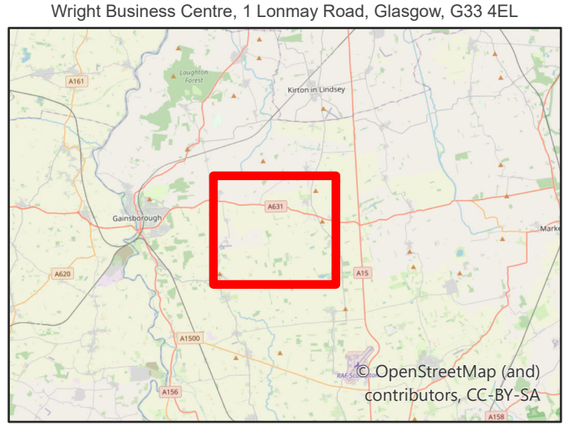
Tillbridge Solar Farm
Road Based Receptors
Figure 2

Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Non-Reflection Zones

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL



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Maxar, Microsoft

0 0.5 1 2 Kilometers

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Drawn By: David Thomson
Scale (A3): 1:27,500
Drawing No: NEO01124/002I/A

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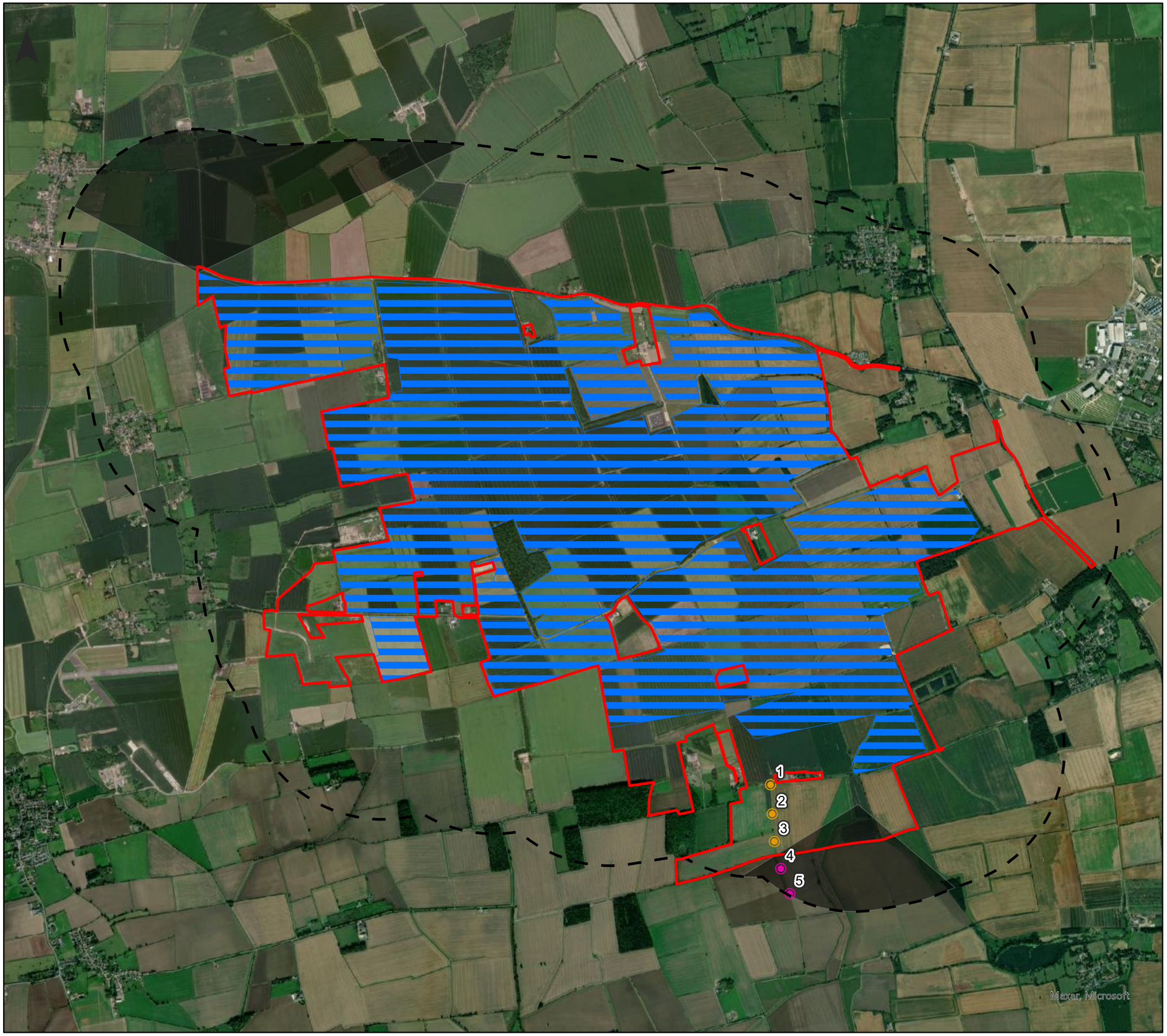
Tillbridge Solar Farm
Bridleway Based Receptors
Figure 3



Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Non-Reflection Zones

0 0.5 1 2 Kilometers

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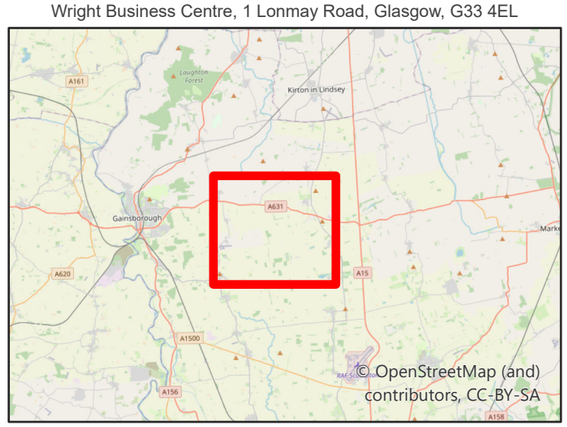

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APPENDIX B: RESIDENTIAL RECEPTOR GLARE RESULTS (1 – 43)

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Tillbridge Solar Farm

Tillbridge Solar Farm Residential 1 - 43

Created Nov. 23, 2022
Updated Nov. 23, 2022
Time-step 1 minute
Timezone offset UTC0
Site ID 79942.14152

Project type Advanced
Project status: active
Category 100 MW to 1 GW

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**

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
PV array 1	SA tracking	SA tracking	0	0	-
PV array 2	SA tracking	SA tracking	0	0	-
PV array 3	SA tracking	SA tracking	0	0	-
PV array 4	SA tracking	SA tracking	0	0	-

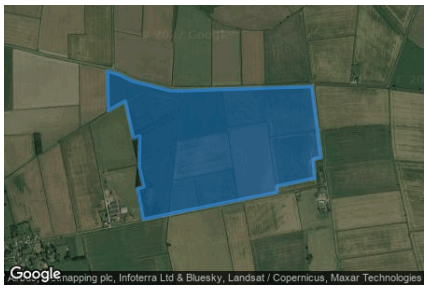
Component Data

PV Array(s)

Total PV footprint area: 10,587,087 m^2

Name: PV array 1
Footprint area: 782,414 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

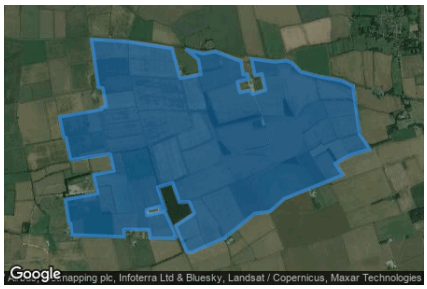
Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.407216	-0.676060	21.00	3.50	24.50
2	53.405042	-0.675995	20.27	3.50	23.77
3	53.405566	-0.674429	20.50	3.50	24.00
4	53.403545	-0.673678	21.88	3.50	25.38
5	53.403647	-0.673098	22.00	3.50	25.50
6	53.401959	-0.673141	22.76	3.50	26.26
7	53.400871	-0.672734	22.00	3.50	25.50
8	53.400769	-0.673292	22.28	3.50	25.78
9	53.399080	-0.672777	22.77	3.50	26.27
10	53.400564	-0.660460	27.07	3.50	30.57
11	53.400897	-0.660481	27.17	3.50	30.67
12	53.401344	-0.656984	27.78	3.50	31.28
13	53.402381	-0.657134	26.26	3.50	29.76
14	53.402470	-0.656426	26.79	3.50	30.29
15	53.406372	-0.657263	24.85	3.50	28.35
16	53.406140	-0.669228	19.61	3.50	23.11
17	53.406153	-0.670301	19.69	3.50	23.19
18	53.406665	-0.673735	20.02	3.50	23.52
19	53.407036	-0.675022	20.66	3.50	24.16

Name: PV array 2
Footprint area: 6,243,906 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.406344	-0.656924	24.80	3.50	28.30
2	53.401070	-0.655649	28.17	3.50	31.67
3	53.400993	-0.654833	27.75	3.50	31.25
4	53.398959	-0.654190	27.90	3.50	31.40
5	53.398869	-0.655155	28.05	3.50	31.55
6	53.398652	-0.655026	27.57	3.50	31.07
7	53.397833	-0.662793	23.46	3.50	26.96
8	53.395528	-0.662017	23.42	3.50	26.92
9	53.395554	-0.661631	23.71	3.50	27.21
10	53.393087	-0.660757	21.28	3.50	24.78
11	53.393753	-0.653504	24.43	3.50	27.93
12	53.391910	-0.652775	22.92	3.50	26.42
13	53.391501	-0.656594	21.50	3.50	25.00
14	53.389428	-0.655757	22.65	3.50	26.15
15	53.388775	-0.661722	21.33	3.50	24.83
16	53.386139	-0.661057	17.30	3.50	20.80
17	53.386139	-0.660757	17.10	3.50	20.60
18	53.384872	-0.660499	19.29	3.50	22.79
19	53.384654	-0.650800	23.99	3.50	27.49
20	53.385473	-0.650908	23.39	3.50	26.89
21	53.385473	-0.646316	25.39	3.50	28.89
22	53.384526	-0.646123	24.46	3.50	27.96
23	53.384462	-0.641681	23.22	3.50	26.72
24	53.384680	-0.641724	23.27	3.50	26.77
25	53.384654	-0.641252	23.42	3.50	26.92
26	53.387444	-0.643376	29.26	3.50	32.76
27	53.387034	-0.646702	26.28	3.50	29.78
28	53.387649	-0.646766	27.16	3.50	30.66
29	53.387969	-0.644299	28.26	3.50	31.76
30	53.387521	-0.644149	28.07	3.50	31.57
31	53.387585	-0.643290	32.90	3.50	36.40
32	53.390106	-0.644706	28.21	3.50	31.71
33	53.390592	-0.641981	27.06	3.50	30.56
34	53.388442	-0.640737	32.13	3.50	35.63
35	53.388519	-0.638934	29.46	3.50	32.96
36	53.387214	-0.638033	28.35	3.50	31.85
37	53.385844	-0.641488	26.53	3.50	30.03
38	53.383003	-0.639385	22.83	3.50	26.33
39	53.382952	-0.638548	23.74	3.50	27.24
40	53.384475	-0.632583	26.08	3.50	29.58
41	53.387214	-0.626897	25.61	3.50	29.11
42	53.387444	-0.624113	25.66	3.50	29.16
43	53.388864	-0.621410	25.53	3.50	29.03
44	53.391437	-0.610659	26.43	3.50	29.93
45	53.392703	-0.612097	26.30	3.50	29.80
46	53.393593	-0.609468	27.96	3.50	31.46
47	53.394284	-0.605670	29.95	3.50	33.45
48	53.395960	-0.607601	28.37	3.50	31.87
49	53.401219	-0.608802	27.57	3.50	31.07
50	53.401833	-0.610970	25.55	3.50	29.05
51	53.402223	-0.614682	24.61	3.50	28.11
52	53.402767	-0.618394	22.71	3.50	26.21
53	53.403790	-0.620111	22.12	3.50	25.62
54	53.404020	-0.621076	22.07	3.50	25.57
55	53.403867	-0.623158	22.03	3.50	25.53
56	53.404212	-0.627514	20.65	3.50	24.15
57	53.402396	-0.626848	23.25	3.50	26.75
58	53.402523	-0.625561	23.72	3.50	27.22
59	53.400758	-0.624917	25.49	3.50	28.99
60	53.400323	-0.627277	25.12	3.50	28.62
61	53.400758	-0.627599	24.79	3.50	28.29
62	53.400515	-0.629616	24.16	3.50	27.66
63	53.401666	-0.630088	23.57	3.50	27.07
64	53.401961	-0.628028	24.34	3.50	27.84
65	53.402523	-0.628222	22.24	3.50	25.74
66	53.402460	-0.628994	22.11	3.50	25.61

67	53.403918	-0.629380	20.37	3.50	23.87
68	53.405008	-0.634115	19.11	3.50	22.61
69	53.404778	-0.636304	18.91	3.50	22.41
70	53.405213	-0.639436	20.01	3.50	23.51
71	53.404087	-0.637248	18.52	3.50	22.02
72	53.402501	-0.636819	19.41	3.50	22.91
73	53.402066	-0.640595	22.92	3.50	26.42
74	53.405341	-0.642054	19.02	3.50	22.52
75	53.406108	-0.650466	19.99	3.50	23.49

Name: PV array 3
Footprint area: 155,264 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384474	-0.658826	18.53	3.50	22.03
2	53.380314	-0.656701	15.17	3.50	18.67
3	53.380468	-0.655886	15.47	3.50	18.97
4	53.380993	-0.651551	15.76	3.50	19.26
5	53.384410	-0.653139	21.02	3.50	24.52

Name: PV array 4
Footprint area: 3,405,503 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384205	-0.646118	24.01	3.50	27.51
2	53.381543	-0.644787	19.33	3.50	22.83
3	53.381185	-0.645839	18.48	3.50	21.98
4	53.379201	-0.644659	21.84	3.50	25.34
5	53.381006	-0.633200	21.41	3.50	24.91
6	53.377255	-0.632235	17.94	3.50	21.44
7	53.378087	-0.619682	17.12	3.50	20.62
8	53.378420	-0.619832	17.42	3.50	20.92
9	53.378894	-0.612601	19.79	3.50	23.29
10	53.377460	-0.619167	17.18	3.50	20.68
11	53.376193	-0.617214	19.36	3.50	22.86
12	53.377422	-0.602752	21.27	3.50	24.77
13	53.376052	-0.603825	20.55	3.50	24.05
14	53.374401	-0.605477	19.49	3.50	22.99
15	53.374093	-0.605348	18.76	3.50	22.26
16	53.374093	-0.604962	18.93	3.50	22.43
17	53.373760	-0.604898	19.50	3.50	23.00
18	53.373837	-0.603374	21.52	3.50	25.02
19	53.374477	-0.600520	24.41	3.50	27.91
20	53.374977	-0.597645	24.53	3.50	28.03
21	53.377921	-0.599340	22.67	3.50	26.17
22	53.378049	-0.598975	23.38	3.50	26.88
23	53.381133	-0.600949	24.71	3.50	28.21
24	53.380929	-0.602387	24.99	3.50	28.49
25	53.381940	-0.602859	25.05	3.50	28.55
26	53.382183	-0.601421	25.34	3.50	28.84
27	53.384077	-0.602366	29.83	3.50	33.33
28	53.384448	-0.602580	29.74	3.50	33.24
29	53.384653	-0.601529	29.74	3.50	33.24
30	53.384154	-0.601293	29.42	3.50	32.92
31	53.384589	-0.599061	28.22	3.50	31.72
32	53.384845	-0.599319	28.50	3.50	32.00
33	53.385293	-0.597323	29.07	3.50	32.57
34	53.387494	-0.598460	32.57	3.50	36.07
35	53.388825	-0.591798	37.24	3.50	40.74
36	53.389196	-0.591069	39.02	3.50	42.52
37	53.391410	-0.593279	43.19	3.50	46.69
38	53.391308	-0.593622	44.25	3.50	47.75
39	53.392063	-0.594438	43.60	3.50	47.10
40	53.391589	-0.595789	42.13	3.50	45.63
41	53.392562	-0.596605	41.34	3.50	44.84
42	53.393560	-0.597141	40.83	3.50	44.33
43	53.392766	-0.599931	35.79	3.50	39.29
44	53.392920	-0.600424	35.55	3.50	39.05
45	53.390207	-0.612776	26.15	3.50	29.65
46	53.388459	-0.611221	28.09	3.50	31.59
47	53.387307	-0.615877	25.87	3.50	29.37
48	53.389585	-0.617400	25.89	3.50	29.39
49	53.388753	-0.620812	25.49	3.50	28.99
50	53.388280	-0.622014	25.02	3.50	28.52
51	53.387205	-0.623988	25.66	3.50	29.16
52	53.386962	-0.626541	25.48	3.50	28.98
53	53.385465	-0.629824	26.17	3.50	29.67
54	53.383711	-0.627571	22.96	3.50	26.46
55	53.382047	-0.626305	25.12	3.50	28.62
56	53.381356	-0.631069	20.17	3.50	23.67
57	53.383724	-0.631949	25.14	3.50	28.64
58	53.384159	-0.632550	25.74	3.50	29.24
59	53.382470	-0.639759	22.77	3.50	26.27
60	53.384082	-0.641068	21.52	3.50	25.02

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	m	m	m
OP 1	53.398434	-0.686075	19.74	2.00	21.74
OP 2	53.398031	-0.683650	22.84	2.00	24.84
OP 3	53.398210	-0.681665	23.27	2.00	25.27
OP 4	53.397180	-0.681150	25.72	2.00	27.72
OP 5	53.395721	-0.682534	22.31	2.00	24.31
OP 6	53.395485	-0.684187	19.38	2.00	21.38
OP 7	53.398882	-0.676218	22.24	2.00	24.24
OP 8	53.400466	-0.658500	28.41	2.00	30.41
OP 9	53.399593	-0.656005	30.32	2.00	32.32
OP 10	53.393721	-0.678214	24.41	2.00	26.41
OP 11	53.391917	-0.680081	22.18	2.00	24.18
OP 12	53.392397	-0.678772	22.00	2.00	24.00
OP 13	53.392102	-0.678300	20.88	2.00	22.88
OP 14	53.392825	-0.678268	22.70	2.00	24.70
OP 15	53.392467	-0.677420	20.98	2.00	22.98
OP 16	53.388804	-0.675335	20.43	2.00	22.43
OP 17	53.387757	-0.676225	20.44	2.00	22.44
OP 18	53.387167	-0.676284	20.73	2.00	22.73
OP 19	53.386857	-0.675758	20.89	2.00	22.89
OP 20	53.386156	-0.675123	21.79	2.00	23.79
OP 21	53.385670	-0.674345	21.58	2.00	23.58
OP 22	53.385193	-0.675424	22.35	2.00	24.35
OP 23	53.388904	-0.663037	21.06	2.00	23.06
OP 24	53.384892	-0.661428	18.84	2.00	20.84
OP 25	53.384381	-0.660055	19.94	2.00	21.94
OP 26	53.384157	-0.649550	23.98	2.00	25.98
OP 27	53.384662	-0.649078	25.67	2.00	27.67
OP 28	53.384595	-0.646648	25.45	2.00	27.45
OP 29	53.377260	-0.665998	19.03	2.00	21.03
OP 30	53.375410	-0.665783	17.43	2.00	19.43
OP 31	53.375058	-0.665268	18.53	2.00	20.53
OP 32	53.373516	-0.662135	16.38	2.00	18.38
OP 33	53.373829	-0.661695	17.18	2.00	19.18
OP 34	53.374600	-0.641149	21.31	2.00	23.31
OP 35	53.371617	-0.640656	17.89	2.00	19.89
OP 36	53.384156	-0.631110	26.11	2.00	28.11
OP 37	53.374453	-0.622761	20.57	2.00	22.57
OP 38	53.372763	-0.618587	24.67	2.00	26.67
OP 39	53.373179	-0.618855	23.75	2.00	25.75
OP 40	53.373710	-0.618083	24.39	2.00	26.39
OP 41	53.373531	-0.612608	27.58	2.00	29.58
OP 42	53.373620	-0.609529	25.08	2.00	27.08
OP 43	53.378036	-0.584010	33.55	2.00	35.55

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	
PV array 1	SA tracking	SA tracking	0	0	-	
PV array 2	SA tracking	SA tracking	0	0	-	
PV array 3	SA tracking	SA tracking	0	0	-	
PV array 4	SA tracking	SA tracking	0	0	-	

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0

No glare found

PV array 2 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0

No glare found

PV array 3 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0

No glare found

PV array 4 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	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. Actual 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 fo 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 combined 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.

APPENDIX C: RESIDENTIAL RECEPTOR GLARE RESULTS (44 – 85)

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ForgeSolar

Tillbridge Solar Farm

Tillbridge Solar Farm Residential 44 - 85

Created Nov. 23, 2022
Updated Nov. 23, 2022
Time-step 1 minute
Timezone offset UTC0
Site ID 79943.14152

Project type Advanced
Project status: active
Category 100 MW to 1 GW

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**

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
PV array 1	SA tracking	SA tracking	0	0	-
PV array 2	SA tracking	SA tracking	0	0	-
PV array 3	SA tracking	SA tracking	0	0	-
PV array 4	SA tracking	SA tracking	0	0	-

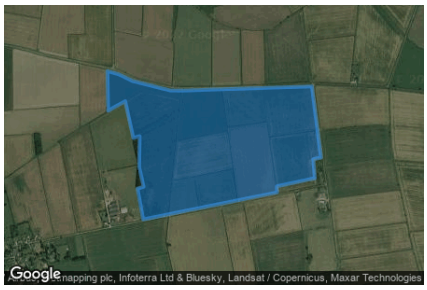
Component Data

PV Array(s)

Total PV footprint area: 10,587,087 m^2

Name: PV array 1
Footprint area: 782,414 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

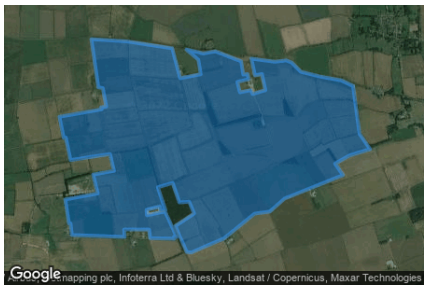
Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.407216	-0.676060	21.00	3.50	24.50
2	53.405042	-0.675995	20.27	3.50	23.77
3	53.405566	-0.674429	20.50	3.50	24.00
4	53.403545	-0.673678	21.88	3.50	25.38
5	53.403647	-0.673098	22.00	3.50	25.50
6	53.401959	-0.673141	22.76	3.50	26.26
7	53.400871	-0.672734	22.00	3.50	25.50
8	53.400769	-0.673292	22.28	3.50	25.78
9	53.399080	-0.672777	22.77	3.50	26.27
10	53.400564	-0.660460	27.07	3.50	30.57
11	53.400897	-0.660481	27.17	3.50	30.67
12	53.401344	-0.656984	27.78	3.50	31.28
13	53.402381	-0.657134	26.26	3.50	29.76
14	53.402470	-0.656426	26.79	3.50	30.29
15	53.406372	-0.657263	24.85	3.50	28.35
16	53.406140	-0.669228	19.61	3.50	23.11
17	53.406153	-0.670301	19.69	3.50	23.19
18	53.406665	-0.673735	20.02	3.50	23.52
19	53.407036	-0.675022	20.66	3.50	24.16

Name: PV array 2
Footprint area: 6,243,906 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.406344	-0.656924	24.80	3.50	28.30
2	53.401070	-0.655649	28.17	3.50	31.67
3	53.400993	-0.654833	27.75	3.50	31.25
4	53.398959	-0.654190	27.90	3.50	31.40
5	53.398869	-0.655155	28.05	3.50	31.55
6	53.398652	-0.655026	27.57	3.50	31.07
7	53.397833	-0.662793	23.46	3.50	26.96
8	53.395528	-0.662017	23.42	3.50	26.92
9	53.395554	-0.661631	23.71	3.50	27.21
10	53.393087	-0.660757	21.28	3.50	24.78
11	53.393753	-0.653504	24.43	3.50	27.93
12	53.391910	-0.652775	22.92	3.50	26.42
13	53.391501	-0.656594	21.50	3.50	25.00
14	53.389428	-0.655757	22.65	3.50	26.15
15	53.388775	-0.661722	21.33	3.50	24.83
16	53.386139	-0.661057	17.30	3.50	20.80
17	53.386139	-0.660757	17.10	3.50	20.60
18	53.384872	-0.660499	19.29	3.50	22.79
19	53.384654	-0.650800	23.99	3.50	27.49
20	53.385473	-0.650908	23.39	3.50	26.89
21	53.385473	-0.646316	25.39	3.50	28.89
22	53.384526	-0.646123	24.46	3.50	27.96
23	53.384462	-0.641681	23.22	3.50	26.72
24	53.384680	-0.641724	23.27	3.50	26.77
25	53.384654	-0.641252	23.42	3.50	26.92
26	53.387444	-0.643376	29.26	3.50	32.76
27	53.387034	-0.646702	26.28	3.50	29.78
28	53.387649	-0.646766	27.16	3.50	30.66
29	53.387969	-0.644299	28.26	3.50	31.76
30	53.387521	-0.644149	28.07	3.50	31.57
31	53.387585	-0.643290	32.90	3.50	36.40
32	53.390106	-0.644706	28.21	3.50	31.71
33	53.390592	-0.641981	27.06	3.50	30.56
34	53.388442	-0.640737	32.13	3.50	35.63
35	53.388519	-0.638934	29.46	3.50	32.96
36	53.387214	-0.638033	28.35	3.50	31.85
37	53.385844	-0.641488	26.53	3.50	30.03
38	53.383003	-0.639385	22.83	3.50	26.33
39	53.382952	-0.638548	23.74	3.50	27.24
40	53.384475	-0.632583	26.08	3.50	29.58
41	53.387214	-0.626897	25.61	3.50	29.11
42	53.387444	-0.624113	25.66	3.50	29.16
43	53.388864	-0.621410	25.53	3.50	29.03
44	53.391437	-0.610659	26.43	3.50	29.93
45	53.392703	-0.612097	26.30	3.50	29.80
46	53.393593	-0.609468	27.96	3.50	31.46
47	53.394284	-0.605670	29.95	3.50	33.45
48	53.395960	-0.607601	28.37	3.50	31.87
49	53.401219	-0.608802	27.57	3.50	31.07
50	53.401833	-0.610970	25.55	3.50	29.05
51	53.402223	-0.614682	24.61	3.50	28.11
52	53.402767	-0.618394	22.71	3.50	26.21
53	53.403790	-0.620111	22.12	3.50	25.62
54	53.404020	-0.621076	22.07	3.50	25.57
55	53.403867	-0.623158	22.03	3.50	25.53
56	53.404212	-0.627514	20.65	3.50	24.15
57	53.402396	-0.626848	23.25	3.50	26.75
58	53.402523	-0.625561	23.72	3.50	27.22
59	53.400758	-0.624917	25.49	3.50	28.99
60	53.400323	-0.627277	25.12	3.50	28.62
61	53.400758	-0.627599	24.79	3.50	28.29
62	53.400515	-0.629616	24.16	3.50	27.66
63	53.401666	-0.630088	23.57	3.50	27.07
64	53.401961	-0.628028	24.34	3.50	27.84
65	53.402523	-0.628222	22.24	3.50	25.74
66	53.402460	-0.628994	22.11	3.50	25.61

67	53.403918	-0.629380	20.37	3.50	23.87
68	53.405008	-0.634115	19.11	3.50	22.61
69	53.404778	-0.636304	18.91	3.50	22.41
70	53.405213	-0.639436	20.01	3.50	23.51
71	53.404087	-0.637248	18.52	3.50	22.02
72	53.402501	-0.636819	19.41	3.50	22.91
73	53.402066	-0.640595	22.92	3.50	26.42
74	53.405341	-0.642054	19.02	3.50	22.52
75	53.406108	-0.650466	19.99	3.50	23.49

Name: PV array 3
Footprint area: 155,264 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384474	-0.658826	18.53	3.50	22.03
2	53.380314	-0.656701	15.17	3.50	18.67
3	53.380468	-0.655886	15.47	3.50	18.97
4	53.380993	-0.651551	15.76	3.50	19.26
5	53.384410	-0.653139	21.02	3.50	24.52

Name: PV array 4
Footprint area: 3,405,503 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384205	-0.646118	24.01	3.50	27.51
2	53.381543	-0.644787	19.33	3.50	22.83
3	53.381185	-0.645839	18.48	3.50	21.98
4	53.379201	-0.644659	21.84	3.50	25.34
5	53.381006	-0.633200	21.41	3.50	24.91
6	53.377255	-0.632235	17.94	3.50	21.44
7	53.378087	-0.619682	17.12	3.50	20.62
8	53.378420	-0.619832	17.42	3.50	20.92
9	53.378894	-0.612601	19.79	3.50	23.29
10	53.377460	-0.619167	17.18	3.50	20.68
11	53.376193	-0.617214	19.36	3.50	22.86
12	53.377422	-0.602752	21.27	3.50	24.77
13	53.376052	-0.603825	20.55	3.50	24.05
14	53.374401	-0.605477	19.49	3.50	22.99
15	53.374093	-0.605348	18.76	3.50	22.26
16	53.374093	-0.604962	18.93	3.50	22.43
17	53.373760	-0.604898	19.50	3.50	23.00
18	53.373837	-0.603374	21.52	3.50	25.02
19	53.374477	-0.600520	24.41	3.50	27.91
20	53.374977	-0.597645	24.53	3.50	28.03
21	53.377921	-0.599340	22.67	3.50	26.17
22	53.378049	-0.598975	23.38	3.50	26.88
23	53.381133	-0.600949	24.71	3.50	28.21
24	53.380929	-0.602387	24.99	3.50	28.49
25	53.381940	-0.602859	25.05	3.50	28.55
26	53.382183	-0.601421	25.34	3.50	28.84
27	53.384077	-0.602366	29.83	3.50	33.33
28	53.384448	-0.602580	29.74	3.50	33.24
29	53.384653	-0.601529	29.74	3.50	33.24
30	53.384154	-0.601293	29.42	3.50	32.92
31	53.384589	-0.599061	28.22	3.50	31.72
32	53.384845	-0.599319	28.50	3.50	32.00
33	53.385293	-0.597323	29.07	3.50	32.57
34	53.387494	-0.598460	32.57	3.50	36.07
35	53.388825	-0.591798	37.24	3.50	40.74
36	53.389196	-0.591069	39.02	3.50	42.52
37	53.391410	-0.593279	43.19	3.50	46.69
38	53.391308	-0.593622	44.25	3.50	47.75
39	53.392063	-0.594438	43.60	3.50	47.10
40	53.391589	-0.595789	42.13	3.50	45.63
41	53.392562	-0.596605	41.34	3.50	44.84
42	53.393560	-0.597141	40.83	3.50	44.33
43	53.392766	-0.599931	35.79	3.50	39.29
44	53.392920	-0.600424	35.55	3.50	39.05
45	53.390207	-0.612776	26.15	3.50	29.65
46	53.388459	-0.611221	28.09	3.50	31.59
47	53.387307	-0.615877	25.87	3.50	29.37
48	53.389585	-0.617400	25.89	3.50	29.39
49	53.388753	-0.620812	25.49	3.50	28.99
50	53.388280	-0.622014	25.02	3.50	28.52
51	53.387205	-0.623988	25.66	3.50	29.16
52	53.386962	-0.626541	25.48	3.50	28.98
53	53.385465	-0.629824	26.17	3.50	29.67
54	53.383711	-0.627571	22.96	3.50	26.46
55	53.382047	-0.626305	25.12	3.50	28.62
56	53.381356	-0.631069	20.17	3.50	23.67
57	53.383724	-0.631949	25.14	3.50	28.64
58	53.384159	-0.632550	25.74	3.50	29.24
59	53.382470	-0.639759	22.77	3.50	26.27
60	53.384082	-0.641068	21.52	3.50	25.02

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	m	m	m
OP 1	53.383188	-0.594427	33.08	2.00	35.08
OP 2	53.382479	-0.583027	41.88	2.00	43.88
OP 3	53.383158	-0.584347	41.33	2.00	43.33
OP 4	53.383388	-0.582995	39.70	2.00	41.70
OP 5	53.384770	-0.583467	41.09	2.00	43.09
OP 6	53.385333	-0.585044	41.59	2.00	43.59
OP 7	53.389695	-0.616227	26.26	2.00	28.26
OP 8	53.395670	-0.593107	44.14	2.00	46.14
OP 9	53.396079	-0.595714	39.38	2.00	41.38
OP 10	53.397304	-0.593504	47.28	2.00	49.28
OP 11	53.398417	-0.594319	48.54	2.00	50.54
OP 12	53.398955	-0.594416	51.18	2.00	53.18
OP 13	53.399243	-0.595553	47.07	2.00	49.07
OP 14	53.397711	-0.599265	40.62	2.00	42.62
OP 15	53.398030	-0.598809	39.77	2.00	41.77
OP 16	53.398389	-0.599458	40.49	2.00	42.49
OP 17	53.398654	-0.598176	40.89	2.00	42.89
OP 18	53.399367	-0.599748	40.21	2.00	42.21
OP 19	53.401002	-0.604866	31.51	2.00	33.51
OP 20	53.400819	-0.605473	31.41	2.00	33.41
OP 21	53.400375	-0.604523	31.74	2.00	33.74
OP 22	53.400349	-0.603203	32.64	2.00	34.64
OP 23	53.401005	-0.603472	33.77	2.00	35.77
OP 24	53.402394	-0.594863	66.89	2.00	68.89
OP 25	53.408484	-0.604371	39.90	2.00	41.90
OP 26	53.406738	-0.605573	39.42	2.00	41.42
OP 27	53.406508	-0.602215	41.96	2.00	43.96
OP 28	53.405854	-0.600681	43.59	2.00	45.59
OP 29	53.404556	-0.600090	44.54	2.00	46.54
OP 30	53.404825	-0.597516	60.66	2.00	62.66
OP 31	53.406686	-0.597333	65.36	2.00	67.36
OP 32	53.408150	-0.597655	63.83	2.00	65.83
OP 33	53.409039	-0.600369	43.77	2.00	45.77
OP 34	53.407779	-0.607247	38.46	2.00	40.46
OP 35	53.408195	-0.609242	35.36	2.00	37.36
OP 36	53.403424	-0.627889	22.57	2.00	24.57
OP 37	53.403155	-0.627771	22.58	2.00	24.58
OP 38	53.401614	-0.626709	26.08	2.00	28.08
OP 39	53.405451	-0.634273	21.08	2.00	23.08
OP 40	53.405413	-0.636483	20.84	2.00	22.84
OP 41	53.402931	-0.639877	23.81	2.00	25.81
OP 42	53.406628	-0.653275	23.02	2.00	25.02

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	
PV array 1	SA tracking	SA tracking	0	0	-	
PV array 2	SA tracking	SA tracking	0	0	-	
PV array 3	SA tracking	SA tracking	0	0	-	
PV array 4	SA tracking	SA tracking	0	0	-	

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0

No glare found

PV array 2 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0

No glare found

PV array 3 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0

No glare found

PV array 4 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	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. Actual 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 fo 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 combined 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.

APPENDIX D: ROAD RECEPTOR GLARE RESULTS (1 – 81)

ForgeSolar

Tillbridge Solar Farm

Tillbridge Solar Farm Road 1 - 81

Created Nov. 23, 2022
Updated Nov. 23, 2022
Time-step 1 minute
Timezone offset UTC0
Site ID 79944.14152

Project type Advanced
Project status: active
Category 100 MW to 1 GW

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**

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

Summary of Results Glare with low potential for temporary after-image predicted

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV array 1	SA tracking	SA tracking	20,645	0	-
PV array 2	SA tracking	SA tracking	0	0	-
PV array 3	SA tracking	SA tracking	0	0	-
PV array 4	SA tracking	SA tracking	0	0	-

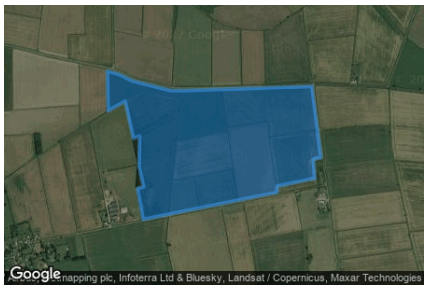
Component Data

PV Array(s)

Total PV footprint area: 10,587,087 m^2

Name: PV array 1
Footprint area: 782,414 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

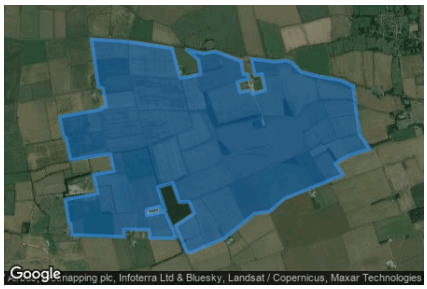
Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.407216	-0.676060	21.00	3.50	24.50
2	53.405042	-0.675995	20.27	3.50	23.77
3	53.405566	-0.674429	20.50	3.50	24.00
4	53.403545	-0.673678	21.88	3.50	25.38
5	53.403647	-0.673098	22.00	3.50	25.50
6	53.401959	-0.673141	22.76	3.50	26.26
7	53.400871	-0.672734	22.00	3.50	25.50
8	53.400769	-0.673292	22.28	3.50	25.78
9	53.399080	-0.672777	22.77	3.50	26.27
10	53.400564	-0.660460	27.07	3.50	30.57
11	53.400897	-0.660481	27.17	3.50	30.67
12	53.401344	-0.656984	27.78	3.50	31.28
13	53.402381	-0.657134	26.26	3.50	29.76
14	53.402470	-0.656426	26.79	3.50	30.29
15	53.406372	-0.657263	24.85	3.50	28.35
16	53.406140	-0.669228	19.61	3.50	23.11
17	53.406153	-0.670301	19.69	3.50	23.19
18	53.406665	-0.673735	20.02	3.50	23.52
19	53.407036	-0.675022	20.66	3.50	24.16

Name: PV array 2
Footprint area: 6,243,906 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.406344	-0.656924	24.80	3.50	28.30
2	53.401070	-0.655649	28.17	3.50	31.67
3	53.400993	-0.654833	27.75	3.50	31.25
4	53.398959	-0.654190	27.90	3.50	31.40
5	53.398869	-0.655155	28.05	3.50	31.55
6	53.398652	-0.655026	27.57	3.50	31.07
7	53.397833	-0.662793	23.46	3.50	26.96
8	53.395528	-0.662017	23.42	3.50	26.92
9	53.395554	-0.661631	23.71	3.50	27.21
10	53.393087	-0.660757	21.28	3.50	24.78
11	53.393753	-0.653504	24.43	3.50	27.93
12	53.391910	-0.652775	22.92	3.50	26.42
13	53.391501	-0.656594	21.50	3.50	25.00
14	53.389428	-0.655757	22.65	3.50	26.15
15	53.388775	-0.661722	21.33	3.50	24.83
16	53.386139	-0.661057	17.30	3.50	20.80
17	53.386139	-0.660757	17.10	3.50	20.60
18	53.384872	-0.660499	19.29	3.50	22.79
19	53.384654	-0.650800	23.99	3.50	27.49
20	53.385473	-0.650908	23.39	3.50	26.89
21	53.385473	-0.646316	25.39	3.50	28.89
22	53.384526	-0.646123	24.46	3.50	27.96
23	53.384462	-0.641681	23.22	3.50	26.72
24	53.384680	-0.641724	23.27	3.50	26.77
25	53.384654	-0.641252	23.42	3.50	26.92
26	53.387444	-0.643376	29.26	3.50	32.76
27	53.387034	-0.646702	26.28	3.50	29.78
28	53.387649	-0.646766	27.16	3.50	30.66
29	53.387969	-0.644299	28.26	3.50	31.76
30	53.387521	-0.644149	28.07	3.50	31.57
31	53.387585	-0.643290	32.90	3.50	36.40
32	53.390106	-0.644706	28.21	3.50	31.71
33	53.390592	-0.641981	27.06	3.50	30.56
34	53.388442	-0.640737	32.13	3.50	35.63
35	53.388519	-0.638934	29.46	3.50	32.96
36	53.387214	-0.638033	28.35	3.50	31.85
37	53.385844	-0.641488	26.53	3.50	30.03
38	53.383003	-0.639385	22.83	3.50	26.33
39	53.382952	-0.638548	23.74	3.50	27.24
40	53.384475	-0.632583	26.08	3.50	29.58
41	53.387214	-0.626897	25.61	3.50	29.11
42	53.387444	-0.624113	25.66	3.50	29.16
43	53.388864	-0.621410	25.53	3.50	29.03
44	53.391437	-0.610659	26.43	3.50	29.93
45	53.392703	-0.612097	26.30	3.50	29.80
46	53.393593	-0.609468	27.96	3.50	31.46
47	53.394284	-0.605670	29.95	3.50	33.45
48	53.395960	-0.607601	28.37	3.50	31.87
49	53.401219	-0.608802	27.57	3.50	31.07
50	53.401833	-0.610970	25.55	3.50	29.05
51	53.402223	-0.614682	24.61	3.50	28.11
52	53.402767	-0.618394	22.71	3.50	26.21
53	53.403790	-0.620111	22.12	3.50	25.62
54	53.404020	-0.621076	22.07	3.50	25.57
55	53.403867	-0.623158	22.03	3.50	25.53
56	53.404212	-0.627514	20.65	3.50	24.15
57	53.402396	-0.626848	23.25	3.50	26.75
58	53.402523	-0.625561	23.72	3.50	27.22
59	53.400758	-0.624917	25.49	3.50	28.99
60	53.400323	-0.627277	25.12	3.50	28.62
61	53.400758	-0.627599	24.79	3.50	28.29
62	53.400515	-0.629616	24.16	3.50	27.66
63	53.401666	-0.630088	23.57	3.50	27.07
64	53.401961	-0.628028	24.34	3.50	27.84
65	53.402523	-0.628222	22.24	3.50	25.74
66	53.402460	-0.628994	22.11	3.50	25.61

67	53.403918	-0.629380	20.37	3.50	23.87
68	53.405008	-0.634115	19.11	3.50	22.61
69	53.404778	-0.636304	18.91	3.50	22.41
70	53.405213	-0.639436	20.01	3.50	23.51
71	53.404087	-0.637248	18.52	3.50	22.02
72	53.402501	-0.636819	19.41	3.50	22.91
73	53.402066	-0.640595	22.92	3.50	26.42
74	53.405341	-0.642054	19.02	3.50	22.52
75	53.406108	-0.650466	19.99	3.50	23.49

Name: PV array 3
Footprint area: 155,264 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384474	-0.658826	18.53	3.50	22.03
2	53.380314	-0.656701	15.17	3.50	18.67
3	53.380468	-0.655886	15.47	3.50	18.97
4	53.380993	-0.651551	15.76	3.50	19.26
5	53.384410	-0.653139	21.02	3.50	24.52

Name: PV array 4
Footprint area: 3,405,503 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384205	-0.646118	24.01	3.50	27.51
2	53.381543	-0.644787	19.33	3.50	22.83
3	53.381185	-0.645839	18.48	3.50	21.98
4	53.379201	-0.644659	21.84	3.50	25.34
5	53.381006	-0.633200	21.41	3.50	24.91
6	53.377255	-0.632235	17.94	3.50	21.44
7	53.378087	-0.619682	17.12	3.50	20.62
8	53.378420	-0.619832	17.42	3.50	20.92
9	53.378894	-0.612601	19.79	3.50	23.29
10	53.377460	-0.619167	17.18	3.50	20.68
11	53.376193	-0.617214	19.36	3.50	22.86
12	53.377422	-0.602752	21.27	3.50	24.77
13	53.376052	-0.603825	20.55	3.50	24.05
14	53.374401	-0.605477	19.49	3.50	22.99
15	53.374093	-0.605348	18.76	3.50	22.26
16	53.374093	-0.604962	18.93	3.50	22.43
17	53.373760	-0.604898	19.50	3.50	23.00
18	53.373837	-0.603374	21.52	3.50	25.02
19	53.374477	-0.600520	24.41	3.50	27.91
20	53.374977	-0.597645	24.53	3.50	28.03
21	53.377921	-0.599340	22.67	3.50	26.17
22	53.378049	-0.598975	23.38	3.50	26.88
23	53.381133	-0.600949	24.71	3.50	28.21
24	53.380929	-0.602387	24.99	3.50	28.49
25	53.381940	-0.602859	25.05	3.50	28.55
26	53.382183	-0.601421	25.34	3.50	28.84
27	53.384077	-0.602366	29.83	3.50	33.33
28	53.384448	-0.602580	29.74	3.50	33.24
29	53.384653	-0.601529	29.74	3.50	33.24
30	53.384154	-0.601293	29.42	3.50	32.92
31	53.384589	-0.599061	28.22	3.50	31.72
32	53.384845	-0.599319	28.50	3.50	32.00
33	53.385293	-0.597323	29.07	3.50	32.57
34	53.387494	-0.598460	32.57	3.50	36.07
35	53.388825	-0.591798	37.24	3.50	40.74
36	53.389196	-0.591069	39.02	3.50	42.52
37	53.391410	-0.593279	43.19	3.50	46.69
38	53.391308	-0.593622	44.25	3.50	47.75
39	53.392063	-0.594438	43.60	3.50	47.10
40	53.391589	-0.595789	42.13	3.50	45.63
41	53.392562	-0.596605	41.34	3.50	44.84
42	53.393560	-0.597141	40.83	3.50	44.33
43	53.392766	-0.599931	35.79	3.50	39.29
44	53.392920	-0.600424	35.55	3.50	39.05
45	53.390207	-0.612776	26.15	3.50	29.65
46	53.388459	-0.611221	28.09	3.50	31.59
47	53.387307	-0.615877	25.87	3.50	29.37
48	53.389585	-0.617400	25.89	3.50	29.39
49	53.388753	-0.620812	25.49	3.50	28.99
50	53.388280	-0.622014	25.02	3.50	28.52
51	53.387205	-0.623988	25.66	3.50	29.16
52	53.386962	-0.626541	25.48	3.50	28.98
53	53.385465	-0.629824	26.17	3.50	29.67
54	53.383711	-0.627571	22.96	3.50	26.46
55	53.382047	-0.626305	25.12	3.50	28.62
56	53.381356	-0.631069	20.17	3.50	23.67
57	53.383724	-0.631949	25.14	3.50	28.64
58	53.384159	-0.632550	25.74	3.50	29.24
59	53.382470	-0.639759	22.77	3.50	26.27
60	53.384082	-0.641068	21.52	3.50	25.02

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	m	m	m
OP 1	53.408729	-0.690195	17.26	1.50	18.76
OP 2	53.408755	-0.687963	17.00	1.50	18.50
OP 3	53.408531	-0.684884	19.65	1.50	21.15
OP 4	53.408125	-0.682077	20.65	1.50	22.15
OP 5	53.407664	-0.678494	21.46	1.50	22.96
OP 6	53.406747	-0.673309	20.00	1.50	21.50
OP 7	53.406312	-0.670069	20.22	1.50	21.72
OP 8	53.406261	-0.666893	21.26	1.50	22.76
OP 9	53.406325	-0.663825	22.55	1.50	24.05
OP 10	53.406389	-0.661078	24.49	1.50	25.99
OP 11	53.406517	-0.657691	25.16	1.50	26.66
OP 12	53.406504	-0.655266	23.82	1.50	25.32
OP 13	53.406363	-0.652176	21.29	1.50	22.79
OP 14	53.406235	-0.649323	19.22	1.50	20.72
OP 15	53.405954	-0.645932	19.89	1.50	21.39
OP 16	53.405659	-0.642499	18.83	1.50	20.33
OP 17	53.405429	-0.640160	18.86	1.50	20.36
OP 18	53.405045	-0.637092	19.39	1.50	20.89
OP 19	53.405122	-0.634002	19.74	1.50	21.24
OP 20	53.404598	-0.631126	20.25	1.50	21.75
OP 21	53.404429	-0.628190	21.68	1.50	23.18
OP 22	53.404199	-0.625358	22.06	1.50	23.56
OP 23	53.404084	-0.622694	22.34	1.50	23.84
OP 24	53.404033	-0.620076	22.70	1.50	24.20
OP 25	53.402843	-0.617909	23.69	1.50	25.19
OP 26	53.402472	-0.615205	25.22	1.50	26.72
OP 27	53.402127	-0.612008	25.88	1.50	27.38
OP 28	53.401474	-0.609047	26.66	1.50	28.16
OP 29	53.400818	-0.605965	30.10	1.50	31.60
OP 30	53.400101	-0.603648	32.00	1.50	33.50
OP 31	53.400127	-0.601245	37.83	1.50	39.33
OP 32	53.399781	-0.598112	40.44	1.50	41.94
OP 33	53.399462	-0.595322	48.62	1.50	50.12
OP 34	53.399065	-0.592683	62.99	1.50	64.49
OP 35	53.398387	-0.589894	69.39	1.50	70.89
OP 36	53.397747	-0.587061	68.87	1.50	70.37
OP 37	53.396979	-0.584158	65.95	1.50	67.45
OP 38	53.396314	-0.581068	62.58	1.50	64.08
OP 39	53.408915	-0.596515	68.95	1.50	70.45
OP 40	53.406817	-0.596451	67.98	1.50	69.48
OP 41	53.405014	-0.596322	67.83	1.50	69.33
OP 42	53.403312	-0.594863	68.98	1.50	70.48
OP 43	53.401713	-0.593468	67.61	1.50	69.11
OP 44	53.400165	-0.592159	68.78	1.50	70.28
OP 45	53.398054	-0.590807	69.71	1.50	71.21
OP 46	53.396353	-0.589434	69.16	1.50	70.66
OP 47	53.394856	-0.588640	70.01	1.50	71.51
OP 48	53.393768	-0.587288	69.64	1.50	71.14
OP 49	53.391439	-0.585615	67.73	1.50	69.23
OP 50	53.389929	-0.584005	65.41	1.50	66.91
OP 51	53.388509	-0.581602	63.38	1.50	64.88
OP 52	53.387319	-0.579606	63.74	1.50	65.24
OP 53	53.386128	-0.577954	66.35	1.50	67.85
OP 54	53.407775	-0.687418	18.25	1.50	19.75
OP 55	53.405088	-0.687386	20.00	1.50	21.50
OP 56	53.403399	-0.687386	20.00	1.50	21.50
OP 57	53.401417	-0.687300	17.46	1.50	18.96
OP 58	53.399651	-0.686806	18.09	1.50	19.59
OP 59	53.397706	-0.686227	20.18	1.50	21.68
OP 60	53.396913	-0.684661	21.87	1.50	23.37
OP 61	53.395531	-0.683073	21.78	1.50	23.28
OP 62	53.393535	-0.683051	19.21	1.50	20.71
OP 63	53.397642	-0.684124	22.98	1.50	24.48
OP 64	53.397994	-0.680948	24.08	1.50	25.58

OP 65	53.398282	-0.678449	22.90	1.50	24.40
OP 66	53.398672	-0.675176	22.86	1.50	24.36
OP 67	53.399075	-0.671689	21.86	1.50	23.36
OP 68	53.399363	-0.669351	21.16	1.50	22.66
OP 69	53.399715	-0.666293	22.27	1.50	23.77
OP 70	53.400041	-0.663471	25.07	1.50	26.57
OP 71	53.400425	-0.660338	26.73	1.50	28.23
OP 72	53.400841	-0.656830	28.48	1.50	29.98
OP 73	53.401353	-0.655929	29.20	1.50	30.70
OP 74	53.403335	-0.656433	26.94	1.50	28.44
OP 75	53.405728	-0.656927	25.54	1.50	27.04
OP 76	53.406860	-0.649921	22.12	1.50	23.62
OP 77	53.408542	-0.648912	19.72	1.50	21.22
OP 78	53.410070	-0.647936	19.13	1.50	20.63
OP 79	53.412014	-0.646777	21.22	1.50	22.72
OP 80	53.413182	-0.644855	23.10	1.50	24.60
OP 81	53.414150	-0.642416	22.86	1.50	24.36

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	
PV array 1	SA tracking	SA tracking	20,645	0	-	-
PV array 2	SA tracking	SA tracking	0	0	-	
PV array 3	SA tracking	SA tracking	0	0	-	
PV array 4	SA tracking	SA tracking	0	0	-	

Distinct glare per month

Excludes overlapping glare from PV array for multiple receptors at matching time(s)

PV	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pv-array-1 (green)	4065	0	0	0	0	0	0	0	0	0	2091	6330
pv-array-1 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 low potential for temporary after-image

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	12486	0
OP: OP 11	8159	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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0
OP: OP 44	0	0
OP: OP 45	0	0
OP: OP 46	0	0
OP: OP 47	0	0
OP: OP 48	0	0
OP: OP 49	0	0
OP: OP 50	0	0
OP: OP 51	0	0
OP: OP 52	0	0
OP: OP 53	0	0
OP: OP 54	0	0
OP: OP 55	0	0
OP: OP 56	0	0
OP: OP 57	0	0
OP: OP 58	0	0
OP: OP 59	0	0
OP: OP 60	0	0
OP: OP 61	0	0
OP: OP 62	0	0
OP: OP 63	0	0
OP: OP 64	0	0
OP: OP 65	0	0
OP: OP 66	0	0
OP: OP 67	0	0
OP: OP 68	0	0
OP: OP 69	0	0
OP: OP 70	0	0
OP: OP 71	0	0
OP: OP 72	0	0
OP: OP 73	0	0
OP: OP 74	0	0
OP: OP 75	0	0
OP: OP 76	0	0
OP: OP 77	0	0
OP: OP 78	0	0
OP: OP 79	0	0
OP: OP 80	0	0
OP: OP 81	0	0

PV array 1 - OP Receptor (OP 1)

No glare found

PV array 1 - OP Receptor (OP 2)

No glare found

PV array 1 - OP Receptor (OP 3)

No glare found

PV array 1 - OP Receptor (OP 4)

No glare found

PV array 1 - OP Receptor (OP 5)

No glare found

PV array 1 - OP Receptor (OP 6)

No glare found

PV array 1 - OP Receptor (OP 7)

No glare found

PV array 1 - OP Receptor (OP 8)

No glare found

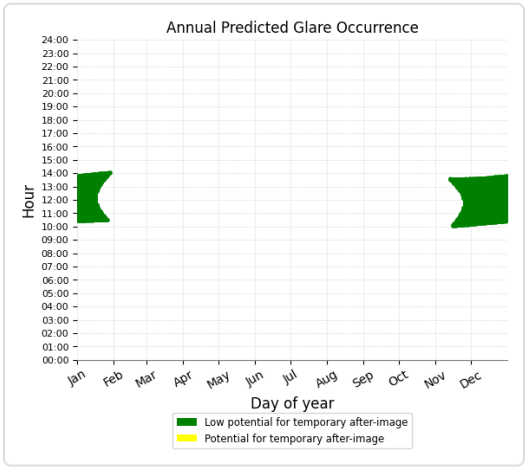
PV array 1 - OP Receptor (OP 9)

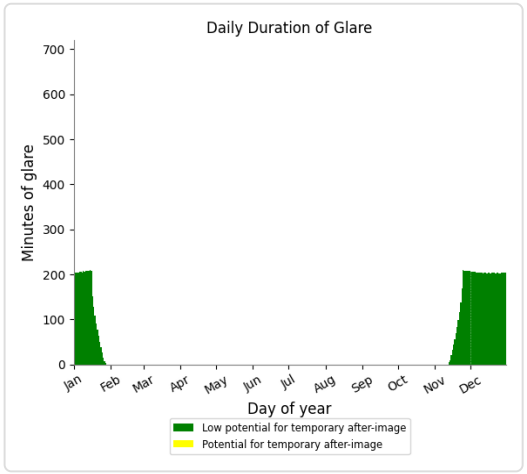
No glare found

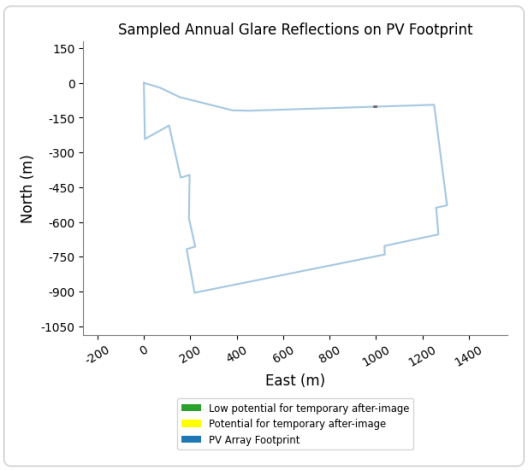
PV array 1 - OP Receptor (OP 10)

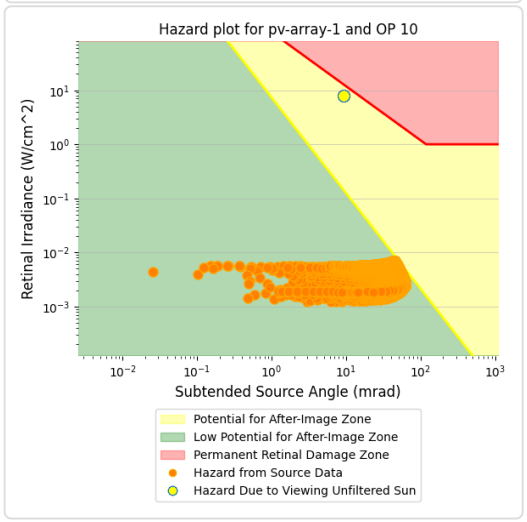
PV array is expected to produce the following glare for receptors at this location:

- 12,486 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.





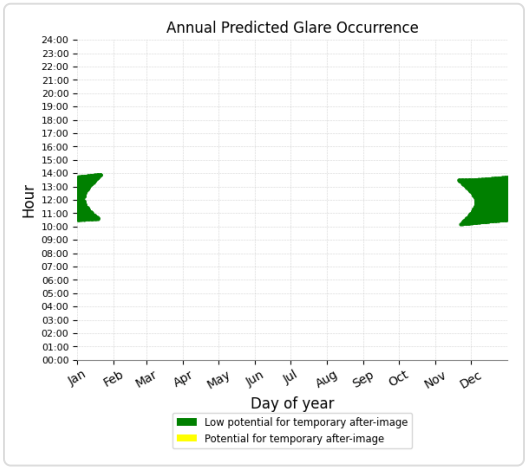


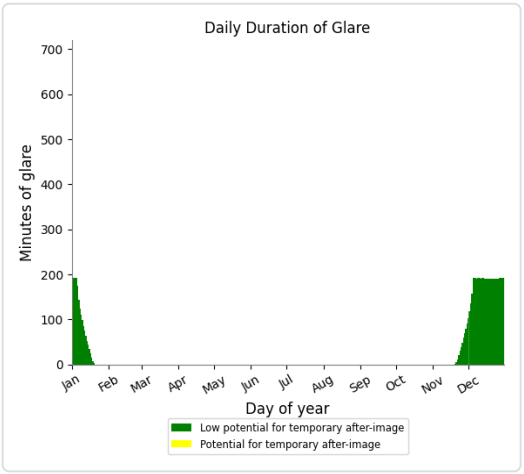


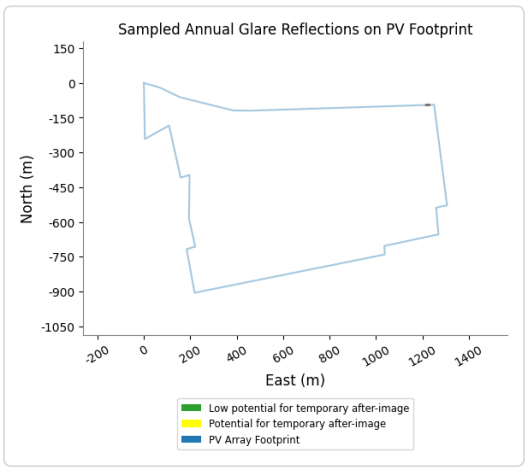
PV array 1 - OP Receptor (OP 11)

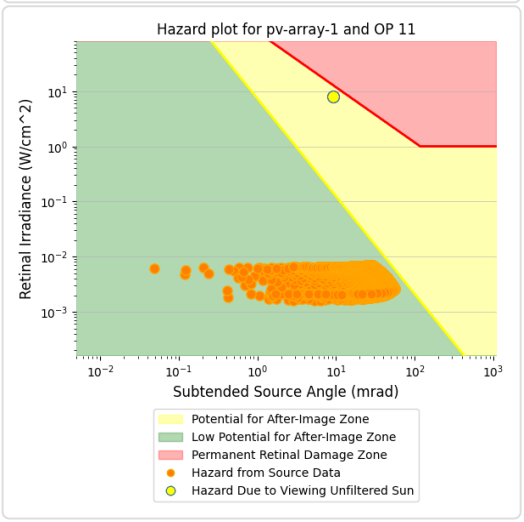
PV array is expected to produce the following glare for receptors at this location:

- 8,159 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.









PV array 1 - OP Receptor (OP 12)

No glare found

PV array 1 - OP Receptor (OP 13)

No glare found

PV array 1 - OP Receptor (OP 14)

No glare found

PV array 1 - OP Receptor (OP 15)

No glare found

PV array 1 - OP Receptor (OP 16)

No glare found

PV array 1 - OP Receptor (OP 17)

No glare found

PV array 1 - OP Receptor (OP 18)

No glare found

PV array 1 - OP Receptor (OP 19)

No glare found

PV array 1 - OP Receptor (OP 20)
No glare found

PV array 1 - OP Receptor (OP 21)
No glare found

PV array 1 - OP Receptor (OP 22)
No glare found

PV array 1 - OP Receptor (OP 23)
No glare found

PV array 1 - OP Receptor (OP 24)
No glare found

PV array 1 - OP Receptor (OP 25)
No glare found

PV array 1 - OP Receptor (OP 26)
No glare found

PV array 1 - OP Receptor (OP 27)
No glare found

PV array 1 - OP Receptor (OP 28)
No glare found

PV array 1 - OP Receptor (OP 29)
No glare found

PV array 1 - OP Receptor (OP 30)
No glare found

PV array 1 - OP Receptor (OP 31)
No glare found

PV array 1 - OP Receptor (OP 32)
No glare found

PV array 1 - OP Receptor (OP 33)
No glare found

PV array 1 - OP Receptor (OP 34)
No glare found

PV array 1 - OP Receptor (OP 35)
No glare found

PV array 1 - OP Receptor (OP 36)
No glare found

PV array 1 - OP Receptor (OP 37)
No glare found

PV array 1 - OP Receptor (OP 38)
No glare found

PV array 1 - OP Receptor (OP 39)
No glare found

PV array 1 - OP Receptor (OP 40)
No glare found

PV array 1 - OP Receptor (OP 41)
No glare found

PV array 1 - OP Receptor (OP 42)
No glare found

PV array 1 - OP Receptor (OP 43)
No glare found

PV array 1 - OP Receptor (OP 44)
No glare found

PV array 1 - OP Receptor (OP 45)
No glare found

PV array 1 - OP Receptor (OP 46)
No glare found

PV array 1 - OP Receptor (OP 47)
No glare found

PV array 1 - OP Receptor (OP 48)
No glare found

PV array 1 - OP Receptor (OP 49)
No glare found

PV array 1 - OP Receptor (OP 50)
No glare found

PV array 1 - OP Receptor (OP 51)
No glare found

PV array 1 - OP Receptor (OP 52)
No glare found

PV array 1 - OP Receptor (OP 53)
No glare found

PV array 1 - OP Receptor (OP 54)
No glare found

PV array 1 - OP Receptor (OP 55)
No glare found

PV array 1 - OP Receptor (OP 56)
No glare found

PV array 1 - OP Receptor (OP 57)
No glare found

PV array 1 - OP Receptor (OP 58)
No glare found

PV array 1 - OP Receptor (OP 59)
No glare found

PV array 1 - OP Receptor (OP 60)
No glare found

PV array 1 - OP Receptor (OP 61)
No glare found

PV array 1 - OP Receptor (OP 62)
No glare found

PV array 1 - OP Receptor (OP 63)
No glare found

PV array 1 - OP Receptor (OP 64)
No glare found

PV array 1 - OP Receptor (OP 65)
No glare found

PV array 1 - OP Receptor (OP 66)
No glare found

PV array 1 - OP Receptor (OP 67)
No glare found

PV array 1 - OP Receptor (OP 68)
No glare found

PV array 1 - OP Receptor (OP 69)
No glare found

PV array 1 - OP Receptor (OP 70)
No glare found

PV array 1 - OP Receptor (OP 71)
No glare found

PV array 1 - OP Receptor (OP 72)
No glare found

PV array 1 - OP Receptor (OP 73)
No glare found

PV array 1 - OP Receptor (OP 74)
No glare found

PV array 1 - OP Receptor (OP 75)
No glare found

PV array 1 - OP Receptor (OP 76)
No glare found

PV array 1 - OP Receptor (OP 77)
No glare found

PV array 1 - OP Receptor (OP 78)
No glare found

PV array 1 - OP Receptor (OP 79)
No glare found

PV array 1 - OP Receptor (OP 80)

No glare found

PV array 1 - OP Receptor (OP 81)

No glare found

PV array 2 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0
OP: OP 44	0	0
OP: OP 45	0	0
OP: OP 46	0	0
OP: OP 47	0	0
OP: OP 48	0	0
OP: OP 49	0	0
OP: OP 50	0	0
OP: OP 51	0	0
OP: OP 52	0	0
OP: OP 53	0	0

OP: OP 54	0	0
OP: OP 55	0	0
OP: OP 56	0	0
OP: OP 57	0	0
OP: OP 58	0	0
OP: OP 59	0	0
OP: OP 60	0	0
OP: OP 61	0	0
OP: OP 62	0	0
OP: OP 63	0	0
OP: OP 64	0	0
OP: OP 65	0	0
OP: OP 66	0	0
OP: OP 67	0	0
OP: OP 68	0	0
OP: OP 69	0	0
OP: OP 70	0	0
OP: OP 71	0	0
OP: OP 72	0	0
OP: OP 73	0	0
OP: OP 74	0	0
OP: OP 75	0	0
OP: OP 76	0	0
OP: OP 77	0	0
OP: OP 78	0	0
OP: OP 79	0	0
OP: OP 80	0	0
OP: OP 81	0	0

No glare found

PV array 3 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0
OP: OP 44	0	0
OP: OP 45	0	0
OP: OP 46	0	0
OP: OP 47	0	0
OP: OP 48	0	0
OP: OP 49	0	0
OP: OP 50	0	0
OP: OP 51	0	0
OP: OP 52	0	0
OP: OP 53	0	0

OP: OP 54	0	0
OP: OP 55	0	0
OP: OP 56	0	0
OP: OP 57	0	0
OP: OP 58	0	0
OP: OP 59	0	0
OP: OP 60	0	0
OP: OP 61	0	0
OP: OP 62	0	0
OP: OP 63	0	0
OP: OP 64	0	0
OP: OP 65	0	0
OP: OP 66	0	0
OP: OP 67	0	0
OP: OP 68	0	0
OP: OP 69	0	0
OP: OP 70	0	0
OP: OP 71	0	0
OP: OP 72	0	0
OP: OP 73	0	0
OP: OP 74	0	0
OP: OP 75	0	0
OP: OP 76	0	0
OP: OP 77	0	0
OP: OP 78	0	0
OP: OP 79	0	0
OP: OP 80	0	0
OP: OP 81	0	0

No glare found

PV array 4 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0
OP: OP 44	0	0
OP: OP 45	0	0
OP: OP 46	0	0
OP: OP 47	0	0
OP: OP 48	0	0
OP: OP 49	0	0
OP: OP 50	0	0
OP: OP 51	0	0
OP: OP 52	0	0
OP: OP 53	0	0

OP: OP 54	0	0
OP: OP 55	0	0
OP: OP 56	0	0
OP: OP 57	0	0
OP: OP 58	0	0
OP: OP 59	0	0
OP: OP 60	0	0
OP: OP 61	0	0
OP: OP 62	0	0
OP: OP 63	0	0
OP: OP 64	0	0
OP: OP 65	0	0
OP: OP 66	0	0
OP: OP 67	0	0
OP: OP 68	0	0
OP: OP 69	0	0
OP: OP 70	0	0
OP: OP 71	0	0
OP: OP 72	0	0
OP: OP 73	0	0
OP: OP 74	0	0
OP: OP 75	0	0
OP: OP 76	0	0
OP: OP 77	0	0
OP: OP 78	0	0
OP: OP 79	0	0
OP: OP 80	0	0
OP: OP 81	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. Actual 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 fo 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 combined 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.

APPENDIX E: ROAD RECEPTOR GLARE RESULTS (82 – 161)

ForgeSolar

Tillbridge Solar Farm

Tillbridge Solar Farm Road 82 - 161

Created Nov. 23, 2022
Updated Nov. 23, 2022
Time-step 1 minute
Timezone offset UTC0
Site ID 79945.14152

Project type Advanced
Project status: active
Category 100 MW to 1 GW

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**

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
PV array 1	SA tracking	SA tracking	0	0	-
PV array 2	SA tracking	SA tracking	0	0	-
PV array 3	SA tracking	SA tracking	0	0	-
PV array 4	SA tracking	SA tracking	0	0	-

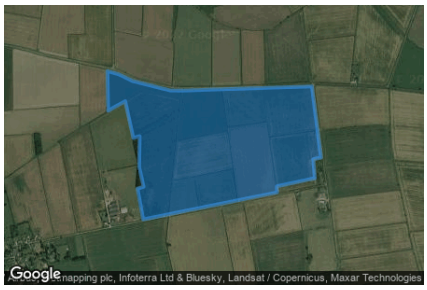
Component Data

PV Array(s)

Total PV footprint area: 10,587,087 m^2

Name: PV array 1
Footprint area: 782,414 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

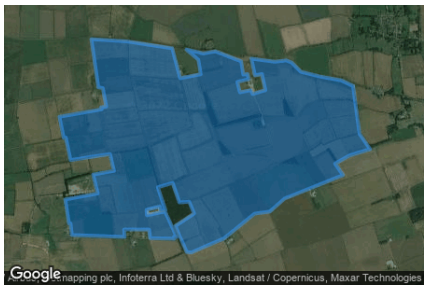
Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.407216	-0.676060	21.00	3.50	24.50
2	53.405042	-0.675995	20.27	3.50	23.77
3	53.405566	-0.674429	20.50	3.50	24.00
4	53.403545	-0.673678	21.88	3.50	25.38
5	53.403647	-0.673098	22.00	3.50	25.50
6	53.401959	-0.673141	22.76	3.50	26.26
7	53.400871	-0.672734	22.00	3.50	25.50
8	53.400769	-0.673292	22.28	3.50	25.78
9	53.399080	-0.672777	22.77	3.50	26.27
10	53.400564	-0.660460	27.07	3.50	30.57
11	53.400897	-0.660481	27.17	3.50	30.67
12	53.401344	-0.656984	27.78	3.50	31.28
13	53.402381	-0.657134	26.26	3.50	29.76
14	53.402470	-0.656426	26.79	3.50	30.29
15	53.406372	-0.657263	24.85	3.50	28.35
16	53.406140	-0.669228	19.61	3.50	23.11
17	53.406153	-0.670301	19.69	3.50	23.19
18	53.406665	-0.673735	20.02	3.50	23.52
19	53.407036	-0.675022	20.66	3.50	24.16

Name: PV array 2
Footprint area: 6,243,906 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.406344	-0.656924	24.80	3.50	28.30
2	53.401070	-0.655649	28.17	3.50	31.67
3	53.400993	-0.654833	27.75	3.50	31.25
4	53.398959	-0.654190	27.90	3.50	31.40
5	53.398869	-0.655155	28.05	3.50	31.55
6	53.398652	-0.655026	27.57	3.50	31.07
7	53.397833	-0.662793	23.46	3.50	26.96
8	53.395528	-0.662017	23.42	3.50	26.92
9	53.395554	-0.661631	23.71	3.50	27.21
10	53.393087	-0.660757	21.28	3.50	24.78
11	53.393753	-0.653504	24.43	3.50	27.93
12	53.391910	-0.652775	22.92	3.50	26.42
13	53.391501	-0.656594	21.50	3.50	25.00
14	53.389428	-0.655757	22.65	3.50	26.15
15	53.388775	-0.661722	21.33	3.50	24.83
16	53.386139	-0.661057	17.30	3.50	20.80
17	53.386139	-0.660757	17.10	3.50	20.60
18	53.384872	-0.660499	19.29	3.50	22.79
19	53.384654	-0.650800	23.99	3.50	27.49
20	53.385473	-0.650908	23.39	3.50	26.89
21	53.385473	-0.646316	25.39	3.50	28.89
22	53.384526	-0.646123	24.46	3.50	27.96
23	53.384462	-0.641681	23.22	3.50	26.72
24	53.384680	-0.641724	23.27	3.50	26.77
25	53.384654	-0.641252	23.42	3.50	26.92
26	53.387444	-0.643376	29.26	3.50	32.76
27	53.387034	-0.646702	26.28	3.50	29.78
28	53.387649	-0.646766	27.16	3.50	30.66
29	53.387969	-0.644299	28.26	3.50	31.76
30	53.387521	-0.644149	28.07	3.50	31.57
31	53.387585	-0.643290	32.90	3.50	36.40
32	53.390106	-0.644706	28.21	3.50	31.71
33	53.390592	-0.641981	27.06	3.50	30.56
34	53.388442	-0.640737	32.13	3.50	35.63
35	53.388519	-0.638934	29.46	3.50	32.96
36	53.387214	-0.638033	28.35	3.50	31.85
37	53.385844	-0.641488	26.53	3.50	30.03
38	53.383003	-0.639385	22.83	3.50	26.33
39	53.382952	-0.638548	23.74	3.50	27.24
40	53.384475	-0.632583	26.08	3.50	29.58
41	53.387214	-0.626897	25.61	3.50	29.11
42	53.387444	-0.624113	25.66	3.50	29.16
43	53.388864	-0.621410	25.53	3.50	29.03
44	53.391437	-0.610659	26.43	3.50	29.93
45	53.392703	-0.612097	26.30	3.50	29.80
46	53.393593	-0.609468	27.96	3.50	31.46
47	53.394284	-0.605670	29.95	3.50	33.45
48	53.395960	-0.607601	28.37	3.50	31.87
49	53.401219	-0.608802	27.57	3.50	31.07
50	53.401833	-0.610970	25.55	3.50	29.05
51	53.402223	-0.614682	24.61	3.50	28.11
52	53.402767	-0.618394	22.71	3.50	26.21
53	53.403790	-0.620111	22.12	3.50	25.62
54	53.404020	-0.621076	22.07	3.50	25.57
55	53.403867	-0.623158	22.03	3.50	25.53
56	53.404212	-0.627514	20.65	3.50	24.15
57	53.402396	-0.626848	23.25	3.50	26.75
58	53.402523	-0.625561	23.72	3.50	27.22
59	53.400758	-0.624917	25.49	3.50	28.99
60	53.400323	-0.627277	25.12	3.50	28.62
61	53.400758	-0.627599	24.79	3.50	28.29
62	53.400515	-0.629616	24.16	3.50	27.66
63	53.401666	-0.630088	23.57	3.50	27.07
64	53.401961	-0.628028	24.34	3.50	27.84
65	53.402523	-0.628222	22.24	3.50	25.74
66	53.402460	-0.628994	22.11	3.50	25.61

67	53.403918	-0.629380	20.37	3.50	23.87
68	53.405008	-0.634115	19.11	3.50	22.61
69	53.404778	-0.636304	18.91	3.50	22.41
70	53.405213	-0.639436	20.01	3.50	23.51
71	53.404087	-0.637248	18.52	3.50	22.02
72	53.402501	-0.636819	19.41	3.50	22.91
73	53.402066	-0.640595	22.92	3.50	26.42
74	53.405341	-0.642054	19.02	3.50	22.52
75	53.406108	-0.650466	19.99	3.50	23.49

Name: PV array 3
Footprint area: 155,264 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384474	-0.658826	18.53	3.50	22.03
2	53.380314	-0.656701	15.17	3.50	18.67
3	53.380468	-0.655886	15.47	3.50	18.97
4	53.380993	-0.651551	15.76	3.50	19.26
5	53.384410	-0.653139	21.02	3.50	24.52

Name: PV array 4
Footprint area: 3,405,503 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384205	-0.646118	24.01	3.50	27.51
2	53.381543	-0.644787	19.33	3.50	22.83
3	53.381185	-0.645839	18.48	3.50	21.98
4	53.379201	-0.644659	21.84	3.50	25.34
5	53.381006	-0.633200	21.41	3.50	24.91
6	53.377255	-0.632235	17.94	3.50	21.44
7	53.378087	-0.619682	17.12	3.50	20.62
8	53.378420	-0.619832	17.42	3.50	20.92
9	53.378894	-0.612601	19.79	3.50	23.29
10	53.377460	-0.619167	17.18	3.50	20.68
11	53.376193	-0.617214	19.36	3.50	22.86
12	53.377422	-0.602752	21.27	3.50	24.77
13	53.376052	-0.603825	20.55	3.50	24.05
14	53.374401	-0.605477	19.49	3.50	22.99
15	53.374093	-0.605348	18.76	3.50	22.26
16	53.374093	-0.604962	18.93	3.50	22.43
17	53.373760	-0.604898	19.50	3.50	23.00
18	53.373837	-0.603374	21.52	3.50	25.02
19	53.374477	-0.600520	24.41	3.50	27.91
20	53.374977	-0.597645	24.53	3.50	28.03
21	53.377921	-0.599340	22.67	3.50	26.17
22	53.378049	-0.598975	23.38	3.50	26.88
23	53.381133	-0.600949	24.71	3.50	28.21
24	53.380929	-0.602387	24.99	3.50	28.49
25	53.381940	-0.602859	25.05	3.50	28.55
26	53.382183	-0.601421	25.34	3.50	28.84
27	53.384077	-0.602366	29.83	3.50	33.33
28	53.384448	-0.602580	29.74	3.50	33.24
29	53.384653	-0.601529	29.74	3.50	33.24
30	53.384154	-0.601293	29.42	3.50	32.92
31	53.384589	-0.599061	28.22	3.50	31.72
32	53.384845	-0.599319	28.50	3.50	32.00
33	53.385293	-0.597323	29.07	3.50	32.57
34	53.387494	-0.598460	32.57	3.50	36.07
35	53.388825	-0.591798	37.24	3.50	40.74
36	53.389196	-0.591069	39.02	3.50	42.52
37	53.391410	-0.593279	43.19	3.50	46.69
38	53.391308	-0.593622	44.25	3.50	47.75
39	53.392063	-0.594438	43.60	3.50	47.10
40	53.391589	-0.595789	42.13	3.50	45.63
41	53.392562	-0.596605	41.34	3.50	44.84
42	53.393560	-0.597141	40.83	3.50	44.33
43	53.392766	-0.599931	35.79	3.50	39.29
44	53.392920	-0.600424	35.55	3.50	39.05
45	53.390207	-0.612776	26.15	3.50	29.65
46	53.388459	-0.611221	28.09	3.50	31.59
47	53.387307	-0.615877	25.87	3.50	29.37
48	53.389585	-0.617400	25.89	3.50	29.39
49	53.388753	-0.620812	25.49	3.50	28.99
50	53.388280	-0.622014	25.02	3.50	28.52
51	53.387205	-0.623988	25.66	3.50	29.16
52	53.386962	-0.626541	25.48	3.50	28.98
53	53.385465	-0.629824	26.17	3.50	29.67
54	53.383711	-0.627571	22.96	3.50	26.46
55	53.382047	-0.626305	25.12	3.50	28.62
56	53.381356	-0.631069	20.17	3.50	23.67
57	53.383724	-0.631949	25.14	3.50	28.64
58	53.384159	-0.632550	25.74	3.50	29.24
59	53.382470	-0.639759	22.77	3.50	26.27
60	53.384082	-0.641068	21.52	3.50	25.02

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	m	m	m
OP 1	53.384942	-0.675525	22.20	1.50	23.70
OP 2	53.385428	-0.673100	20.27	1.50	21.77
OP 3	53.385012	-0.670354	17.59	1.50	19.09
OP 4	53.384839	-0.667618	15.96	1.50	17.46
OP 5	53.384795	-0.664206	15.81	1.50	17.31
OP 6	53.384718	-0.660707	18.48	1.50	19.98
OP 7	53.384640	-0.658109	19.91	1.50	21.41
OP 8	53.384583	-0.654858	20.93	1.50	22.43
OP 9	53.384489	-0.651610	22.68	1.50	24.18
OP 10	53.384450	-0.648869	24.75	1.50	26.25
OP 11	53.384374	-0.646037	24.08	1.50	25.58
OP 12	53.384290	-0.642489	22.94	1.50	24.44
OP 13	53.383855	-0.640632	22.11	1.50	23.61
OP 14	53.382876	-0.638412	24.30	1.50	25.80
OP 15	53.383459	-0.635805	24.95	1.50	26.45
OP 16	53.384130	-0.633122	25.53	1.50	27.03
OP 17	53.385109	-0.630966	27.11	1.50	28.61
OP 18	53.386315	-0.628399	26.07	1.50	27.57
OP 19	53.387141	-0.625953	25.46	1.50	26.96
OP 20	53.387646	-0.623453	25.19	1.50	26.69
OP 21	53.388811	-0.621017	25.40	1.50	26.90
OP 22	53.389720	-0.617316	25.63	1.50	27.13
OP 23	53.390231	-0.614977	25.59	1.50	27.09
OP 24	53.391000	-0.611578	26.53	1.50	28.03
OP 25	53.391806	-0.610838	26.31	1.50	27.81
OP 26	53.393016	-0.610752	27.29	1.50	28.79
OP 27	53.393694	-0.607963	29.21	1.50	30.71
OP 28	53.394340	-0.604747	29.46	1.50	30.96
OP 29	53.395027	-0.601294	31.45	1.50	32.95
OP 30	53.395206	-0.599129	34.60	1.50	36.10
OP 31	53.395603	-0.596630	39.89	1.50	41.39
OP 32	53.396204	-0.594688	37.80	1.50	39.30
OP 33	53.398392	-0.594485	47.00	1.50	48.50
OP 34	53.375046	-0.668943	16.28	1.50	17.78
OP 35	53.375225	-0.666207	17.07	1.50	18.57
OP 36	53.375532	-0.663407	16.31	1.50	17.81
OP 37	53.375878	-0.660521	14.84	1.50	16.34
OP 38	53.375923	-0.657551	14.81	1.50	16.31
OP 39	53.376012	-0.654433	16.88	1.50	18.38
OP 40	53.376287	-0.651764	18.99	1.50	20.49
OP 41	53.376460	-0.648470	21.80	1.50	23.30
OP 42	53.374649	-0.648191	24.10	1.50	25.60
OP 43	53.372383	-0.647698	20.29	1.50	21.79
OP 44	53.370633	-0.647068	17.90	1.50	19.40
OP 45	53.370813	-0.644483	18.13	1.50	19.63
OP 46	53.371280	-0.641564	16.64	1.50	18.14
OP 47	53.371504	-0.638957	16.51	1.50	18.01
OP 48	53.371805	-0.636071	17.50	1.50	19.00
OP 49	53.370454	-0.635213	16.37	1.50	17.87
OP 50	53.370691	-0.632424	16.67	1.50	18.17
OP 51	53.370973	-0.629195	15.93	1.50	17.43
OP 52	53.371318	-0.626148	15.80	1.50	17.30
OP 53	53.371363	-0.622993	20.34	1.50	21.84
OP 54	53.371721	-0.620266	22.53	1.50	24.03
OP 55	53.372207	-0.618034	23.78	1.50	25.28
OP 56	53.373014	-0.616253	24.09	1.50	25.59
OP 57	53.373193	-0.613239	26.10	1.50	27.60
OP 58	53.373334	-0.610234	25.26	1.50	26.76
OP 59	53.373500	-0.607209	19.92	1.50	21.42
OP 60	53.373647	-0.604570	19.76	1.50	21.26
OP 61	53.374038	-0.601619	23.34	1.50	24.84
OP 62	53.374620	-0.598647	26.14	1.50	27.64
OP 63	53.375094	-0.596480	25.65	1.50	27.15
OP 64	53.375753	-0.593927	30.88	1.50	32.38

OP 65	53.376463	-0.590772	32.41	1.50	33.91
OP 66	53.376902	-0.587718	29.30	1.50	30.80
OP 67	53.377523	-0.585057	32.52	1.50	34.02
OP 68	53.376210	-0.597305	25.80	1.50	27.30
OP 69	53.378033	-0.598762	23.25	1.50	24.75
OP 70	53.380031	-0.600078	26.32	1.50	27.82
OP 71	53.381426	-0.600421	25.27	1.50	26.77
OP 72	53.382194	-0.597396	30.78	1.50	32.28
OP 73	53.383051	-0.594156	31.82	1.50	33.32
OP 74	53.383506	-0.591946	29.87	1.50	31.37
OP 75	53.383730	-0.588984	32.65	1.50	34.15
OP 76	53.384465	-0.586564	41.13	1.50	42.63
OP 77	53.384926	-0.583914	40.72	1.50	42.22
OP 78	53.383467	-0.582090	39.27	1.50	40.77
OP 79	53.385249	-0.581650	40.22	1.50	41.72
OP 80	53.386513	-0.578807	63.23	1.50	64.73

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	
PV array 1	SA tracking	SA tracking	0	0	-	
PV array 2	SA tracking	SA tracking	0	0	-	
PV array 3	SA tracking	SA tracking	0	0	-	
PV array 4	SA tracking	SA tracking	0	0	-	

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0
OP: OP 44	0	0
OP: OP 45	0	0
OP: OP 46	0	0
OP: OP 47	0	0
OP: OP 48	0	0
OP: OP 49	0	0
OP: OP 50	0	0
OP: OP 51	0	0
OP: OP 52	0	0
OP: OP 53	0	0

OP: OP 54	0	0
OP: OP 55	0	0
OP: OP 56	0	0
OP: OP 57	0	0
OP: OP 58	0	0
OP: OP 59	0	0
OP: OP 60	0	0
OP: OP 61	0	0
OP: OP 62	0	0
OP: OP 63	0	0
OP: OP 64	0	0
OP: OP 65	0	0
OP: OP 66	0	0
OP: OP 67	0	0
OP: OP 68	0	0
OP: OP 69	0	0
OP: OP 70	0	0
OP: OP 71	0	0
OP: OP 72	0	0
OP: OP 73	0	0
OP: OP 74	0	0
OP: OP 75	0	0
OP: OP 76	0	0
OP: OP 77	0	0
OP: OP 78	0	0
OP: OP 79	0	0
OP: OP 80	0	0

No glare found

PV array 2 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0
OP: OP 44	0	0
OP: OP 45	0	0
OP: OP 46	0	0
OP: OP 47	0	0
OP: OP 48	0	0
OP: OP 49	0	0
OP: OP 50	0	0
OP: OP 51	0	0
OP: OP 52	0	0
OP: OP 53	0	0

OP: OP 54	0	0
OP: OP 55	0	0
OP: OP 56	0	0
OP: OP 57	0	0
OP: OP 58	0	0
OP: OP 59	0	0
OP: OP 60	0	0
OP: OP 61	0	0
OP: OP 62	0	0
OP: OP 63	0	0
OP: OP 64	0	0
OP: OP 65	0	0
OP: OP 66	0	0
OP: OP 67	0	0
OP: OP 68	0	0
OP: OP 69	0	0
OP: OP 70	0	0
OP: OP 71	0	0
OP: OP 72	0	0
OP: OP 73	0	0
OP: OP 74	0	0
OP: OP 75	0	0
OP: OP 76	0	0
OP: OP 77	0	0
OP: OP 78	0	0
OP: OP 79	0	0
OP: OP 80	0	0

No glare found

PV array 3 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0
OP: OP 44	0	0
OP: OP 45	0	0
OP: OP 46	0	0
OP: OP 47	0	0
OP: OP 48	0	0
OP: OP 49	0	0
OP: OP 50	0	0
OP: OP 51	0	0
OP: OP 52	0	0
OP: OP 53	0	0

OP: OP 54	0	0
OP: OP 55	0	0
OP: OP 56	0	0
OP: OP 57	0	0
OP: OP 58	0	0
OP: OP 59	0	0
OP: OP 60	0	0
OP: OP 61	0	0
OP: OP 62	0	0
OP: OP 63	0	0
OP: OP 64	0	0
OP: OP 65	0	0
OP: OP 66	0	0
OP: OP 67	0	0
OP: OP 68	0	0
OP: OP 69	0	0
OP: OP 70	0	0
OP: OP 71	0	0
OP: OP 72	0	0
OP: OP 73	0	0
OP: OP 74	0	0
OP: OP 75	0	0
OP: OP 76	0	0
OP: OP 77	0	0
OP: OP 78	0	0
OP: OP 79	0	0
OP: OP 80	0	0

No glare found

PV array 4 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
OP: OP 29	0	0
OP: OP 30	0	0
OP: OP 31	0	0
OP: OP 32	0	0
OP: OP 33	0	0
OP: OP 34	0	0
OP: OP 35	0	0
OP: OP 36	0	0
OP: OP 37	0	0
OP: OP 38	0	0
OP: OP 39	0	0
OP: OP 40	0	0
OP: OP 41	0	0
OP: OP 42	0	0
OP: OP 43	0	0
OP: OP 44	0	0
OP: OP 45	0	0
OP: OP 46	0	0
OP: OP 47	0	0
OP: OP 48	0	0
OP: OP 49	0	0
OP: OP 50	0	0
OP: OP 51	0	0
OP: OP 52	0	0
OP: OP 53	0	0

OP: OP 54	0	0
OP: OP 55	0	0
OP: OP 56	0	0
OP: OP 57	0	0
OP: OP 58	0	0
OP: OP 59	0	0
OP: OP 60	0	0
OP: OP 61	0	0
OP: OP 62	0	0
OP: OP 63	0	0
OP: OP 64	0	0
OP: OP 65	0	0
OP: OP 66	0	0
OP: OP 67	0	0
OP: OP 68	0	0
OP: OP 69	0	0
OP: OP 70	0	0
OP: OP 71	0	0
OP: OP 72	0	0
OP: OP 73	0	0
OP: OP 74	0	0
OP: OP 75	0	0
OP: OP 76	0	0
OP: OP 77	0	0
OP: OP 78	0	0
OP: OP 79	0	0
OP: OP 80	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. Actual 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 fo 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 combined 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.

APPENDIX F: BRIDLEWAY RECEPTOR GLARE RESULTS

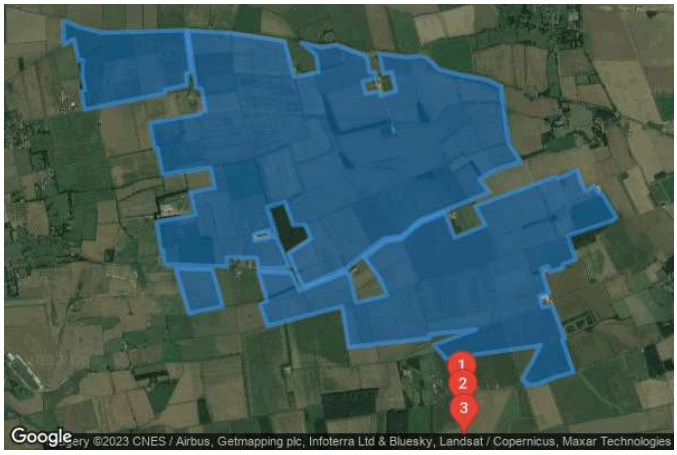
ForgeSolar

Tillbridge Solar Farm

Tillbridge Solar Farm Bridleway

Created Jan. 17, 2023
Updated Jan. 17, 2023
Time-step 1 minute
Timezone offset UTC0
Site ID 82537.14152

Project type Advanced
Project status: active
Category 100 MW to 1 GW



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
PV array 1	SA tracking	SA tracking	0	0	-
PV array 2	SA tracking	SA tracking	0	0	-
PV array 3	SA tracking	SA tracking	0	0	-
PV array 4	SA tracking	SA tracking	0	0	-

Component Data

PV Array(s)

Total PV footprint area: 10,587,087 m^2

Name: PV array 1
Footprint area: 782,414 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.407216	-0.676060	21.00	3.50	24.50
2	53.405042	-0.675995	20.27	3.50	23.77
3	53.405566	-0.674429	20.50	3.50	24.00
4	53.403545	-0.673678	21.88	3.50	25.38
5	53.403647	-0.673098	22.00	3.50	25.50
6	53.401959	-0.673141	22.76	3.50	26.26
7	53.400871	-0.672734	22.00	3.50	25.50
8	53.400769	-0.673292	22.28	3.50	25.78
9	53.399080	-0.672777	22.77	3.50	26.27
10	53.400564	-0.660460	27.07	3.50	30.57
11	53.400897	-0.660481	27.17	3.50	30.67
12	53.401344	-0.656984	27.78	3.50	31.28
13	53.402381	-0.657134	26.26	3.50	29.76
14	53.402470	-0.656426	26.79	3.50	30.29
15	53.406372	-0.657263	24.85	3.50	28.35
16	53.406140	-0.669228	19.61	3.50	23.11
17	53.406153	-0.670301	19.69	3.50	23.19
18	53.406665	-0.673735	20.02	3.50	23.52
19	53.407036	-0.675022	20.66	3.50	24.16

Name: PV array 2
Footprint area: 6,243,906 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.406344	-0.656924	24.80	3.50	28.30
2	53.401070	-0.655649	28.17	3.50	31.67
3	53.400993	-0.654833	27.75	3.50	31.25
4	53.398959	-0.654190	27.90	3.50	31.40
5	53.398869	-0.655155	28.05	3.50	31.55
6	53.398652	-0.655026	27.57	3.50	31.07
7	53.397833	-0.662793	23.46	3.50	26.96
8	53.395528	-0.662017	23.42	3.50	26.92
9	53.395554	-0.661631	23.71	3.50	27.21
10	53.393087	-0.660757	21.28	3.50	24.78
11	53.393753	-0.653504	24.43	3.50	27.93
12	53.391910	-0.652775	22.92	3.50	26.42
13	53.391501	-0.656594	21.50	3.50	25.00
14	53.389428	-0.655757	22.65	3.50	26.15
15	53.388775	-0.661722	21.33	3.50	24.83
16	53.386139	-0.661057	17.30	3.50	20.80
17	53.386139	-0.660757	17.10	3.50	20.60
18	53.384872	-0.660499	19.29	3.50	22.79
19	53.384654	-0.650800	23.99	3.50	27.49
20	53.385473	-0.650908	23.39	3.50	26.89
21	53.385473	-0.646316	25.39	3.50	28.89
22	53.384526	-0.646123	24.46	3.50	27.96
23	53.384462	-0.641681	23.22	3.50	26.72
24	53.384680	-0.641724	23.27	3.50	26.77
25	53.384654	-0.641252	23.42	3.50	26.92
26	53.387444	-0.643376	29.26	3.50	32.76
27	53.387034	-0.646702	26.28	3.50	29.78
28	53.387649	-0.646766	27.16	3.50	30.66
29	53.387969	-0.644299	28.26	3.50	31.76
30	53.387521	-0.644149	28.07	3.50	31.57
31	53.387585	-0.643290	32.90	3.50	36.40
32	53.390106	-0.644706	28.21	3.50	31.71
33	53.390592	-0.641981	27.06	3.50	30.56
34	53.388442	-0.640737	32.13	3.50	35.63
35	53.388519	-0.638934	29.46	3.50	32.96
36	53.387214	-0.638033	28.35	3.50	31.85
37	53.385844	-0.641488	26.53	3.50	30.03
38	53.383003	-0.639385	22.83	3.50	26.33
39	53.382952	-0.638548	23.74	3.50	27.24
40	53.384475	-0.632583	26.08	3.50	29.58
41	53.387214	-0.626897	25.61	3.50	29.11
42	53.387444	-0.624113	25.66	3.50	29.16
43	53.388864	-0.621410	25.53	3.50	29.03
44	53.391437	-0.610659	26.43	3.50	29.93
45	53.392703	-0.612097	26.30	3.50	29.80
46	53.393593	-0.609468	27.96	3.50	31.46
47	53.394284	-0.605670	29.95	3.50	33.45
48	53.395960	-0.607601	28.37	3.50	31.87
49	53.401219	-0.608802	27.57	3.50	31.07
50	53.401833	-0.610970	25.55	3.50	29.05
51	53.402223	-0.614682	24.61	3.50	28.11
52	53.402767	-0.618394	22.71	3.50	26.21
53	53.403790	-0.620111	22.12	3.50	25.62
54	53.404020	-0.621076	22.07	3.50	25.57
55	53.403867	-0.623158	22.03	3.50	25.53
56	53.404212	-0.627514	20.65	3.50	24.15
57	53.402396	-0.626848	23.25	3.50	26.75
58	53.402523	-0.625561	23.72	3.50	27.22
59	53.400758	-0.624917	25.49	3.50	28.99
60	53.400323	-0.627277	25.12	3.50	28.62
61	53.400758	-0.627599	24.79	3.50	28.29
62	53.400515	-0.629616	24.16	3.50	27.66
63	53.401666	-0.630088	23.57	3.50	27.07
64	53.401961	-0.628028	24.34	3.50	27.84

65	53.402523	-0.628222	22.24	3.50	25.74
66	53.402460	-0.628994	22.11	3.50	25.61
67	53.403918	-0.629380	20.37	3.50	23.87
68	53.405008	-0.634115	19.11	3.50	22.61
69	53.404778	-0.636304	18.91	3.50	22.41
70	53.405213	-0.639436	20.01	3.50	23.51
71	53.404087	-0.637248	18.52	3.50	22.02
72	53.402501	-0.636819	19.41	3.50	22.91
73	53.402066	-0.640595	22.92	3.50	26.42
74	53.405341	-0.642054	19.02	3.50	22.52
75	53.406108	-0.650466	19.99	3.50	23.49

Name: PV array 3
Footprint area: 155,264 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384474	-0.658826	18.53	3.50	22.03
2	53.380314	-0.656701	15.17	3.50	18.67
3	53.380468	-0.655886	15.47	3.50	18.97
4	53.380993	-0.651551	15.76	3.50	19.26
5	53.384410	-0.653139	21.02	3.50	24.52

Name: PV array 4
Footprint area: 3,405,503 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384205	-0.646118	24.01	3.50	27.51
2	53.381543	-0.644787	19.33	3.50	22.83
3	53.381185	-0.645839	18.48	3.50	21.98
4	53.379201	-0.644659	21.84	3.50	25.34
5	53.381006	-0.633200	21.41	3.50	24.91
6	53.377255	-0.632235	17.94	3.50	21.44
7	53.378087	-0.619682	17.12	3.50	20.62
8	53.378420	-0.619832	17.42	3.50	20.92
9	53.378894	-0.612601	19.79	3.50	23.29
10	53.377460	-0.619167	17.18	3.50	20.68
11	53.376193	-0.617214	19.36	3.50	22.86
12	53.377422	-0.602752	21.27	3.50	24.77
13	53.376052	-0.603825	20.55	3.50	24.05
14	53.374401	-0.605477	19.49	3.50	22.99
15	53.374093	-0.605348	18.76	3.50	22.26
16	53.374093	-0.604962	18.93	3.50	22.43
17	53.373760	-0.604898	19.50	3.50	23.00
18	53.373837	-0.603374	21.52	3.50	25.02
19	53.374477	-0.600520	24.41	3.50	27.91
20	53.374977	-0.597645	24.53	3.50	28.03
21	53.377921	-0.599340	22.67	3.50	26.17
22	53.378049	-0.598975	23.38	3.50	26.88
23	53.381133	-0.600949	24.71	3.50	28.21
24	53.380929	-0.602387	24.99	3.50	28.49
25	53.381940	-0.602859	25.05	3.50	28.55
26	53.382183	-0.601421	25.34	3.50	28.84
27	53.384077	-0.602366	29.83	3.50	33.33
28	53.384448	-0.602580	29.74	3.50	33.24
29	53.384653	-0.601529	29.74	3.50	33.24
30	53.384154	-0.601293	29.42	3.50	32.92
31	53.384589	-0.599061	28.22	3.50	31.72
32	53.384845	-0.599319	28.50	3.50	32.00
33	53.385293	-0.597323	29.07	3.50	32.57
34	53.387494	-0.598460	32.57	3.50	36.07
35	53.388825	-0.591798	37.24	3.50	40.74
36	53.389196	-0.591069	39.02	3.50	42.52
37	53.391410	-0.593279	43.19	3.50	46.69
38	53.391308	-0.593622	44.25	3.50	47.75
39	53.392063	-0.594438	43.60	3.50	47.10
40	53.391589	-0.595789	42.13	3.50	45.63
41	53.392562	-0.596605	41.34	3.50	44.84
42	53.393560	-0.597141	40.83	3.50	44.33
43	53.392766	-0.599931	35.79	3.50	39.29
44	53.392920	-0.600424	35.55	3.50	39.05
45	53.390207	-0.612776	26.15	3.50	29.65
46	53.388459	-0.611221	28.09	3.50	31.59
47	53.387307	-0.615877	25.87	3.50	29.37
48	53.389585	-0.617400	25.89	3.50	29.39
49	53.388753	-0.620812	25.49	3.50	28.99
50	53.388280	-0.622014	25.02	3.50	28.52
51	53.387205	-0.623988	25.66	3.50	29.16
52	53.386962	-0.626541	25.48	3.50	28.98
53	53.385465	-0.629824	26.17	3.50	29.67
54	53.383711	-0.627571	22.96	3.50	26.46
55	53.382047	-0.626305	25.12	3.50	28.62
56	53.381356	-0.631069	20.17	3.50	23.67
57	53.383724	-0.631949	25.14	3.50	28.64
58	53.384159	-0.632550	25.74	3.50	29.24
59	53.382470	-0.639759	22.77	3.50	26.27
60	53.384082	-0.641068	21.52	3.50	25.02

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	m	m	m
OP 1	53.373057	-0.614739	24.74	2.50	27.24
OP 2	53.371399	-0.614589	24.48	2.50	26.98
OP 3	53.369233	-0.614372	23.63	2.50	26.13

Summary of PV Glare Analysis

PV configuration and total predicted glare

PV Name	Tilt deg	Orientation deg	"Green" Glare min	"Yellow" Glare min	Energy Produced kWh	Data File
PV array 1	SA tracking	SA tracking	0	0	-	
PV array 2	SA tracking	SA tracking	0	0	-	
PV array 3	SA tracking	SA tracking	0	0	-	
PV array 4	SA tracking	SA tracking	0	0	-	

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 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

No glare found

PV array 2 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

No glare found

PV array 3 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

No glare found

PV array 4 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

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. Actual 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 fo 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 combined 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.

APPENDIX G: AVIATION RECEPTOR GLARE RESULTS

ForgeSolar

Tillbridge Solar Farm

Tillbridge Solar Farm Aviation

Created Nov. 23, 2022
Updated Nov. 24, 2022
Time-step 1 minute
Timezone offset UTC0
Site ID 79946.14152

Project type Advanced
Project status: active
Category 100 MW to 1 GW

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**

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

Summary of Results Glare with low potential for temporary after-image predicted

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV array 1	SA tracking	SA tracking	0	0	-
PV array 2	SA tracking	SA tracking	1,021	0	-
PV array 3	SA tracking	SA tracking	26,924	0	-
PV array 4	SA tracking	SA tracking	27,057	0	-

Component Data

PV Array(s)

Total PV footprint area: 10,587,087 m^2

Name: PV array 1
Footprint area: 782,414 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.407216	-0.676060	21.00	3.50	24.50
2	53.405042	-0.675995	20.27	3.50	23.77
3	53.405566	-0.674429	20.50	3.50	24.00
4	53.403545	-0.673678	21.88	3.50	25.38
5	53.403647	-0.673098	22.00	3.50	25.50
6	53.401959	-0.673141	22.76	3.50	26.26
7	53.400871	-0.672734	22.00	3.50	25.50
8	53.400769	-0.673292	22.28	3.50	25.78
9	53.399080	-0.672777	22.77	3.50	26.27
10	53.400564	-0.660460	27.07	3.50	30.57
11	53.400897	-0.660481	27.17	3.50	30.67
12	53.401344	-0.656984	27.78	3.50	31.28
13	53.402381	-0.657134	26.26	3.50	29.76
14	53.402470	-0.656426	26.79	3.50	30.29
15	53.406372	-0.657263	24.85	3.50	28.35
16	53.406140	-0.669228	19.61	3.50	23.11
17	53.406153	-0.670301	19.69	3.50	23.19
18	53.406665	-0.673735	20.02	3.50	23.52
19	53.407036	-0.675022	20.66	3.50	24.16

Name: PV array 2
Footprint area: 6,243,906 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.406344	-0.656924	24.80	3.50	28.30
2	53.401070	-0.655649	28.17	3.50	31.67
3	53.400993	-0.654833	27.75	3.50	31.25
4	53.398959	-0.654190	27.90	3.50	31.40
5	53.398869	-0.655155	28.05	3.50	31.55
6	53.398652	-0.655026	27.57	3.50	31.07
7	53.397833	-0.662793	23.46	3.50	26.96
8	53.395528	-0.662017	23.42	3.50	26.92
9	53.395554	-0.661631	23.71	3.50	27.21
10	53.393087	-0.660757	21.28	3.50	24.78
11	53.393753	-0.653504	24.43	3.50	27.93
12	53.391910	-0.652775	22.92	3.50	26.42
13	53.391501	-0.656594	21.50	3.50	25.00
14	53.389428	-0.655757	22.65	3.50	26.15
15	53.388775	-0.661722	21.33	3.50	24.83
16	53.386139	-0.661057	17.30	3.50	20.80
17	53.386139	-0.660757	17.10	3.50	20.60
18	53.384872	-0.660499	19.29	3.50	22.79
19	53.384654	-0.650800	23.99	3.50	27.49
20	53.385473	-0.650908	23.39	3.50	26.89
21	53.385473	-0.646316	25.39	3.50	28.89
22	53.384526	-0.646123	24.46	3.50	27.96
23	53.384462	-0.641681	23.22	3.50	26.72
24	53.384680	-0.641724	23.27	3.50	26.77
25	53.384654	-0.641252	23.42	3.50	26.92
26	53.387444	-0.643376	29.26	3.50	32.76
27	53.387034	-0.646702	26.28	3.50	29.78
28	53.387649	-0.646766	27.16	3.50	30.66
29	53.387969	-0.644299	28.26	3.50	31.76
30	53.387521	-0.644149	28.07	3.50	31.57
31	53.387585	-0.643290	32.90	3.50	36.40
32	53.390106	-0.644706	28.21	3.50	31.71
33	53.390592	-0.641981	27.06	3.50	30.56
34	53.388442	-0.640737	32.13	3.50	35.63
35	53.388519	-0.638934	29.46	3.50	32.96
36	53.387214	-0.638033	28.35	3.50	31.85
37	53.385844	-0.641488	26.53	3.50	30.03
38	53.383003	-0.639385	22.83	3.50	26.33
39	53.382952	-0.638548	23.74	3.50	27.24
40	53.384475	-0.632583	26.08	3.50	29.58
41	53.387214	-0.626897	25.61	3.50	29.11
42	53.387444	-0.624113	25.66	3.50	29.16
43	53.388864	-0.621410	25.53	3.50	29.03
44	53.391437	-0.610659	26.43	3.50	29.93
45	53.392703	-0.612097	26.30	3.50	29.80
46	53.393593	-0.609468	27.96	3.50	31.46
47	53.394284	-0.605670	29.95	3.50	33.45
48	53.395960	-0.607601	28.37	3.50	31.87
49	53.401219	-0.608802	27.57	3.50	31.07
50	53.401833	-0.610970	25.55	3.50	29.05
51	53.402223	-0.614682	24.61	3.50	28.11
52	53.402767	-0.618394	22.71	3.50	26.21
53	53.403790	-0.620111	22.12	3.50	25.62
54	53.404020	-0.621076	22.07	3.50	25.57
55	53.403867	-0.623158	22.03	3.50	25.53
56	53.404212	-0.627514	20.65	3.50	24.15
57	53.402396	-0.626848	23.25	3.50	26.75
58	53.402523	-0.625561	23.72	3.50	27.22
59	53.400758	-0.624917	25.49	3.50	28.99
60	53.400323	-0.627277	25.12	3.50	28.62
61	53.400758	-0.627599	24.79	3.50	28.29
62	53.400515	-0.629616	24.16	3.50	27.66
63	53.401666	-0.630088	23.57	3.50	27.07
64	53.401961	-0.628028	24.34	3.50	27.84
65	53.402523	-0.628222	22.24	3.50	25.74
66	53.402460	-0.628994	22.11	3.50	25.61

67	53.403918	-0.629380	20.37	3.50	23.87
68	53.405008	-0.634115	19.11	3.50	22.61
69	53.404778	-0.636304	18.91	3.50	22.41
70	53.405213	-0.639436	20.01	3.50	23.51
71	53.404087	-0.637248	18.52	3.50	22.02
72	53.402501	-0.636819	19.41	3.50	22.91
73	53.402066	-0.640595	22.92	3.50	26.42
74	53.405341	-0.642054	19.02	3.50	22.52
75	53.406108	-0.650466	19.99	3.50	23.49

Name: PV array 3
Footprint area: 155,264 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384474	-0.658826	18.53	3.50	22.03
2	53.380314	-0.656701	15.17	3.50	18.67
3	53.380468	-0.655886	15.47	3.50	18.97
4	53.380993	-0.651551	15.76	3.50	19.26
5	53.384410	-0.653139	21.02	3.50	24.52

Name: PV array 4
Footprint area: 3,405,503 m^2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	53.384205	-0.646118	24.01	3.50	27.51
2	53.381543	-0.644787	19.33	3.50	22.83
3	53.381185	-0.645839	18.48	3.50	21.98
4	53.379201	-0.644659	21.84	3.50	25.34
5	53.381006	-0.633200	21.41	3.50	24.91
6	53.377255	-0.632235	17.94	3.50	21.44
7	53.378087	-0.619682	17.12	3.50	20.62
8	53.378420	-0.619832	17.42	3.50	20.92
9	53.378894	-0.612601	19.79	3.50	23.29
10	53.377460	-0.619167	17.18	3.50	20.68
11	53.376193	-0.617214	19.36	3.50	22.86
12	53.377422	-0.602752	21.27	3.50	24.77
13	53.376052	-0.603825	20.55	3.50	24.05
14	53.374401	-0.605477	19.49	3.50	22.99
15	53.374093	-0.605348	18.76	3.50	22.26
16	53.374093	-0.604962	18.93	3.50	22.43
17	53.373760	-0.604898	19.50	3.50	23.00
18	53.373837	-0.603374	21.52	3.50	25.02
19	53.374477	-0.600520	24.41	3.50	27.91
20	53.374977	-0.597645	24.53	3.50	28.03
21	53.377921	-0.599340	22.67	3.50	26.17
22	53.378049	-0.598975	23.38	3.50	26.88
23	53.381133	-0.600949	24.71	3.50	28.21
24	53.380929	-0.602387	24.99	3.50	28.49
25	53.381940	-0.602859	25.05	3.50	28.55
26	53.382183	-0.601421	25.34	3.50	28.84
27	53.384077	-0.602366	29.83	3.50	33.33
28	53.384448	-0.602580	29.74	3.50	33.24
29	53.384653	-0.601529	29.74	3.50	33.24
30	53.384154	-0.601293	29.42	3.50	32.92
31	53.384589	-0.599061	28.22	3.50	31.72
32	53.384845	-0.599319	28.50	3.50	32.00
33	53.385293	-0.597323	29.07	3.50	32.57
34	53.387494	-0.598460	32.57	3.50	36.07
35	53.388825	-0.591798	37.24	3.50	40.74
36	53.389196	-0.591069	39.02	3.50	42.52
37	53.391410	-0.593279	43.19	3.50	46.69
38	53.391308	-0.593622	44.25	3.50	47.75
39	53.392063	-0.594438	43.60	3.50	47.10
40	53.391589	-0.595789	42.13	3.50	45.63
41	53.392562	-0.596605	41.34	3.50	44.84
42	53.393560	-0.597141	40.83	3.50	44.33
43	53.392766	-0.599931	35.79	3.50	39.29
44	53.392920	-0.600424	35.55	3.50	39.05
45	53.390207	-0.612776	26.15	3.50	29.65
46	53.388459	-0.611221	28.09	3.50	31.59
47	53.387307	-0.615877	25.87	3.50	29.37
48	53.389585	-0.617400	25.89	3.50	29.39
49	53.388753	-0.620812	25.49	3.50	28.99
50	53.388280	-0.622014	25.02	3.50	28.52
51	53.387205	-0.623988	25.66	3.50	29.16
52	53.386962	-0.626541	25.48	3.50	28.98
53	53.385465	-0.629824	26.17	3.50	29.67
54	53.383711	-0.627571	22.96	3.50	26.46
55	53.382047	-0.626305	25.12	3.50	28.62
56	53.381356	-0.631069	20.17	3.50	23.67
57	53.383724	-0.631949	25.14	3.50	28.64
58	53.384159	-0.632550	25.74	3.50	29.24
59	53.382470	-0.639759	22.77	3.50	26.27
60	53.384082	-0.641068	21.52	3.50	25.02

2-Mile Flight Path Receptor(s)

Name: RAF Scampton - Runway 04
Description:
Threshold height : 15 m
Direction: 41.1 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	53.298827	-0.564122	59.92	15.24	75.16
2-mile point	53.277040	-0.595961	6.85	236.99	243.85

Name: RAF Scampton - Runway 04
Description:
Threshold height : 15 m
Direction: 221.1 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	53.317080	-0.537487	50.54	15.24	65.78
2-mile point	53.338868	-0.505634	25.83	208.63	234.46

Name: Sturgate - Runway 09
Description:
Threshold height : 15 m
Direction: 86.4 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	53.381014	-0.690081	17.00	15.24	32.24
2-mile point	53.379208	-0.738514	25.56	175.36	200.92

Name: Sturgate - Runway 27
Description:
Threshold height : 15 m
Direction: 267.3 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	53.381422	-0.679633	17.67	15.24	32.91
2-mile point	53.382774	-0.631158	22.20	179.40	201.60

Name: Wickenby -Runway 03
Description:
Threshold height : 15 m
Direction: 25.3 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	53.314875	-0.350430	26.58	15.24	41.82
2-mile point	53.288736	-0.371137	12.17	198.33	210.50

Name: Wickenby -Runway 15
Description:
Threshold height : 15 m
Direction: 150.2 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	53.319113	-0.352010	23.42	15.24	38.66
2-mile point	53.344202	-0.376092	21.66	185.69	207.34

Name: Wickenby -Runway 21
Description:
Threshold height : 15 m
Direction: 205.3 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	53.318995	-0.347152	24.82	15.24	40.06
2-mile point	53.345135	-0.326443	31.80	176.94	208.75

Name: Wickenby -Runway 33
Description:
Threshold height : 15 m
Direction: 330.2 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	53.315414	-0.348461	25.81	15.24	41.05
2-mile point	53.290317	-0.324403	24.35	185.38	209.73

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	m	m	m
1-ATCT	53.306013	-0.548275	59.12	10.00	69.12
2-ATCT	53.316185	-0.346718	26.69	5.00	31.69

1-ATCT map image

2-ATCT map image

Summary of PV Glare Analysis

PV configuration and total predicted glare

PV Name	Tilt deg	Orientation deg	"Green" Glare min	"Yellow" Glare min	Energy Produced kWh	Data File
PV array 1	SA tracking	SA tracking	0	0	-	
PV array 2	SA tracking	SA tracking	1,021	0	-	-
PV array 3	SA tracking	SA tracking	26,924	0	-	-
PV array 4	SA tracking	SA tracking	27,057	0	-	-

Distinct glare per month

Excludes overlapping glare from PV array for multiple receptors at matching time(s)

PV	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pv-array-2 (green)	0	0	0	0	30	743	248	0	0	0	0	0
pv-array-2 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-3 (green)	49	1814	3592	3390	2744	2714	2743	3048	3792	2682	356	0
pv-array-3 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-4 (green)	49	1880	3592	3390	2744	2714	2743	3048	3792	2749	356	0
pv-array-4 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 no glare found

Component	Green glare (min)	Yellow glare (min)
FP: RAF Scampton - Runway 04	0	0
FP: RAF Scampton - Runway 04	0	0
FP: Sturgate - Runway 09	0	0
FP: Sturgate - Runway 27	0	0
FP: Wickenby -Runway 03	0	0
FP: Wickenby -Runway 15	0	0
FP: Wickenby -Runway 21	0	0
FP: Wickenby -Runway 33	0	0
OP: 1-ATCT	0	0
OP: 2-ATCT	0	0

No glare found

PV array 2 low potential for temporary after-image

Component	Green glare (min)	Yellow glare (min)
FP: RAF Scampton - Runway 04	0	0
FP: RAF Scampton - Runway 04	0	0
FP: Sturgate - Runway 09	0	0

FP: Sturgate - Runway 27	1021	0
FP: Wickenby -Runway 03	0	0
FP: Wickenby -Runway 15	0	0
FP: Wickenby -Runway 21	0	0
FP: Wickenby -Runway 33	0	0
OP: 1-ATCT	0	0
OP: 2-ATCT	0	0

PV array 2 - Receptor (RAF Scampton - Runway 04)

No glare found

PV array 2 - Receptor (RAF Scampton - Runway 04)

No glare found

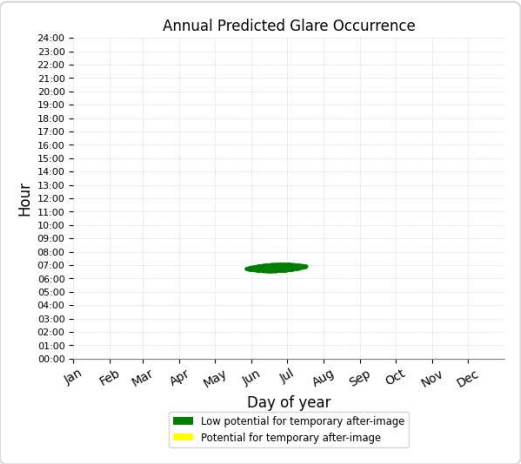
PV array 2 - Receptor (Sturgate - Runway 09)

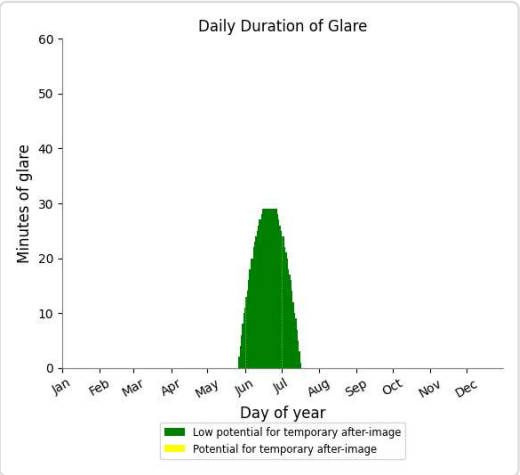
No glare found

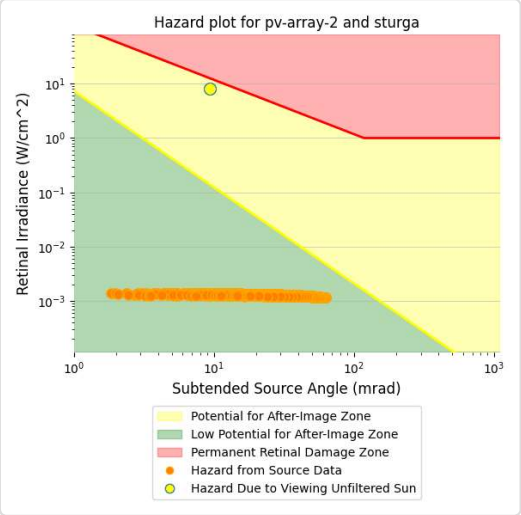
PV array 2 - Receptor (Sturgate - Runway 27)

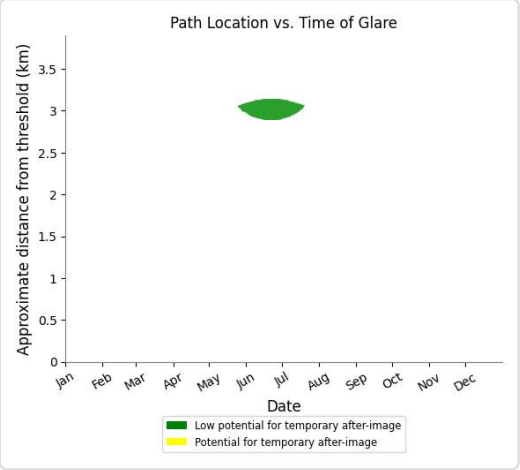
PV array is expected to produce the following glare for observers on this flight path:

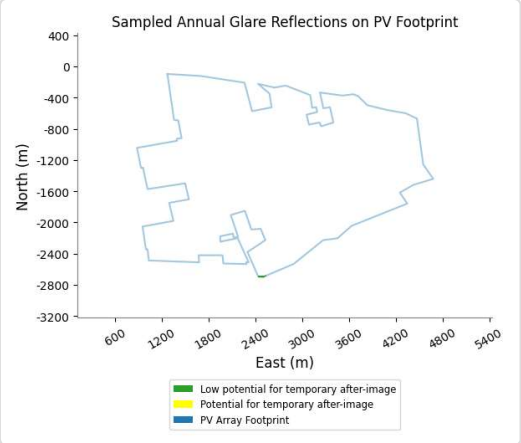
- 1,021 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.

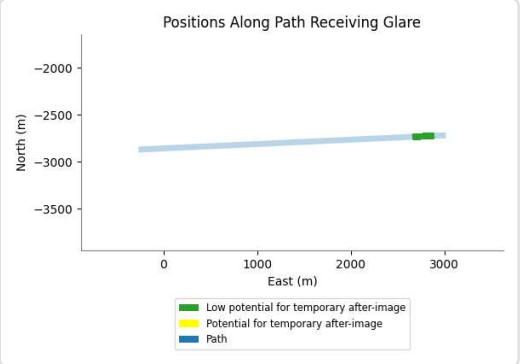












PV array 2 - Receptor (Wickenby -Runway 03)

No glare found

PV array 2 - Receptor (Wickenby -Runway 15)

No glare found

PV array 2 - Receptor (Wickenby -Runway 21)

No glare found

PV array 2 - Receptor (Wickenby -Runway 33)

No glare found

PV array 2 - OP Receptor (1-ATCT)

No glare found

PV array 2 - OP Receptor (2-ATCT)

No glare found

PV array 3 low potential for temporary after-image

Component	Green glare (min)	Yellow glare (min)
FP: RAF Scampton - Runway 04	0	0
FP: RAF Scampton - Runway 04	0	0
FP: Sturgate - Runway 09	0	0
FP: Sturgate - Runway 27	26924	0
FP: Wickenby -Runway 03	0	0
FP: Wickenby -Runway 15	0	0
FP: Wickenby -Runway 21	0	0
FP: Wickenby -Runway 33	0	0
OP: 1-ATCT	0	0
OP: 2-ATCT	0	0

PV array 3 - Receptor (RAF Scampton - Runway 04)

No glare found

PV array 3 - Receptor (RAF Scampton - Runway 04)

No glare found

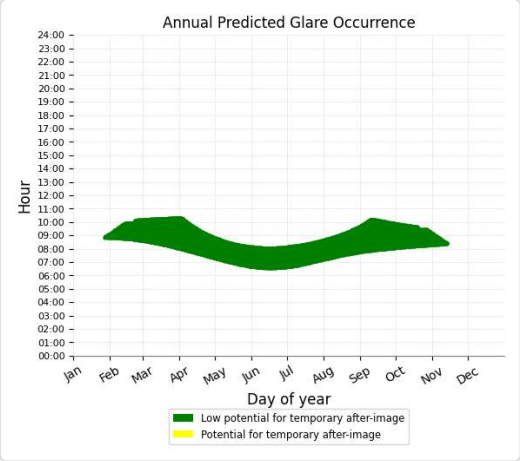
PV array 3 - Receptor (Sturgate - Runway 09)

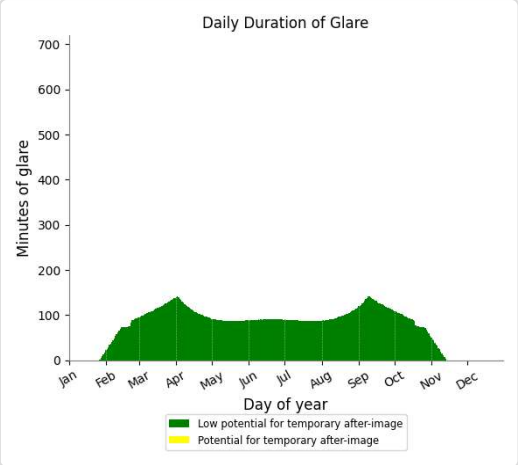
No glare found

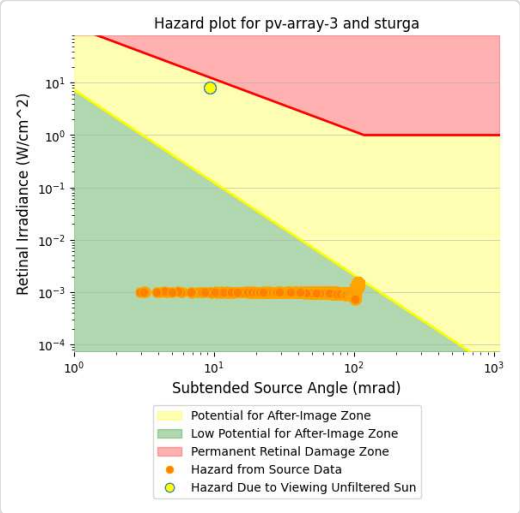
PV array 3 - Receptor (Sturgate - Runway 27)

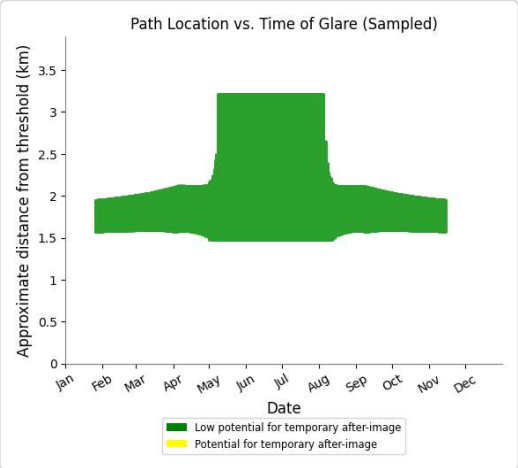
PV array is expected to produce the following glare for observers on this flight path:

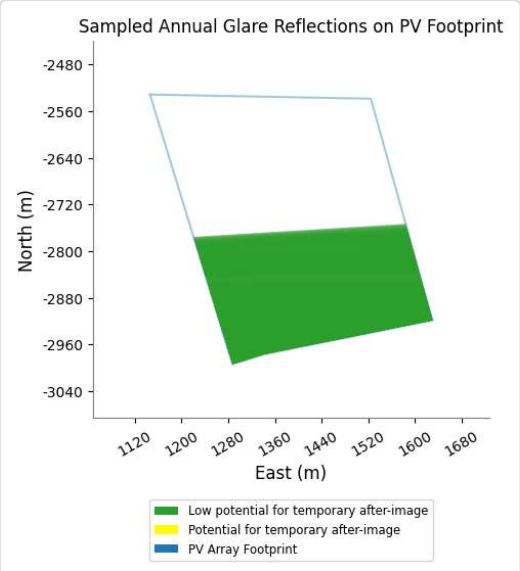
- 26,924 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.

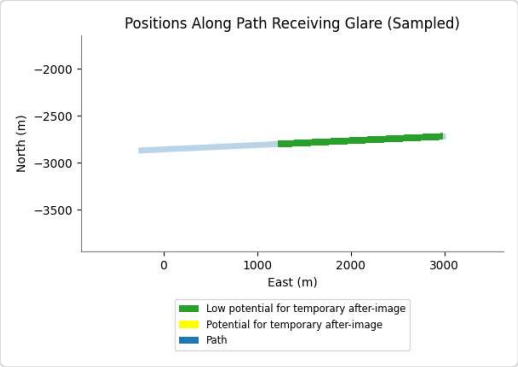












PV array 3 - Receptor (Wickenby -Runway 03)

No glare found

PV array 3 - Receptor (Wickenby -Runway 15)

No glare found

PV array 3 - Receptor (Wickenby -Runway 21)

No glare found

PV array 3 - Receptor (Wickenby -Runway 33)

No glare found

PV array 3 - OP Receptor (1-ATCT)

No glare found

PV array 3 - OP Receptor (2-ATCT)

No glare found

PV array 4 low potential for temporary after-image

Component	Green glare (min)	Yellow glare (min)
FP: RAF Scampton - Runway 04	0	0
FP: RAF Scampton - Runway 04	0	0
FP: Sturgate - Runway 09	0	0
FP: Sturgate - Runway 27	27057	0
FP: Wickenby -Runway 03	0	0
FP: Wickenby -Runway 15	0	0
FP: Wickenby -Runway 21	0	0
FP: Wickenby -Runway 33	0	0
OP: 1-ATCT	0	0
OP: 2-ATCT	0	0

PV array 4 - Receptor (RAF Scampton - Runway 04)

No glare found

PV array 4 - Receptor (RAF Scampton - Runway 04)

No glare found

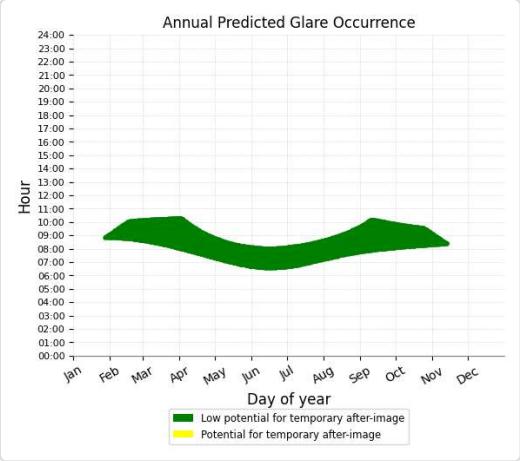
PV array 4 - Receptor (Sturgate - Runway 09)

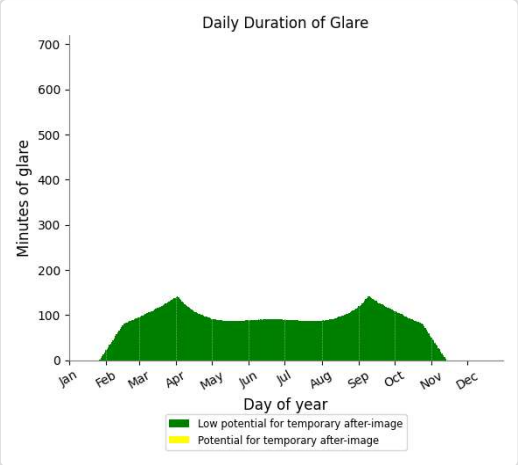
No glare found

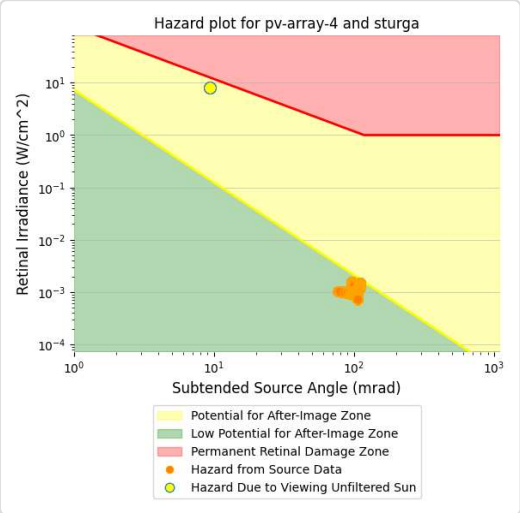
PV array 4 - Receptor (Sturgate - Runway 27)

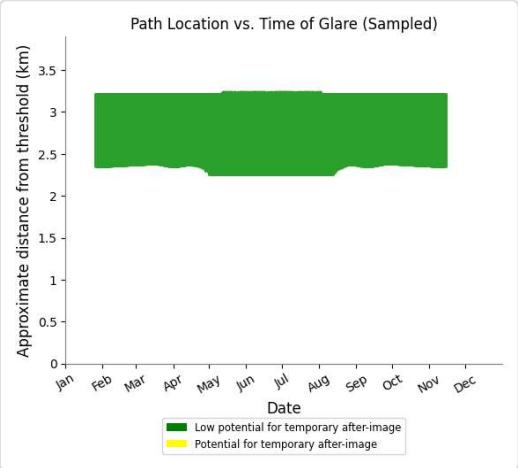
PV array is expected to produce the following glare for observers on this flight path:

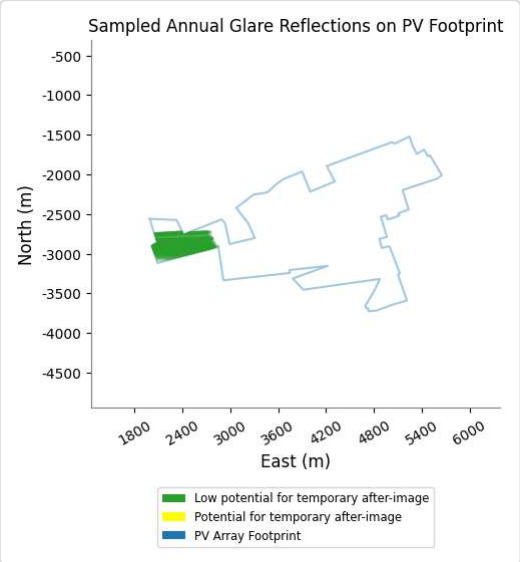
- 27,057 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.

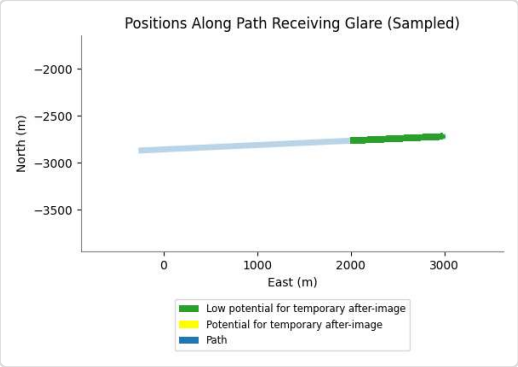












PV array 4 - Receptor (Wickenby -Runway 03)

No glare found

PV array 4 - Receptor (Wickenby -Runway 15)

No glare found

PV array 4 - Receptor (Wickenby -Runway 21)

No glare found

PV array 4 - Receptor (Wickenby -Runway 33)

No glare found

PV array 4 - OP Receptor (1-ATCT)

No glare found

PV array 4 - OP Receptor (2-ATCT)

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. Actual 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 fo 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 combined 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.

Appendix H: Visibility Assessment Evidence

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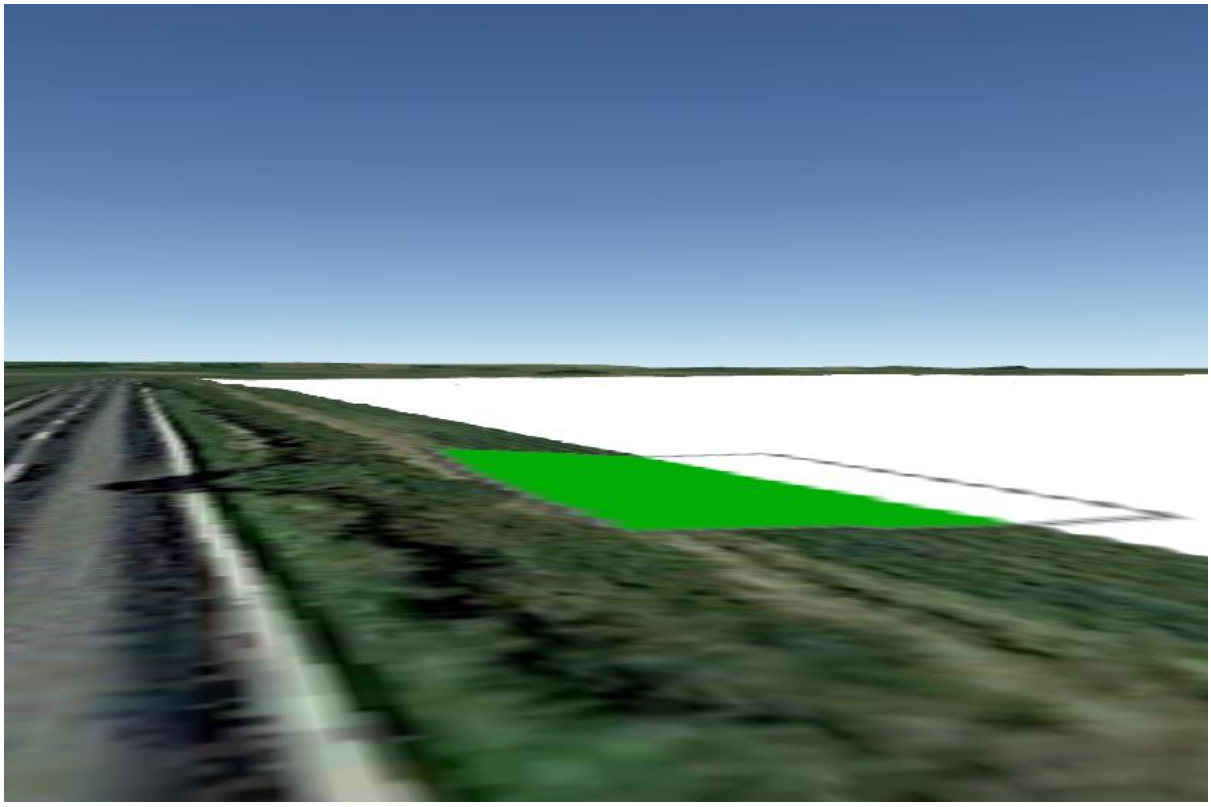
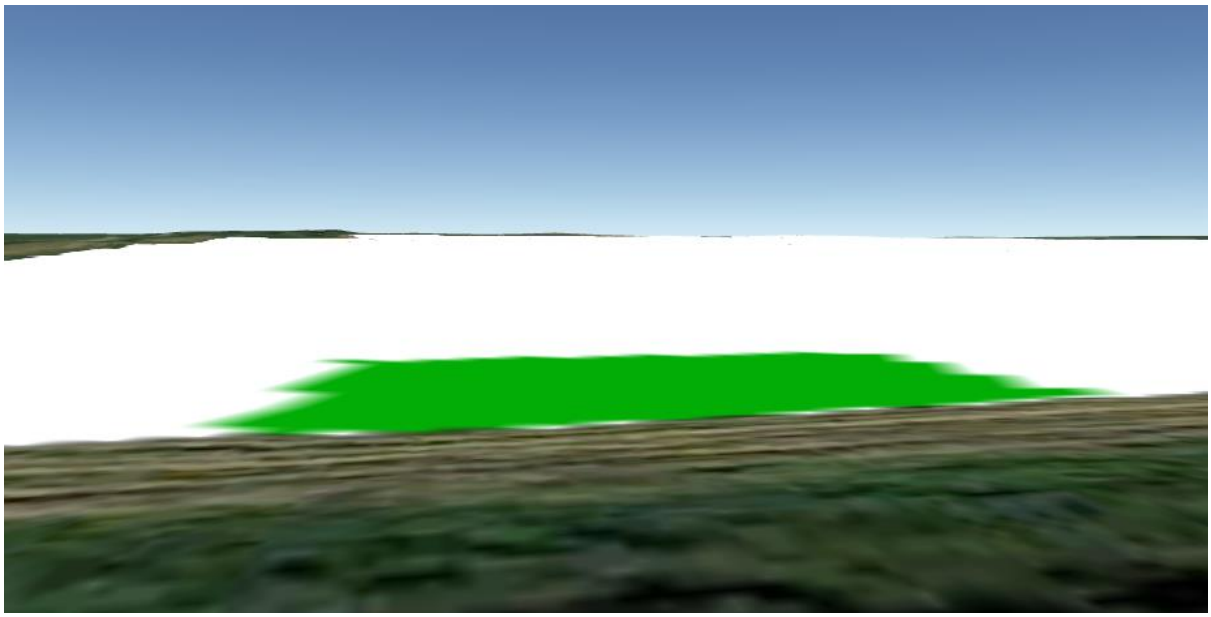
Road Receptors

Receptor 10



Receptor 11



Appendix I

Solar Module Glare and Reflectance Technical Memo

SUNPOWER®

Technical Notification

TITLE: SunPower Solar Module Glare and Reflectance
AUTHORS: Technical Support
APPLICATION: Residential/ Commercial
SCOPE: SunPower Modules

SUMMARY:

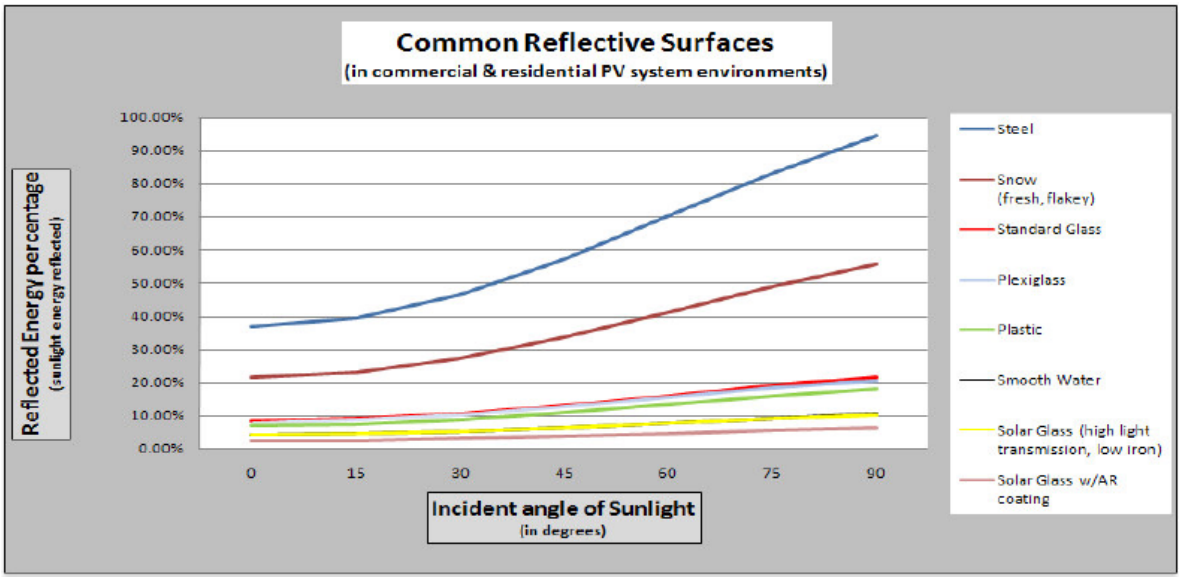
The objective of this document is to increase awareness concerning the possible glare and reflectance impact of PV Systems on their surrounding environment.

The glare and reflectance levels from a given PV system are decisively lower than the glare and reflectance generated by the standard glass and other common reflective surfaces in the environments surrounding the given PV system. Concerning random glare and reflectance observed from the air: SunPower has several large projects installed near airports or on air force bases. Each of these large projects has passed FAA or Air Force standards and all projects have been determined as "No Hazard to Air Navigation". Although the possible glare and reflectance from PV systems are at safe levels and are usually decisively lower than other standard residential and commercial reflective surfaces, SunPower suggests that customers and installers discuss any possible concerns with the neighbors/cohabitants near the planned PV system installation.

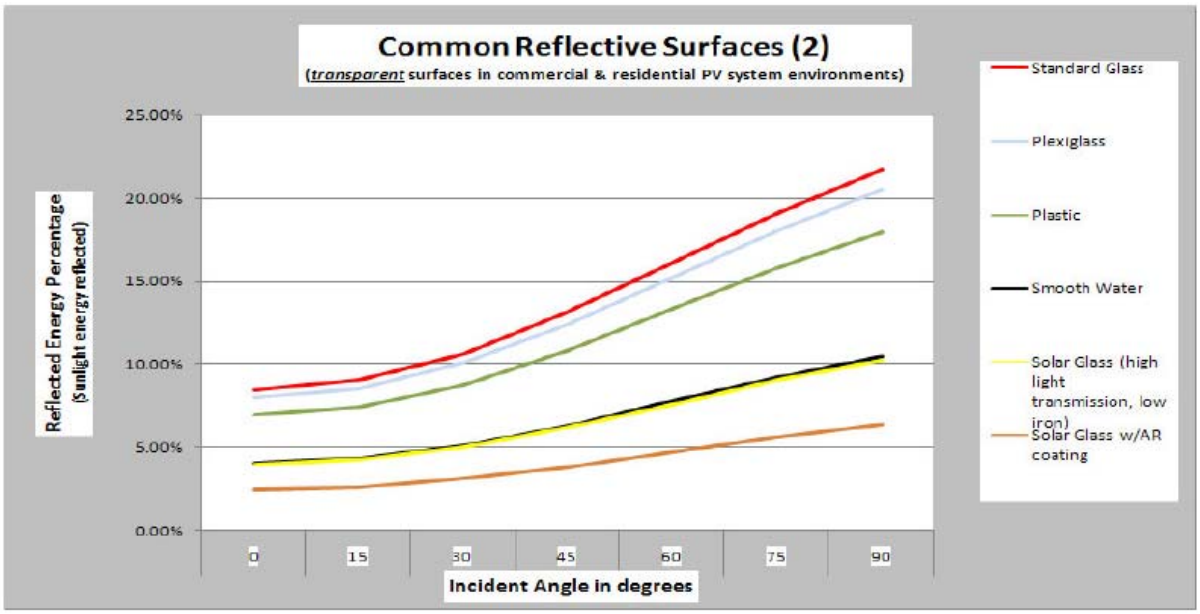
DETAILED EXPLANATION:

In general, since the whole concept of efficient solar power is to absorb as much light as possible while reflecting as little light as possible, standard solar module produces less glare and reflectance than standard window glass. This is pointed out very well in US Patent #6359212 which explains the differences in the refraction and reflection of solar module glass versus standard window glass. Solar modules use "high-transmission, low iron glass" which absorbs more light, producing small amounts of glare and reflectance than normal glass.

In the graph below, we show the reflected energy percentages of sunlight, of some common residential and commercial surfaces. The legend and the graph lists the items from top to bottom in order of the highest percentage of reflected energy.



It should be noted that the reflected energy percentage of Solar Glass is far below that of a standard glass and more on the level of smooth water. Also, below are the ratios of the common reflective surfaces:



Light beam physics resolves that the least amount of light is reflected when the beam is the normal, in other words, least light energy is reflected when the beam is at 0 degrees to the normal. The chart below is a result of light beam physics calculations:

Common Reflective Surfaces (in surrounding environments for PV systems)		Incident angle in degrees						
		0	15	30	45	60	75	90
Material Reflectivity (percent of incident light reflected)	Steel	36.73%	39.22%	46.34%	57.11%	70.02%	83.15%	94.40%
	Snow (fresh, flakey)	21.63%	23.09%	27.29%	33.63%	41.23%	48.96%	55.59%
	Standard Glass	8.44%	9.01%	10.65%	13.12%	16.09%	19.10%	21.69%
	Plexiglass	8.00%	8.54%	10.09%	12.44%	15.25%	18.11%	20.56%
	Plastic	6.99%	7.46%	8.82%	10.87%	13.33%	15.83%	17.97%
	Smooth Water	4.07%	4.35%	5.14%	6.33%	7.76%	9.22%	10.47%
	Solar Glass (high light transmission, low iron)	3.99%	4.26%	5.03%	6.20%	7.61%	9.03%	10.26%
	Solar Glass w/AR coating	2.47%	2.64%	3.12%	3.84%	4.71%	5.59%	6.35%

(Note: Index of refraction values may vary slightly depending on suppliers and reference documentation. The values for the above calculations are averages or single values obtained from the list of references for this document).

Important reference – "Stipples glass": In addition to the superior refractive/reflective properties of solar glass versus standard glass, SunPower uses stippled solar glass for our modules. Stippled glass is used with high powered telescopes and powerful beacons and lights. The basic concept behind stippling is for the surfaces of the glass to be textured with small types of indentations. As a result, stippling allows more light energy to be channeled/ transmitted through the glass while diffusing the reflected light energy. This concept is why the reflection of off a SunPower solar module will look hazy and less-defined than the reflection from standard glass, this occurs because the stippled SunPower glass is transmitting a larger percentage of light to the solar cell while breaking up the intensity of the reflected light energy.

SUMMARY / ACTION REQUIRED:

The studies, data and light beam physics behind the charts and graphs prove beyond a reasonable doubt that solar glass has less glare and reflectance than standard glass. The figures also make it clear that the difference is very decisive between solar glass and other common residential/commercial glasses. In addition, not to be lost in the standard light/glass equations and calculations, the SunPower solar glass is stippled and has a very photon-absorbent solar cell attached to the back side, contributing two additional factors which results in even less light energy being reflected.

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