

GLINT AND GLARE ASSESSMENT

Allington Lane Solar Farm

VERSION 3
July 2024

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1 INTRODUCTION

Metrica Environmental Consulting Ltd ('Metrica') has been commissioned by Locogen Consulting Ltd ('the Client') to undertake a Glint and Glare Impact Assessment in relation to the proposed Solar Farm ('the Development'), located on land off Allington Lane, Eastleigh ('the Site').

2 GLINT AND GLARE DEFINITION

'Glint' and 'Glare' are the effects caused by the reflection of sunlight from reflective surfaces such as glazing or solar photovoltaic (PV) panels. The United States' Federal Aviation Administration's (FAA) glint and glare guidance¹ defines these terms as follows:

- ◆ Glint: *"A momentary flash of bright light"*; and
- ◆ Glare: *"A continuous source of bright light"*.

It goes on to say that... *"solar PV employs glass panels that are designed to maximize absorption and minimize reflection to increase electricity production efficiency. To limit reflection, solar PV panels are constructed of dark, light-absorbing materials and covered with an anti-reflective coating. Today's panels reflect as little as 2% of the incoming sunlight."* The guidance states this level of reflection is slightly more than black asphalt, and similar to bodies of water.

Further details on FAA guidance is provided in Section 4.2.4 of this report.

3 DEVELOPMENT OVERVIEW

The Development is located to the northeast of Southampton, and south of the village of Allington. The Site is located approximately 2.5 km east of Southampton Airport, and is bisected by the Eastleigh to Fareham rail line.

The immediate area is sparsely populated, with a low number of residential dwellings distributed relatively evenly around the Site boundary.

The Development consists of four of fixed-tilt PV panel arrays, all with a tilt angle of 20 degrees and an azimuth of 180 degrees. The majority of panels are to be constructed with a height of 3.2 m above ground level (AGL), with a small section of Array 2 being 3.6 m AGL. A layout drawing is provided in Appendix 1 for reference.

4 GUIDANCE

4.1 PLANNING GUIDANCE

The following guidance and standards are pertinent to this assessment:

- ◆ The National Planning Policy Framework (NPPF)²; and
- ◆ National Policy Statement for Renewable Energy Infrastructure (EN-3)³

¹ Federal Aviation Administration (2021) Review of Solar Energy System Projects on Federally-Obligated Airports.

² UK Government (2012). National Planning Policy Framework (last updated 5th September 2023).

³ UK Government (2023). National Policy Statement for Renewable Energy Infrastructure.

4.1.1 The National Planning Policy Framework

The NPPF sets out the Government's planning policies for England, providing a framework within which local policies can be developed. The key principle of the NPPF is a presumption in favour of sustainable development, although no specific references to solar PV development or glint and glare effects are made.

4.1.2 National Policy Statement for Renewable Energy Infrastructure

EN-3 notes that solar PV panels are specifically designed to absorb, rather than reflect light, however, they may nevertheless reflect the sun's rays at certain times / angles, potentially causing glint and glare effects.

EN-3 recommends a two-stage approach to determining the potential for glint and glare impacts. As a first stage, receptors should be mapped qualitatively to identify any potential glint and glare issues and determine whether a detailed glint and glare assessment is necessary as part of the application.

When a quantitative glint and glare assessment is found to be necessary, the geometric possibility of glint and glare affecting nearby receptors should be investigated through modelling, and an assessment of potential impact provided, based on the angle and duration of incidence and the intensity of the reflection. Notwithstanding the above, EN-3 does not provide specific assessment criteria, or give guidance on what is considered to be an acceptable level of impact.

5 TECHNICAL GUIDANCE

UK planning guidance does not provide a specific methodology for assessing the impact of glint and glare. However, the following guidance is regularly applied to assessments in the UK and together is considered to provide a reasonable and robust approach:

- ◆ Measurement and Assessment of Light Immissions⁴;
- ◆ Rail Industry Standard (RIS) RIS-0737-CCS⁵
- ◆ Renewable Energy Developments: Solar Photovoltaic Developments⁶; and
- ◆ Review of Solar Energy System Projects on Federally-Obligated Airports⁷.

5.1.1 Measurement and Assessment of Light Immissions

The German Ministry for Environment, Health and Consumer Protection published the *Measurement and Assessment of Light Immissions* in 1993, which was most recently updated in 2014. Paragraph 8 of the most recent version of the guidelines is dedicated to the assessment of reflections from solar PV panels.

The guidelines state that... [translated from German] *"experience has shown that immission locations that are more than approximately 100 m away from a photovoltaic system only*

⁴ Ministry for the Environment, Health and Consumer Protection (2014). Light Guidelines (Leitlinie des Ministeriums für Umwelt, Gesundheit und Verbraucherschutz zur Messung und Beurteilung von Lichtimmissionen,

⁵ Rail Industry Standard (RIS) RIS-0737-CCS 'Signal Sighting Assessment Requirements'

⁶ CAA (2023). Solar photovoltaic Developments CAST Aerodrome Safeguarding Guidance Note

⁷ Federal Aviation Administration (2021) Review of Solar Energy System Projects on Federally-Obligated Airports.

experience short-term glare effects. Only in the case of extensive photovoltaic parks could more distant emission locations still be relevant.”

For those receptors⁸ within the study area described above, the guidelines state that effects are acceptable providing that glare is experienced for no more than 30 minutes on any given day, or more than 30 hours per year.

5.1.2 RIS-0737-CCS

Network Rail guidance does not provide a specific methodology for the assessment of glint and glare effects on rail infrastructure. However, Rail Industry Standard (RIS) RIS-0737-CCS states that...*“a planned change external to the railway could affect signal sighting, for example changes that affect the built environment (for example, a new structure causing obscuration, a solar farm causing reflection).”*

5.1.3 Renewable Energy Developments: Solar Photovoltaic Developments

The UK Civil Aviation Authority (CAA) issued a guidance note in July 2023. This guidance note was prepared by the Combined Aerodrome Safeguarding Team (CAST), supported by the CAA, and aims to provide safeguarding advice in relation to solar photovoltaic developments on a range of matters, including glint and glare.

With specific reference to glint and glare effects, the guidance note states that:

“In most cases, an assessment should be undertaken for a solar PV development which is being proposed within a specific distance (indicated by the aerodrome authority) from an aerodrome. For many aerodromes, 5km is the distance of choice but it could be considered out to 10km. In exceptional circumstances, assessments may be required beyond 10km.”

No specific methodology or assessment criteria are defined for assessing the impact of glint and glare on aviation infrastructure.

5.1.4 Review of Solar Energy System Projects on Federally-Obligated Airports

The United States' Federal Aviation Administration (FAA) guidance states that for a solar PV development to obtain FAA approval or to receive no objection, there should be no more than a *“low potential for after-image”* along the final 2-mile approach path for any existing or proposed runway. This criterion was originally defined to relate to Sandia Laboratories' Solar Glare Hazard Analysis Tool (SGHAT). However, the FAA has since withdrawn this requirement as the SGHAT software is no longer available. Metrica therefore uses modelling software developed by Forge Solar, which applies the same methodology as SGHAT.

SGHAT, categorises glint / glare into three tiers of severity (ocular hazards) that are shown by different colours in the model output. It should be noted that these categories are a function of the intensity of the reflection and the viewing angle, rather than being duration-dependant:

- ◆ Red glare: Glare predicted with a potential for permanent eye damage (retinal burn);
- ◆ Yellow glare: Glare predicted with a potential for temporary after-image; and
- ◆ Green glare: Glare predicted with a low potential for temporary after-image.

⁸ In this context, ‘receptors’ are primarily residential dwellings, but where relevant, can also include hotels, hospitals, schools and offices.

It also notes that no significant impacts are possible for reflections located more than 50 degrees either side of the direction of travel.

In the absence of specific guidance on the assessment of glint and glare impacts on road and rail infrastructure, it is generally accepted in the UK and elsewhere that in addition to aircraft, the FAA guidance is also appropriate for drivers of other vehicles (i.e., road and rail traffic).

6 STUDY AREAS

6.1 RESIDENTIAL RECEPTORS

As stated in Section 4.2.1, glint and glare effects are unlikely to be an issue for residential receptors more than approximately 100 m from PV panels, due to the reduced intensity and short duration of effects beyond this distance. However, as this distance is approximate and dependent upon the extent of the Development, the residential receptor study area for this assessment has been based upon a 200 m buffer distance in order to ensure a robust approach.

6.2 ROAD AND RAIL INFRASTRUCTURE

As the assessment criteria for road and rail infrastructure relate purely to glare intensity, rather than duration of effects, it is considered that a study area of 500 m is appropriate for the identification of road and rail infrastructure as a conservative approach.

6.3 AERODROMES AND AVIATION INFRASTRUCTURE

The study area for aerodromes is that defined in CAA guidance (See section 4.2.3), namely:

- ◆ 10 km for safeguarded civil or military aerodromes⁹; and
- ◆ 5 km for other / non-safeguarded aerodromes.

6.4 EXCLUSION AREAS

No visible reflections can occur at receptors located 'behind' the proposed PV panels. For south-facing panels (as is the case for the Development), this covers a sector between 270 and 90 degrees from the northernmost panel.

In addition, the excluded sector has been increased by a further 20 degrees to either side, as there is no reasonable prospect of an adverse impact due to the low height (and therefore intensity) of the sun when located within these 20-degree sectors. Furthermore, at such angles, the sun would be positioned in approximately the same direction as the reflection itself, thereby masking any potential glare effects.

This results in an exclusion area of 110 degrees either side of north, from the northernmost point in the array. Figures 1 and 2 present the study areas applicable to this assessment, derived in accordance with the above criteria.

⁹ As defined in UK Government (2016) 'town and country planning (safeguarded aerodromes, technical sites and military explosives storage areas)',

7 ASSESSMENT CRITERIA

7.1 RESIDENTIAL RECEPTORS

The assessment criteria for residential receptors are those described in Section 4.2.1, i.e., that the glint and glare effects are acceptable providing that it occurs for no more than 30 minutes per day, or 30 hours (equivalent to 1,800 minutes) per year.

7.2 ROAD, RAIL AND AVIATION RECEPTORS

The assessment criteria for road, rail and aviation receptors are those described in Section 4.2.4, i.e., that the glint and glare effects are acceptable providing there is found to be no more than a low potential for after-image (i.e., 'green glare') when assessing in accordance with the SGHAT methodology. As previously stated, the SGHAT methodology is based purely upon the intensity of the reflection and the viewing angle and is not duration-dependant.

8 METHODOLOGY

As discussed in Section 4.2.4, modelling and assessment of glint and glare effects has been conducted using software implementing the SGHAT methodology, which accounts for the following site-specific parameters:

- ◆ Reflection Source:
 - ◇ Latitude, longitude and elevation of the Development;
 - ◇ Panel tilt, height, and azimuth (orientation relative to north); and
 - ◇ Panel technology (fixed / tracking, and presence of anti-reflective coatings);
- ◆ Propagation path:
 - ◇ Local terrain; and
 - ◇ Existing or proposed obstructions (e.g., forestry, non-sensitive buildings, etc.)
- ◆ Receptor:
 - ◇ Receptor type e.g. (dwelling, road, rail, flight path, ground-based aviation assets);
 - ◇ Receptor location;
 - ◇ Height above ground level (typically taken as 1.5 m for terrestrial receptors, except for rail where a height of 2.75 m is applied, or structures such as Air Traffic Control Towers which are modelled on a case-by case basis); and
 - ◇ Viewing angle and direction of travel (mobile receptors only).

8.1 IDENTIFICATION OF RECEPTORS

Figures 1 and 2 present large and small scale maps respectively, showing the Development boundary and the study areas applicable to this assessment.

Each receptor within the respective study area has then been analysed using online mapping and aerial imagery to exclude those which clearly have no line of sight to the Development, either through screening from local terrain, vegetation or other buildings/infrastructure. Where the extent of the screening is unclear / uncertain, the receptor has not been excluded, to ensure a robust assessment.

Following the above filtering process, all remaining receptors within the respective study areas have been assessed.

8.1.1 Site-specific Aerodrome Parameters

Southampton Airport

As shown in Figure 1, one aerodrome (Southampton Airport) has been identified as requiring assessment. This airport operates a single runway (runway 20 when approached from the northeast, and runway 02 when approached from the southwest).

Consultation was undertaken with the airport's Safeguarding team, who confirmed that an assessment of glint and glare impacts was necessary. As the consultee did not provide any site-specific guidance in terms of the assessment, effects have been predicted for both runway approaches, using the standard 2-mile approach with a 3-degree glide slope as recommended in FAA guidance (see Section 4.2.4).

Southampton Airport Air Traffic Control is located immediately north of the main terminal building, with a maximum height of 37 m AGL¹⁰. For the purposes of this assessment, a receptor height of 35 m has been assumed, approximating controller's head height when working in the ATCT.

Lower Upham Airfield

Lower Upham Airfield is a non-safeguarded, grass airstrip located 5 km northeast of the Development, as detailed in Figure 1. Given the location of this aerodrome on the boundary of the respective study area, aircraft approaching from the southwest will have fully passed the Development prior to the 2-mile final approach. In addition, all aircraft approaching from the northeast will be facing the rear of Development's PV panels, with no line of sight to the reflective surfaces, meaning no glint and glare effects can occur. On this basis, no glint and glare effects are anticipated, and this aerodrome has not been considered further.

8.2 METEOROLOGICAL FACTORS

For much of a given year, weather conditions will be such that bright sunshine does not occur, and thus would not give rise to glint and glare effects. In Southampton¹¹ (the closest Met Office long term weather station to the proposed development), the average duration of sunshine recorded by the Met Office during the period where glint and glare has been predicted (February to October) is 1,513 hours, which is approximately 39 % of the total daylight hours during the same period. This has been accounted for as shown in Section 7.

9 RESULTS

Table 1 presents a summary of the results of the modeling exercise, presenting both theoretical maximum values assuming constant bright sunshine, and likely values after accounting for the percentage of sunshine as described in Section 7.3.

For those observation points (OP) or linear receptors where potential effects have been predicted, detailed results are presented in Appendix 2.

¹⁰ https://www.nats.aero/wp-content/uploads/2017/09/SouthamptonAirport_2016Factsheets.pdf

¹¹ <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcp1844rg>

Table 1: Assessment Results

Receptor	Daily Maximum Glare Duration (mins)	Theoretical Maximum Annual Glare Duration (mins)				Likely Annual Glare Duration (mins)			
		Green Glare	Yellow Glare	Red Glare	Total	Green Glare	Yellow Glare	Red Glare	Total
OP1	0	0	0	0	0	0	0	0	0
OP2	0	0	0	0	0	0	0	0	0
OP3	12	625	91	0	716	245	36	0	281
OP4	0	0	0	0	0	0	0	0	0
Rail Line	26	340	700	0	1040	133	275	0	408
Runway 20	0	0	0	0	0	0	0	0	0
Runway 02	22	2505	0	0	2505	983	0	0	983
ATCT	0	0	0	0	0	0	0	0	0

10 ASSESSMENT OF IMPACT

10.1 RESIDENTIAL RECEPTORS

As shown in Table 1, all residential receptors (OP1 – OP4) are predicted to experience glint and glare effects for less than 30 hours (1,800 minutes) per year and less than 30 minutes per day, and are therefore compliant with the respective assessment criteria.

10.2 AERODROME / AVIATION RECEPTORS

With regard to aviation receptors, no 'yellow' or 'red' glare is predicted for approach to runway 20, runway 02, or the ATCT. The Development is therefore compliant with the respective assessment criteria.

10.3 RAIL RECEPTORS

As Table 1 shows, a section of the rail line is predicted to experience 'yellow' glare. As the assessment criterion requires there to be no yellow glare, further mitigation will be required in order to reduce the intensity to no more than 'green' glare, or to remove the glare entirely through additional screening.

11 MITIGATION OPTIONS

In order to reduce the predicted impacts upon the rail line, further modelling was undertaken to identify appropriate mitigation. As can be seen from the charts presented in Section A2.5 of Appendix 2, the source of the impacts is limited to the PV panels in Array 3. It has been found that the key points where there is a potential line of sight from the train drivers eyeline to Array 3 are as follows:

- ◆ Views through gaps in the existing vegetation to the north of the rail line, located near the southeastern corner of Array 3; and
- ◆ Views as trains pass over the elevated section of line on the Development's western boundary (when travelling east only).

Two potential methods of mitigation have been identified, as follows:

- ◆ Additional fencing of at least 3m AGL in order to close gaps in the existing vegetation and to screen views from trains crossing the elevated section of line. It should be noted

that the latter is likely to require fencing to be located on Network Rail land due to the change in elevation; or

- ♦ Modification of the azimuth of all panels in Array 3 from 180 degrees to 165 degrees (tilt to remain at 20 degrees).

It has been found that either of the above approaches in isolation would be sufficient to remove all potential glint and glare effects on the rail line. The preferred method of mitigation is yet to be determined as this is dependent upon the impact of generation capacity, Network Rail negotiations, and on-site technical constraints. Notwithstanding this, the Client has committed to ensuring impacts on the rail line are fully mitigated, and is willing to accept a suitably worded planning condition to this effect.

In the interest of completeness, Table 2 presents the reassessment of all receptors on the basis of the azimuth of all panels in Array 3 being modified to 165 degrees.

Table 2: Mitigated Assessment Results

Receptor	Daily Maximum Glare Duration (mins)	Theoretical Maximum Annual Glare Duration (mins)				Likely Annual Glare Duration (mins)			
		Green Glare	Yellow Glare	Red Glare	Total	Green Glare	Yellow Glare	Red Glare	Total
OP1	17	610	0	0	610	239	0	0	239
OP2	0	0	0	0	0	0	0	0	0
OP3	12	625	91	0	716	245	36	0	281
OP4	0	0	0	0	0	0	0	0	0
Rail Line	0	0	0	0	0	0	0	0	0
Runway 20	0	0	0	0	0	0	0	0	0
Runway 02	22	2695	0	0	2695	1058	0	0	1058
ATCT	0	0	0	0	0	0	0	0	0

As can be seen, no glare is predicted at any point along the rail line following mitigation. It should be noted that the reorientation results in some low-intensity 'green' glare being introduced at OP1, but effects at this location remain comfortably compliant with the criteria for residential receptors.

Following mitigation, predicted glint and glare effects have been found to be compliant with the respective assessment criteria specified at all receptors.

12 CONCLUSION

Metrica was commissioned to undertake a Glint and Glare impact assessment in relation to the proposed Allington Lane Solar Farm.

The assessment has been undertaken in accordance with best practice guidance, and subject to mitigation, effects have been found to be acceptable at all receptors. The Development is therefore acceptable in terms of glint and glare.

13 GLOSSARY OF TERMS

After-Image: An image that continues to appear in the eyes after exposure to the original image has ceased.

Axis Tracking: Motorised PV array modules which are able change their tilt and / or azimuth angle in order to face the sun as it tracks across the sky.

Azimuth: A direction or bearing defined a horizontal angle between 0° and 359° measured clockwise from North.

Elevation: height above mean sea level.

Elevation Angle: An angle that is formed between the horizontal line (0°) and the line of interest.

Glare: A continuous source of bright light typically received by static receptors or from large reflective surfaces.

Glint: A momentary flash of bright light typically received by moving receptors or from moving reflectors.

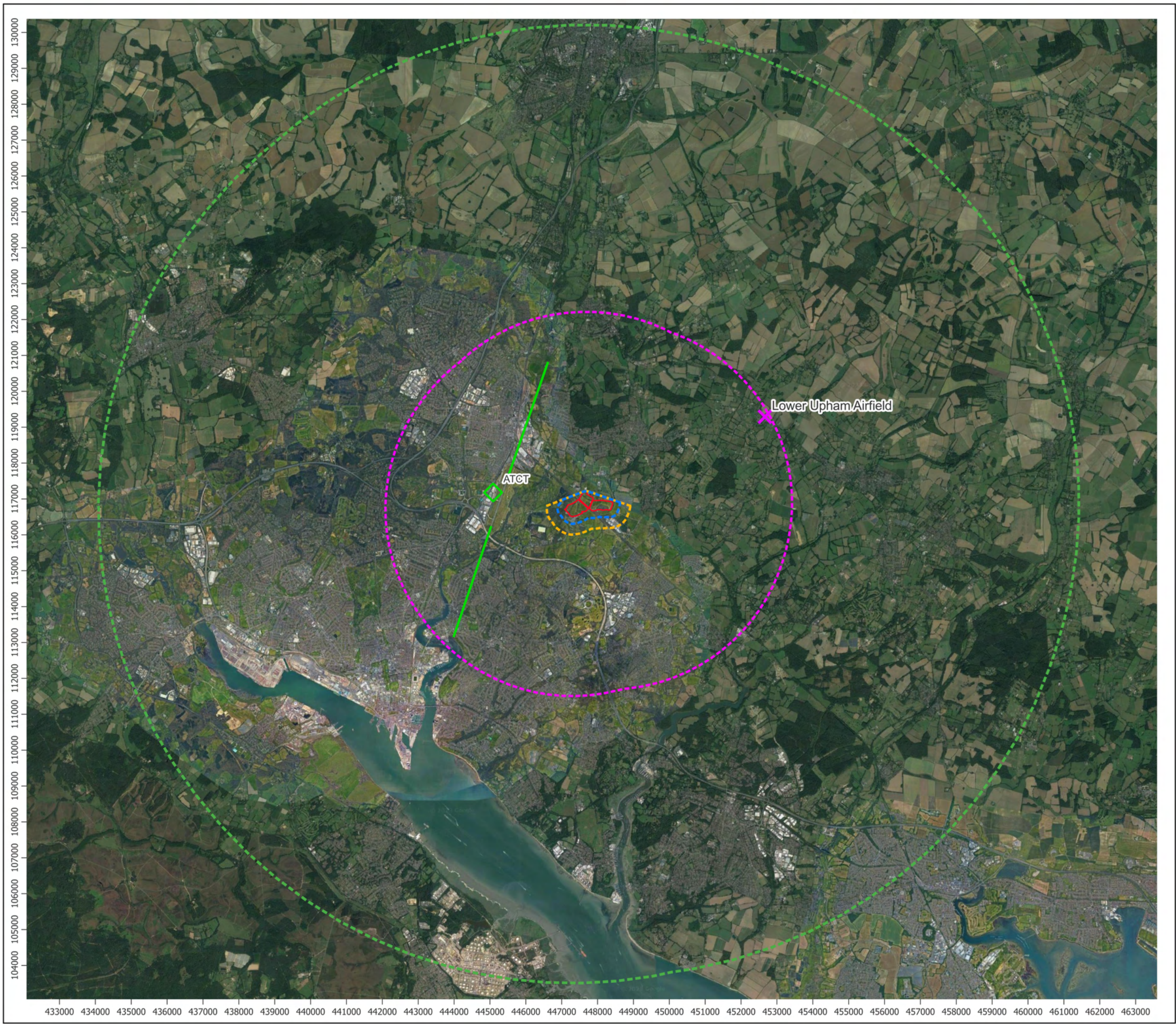
Green Glare: glare predicted with a low potential for temporary after-image.

Receptor: In this context, a receptor is a potential viewer of glint and glare effects.

Red Glare: glare predicted with a potential for permanent eye damage (retinal burn),

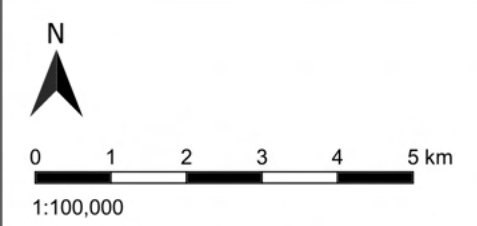
Tile Angle: See Elevation Angle

Yellow Glare: glare predicted with a potential for temporary after-image.



- Development Boundary
- Residential Study Area
- Road and Rail Study Area
- 5km Aerodrome Study Area
- Discounted Aerodrome
- 10km Aerodrome Study Area
- Runway 2-mile Approach
- Air Traffic Control Tower

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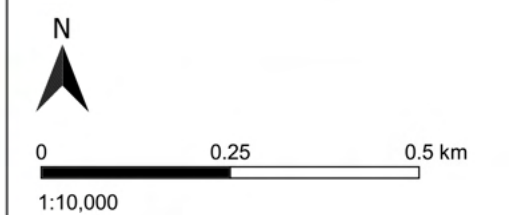
Date: 27/11/2023
Drawing Number: 0170/1
Version Number: 1

Figure 1
Study Areas (Small Scale)



-  Development Boundary
-  Residential Study Area
-  Road and Rail Study Area
-  Assessed Residential Receptor
-  Discounted Residential Receptor
-  Assessed Rail Line

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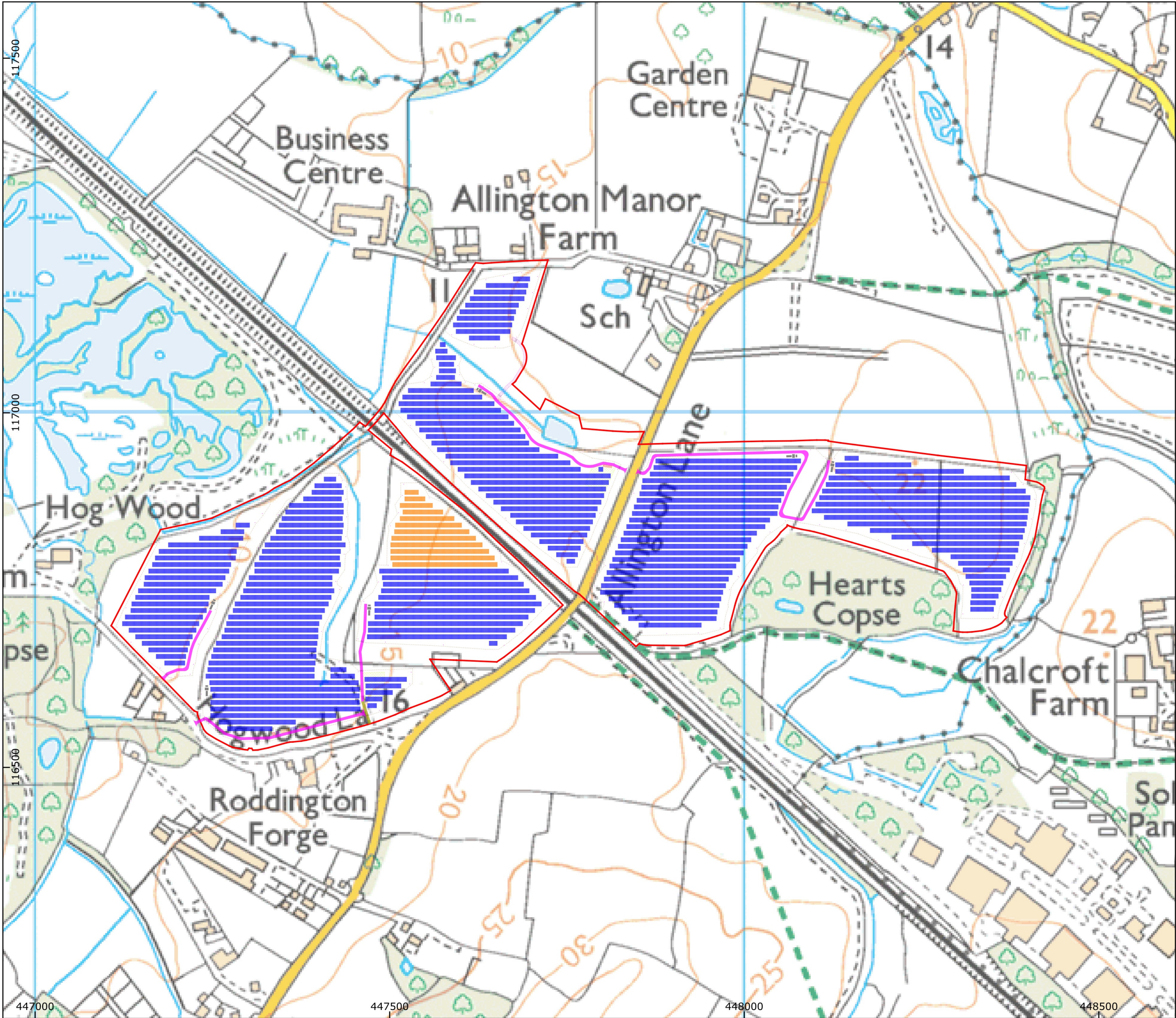
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Version Number: 1

Figure 2
Study Areas (Large Scale)

Allington Solar Farm
Glint and Glare Assessment

APPENDIX 1: DEVELOPMENT LAYOUT

Basemap © Crown copyright and database rights 2023 Ordnance Survey 0100031673





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Company Number: SC521030; VAT Number: 228851291

- Legend
- 

Planning Boundary
- 

Panels (3.2m)
- 

Panels (3.6m)
- 

Access Track
- 

Temporary Access Track
- 

Existing Access Track to be Upgraded
- 

Security Fencing
- 

Access Gates
- 

CCTV
- 

Customer Substation
- 

DNO Substation
- 

Storage Building
- 

Communication Building
- 

Storage Container
- 

Inverter and Transformer Stations
- 

Temporary Compound

0100200

200 m

A3 Horizontal Scale



1:5,000

CRS: British National Grid (EPSG:27700)

Produced:Emma Ballantyne
Reviewed:Amy Talbot
Approved:Ian McLean

Date: 25/06/24

Revision: 1.0

8121-DRW-DES-0027-Layout Plan-v1.0

Allington Lane Solar Farm
Layout Plan

Locogen Consulting Ltd

APPENDIX 2: DETAILED RESULTS (UNMITIGATED SCENARIO)

A2.1: OP1 – NO GLARE

A2.2: OP2 – NO GLARE

A2.3: OP3 – ARRAY 1 ONLY

Chart A2.3.1: Ocular Hazard Plot ¹²

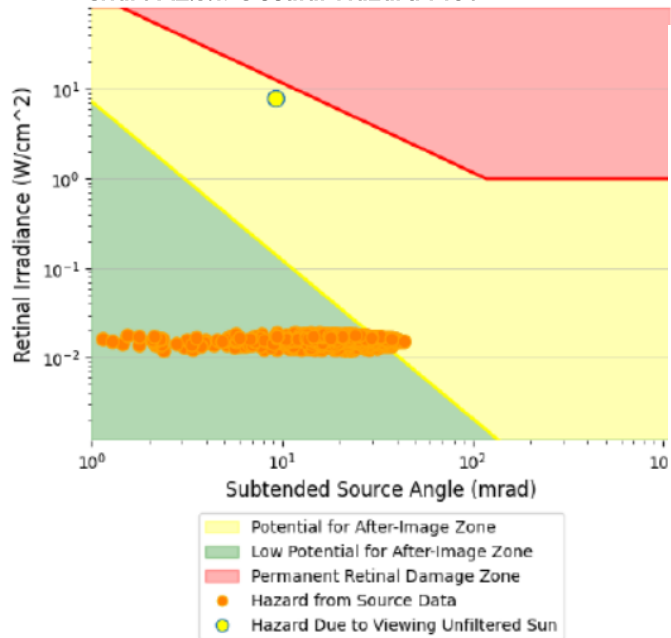


Chart A2.3.2: Daily Glare Duration ¹³

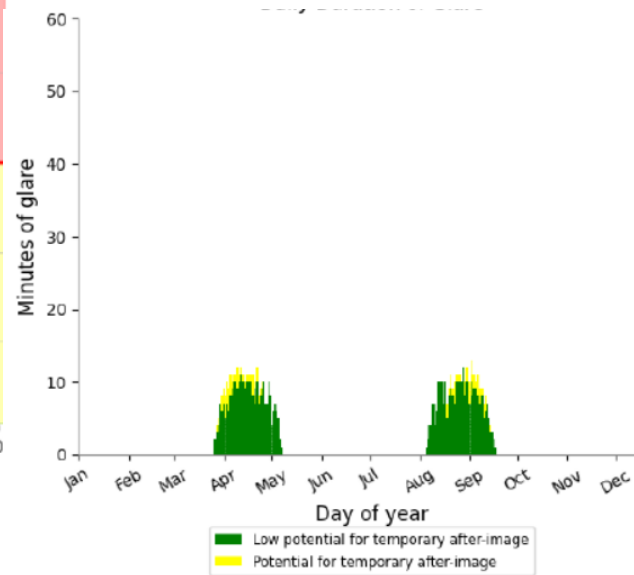
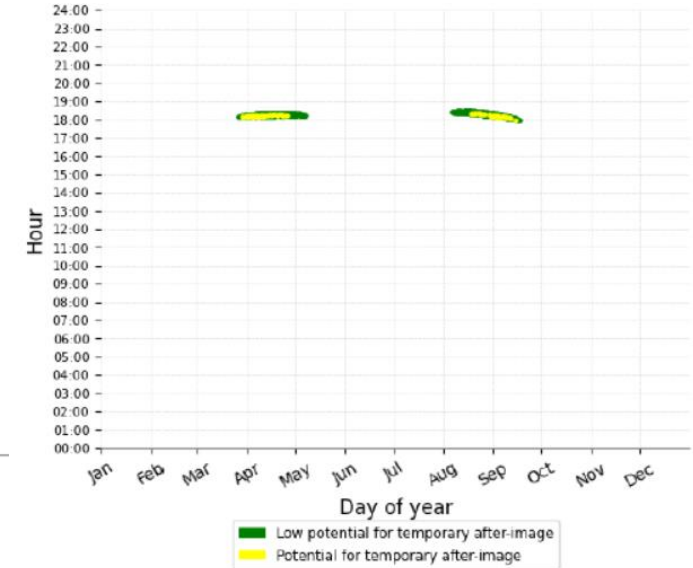


Chart A2.3.3: Annual Glare Occurrence



¹² For comparative purposes, a reference point has been included on this chart which illustrates the relative intensity of the Sun itself.

¹³ This chart shows the total duration that there is potential for theoretical glare effects to occur. Actual durations are likely to be lower in practice due to cloud cover.

A2.4: OP4 – NO GLARE

A2.5: RAIL LINE – ARRAY 3 ONLY

Chart A2.5.1: Ocular Hazard Plot

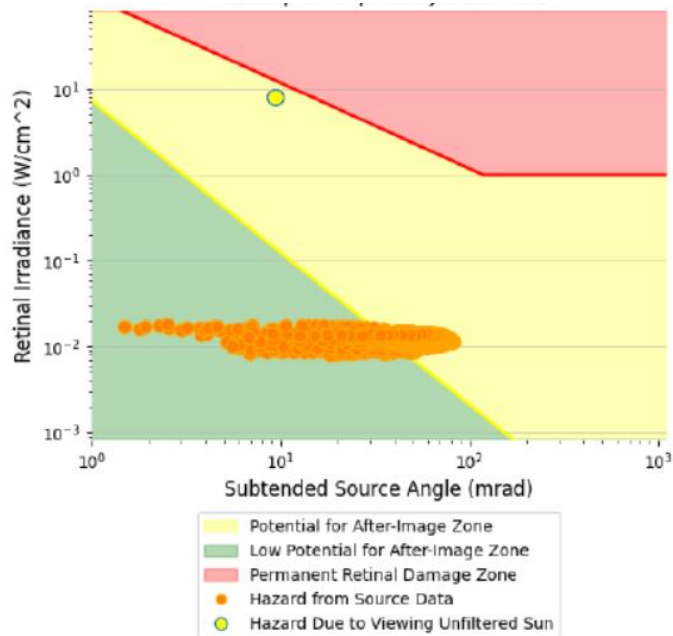


Chart A2.3.2: Glare Source Footprint

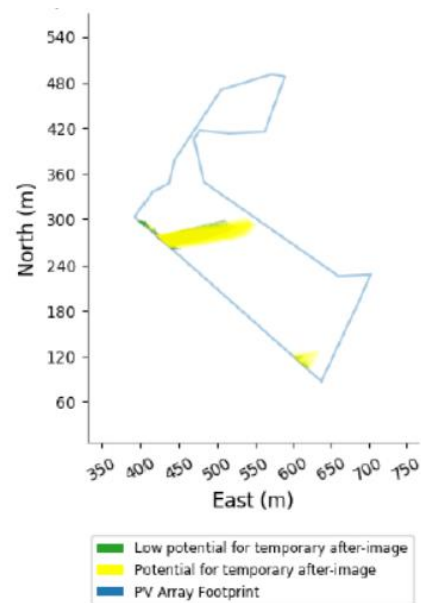
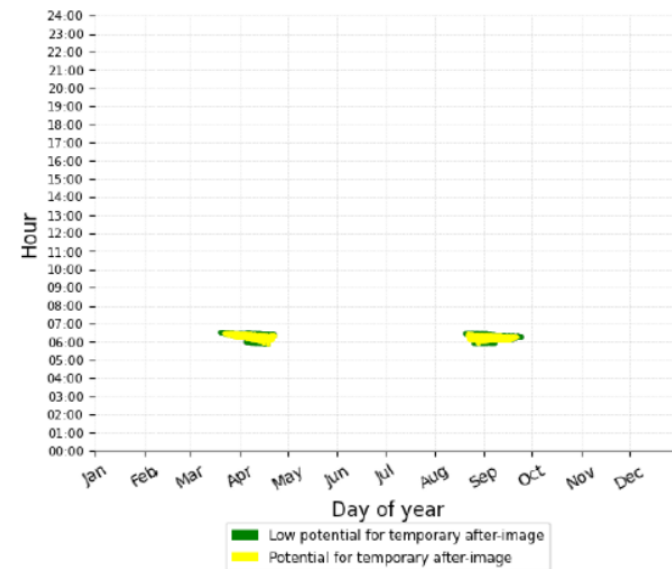


Chart A2.3.3: Annual Glare Occurance



A2.6: RUNWAY 20 (NORTHERN APPROACH) – NO GLARE

A2.7: RUNWAY 02 (SOUTHERN APPROACH) – ARRAY 3 ONLY

Chart A2.7.1: Ocular Hazard Plot

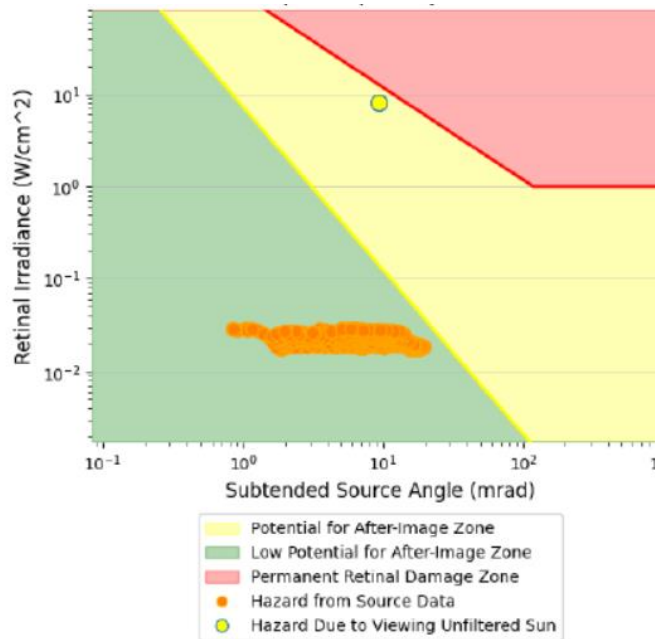


Chart A2.7.2: Glare Source Footprint

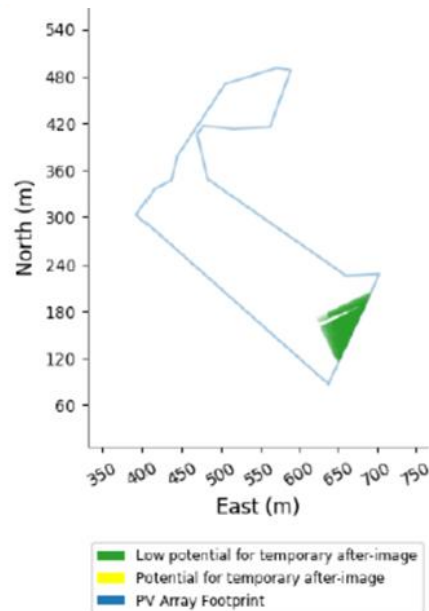
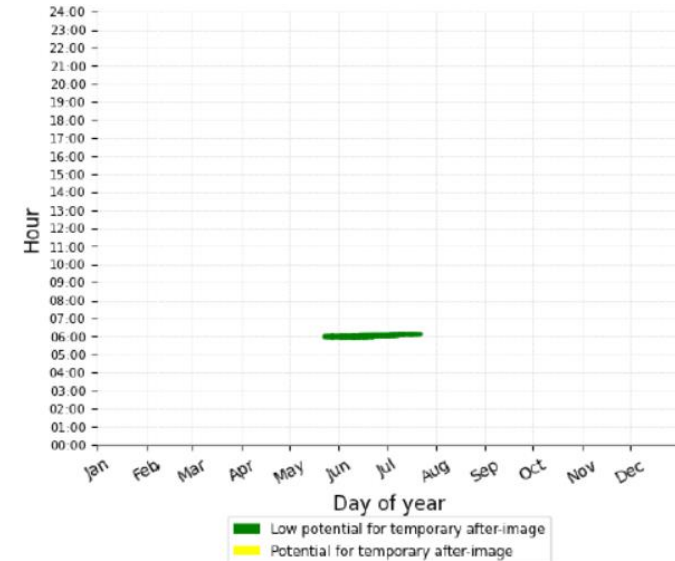


Chart A2.7.3: Annual Glare Occurance



A2.8: AIR TRAFFIC CONTROL TOWER – NO GLARE