CHAPTER 14 - GLINT AND GLARE

INTRODUCTION

14.1 This assessment considers the potential impacts on ground-based receptors such as roads, rail and residential dwellings as well as aviation assets. A 1km survey area around the Application Site is considered adequate for the assessment of ground-based receptors, whilst a 30km study area is chosen for aviation receptors. Within 1km of the Application Site, there are 71 residential receptors, 61 road receptors and six rail receptors which were considered. 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 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. Twelve residential, and 14 road receptors were dismissed as they are located within the no reflection zones. Eleven aerodromes are located within the 30km study area; however, only Wattisham Airfield required a detailed assessment due to its size and/or orientation in relation to the Proposed Development. The other ten aerodromes did not require detailed assessments as they did not fall within their respective safeguarding buffer zones of the Proposed Development, which are outlined in **paragraph 14.54 on page 297**.

14.2 Geometric analysis was conducted at 59 individual residential receptors, including three residential areas, 47 road receptors and six rail receptors.

14.3 The assessment concludes that:

- Solar reflections are possible at 48 of the 59 residential receptors assessed within the 1km study area. The initial bald-earth scenario identified potential impacts as high at 34 receptors, including two residential areas, medium at four receptors, low at ten receptors, including one residential area, and none at the remaining eleven. Upon reviewing the actual visibility of the receptors, glint and glare impacts remained high for two receptors and reduced to none for the remaining 57 receptors, including three residential areas. Once mitigation measures were considered, all impacts reduce to none for all receptors.
- Solar reflections are possible at 35 of the 47 road receptors assessed within the 1km study area. Upon reviewing the actual visibility of the receptors, glint and glare impacts remain high at five receptors, reduce to low at two receptors and none at the remaining 40 receptors. Once mitigation measures were considered, impacts reduce to none for all receptors.

- Solar reflections are possible at all six rail receptors assessed within the 1km study area. Upon reviewing the actual visibility of the receptors, glint and glare impacts reduce to low for two receptors (4 and 6) and reduce to none at the remaining four receptors. Once mitigation measures were considered, impacts reduce to none for all receptors.
- Two runways and an Air Traffic Control Tower (ATCT) were assessed at Wattisham Airfield, and it was found that the impacts would be none.

14.4 Mitigation measures are required to be put in place due to the impact that was found during the visibility analysis at residential receptors 30 and 31 and also at road receptors 7, 18, 32, 34 and 35. This includes a tree belt being implemented along the eastern boundary of the Proposed Development and to ensure that all the hedgerows within the Application Site are gapped up and maintained to height of at least 3m.

14.5 The effects of glint and glare and their impact on local receptors has been analysed in detail and the impact on all receptors is predicted to be None once all mitigation measures have been implemented and the tree belt has sufficiently grown along the eastern boundary of the Proposed Development. However, until the tree belt has grown, in five years, the impacts at Residential Receptors 30 and 31 will be Low.

Background

14.6 Neo Environmental Ltd has been appointed by Engena (the "Applicant") to undertake a Glint and Glare Assessment for a proposed solar farm development (the "Proposed Development") on lands approximately 1km northwest of Bramford (the "Application Site").

Proposed Development Description

14.7 The Proposed Development will consist of the construction of PV panels mounted on metal frames, maintenance tracks, underground cabling, substations, perimeter fencing, a customer cabin and control room.

Site Description

14.8 The area of the Proposed Development (the "Application Site") comprises of approximately 82ha of land contained within five fields. The field boundaries consist of a mixture of trees and hedgerows. Ground levels within the Application Site vary from approximately 16m AOD at the eastern boundaries to 53m AOD in western areas of the Application Site.

14.9 The Application Site is centred at approximate grid reference E610759, N247265. The wider landscape contains the town of Bramford, which is located c. 1km to the southeast of the Application Site.

Scope of Report

14.10 Although there may be small amounts of glint and glare from the metal structures associated with the solar farm, the main source of glint and glare will be from the panels themselves and this will be the focus of this assessment.

14.11 Solar 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.

14.12 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.

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

- **Appendix 14.1**: Assessment Figures
  - Figure 1: Residential Receptor Map
  - Figure 2: Road Receptor Map
  - Figure 3: Rail Receptor Map
  - Figure 4: Site Layout
  - Figure 5: Landscape Planting Proposals
- **Appendix 14.2**: Residential Receptor Glare Results
- **Appendix 14.3**: Road Receptor Glare Results
- **Appendix 14.4**: Rail Receptor Glare Results
- **Appendix 14.5**: Aviation Receptor Glare Results
- **Appendix 14.6**: Visibility Evidence Assessment
- **Appendix 14.7**: Solar Module Glare and Reflectance Technical Memo1

Statement of Authority

14.14 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 (Sunpower Corporation, September 2009).

Definitions

14.15 This study examined the potential hazard and nuisance effects of glint and glare in relation to ground-based receptors, this includes the occupants of surrounding dwellings as well as road users. The Federal Aviation Authority (FAA) in their "Technical Guidance for Evaluating Selected Solar Technologies on Airports (Miller & Hanson Inc, November 2010) have defined the terms 'Glint' and 'Glare' as meaning;

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

14.16 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.

General Nature of Reflectance from Photovoltaic Panels

14.17 In terms of reflectance, photovoltaic solar panels are by no means a highly reflective surface. They are designed to absorb sunlight and not to reflect it. Nonetheless, photovoltaic panels have a flat polished surface, which omits 'specular' reflectance rather than a 'diffuse' reflectance, which would occur from a rough surface. Several studies have shown that photovoltaic 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 14.7**). 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 photovoltaic 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 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…" (Solar Trade Association, April 2016).

Time Zones / Datum's

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

14.19 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.

LEGISLATION AND GUIDANCE

National Planning Policy Guidance (NPPG) on Renewable and Low Carbon Energy (UK)

14.20 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."

Planning Guidance for the Development of Large-Scale Ground Mounted Solar PV Systems

14.21 As outlined within the Building Research Establishment (BRE) document 'Planning Guidance for the Development of Large-Scale Ground Mounted Solar PV Systems'

"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."

Interim CAA Guidance - Solar Photovoltaic Systems (2010)

14.22 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 ', they also intend to undertake a review of the potential impacts of solar PV developments upon aviation, however this is yet to be published. (CAA,2010).

14.23 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 2009. (CAA, 2015). In particular, developers should take cognisant of the following articles of the ANO , including:

- "Article 137 – 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 221 - Lights liable to endanger – "A person must not exhibit in the United Kingdom any light which:
  - 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 222 – 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."

14.24 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).

14.25 These articles are considered within the assessment of glint and glare of the Proposed Development.

US Federal Aviation Administration Policy

14.26 The US Federal Aviation Administration (FAA) in their Solar Guide (Federal Aviation Authority, 2010) 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."

14.27 The current policy (Federal Register, 2013) 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.

14.28 Crucially, the policy provides a quantitative threshold which 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 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.

14.29 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" 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.

14.30 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.

METHODOLOGY

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

Sun Position and Reflection Model

Sun Data Model

14.32 The calculations in the solar position calculator are based on equations from Astronomical Algorithms, (Jean Meeus, 1999) . The sunrise and sunset results are theoretically accurate to within a minute for locations between +/- 72° latitude, and within ten 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

14.33 The position of the sun is calculated at one-minute intervals of a typical year, in this instance the year being assessed was 2021.

14.34 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.

14.35 The model assumes that the azimuth and horizontal angle of the sun is the same across the whole solar farm. This is considered acceptable due to the distance of the sun from the Proposed Development and the miniscule differences in location of the sun over the Proposed Development.

14.36 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.

14.37 On knowing the vector of the solar reflection, the azimuth is calculated and the horizontal reflection from multiple points within the solar farm. These are then compared with the azimuth and horizontal angle of the receptor from the solar farm to determine if it is within range to receive solar reflections.

14.38 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 14.7** outlines the reflective properties of solar glass and compares it to other reflective surfaces. Although the exact figures in this report could be argued, 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 and that the amount of reflective energy drops as the angle of incidence decreases.

14.39 Most modern 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.

DETERMINATION OF OCULAR IMPACT

14.40 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 which should be used in this type of assessment.

14.41 Determination of the ocular impact requires knowledge of the direct normal irradiance, PV module 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.

14.42 The ocular impact, 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). (Ho, Ghanbari, Diver, 2011).

14.43 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.

14.44 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.

Relevant Parameters of the Proposed Development

14.45 The photovoltaic panels are oriented in a southwards direction to maximise solar gain and will remain in a fixed position throughout the day and during the year (i.e. they will not rotate to track the movement of the sun). The panels will face south and will be inclined at an angle of 20 degrees.

14.46 The height of the panels above ground level is a maximum of 2.5m and points at the top of the panels are used to determine the potential for glint and glare generation.

Identification of Receptors

Ground Based Receptors

14.47 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.

14.48 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.

14.49 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.

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

14.51 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

14.52 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. Enroute activities are not considered an issue as the flight will most likely be at a higher altitude than the solar reflection.

14.53 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.

14.54 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

14.55 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 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

Moving Receptors (Road and Rail)

14.56 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.

14.57 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).

14.58 The FAA produced an evaluation of glare as a hazard and concluded in their report 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." (FAA, 2015)

14.59 It is reasonable to assume that although this report was assessing pilots vision impairment that it can be also used to drivers of other 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 low.

Moving Receptors (Aviation)

APPROACH PATHS

14.60 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.

14.61 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 90 degrees left and right from the front of the cockpit whilst the VFOV is modelled at 30 degrees.

14.62 The FAA guidance states that there should be no potential for glare or 'low potential for afterimage' at any existing or future planned runway landing thresholds for the Proposed Development to be acceptable.

AIR TRAFFIC CONTROL TOWER (ATCT)

14.63 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.

14.64 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.

14.65 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 'low potential for AfterImage' or more, then mitigation measures will be required.

Assessment Limitations

14.66 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, 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; and
- The model does not account for the effects of diffraction; however, buffers are applied as a factor of safety.

BASELINE CONDITIONS

Ground Based Receptors Reflection Zones

14.67 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 proposed solar farm within this arc have the potential to be seen by receptors at or near ground level.

14.68 Further analysis showed that this will only occur between the azimuth of 238.15 degrees and 298.73 degrees in the western direction (late day reflections) and 64.76 degrees and 129.14 degrees in the eastern direction (morning reflections) and therefore any ground-based receptor outside these arcs will not have any impact from solar reflections.

14.69 Figure 1, 2 and 3 of **Appendix 14.1** 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 14.67 to 14.68**.

Residential Receptors

14.70 Residential receptors located within 1km of the Application Site have been identified (**Table 14.1**). Glint was assumed to be possible if the receptor is located within the ground-based receptor zones outlined previously.

14.71 There are twelve residential receptors (Receptors 60 to 71) which are within the no-reflection zones and are clearly identifiable in Figure 1: **Appendix 14.1**. The process of how these are calculated is explained in **paragraphs 14.67 to 14.68**.

Table 14.1 - *Residual Receptors*

Receptor	Easting	Northing	Glint and Glare Possible
1	611591	246442	Yes
2	611200	246711	Yes
3	611173	246714	Yes
4	610289	246610	Yes
5	609601	246862	Yes
6	609673	247068	Yes
7	609824	247084	Yes
8	609885	247101	Yes
9	609928	247068	Yes
10	609943	247107	Yes
11	609899	247134	Yes
12	609915	247173	Yes
13	609976	247129	Yes
14	610073	247298	Yes
15	610108	247279	Yes
16	608999	248311	Yes
17	609068	248335	Yes
18	611047	247947	Yes
19	611040	247933	Yes
20	611021	247902	Yes
21	611048	247911	Yes
22	611158	247962	Yes
23	611108	247458	Yes

Receptor	Easting	Northing	Glint and Glare Possible
24	611671	248130	Yes
25	611742	248208	Yes
26	611929	247461	Yes
27	611928	247419	Yes
28	611929	247389	Yes
29	611930	247358	Yes
30	611800	247349	Yes
31	611804	247335	Yes
32	611889	247319	Yes
33	611897	247299	Yes
34	611850	247252	Yes
35	611864	247228	Yes
36	612712	247628	Yes
37	612710	247589	Yes
38	612664	247559	Yes
39	612761	247322	Yes
40	612768	247294	Yes
41	612612	246656	Yes
42	612604	246834	Yes
43	612535	246967	Yes
44	612471	247083	Yes
45	612390	247026	Yes
46	612322	246980	Yes
47	612231	247040	Yes

Receptor	Easting	Northing	Glint and Glare Possible
48	612161	247090	Yes
49	612092	247106	Yes
50	611996	247102	Yes
51	612044	246978	Yes
52	612168	246852	Yes
53	612076	246770	Yes
54	612068	246633	Yes
55	612108	246478	Yes
56	612135	246356	Yes
57	612168	246220	Yes
58	612031	246580	Yes
59	612024	246567	Yes
60	611323	246102	No
61	609453	248481	No
62	609668	248498	No
63	609884	248758	No
64	610202	248706	No
65	610254	248702	No
66	610287	248701	No
67	610343	248680	No
68	610345	248580	No
69	610391	248556	No
70	610343	248537	No
71	610313	248369	No

Road / Rail Receptors

14.72 There are five roads within the 1km study area that require a detailed Glint and Glare Assessment; the B1113, Somersham Road, the B1067, Tye Lane and Bullet Lane. There are some minor roads which 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 Proposed Development.

14.73 The ground receptor no-reflection zones are clearly identifiable on Figure 2: **Appendix 14.1** and the process of how these are calculated is explained in **paragraphs 14.67 to 14.68 on page 299 of this report**.

14.74 **Table 14.2** shows a list of receptors points within the study area which are 200m apart.

Table 14.2 - *Road Based Receptors*

Receptor	Easting	Northing	Glint and Glare Possible
1	611847	248352	Yes
2	611869	248153	Yes
3	611880	247954	Yes
4	611889	247754	Yes
5	611899	247554	Yes
6	611910	247354	Yes
7	611927	247155	Yes
8	611951	246956	Yes
9	612002	246763	Yes
10	612055	246570	Yes
11	612109	246378	Yes
12	612152	246183	Yes
13	611012	248114	Yes
14	611115	247943	Yes
15	611279	247832	Yes
16	611431	247705	Yes
17	611588	247584	Yes
18	611743	247457	Yes
19	611859	247296	Yes
20	612000	247023	Yes
21	612115	246861	Yes
22	612210	246687	Yes
23	612318	246520	Yes

Receptor	Easting	Northing	Glint and Glare Possible
24	612420	246350	Yes
25	609070	246688	Yes
26	609262	246745	Yes
27	609453	246802	Yes
28	609569	246930	Yes
29	609737	247034	Yes
30	609915	247118	Yes
31	610078	247202	Yes
32	610259	247117	Yes
33	610452	247080	Yes
34	610616	247075	Yes
35	610814	247072	Yes
36	611013	247072	Yes
37	611205	247023	Yes
38	611403	247017	Yes
39	611600	247053	Yes
40	611797	247083	Yes
41	610146	246118	Yes
42	610334	246187	Yes
43	610532	246199	Yes
44	611319	246272	Yes
45	611498	246357	Yes
46	611674	246443	Yes
47	611862	246504	Yes

Receptor	Easting	Northing	Glint and Glare Possible
48	609221	248549	No
49	609415	248503	No
50	609613	248516	No
51	609805	248571	No
52	609817	248757	No
53	610014	248769	No
54	610207	248715	No
55	610406	248699	No
56	610606	248693	No
57	611047	248506	No
58	611016	248312	No
59	610731	246210	No
60	610930	246198	No
61	611121	246251	No

14.75 There is one railway line that passes the Proposed Development approximately 850m east which will require assessment.

14.76 **Table 14.3** shows a list of rail receptor points within the study area which are 200m apart.

Table 14.3 - *Rail Based Receptors*

Receptor	Easting	Northing	Glint and Glare Possible
1	612508	248072	Yes
2	612549	247876	Yes
3	612593	247681	Yes
4	612638	247486	Yes
5	612682	247290	Yes
6	612726	247095	Yes

Aviation Receptors

Table 14.4 - *Airfields Within Close Proximity (within 30km)*

Airfield	Distance	Use
Elmsett Airfield	5.44km	Small Unlicensed Aerodrome
Wattisham Airfield	8.15km	Military Aerodrome
Crowfield Airfield	9.61km	Small Unlicensed Aerodrome
RAF Ratttlesden	15.93km	Military Aerodrome
Great Oakley Airfield	19.82km	Small Unlicensed Aerodrome
Woodbridge	20.56km	Military Aerodrome
Cuckoo Tye Farm	21.95km	Small Unlicensed Aerodrome
Bentwaters Parks	23.24km	Ex-Military Aerodrome
Wormingford Airfield	23.86km	Essex Gliding Club
Rougham Airfield	26.39km	Ex-Military Aerodrome
Hinderclay Meadows AIrfield	28.88km	Suffolk Soaring Group

14.77 Wattisham Airfield is located within 10km of the Proposed Development so, a detailed assessment will be required due to the buffer zones outlined in **paragraph 14.54 on page 297**.

14.78 The other ten aviation assets are either military or small and not within their respective buffer zones which were outlined in **paragraph 14.54 on page 297**.

WATTISHAM AIRFIELD

14.79 Wattisham Airfield is a military Aerodrome and is located 4NM (7.41km) south-southwest of Stowmarket.

14.80 The elevation of the aerodrome at the Aerodrome Reference Point (ARP) is 86.26m. It has two asphalt strip runways, details of which are given in **Table 14.5**.

14.81 The threshold locations and heights of the runways at Wattisham Airfield are given in **Table 14.6**.

Table 14.5 - *Wattisham Airfield Runways*

Runway Designation	Bearing(⁰)	Length (m)	Width (m)
05	047.52	2423	45
23	227.53	2423	45

Table 14.6 - *Wattisham Airfield Runway Threshold Locations and Heights*

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
05	052° 07’ 14.03” N	000° 56’ 37.68” E	85.97
23	052° 08’ 03.57” N	000° 58’ 06.71” E	84.74

Table 14.7 - *ATCT*

	Latitude	Longitude	Height AOD (m)	Height AOD (m)
ATCT	052° 07' 25” N	000° 57' 29" E	87.17	15.00

14.82 There is one ATCT present at Wattisham Airfield that has been assessed. **Table 14.7** shows the location and height of the ATCT. The height of the ATCT has been estimated, by looking at images taken within Wattisham Airfield on Google, at being 10m tall, however, 15m has been used as the height to account for any error in the estimation and as a worst-case scenario.

IMPACT ASSESSMENT

14.83 Following the methodology outlined earlier in this report, geometrical analysis comparing the azimuth and horizontal angle of the receptors from the Proposed Development and the solar reflection was conducted. Although this assessment did not take into account obstructions such as vegetation and buildings, discussion on the potentially impacted receptors is provided where necessary.

Ground Based Receptors

Residential Receptors

14.84 **Table 14.8** 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.

14.85 The twelve 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 Proposed Development.

14.86 **Appendix 14.2** shows the analysis with the solar panels at a tilt angle of 20 degrees. **Table 14.8** shows the worst-case impact at each receptor.

Table 14.8 - *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	0.0	None
2	No	Yes	214	3.6	Low
3	No	Yes	163	2.7	Low
4	Yes	No	196	3.3	Low
5	Yes	No	1448	24.1	Medium
6	Yes	No	1817	30.3	High
7	Yes	No	3435	57.3	High
8	Yes	No	3735	62.3	High
9	Yes	No	3771	62.9	High
10	Yes	No	3916	65.3	High
11	Yes	No	4305	71.8	High
12	Yes	No	3902	65.0	High
13	Yes	No	4460	74.3	High
14	Yes	Yes	16902	281.7	High
15	Yes	Yes	15266	254.4	High
16	No	No	0	0.0	None
17	No	No	0	0.0	None
18	No	No	0	0.0	None
19	No	No	0	0.0	None
20	No	No	0	0.0	None
21	No	No	0	0.0	None

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact
	AM	PM	Minutes	Hours	
22	No	No	0	0.0	None
23	Yes	Yes	7963	132.7	High
24	No	No	0	0.0	None
25	No	No	0	0.0	None
26	No	Yes	2192	36.5	High
27	No	Yes	4059	67.7	High
28	No	Yes	5022	83.7	High
29	No	Yes	5012	83.5	High
30	No	Yes	8219	137.0	High
31	No	Yes	5695	94.9	High
32	No	Yes	4278	71.3	High
33	No	Yes	4087	68.1	High
34	No	Yes	4725	78.8	High
35	No	Yes	4480	74.7	High
36	No	Yes	434	7.2	Low
37	No	Yes	427	7.1	Low
38	No	Yes	472	7.9	Low
39	No	Yes	1332	22.2	Medium
40	No	Yes	1590	26.5	Medium
41	No	Yes	2019	33.7	High
42	No	Yes	2434	40.6	High
43	No	Yes	2869	47.8	High

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact
	AM	PM	Minutes	Hours	
44	No	Yes	2993	49.9	High
45	No	Yes	3176	52.9	High
46	No	Yes	2957	49.3	High
47	No	Yes	3156	52.6	High
48	No	Yes	3353	55.9	High
49	No	Yes	3324	55.4	High
50	No	Yes	3841	64.0	High
51	No	Yes	3426	57.1	High
52	No	Yes	2455	40.9	High
53	No	Yes	2339	39.0	High
54	No	Yes	1739	29.0	Medium
55	No	Yes	1052	17.5	Low
56	No	Yes	308	5.1	Low
57	No	Yes	0	0.0	None
58	No	Yes	997	16.6	Low
59	No	Yes	993	16.6	Low

14.87 As can be seen in **Table 14.8**, there is a High impact at 34 receptors, Medium at four receptors, Low at ten receptors and None impact for the remaining eleven receptors. **Appendix 14.2** shows detailed analysis of when the glare impacts are possible, whilst also showing which parts of the solar farm the solar glint is reflected from.

14.88 **Appendix 14.6** shows Google Earth images that give an insight into how each receptor will be impacted by the glint and glare from the Proposed Development. There is a mixture of images used, which include aerial, ground level and street level. The aerial images show the location of the receptor with the solar farm drawn as a white polygon and can be seen on the images when the solar farm is theoretically visible. The area of the solar farm from where reflections may be possible has been drawn as a yellow polygon. The ground level terrain is based on the height data of the surrounding land showing no intervening vegetation or buildings. The white and yellow polygons can be seen in this view also. The street view gives a good indication as to whether the area of the solar farm where

reflections are theoretically possible will be visible from the receptor point.

Receptor 2 and 3

14.89 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that only small southwest sections of the Proposed Development can potentially impact on the receptors.

14.90 The first image in **Appendix 14.6** is an aerial image which shows the location of both receptors in relation to the Proposed Development. It shows that there is likely to be sufficient vegetation located to the northwest of the receptors, which will screen all views of the Proposed Development where glint and glare is possible. The second image is taken using Google Earth 3D modelling from the red point located on the aerial image and shows the vegetation located to the northwest of the receptors. This image confirms that the vegetation located to the northwest of the receptors will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 4

14.91 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that a southeast section of the Proposed Development can potentially impact on the receptor.

14.92 The first image in **Appendix 14.6** is an aerial image which shows the receptor's location in relation to the Proposed Development. It shows that there is sufficient vegetation located to the northeast of the receptor, which will screen all views of the Proposed Development where glint and glare is possible. The second image is taken using Google Earth 3D modelling from the red point located on the aerial image and shows the vegetation located to the northeast of the receptor. This image confirms that the vegetation located to the northeast of the receptor will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 5

14.93 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that all but a northwest section of the Proposed Development can potentially impact on the receptor.

14.94 The first image in **Appendix 14.6** is an aerial image which shows the receptor's location in relation to the Proposed Development. It shows there is likely to be sufficient hedgerows located to the east of the receptor to screen all views of the Proposed Development where glint and glare is possible. The second image has been taken where the red point is located on the aerial image and shows the hedgerow located to the east of the receptor. This image confirms that the hedgerow located to the east of the receptor will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 6

14.95 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that all but a northwest section of the Proposed Development can potentially impact on the receptor.

14.96 The first image in **Appendix 14.6** is an aerial image which shows the receptor's location in relation to the Proposed Development. It shows there

is likely to be sufficient hedgerows located to the east within the grounds of the receptor to screen all views of the Proposed Development where glint and glare is possible. The second image is taken using Google Earth 3D modelling from the red point located on the aerial image and shows the vegetation to the east located within the grounds of the receptor. This image confirms that the vegetation located within the grounds of the receptor will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptors 7 - 13

14.97 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that all but a northwest section of the Proposed Development can potentially impact on the receptors.

14.98 The first image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. It shows that there is likely to be sufficient vegetation located to the east of the receptors, which will screen all views of the Proposed Development where glint and glare is possible. The second image has been taken where the red point is located on the aerial image and shows the vegetation located to the east of the receptors. This image confirms that the vegetation located to the east of the receptors will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 14 and 15

14.99 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that central sections of the Proposed Development can potentially impact on both receptors.

14.100 The first image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. It shows that there is likely to be sufficient vegetation located to the east and west of the receptors, which will screen all views of the Proposed Development where glint and glare is possible. The second image has been taken from within the Application Site using Google Earth's 3D modelling with a view towards Receptor 14. This image confirms that there is sufficient vegetation to the west of the receptors to screen all views of the Proposed Development where glint and glare is possible. The third image has been taken from within the Application Site using Google Earth's 3D modelling with a view towards Receptor 15.

14.101 This image confirms that there is sufficient vegetation to the east of the receptors to screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 23

14.102 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that a small north eastern section and larger north western section of the Proposed Development can potentially impact on the receptor.

14.103 The first image in **Appendix 14.6** is an aerial image which shows the receptor's location in relation to the Proposed Development. It shows that there is likely to be sufficient vegetation located to the east and west of the receptor, which will screen all views of the Proposed

Development where glint and glare is possible. The second image has been taken from within the Application Site using Google Earth's 3D modelling with a view of the eastern boundary of Receptor 23. This image confirms that there is sufficient vegetation to the east of the receptor to screen all views of the Proposed Development where glint and glare is possible. The third image has been taken where the red point is located using Google Earth's 3D modelling and has a view of the vegetation located within the grounds of the receptor. This image confirms that there is sufficient vegetation within the grounds of the receptor to screen all views to the west of the receptor, where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 26

14.104 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that small north eastern and north western sections of the Proposed Development can potentially impact on the receptor.

14.105 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1113 in front of the receptor with a view towards the Proposed Development. It shows a tree line that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 27

14.106 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that a small north eastern section and western section of the Proposed Development can potentially impact on the receptor.

14.107 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1113 in front of the receptor with a view towards the Proposed Development. It shows a tree line that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 28

14.108 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that the north eastern, central and western sections of the Proposed Development can potentially impact on the receptor.

14.109 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1113 in front of the receptor with a view towards the Proposed Development. It shows a tree line that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 29

14.110 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that the north eastern, central and western sections of

the Proposed Development can potentially impact on the receptor.

14.111 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1113 in front of the receptor with a view towards the Proposed Development. It shows a tree line that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 30 and 31

14.112 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that eastern and western sections of the Proposed Development can potentially impact on both the receptors.

14.113 The image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. The second image has been taken from within the Application Site using Google Earth's 3D modelling with a view towards both receptors. This image shows that there is insufficient vegetation to the west of the receptors to screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact remains High.

Receptor 32 and 33

14.114 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that the northern half of the Proposed Development can potentially impact on the receptors.

14.115 The first image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. It shows there is likely to be sufficient buildings and vegetation to the west of the receptors to screen views of the Proposed Development where glint and glare is possible. The second image has been taken where the red point is located on the aerial image and shows the hedgerow located to the west of the receptors. This image confirms that the hedgerow located to the west of the receptors will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 34 and 35

14.116 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that the northern half of the Proposed Development can potentially impact on the receptors.

14.117 The first image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. It shows there is likely to be sufficient vegetation to the west of the receptors to screen views of the Proposed Development where glint and glare is possible. The second image has been taken where the red point is located on the aerial image and has a view of the hedgerow located to the west of the receptors. This image confirms that the hedgerow located to the west (furthest one away in this image) of the receptors will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 36, 37 and 38

14.118 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that the northern half

of the Proposed Development can potentially impact on the receptors.

14.119 The first image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. It shows there is likely to be sufficient vegetation to the west of the receptors to screen views of the Proposed Development where glint and glare is possible. The second image has been taken where the red point is located on the aerial image and has a view towards the receptors and of the hedgerow located to the west of the receptors. This image confirms that the hedgerow located to the west of the receptors will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 39 and 40

14.120 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that all, except a small southern section, of the Proposed Development can potentially impact on the receptors.

14.121 The first image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. It shows there is likely to be sufficient vegetation to the west of the receptors to screen views of the Proposed Development where glint and glare is possible. The second image has been taken where the red point is located on the aerial image and has a view towards the receptors and of the hedgerow located to the west of the receptors. This image confirms that the hedgerow located to the west of the receptors will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 41, 42 and 43

14.122 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that all, except for a northeast section, of the Proposed Development can potentially impact on the receptors.

14.123 The first image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. It shows there will be sufficient screening from other buildings between the receptors and the Proposed Development to screen all views where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 44 and 45

14.124 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that almost all of the Proposed Development can potentially impact on the receptors.

14.125 The first image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. It shows there is likely to be sufficient vegetation to the west of the receptors to screen views of the Proposed Development where glint and glare is possible. The second image has been taken where the red point is located on the aerial image and has a northern view of the vegetation located between the receptors and the Proposed Development. This image confirms that the vegetation located between the receptors and the Proposed Development will screen all views where glint and glare is possible. Therefore, the impact is reduced to None.

Receptors 46 - 50

14.126 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that all, except for a northeast section, of the Proposed Development can potentially impact on the receptors.

14.127 The first image in **Appendix 14.6** is an aerial image which shows the receptors' locations in relation to the Proposed Development. It shows there is likely to be sufficient vegetation to the west of the receptors to screen views of the Proposed Development where glint and glare is possible. The second image has been taken where the red point is located on the aerial image and has a view back towards the receptors and of the vegetation to the west of these receptors. This image confirms that the vegetation located to the west of the receptors will screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 51

14.128 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that all, except for a northeast section, of the Proposed Development can potentially impact on the receptor.

14.129 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1067 in front of the receptor with a view towards the Proposed Development. It shows a tree line that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 52

14.130 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that all, except for an eastern section, of the Proposed Development can potentially impact on the receptor.

14.131 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1067 in front of the receptor with a view towards the Proposed Development. It shows vegetation that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 53

14.132 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that all, except for an eastern section, of the Proposed Development can potentially impact on the receptor.

14.133 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1113 in front of the receptor with a view towards the Proposed Development. It shows vegetation that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 54

14.134 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that the western half of the Proposed Development can potentially impact on the receptor.

14.135 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1113 in front of the receptor with a view towards the Proposed Development. It shows there is sufficient vegetation that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 55

14.136 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that part of the southwest section of the Proposed Development can potentially impact on the receptor.

14.137 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1113 in front of the receptor with a view towards the Proposed Development. It shows there is sufficient vegetation that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 56

14.138 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that part of the southwest section of the Proposed Development can potentially impact on the receptor.

14.139 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of the receptor and the topography of the area. The second image is taken on the B1113 in front of the receptor with a view towards the Proposed Development. It shows there is sufficient vegetation that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 58 and 59

14.140 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that the southwest sections of the Proposed Development can potentially impact on the receptors.

14.141 The first image in **Appendix 14.6** shows the view with no obstructions. This shows the location of the Proposed Development in relation to the location of both receptors and the topography of the area. The second image is taken on Bullet Lane in front of the receptors with a view towards the Proposed Development. It shows that there is sufficient vegetation that will screen all views into the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Residential Area 1

14.142 This encompasses a number of residential receptors including those at receptor points 26-29 (assessed above). Each receptor assessed

represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. Based on the assessments for these four receptor points within **Table 14.8**, and the visibility analysis, the impacts are assessed as being None (worst case scenario).

Residential Area 2

14.143 This encompasses a number of residential receptors including those at receptor points 36-38 (assessed above). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. Based on the assessments for these three receptor points within **Table 14.8**, and the visibility analysis, the impacts are assessed as being None (worst case scenario).

Residential Area 3

14.144 This encompasses a number of residential receptors including those at receptor points 41-57 (assessed above). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. Based on the assessments for these 17 receptor points within **Table 14.8**, and the visibility analysis, the impacts are assessed as being None (worst case scenario).

Road Receptors

14.145 **Table 14.9** 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 14.3**.

14.146 The 14 receptors 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 Proposed Development.

Table 14.9 - *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	1	4	0	High
4	0	57	0	High
5	1	1602	0	High
6	0	4479	0	High
7	0	3843	0	High
8	0	3292	0	High
9	0	2806	0	High
10	0	1855	0	High
11	0	410	0	High
12	0	0	0	None
13	0	0	0	None
14	0	0	0	None
15	0	0	0	None
16	0	5	0	High
17	0	18	0	High
18	0	9451	0	High
19	0	3847	0	High
20	0	4844	0	High
21	0	2605	0	High
22	0	1650	0	High

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
23	0	1082	0	High
24	0	517	0	High
25	17	2102	0	High
26	5	1942	0	High
27	5	2068	0	High
28	1	1693	0	High
29	0	1282	0	High
30	0	3472	0	High
31	0	7778	0	High
32	4201	18526	0	High
33	0	16600	0	High
34	0	8607	0	High
35	0	8639	0	High
36	0	7343	0	High
37	0	6823	0	High
38	0	7650	0	High
39	0	17483	0	High
40	0	5812	0	High
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	9	0	None
47	0	601	0	High

14.147 As can be seen in **Table 14.9**, there are 35 receptor points which have potential glare impacts with the "potential for after-image" (yellow glare), which is a High impact. **Appendix 14.3** shows detailed analysis of when the glint and glare impacts are possible, whilst also showing from which parts of the solar farm the solar glint is reflected from.

14.148 **Appendix 14.6** shows two Google Earth images taken towards the Proposed Development 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 solar farm has been drawn as a white polygon and can be seen on the images when the solar farm is theoretically visible. The area of the solar farm 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 solar farm where reflections are theoretically possible will be visible from the receptor point. For receptor 32 there is another image that has been used to show the

hedgerow height in comparison to the road. Also, each PV Array has been numbered in Figure 2: **Appendix 14.1** so that it can be seen which Array is causing the glare on each receptor.

14.149 As can be seen in **Appendix 14.6**, views of the Proposed Development from all receptors, with the exception of receptors 7, 8, 32, 34, 35 and 37, are blocked by a mixture of intervening vegetation, buildings, and topography. Therefore, impacts upon these receptors reduce to None.

14.150 Receptors 7 and 8, which are located approximately 250m southeast of the Proposed Development on the B1113, has glare impacts that occur outside the driver's field of view (50 Degrees). This is shown with the blue lines which are drawn in **Appendix 14.6**. Therefore, the impact is reduced to low as any glare impacts will be on their peripheral vision and is less likely to cause impairment to the drivers' vision. Impacts upon receptors 18, 32, 34, 35 and 37, remain High.

Rail Receptors

14.151 **Table 14.10** shows a summary of the modelling results for each of the Rail Receptor Points whilst the detailed results and ocular impact charts can be viewed in **Appendix 14.4**.

Table 14.10 - *Potential for Glint and Glare impact on Rail Based Receptors*

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact
1	0	0	0	None
2	15	88	0	High
3	34	260	0	High
4	23	875	0	High
5	7	1895	0	High
6	2	3109	0	High

14.152 As can be seen in **Table 14.10**, there are five receptor points which have potential glare impacts with the "potential for after-image" (yellow glare), which is a High impact. **Appendix 14.4** shows detailed analysis of when the glint and glare impacts are possible, whilst also showing from which parts of the solar farm the solar glint is reflected from.

14.153 **Appendix 14.6** shows Google Earth images that give an insight into how each receptor will be impacted by the glint and glare from the Proposed Development. There is a mixture of images taken, which include aerial, ground level and street level. The aerial images show the location of the receptor with the solar farm drawn as a white polygon and can be seen on the images when the solar farm is theoretically visible. The area of the solar farm from where reflections may be possible has been drawn as a yellow polygon. The ground level terrain is based on the height data of the surrounding land showing no intervening vegetation or buildings. The white and yellow polygons can be seen in this view also. The street view gives a good indication as to whether the area of the solar farm where reflections are theoretically possible will be visible from the receptor point.

Receptor 2

14.154 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.4**, shows that a small northwest section of the Proposed Development can potentially impact on the receptor.

14.155 The first image in **Appendix 14.6** is an aerial image which shows the location of the receptor in relation to the Proposed Development. It shows there is likely to be sufficient buildings and vegetation to the west of the receptors to screen all views of the Proposed Development where glint and glare is possible. The second image has been taken using Google Earth's 3D modelling and has a view of the vegetation located to the west of the receptor. This image confirms that there is sufficient vegetation within the grounds of the receptor to screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 3

14.156 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.4**, shows that a northwest section of the Proposed Development can potentially impact on the receptor.

14.157 The first image in **Appendix 14.6** is an aerial image which shows the receptors' location in relation to the Proposed Development. It shows there is likely to be sufficient buildings and vegetation to the west of the receptors to screen all views of the Proposed Development where glint and glare is possible. The second image has been taken using Google Earth's 3D modelling and has a view of the vegetation located to the west of the receptor. This image confirms that there is sufficient vegetation and structures within the grounds of the receptor to screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 4

14.158 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.2**, shows that the northern half of the Proposed Development can potentially impact on the receptor.

14.159 The image in **Appendix 14.6** is an aerial image which shows the location of the receptor in relation to the Proposed Development. The second image is an aerial image which shows the receptor at the green point, with the driver's field of view (50-degrees) shown between the two green lines for each direction. This image shows the glare that could potentially impact upon the receptor outside the field of view for the train driver. Therefore, the impact is reduced to low as any glare impacts will be on their peripheral vision and is less likely to cause impairment to the drivers' vision.

Receptor 5

14.160 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.4**, shows that all, except for some eastern sections, of the Proposed Development can potentially impact on the receptor.

14.161 The first image in **Appendix 14.6** is an aerial image which shows the location of the receptor in relation to the Proposed Development. It shows there is likely to be sufficient buildings and vegetation to the west of the receptors to screen all views of the Proposed Development where glint and glare is possible. The second image has been taken using Google Earth's 3D modelling and has a view of the vegetation located to the west of the receptor. This image confirms that there is sufficient vegetation within the grounds of the receptor to screen all views of the Proposed Development where glint and glare is possible. Therefore, the impact is reduced to None.

Receptor 6

14.162 The 'Glare Reflections on the PV Footprint' chart shown in **Appendix 14.4**, shows that all of the Proposed Development can potentially impact on the receptor.

14.163 The image in **Appendix 14.6** is an aerial image which shows the location of the receptor in relation to the Proposed Development. The second image is an aerial image which shows the receptor at the green point, with the driver's field of view (50-degrees) shown between the two green lines for each direction. This image shows the glare that could potentially impact upon the receptor outside the field of view for the train driver. Therefore, the impact is reduced to low as any glare impacts will be on their peripheral vision and is less likely to cause impairment to the drivers' vision.

Aviation Receptors

14.164 **Table 14.11** shows a summary of the modelling results for each of the runway approach paths and the ATCT, whilst the detailed results and ocular impact charts can be viewed in **Appendix 14.5**.

14.165 As can be seen in **Table 14.11**, there is no glare anticipated at either of the runways or the ATCT. Therefore, the impact on aviation assets is None and not significant.

Table 14.11 - *Summary of Wattisham Airfield Glare Results*

Component	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)
Runway 05	0	0	0
Runway 23	0	0	0
ATCT	0	0	0

Ground Based Receptor Mitigation

14.166 Mitigation measures are required to be put in place due to the High impact that was found during the visibility analysis at Residential Receptors 30 and 31 and at Road Receptors 18, 32, 34, 35 and 37. Mitigation measures are being included as part of the Landscape Proposals (**Figure 11.8**) which will be submitted in conjunction with this Glint and Glare Assessment. These measures include:

- A tree belt of at least 5m wide has been proposed along the eastern boundary of the Proposed Development. Initial planting will provide some level of screening which will reduce the impact down to Low for Residential Receptors 30 and 31. After five years of the tree belt growing, impacts at Residential Receptors 30 and 31 will reduce to None.
- All hedgerows on the Application Site are to be gapped up and maintained to at least 3m in height. Therefore, this will screen all views of the Proposed Development from Road Receptors 7, 8, 18, 32, 34, 35 and 37 and from Rail Receptors 4 and 6. Therefore, reducing the impacts to None.

14.167 **Tables 14.12, 14.13** and **14.14** 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 14.12 - *Potential Residual Glint and Glare Impacts on Residential Receptors*

	Magnitude of Impact		
Receptor	After Geometric Analysis	After Visibility Analysis	Residual Impacts
1	None	None	None
2	Low	None	None
3	Low	None	None
4	Low	None	None
5	Medium	None	None
6	High	None	None
7	High	None	None
8	High	None	None
9	High	None	None
10	High	None	None
11	High	None	None
12	High	None	None
13	High	None	None
14	High	None	None
15	High	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

	Magnitude of Impact		
Receptor	After Geometric Analysis	After Visibility Analysis	Residual Impacts
23	High	None	None
24	None	None	None
25	None	None	None
26	High	None	None
27	High	None	None
28	High	None	None
29	High	None	None
30	High	High	Low after initial planting. None after five years.
31	High	High	Low after initial planting. None after five years.
32	High	None	None
33	High	None	None
34	High	None	None
35	High	None	None
36	Low	None	None
37	Low	None	None
38	Low	None	None
39	Medium	None	None
40	Medium	None	None
41	High	None	None
42	High	None	None
43	High	None	None
44	High	None	None
45	High	None	None

	Magnitude of Impact		
Receptor	After Geometric Analysis	After Visibility Analysis	Residual Impacts
46	High	None	None
47	High	None	None
48	High	None	None
49	High	None	None
50	High	None	None
51	High	None	None
52	High	None	None
53	High	None	None
54	Medium	None	None
55	Low	None	None
56	Low	None	None
57	None	None	None
58	Low	None	None
59	Low	None	None

Table 14.13 - *Potential Residual Glint and Glare Impacts on Road Receptors*

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

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

	Magnitude of Impact		
Receptor	After Geometric Analysis	After Visibility Analysis	Residual Impacts
46	None	None	None
47	High	None	None

Table 14.14 - *Potential Residual Glint and Glare Impacts on Rail Receptors*

	Magnitude of Impact		
Receptor	After Geometric Analysis	After Visibility Analysis	Residual Impacts
1	None	None	None
2	High	None	None
3	High	None	None
4	High	Low	None
5	High	None	None
6	High	Low	None

SUMMARY

14.168 There is little guidance or policy available in the UK at present in relation to the assessment of glint and glare from Proposed Development developments. However, it is recognised as a potential impact which needs to be considered for a Proposed Development, therefore this assessment considers the potential impacts on ground-based receptors such as roads, rail, and residential dwellings as well as aviation assets.

14.169 This assessment considers the potential impacts on ground-based receptors such as roads, rail and residential dwellings as well as aviation assets. A 1km survey area around the Application Site is considered adequate for the assessment of ground-based receptors, whilst a 30km study area is chosen for aviation receptors. Within 1km of the Application Site, there are 71 residential receptors, 61 road receptors and six rail receptors which were considered. 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 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. Twelve residential, and 14 road receptors were dismissed as they are located within the no reflection zones. Eleven aerodromes are located within the 30km study area; however, only Wattisham Airfield required a detailed assessment due to its size and/or orientation in relation to the Proposed Development. The other ten aerodromes did not require detailed assessments as they did not fall within their respective safeguarding buffer zones of the Proposed Development, which are outlined in **paragraph 14.54 on page 297**.

14.170 Geometric analysis was conducted at 59 individual residential receptors, including three residential areas, 47 road receptors and six rail receptors.

14.171 The assessment concludes that:

- Solar reflections are possible at 48 of the 59 residential receptors assessed within the 1km study area. The initial bald-earth scenario identified potential impacts as High at 34 receptors, including two residential areas, Medium at four receptors, Low at ten receptors, including one residential area, and None at the remaining eleven. Upon reviewing the actual visibility of the receptors, glint and glare impacts remained High for two receptors and reduced to None for the remaining 57 receptors, including three residential areas. Once mitigation measures were considered, all impacts reduce to None for all receptors.
- Solar reflections are possible at 35 of the 47 road receptors assessed within the 1km study area. Upon reviewing the actual visibility of the receptors, glint and glare impacts remain High at five receptors, reduce to Low at two receptors and None at the remaining receptors. Once mitigation measures were considered, impacts reduce to None for all receptors.
- Solar reflections are possible at all six rail receptors assessed within the 1km study area. Upon reviewing the actual visibility of the receptors, glint and glare impacts reduce to Low for two receptors (4 and 6) and reduce to None at the remaining four receptors. Once mitigation measures were considered, impacts reduce to None for all receptors.
- Two runways and an ATCT were assessed at Wattisham Airfield, and it was found that the impacts would be None.

14.172 Mitigation measures are required to be put in place due to the High impact that was found during the visibility analysis at residential receptors 30 and 31 and also at road receptors 7, 18, 32, 34 and 35. This includes a tree belt being implemented along the eastern boundary of the Proposed Development and to ensure that all the hedgerows within the Application Site are gapped up and maintained to height of at least 3m.

14.173 The effects of glint and glare and their impact on local receptors has been analysed in detail and the impact on all receptors is predicted to be None once all mitigation measures have been implemented and the tree belt has sufficiently grown along the eastern boundary of the Proposed Development. However, until the tree belt has grown, in five years, the impacts at Residential Receptors 30 and 31 will be Low.

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