Glint and Glare Assessment

North Farm Solar Farm

29/07/2020

Disclaimer

Neo Environmental Limited shall have no liability for any loss, damage, injury, claim, expense, cost or other consequence arising as a result of use or reliance upon any information contained in or omitted from this document.

Neo Environmental Ltd	
Head Office - Glasgow: Wright Business Centre, 1 Lonmay Road, Glasgow. G33 4EL T 0141 773 6262 E: info@neo-environmental.co.uk	
Warrington Office: Cinnamon House, Crab Lane, Warrington, WA2 0XP. T: 01925 661 716 E: info@neo-environmental.co.uk	**Rugby Office:** Valiant Suites, Lumonics House, Valley Drive, Swift Valley, Rugby, Warwickshire, CV21 1TQ. T: 01788 297012 E: info@neo-environmental.co.uk
Ireland Office: Johnstown Business Centre, Johnstown House, Naas, Co. Kildare. T: 00 353 (0)45 844250 E: info@neo-environmental.ie	**Northern Ireland Office:** Unit 3, the Courtyard Business Park, Galgorm Castle, Ballymena, Northern Ireland, BT42 1HL. T: 02890 517 092 E: info@neo-environmental.co.uk

Prepared For:

North Farm Solar Extension Ltd

Prepared By:

Michael McGhee BSc TechIOA

	Name	Date
Edited By:	Michael McGhee	29/07/2020
Checked By:	Colleen Patterson	29/07/2020
	Name	**Signature**
Approved By	Paul Neary	

Contents

1. EXECUTIVE SUMMARY

1.1. This glint and glare assessment has been undertaken in relation to the extension of a solar on lands at North Farm, Dorset.

1.2. There is little guidance or policy available in the UK at present in relation to the assessment of glint and glare from proposed solar farm 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.

1.3. A 1km survey area around the Application Site is considered adequate for the assessment of ground-based receptors, whilst a 20km study area is chosen for aviation receptors. Following an initial assessment, rail and road receptors were scoped out as assets that will be impacted upon from the Proposed Development.

1.4. There are two Aerodromes within the 20km study area, however these are small grass strips and would only require detailed assessment if they were within 5km, therefore aviation assets were also scoped out of assets that will be impacted by the Proposed Development.

1.5. Within the 1km study area, there are six residential receptors which were considered. However, four of these residential receptors were also dismissed as they are located within the no reflection zones.

1.6. Geometric analysis was conducted at two residential receptors and the assessment concludes that:

- Solar reflections are possible at both of the residential receptors which were assessed in detail. The initial bald-earth scenario identified potential impacts at both was **High**. Upon reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** at both.

1.7. The impacts of glint and glare and their associated effects on local receptors has been analysed in detail and there is predicted to be **None** impacts, and therefore **No Significant Effects**.

2. INTRODUCTION

BACKGROUND

2.1. Neo Environmental Ltd has been appointed by North Farm Solar Extension Ltd (the "Applicant") to undertake a Glint and Glare Assessment for a proposed solar farm development (the "Proposed Development") on lands at North Farm, Dorset (the "Application Site").

2.2. Please see **Figure 2: Appendix A** for the layout of the Proposed Development.

DEVELOPMENT DESCRIPTION

2.3. The Proposed Development will consist of an extension to an existing North Solar Farm comprising ground mounted solar PV panels with a capacity 20 MW, including mounting system, battery storage units, inverters, underground cabling, grid connection hub, stock proof fence, CCTV, internal tracks and associated infrastructure, landscaping and environmental enhancements, for a temporary period of 40 years.

SCOPE OF REPORT

2.4. 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.

2.5. 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.

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

2.7. This report will concentrate on the impacts of glint and their effects on local receptors and will be supported with the following Figures and Appendices.

- Appendix A: Figures
  - Figure 1: Residential Receptors

  - Figure 2: Infrastructure Layout

- Appendix B: Residential Receptor Results
- Appendix C: Photo Register
- Appendix D: Solar Module Glare and Reflectance Technical Memo[1]

Statement of Authority

2.8. This Glint and Glare Assessment has been produced by 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.

Definitions

2.9. 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 Guidance (FAA) in their "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[2] have defined the terms 'Glint' and 'Glare' as meaning;

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

2.10. 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 had 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.

[1] Sunpower Corporation (September 2009), T09014 Solar Module Glare and Reflectance Technical Memo

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

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

General Nature of Reflectance from Photovoltaic Panels

2.11. In terms of reflectance, photovoltaic solar panels are not highly reflective surfaces. 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 glass, steel, snow and white concrete by comparison (see **Appendix D** for details). Similar levels of reflectance can be found in rural environments from 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 several 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 which used a number of case studies and expert opinions, including from Neo Environmental. 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…*"[3].

Time Zones / Datum's

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

2.13. 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.

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

3. LEGISLATION AND GUIDANCE

National Planning Policy Guidance (NPPG) on Renewable and Low Carbon Energy (UK) [4]

3.1. 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

3.2. As outlined within the BRE document 'Planning Guidance for the Development of Large Scale Ground Mounted Solar PV Systems'[5]

"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

---

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

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

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)

3.3. 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[6]', they also intend to undertake a review of the potential impacts of solar PV developments upon aviation, however this is yet to be published.

3.4. 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. In particular, developers should take cognisant of the following articles of the ANO[7], 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."*

[6] CAA (2010) Interim CAA Guidance – Solar Photovoltaic Systems. Available at: http://www.enstoneflyingclub.co.uk/files/caa_view_on_solar_panel_instalations.pdf?PHPSESSID=8900a41db8a205da84fca7bbc14eae69

[7] CAA (2015) Air Navigation: The Order and Regulations. Available at: http://publicapps.caa.co.uk/docs/33/CAP%20393%20Fourth%20edition%20Amendment%201%20April%202015.pdf

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

3.6. These Articles are considered within the assessment of glint and glare of the Proposed Development.

US Federal Aviation Administration Policy

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

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

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

3.3. Crucially, the policy provides a quantitative threshold which is lacking in the Irish 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 Ireland, this US document has been utilised as guidance for this report.

3.4. 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:

---

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

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

- 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.

3.5. 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 reportfollows the methodology required by the FAA as it offers the most robust assessment method currently available.

4. METHODOLOGY

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

Sun Position and Reflection Model

Sun Data Model

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

Solar Reflection Model

4.3. The position of the sun is calculated at one-minute intervals of a typical year, in this instance the year assessed is 2020.

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

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

4.5. The model assumes that the azimuth and horizontal angle of the sun is the same across the whole 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.

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

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

4.7. 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.

4.8. The solar reflection in the model is considered to be specular as a worst-case scenario. In practice, the light from the sun will not be fully reflected as solar panels are designed to absorb light rather than reflect it. The previous text and **Appendix D** outline the reflective properties of solar glass and compares it to other reflective surfaces. Although the exact figures in this report are not conclusive, 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 decreases as the angle of incidence decreases.

4.9. 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.

Relevant Parameters of the Proposed Development

4.10. The photovoltaic (PV) 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 be inclined at an angle of 20 degrees.

4.11. The maximum above ground level height of the panels is 2.8m and points at the centre of the panels are used to determine the potential for glint and glare generation.

IDENTIFICATION OF RECEPTORS

Ground Based Receptors

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

4.13. 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.

4.14. An observer height of 2m was utilised for residential receptors, as this is a typical height for a ground-floor window. Upper floor windows are not analysed geometrically; however, are considered as part of the visual analysis. 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 within this assessment.

4.15. An assessment was undertaken to determine zones where solar reflections will never be directed near ground level, known as "no reflection zones".

Aviation

4.16. 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. En-route activities are not considered an issue as the flight will most likely be at a higher altitude than the solar reflection.

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

4.18. Buffer zones to identify aviation assets varies depending on the safeguarding criteria of that asset. For large aerodromes a study area of 20km is standard, however for small private airstrips this can be reduced to approximately 5km.

Magnitude of Impact

Static Receptors

4.19. 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)

4.20. 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 applied to aviation assets, based on the ocular impact and the potential for after-image.

4.21. 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).

Moving Receptors (Aviation)

Approach Paths

4.22. Each final approach path which has the potential to receive glint is assessed using the Solar Glare Hazard Analysis Tool (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.

4.23. 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.

4.24. The FAA guidance states that there should be no potential for glare or 'low potential for after-image' at any existing or future planned runway landing thresholds in order for the proposed Development to be acceptable.

Air Traffic Control Tower (ATCT)

4.25. 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 and unobstructed view of aviation activity. The key areas on an aerodrome are the views towards the runway thresholds, taxiways and aircraft bays.

4.26. The FAA guidance states that no solar reflection towards the ATCT should be produced by a proposed solar development (see Policy and Guidance Chapter), however this should be assessed on a site by site basis and will depend on the operations at a particular aerodrome.

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

Determination of Ocular Impact

4.28. 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.

4.29. 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.

4.30. The ocular impact[11] of viewed glare can be classified into three levels based on the retinal irradiance and subtended source angle: low potential for after-image (green), potential for after-image (yellow), and potential for permanent eye damage (red).

4.31. 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.

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

Assessment Limitations

4.32. 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.

5. BASELINE CONDITIONS

Ground Based Receptors Reflection Zones

5.1. In the northern hemisphere, there will never be solar reflections due south of a solar PV development as the position of the sun is always south. Furthermore, due to the slant of a solar panel (where the sun is due south, with an azimuth angle of 180 degrees), reflections will be directed skyward and not impact on ground-based receptors. The ground-based receptor reflection zone is a procedure which eliminates certain areas in order to reduce the assessment procedure, much in the same way a zone of theoretical visibility (ZTV) map allows a Landscape Architect to focus their assessment on areas where the solar PV development will be visible.

5.2. 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.

5.3. Further analysis showed that this will only occur between the azimuth of 248.4 degrees and 291.6 degrees in the western direction (late day reflections) and 68.4 degrees and 111.6 degrees in the eastern direction (morning reflections) and therefore any ground-based receptor outside these arcs will not have any impact from solar reflections.

5.4. **Figure 1: Appendix A** shows the study area whilst also subtracting from this the area where solar reflections will not impact on ground-based receptors due to the reasons set out in **paragraphs 5.1 to 5.3.**

Residential Receptors

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

5.6. The ground receptor no-reflection zones are clearly identifiable on **Figure 1: Appendix A** and the process of how these are calculated is explained in **paragraphs 5.1 to 5.3** of this report.

Table 5-1: Residential Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1	386402	100890	Yes
2	386344	101417	Yes

3	387735	102324	No
4	387888	102510	No
5	387891	102534	No
6	387923	102540	No

Road / Rail Receptors

5.7. There are no railway lines within close proximity to the site which require assessment and therefore the impact on railway infrastructure is **None**.

5.8. There are some minor roads which serve dwellings and farms within the study area; however, these have been dismissed as vehicle users of these roads will likely be travelling at low speeds and therefore, there is a reduced risk of safety effects from glint and glare. The closest road which would require a detailed assessment is the A354 which is located 1.6km to the west. A brief visual analysis of this road confirmed that the Proposed Development would not be visible along the stretch where glint and glare impacts could be possible and therefore the impact on roads is **None** and hence, there will be **no significant effects** on users of this road.

Aviation Receptors

5.9. Aerodromes within 20km of the proposed solar development can be found in **Table 5-2.**

Table 5-2: Airfields within close proximity

Airfield	Distance	Use
Newton Peveril	5.2km	Small Grass Strip
Bovington	11.2km	Small Grass Strip

5.10. There are two Aerodromes within 20km of the Proposed Development, however these are small grass strips and would only require detailed assessment if they were within 5km. The impact on Aviation is therefore **None** and hence, there will be **no significant effects** on aviation as a result of the Proposed Development.

6. IMPACT ASSESSMENT

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

GROUND BASED RECEPTORS

Residential Receptors

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

6.3. The 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.

6.4. **Appendix B** contains the detailed analysis of the glint and glare impacts. **Table 6.1** shows the impact at each receptor.

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

	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact
Receptor	AM	PM	Minutes	Hours	
1	Yes	No	2240	37.3	High
2	Yes	No	2232	37.2	High

6.5. As detailed in **Table 6-1,** there is a **High** impact at both the receptor points.

6.6. **Appendix C** shows an aerial image of the Proposed Development and receptor location. The solar farm has been drawn as a white polygon and the area of the solar farm from where reflections may be possible has been drawn as a yellow polygon.

6.7. As can be seen in **Appendix C**, Receptors 1 and 2 will have views of the site blocked by the intervening vegetation which surrounds the dwellings and therefore the impact can be reduced to **None**.

7. CUMULATIVE ASSESSMENT

7.1. The Proposed Development is adjacent to the constructed North Farm Solar Farm. Due to the fact that the Proposed Development has no impact at any receptor, the cumulative assessment can be dismissed.

8. SUMMARY

8.1. As identified by UK policy, glint and glare is recognised as a potential impact which needs to be considered for a proposed solar development.

8.2. 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 20km study area is chosen for aviation receptors. Following an initial assessment, rail and road receptors were scoped out as assets that will be impacted upon from the Proposed Development.

8.3. There are two Aerodromes within the 20km study area, however these are small grass strips and would only require detailed assessment if they were within 5km, therefore aviation assets were also scoped out of assets that will be impacted by the Proposed Development.

8.4. Within the 1km study area, there are six residential receptors which were considered. However, four of these residential receptors were also dismissed as they are located within the no reflection zones.

8.5. Geometric analysis was conducted at two residential receptors and the assessment concludes that:

- Solar reflections are possible at both of the residential receptors which were assessed in detail. The initial bald-earth scenario identified potential impacts at both was **High**. Upon reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** at both.

8.6. The impacts of glint and glare and their associated effects on local receptors has been analysed in detail and there is predicted to be **None** impacts, and therefore **No Significant Effects**.

9. APPENDICES

Appendix A: Figures

- Figure 1: Residential Receptors
- Figure 2: Infrastructure Layout

Appendix B: Residential Receptor Results

Appendix C: Photo Register

Appendix D: Solar Module Glare and Reflectance Technical Memo

HEAD OFFICE - GLASGOW

Wright Business Centre, 1 Lonmay Road, Glasgow G33 4EL | T: 0141 773 6262 | W: www.neo-environmental.co.uk

N. IRELAND OFFICE

Unit 3, The Courtyard Business Park
Gargorm Castle, Ballymena,
Northern Ireland
BT42 1HL
T: 0282 565 04 13
E: info@neo-environmental.co.uk

IRELAND OFFICE

Johnstown Business Centre
Johnstown House, Naas
Co. Kildare
T: 00 353 (0)45 844250
E: info@neo-environmental.ie
W: neo-environmental.ie

RUGBY OFFICE

Valiant Office Suites
Lumonics House, Valley Drive,
Swift Valley, Rugby,
Warwickshire, CV21 1TQ
T: 01788 297012
E: info@neo-environmental.co.uk

WARRINGTON OFFICE

Cinnamon House, Cinnamon Park
Crab Lane, Fearnhead
Warrington
Cheshire
T: 01925 661 716
E: info@neo-environmental.co.uk