

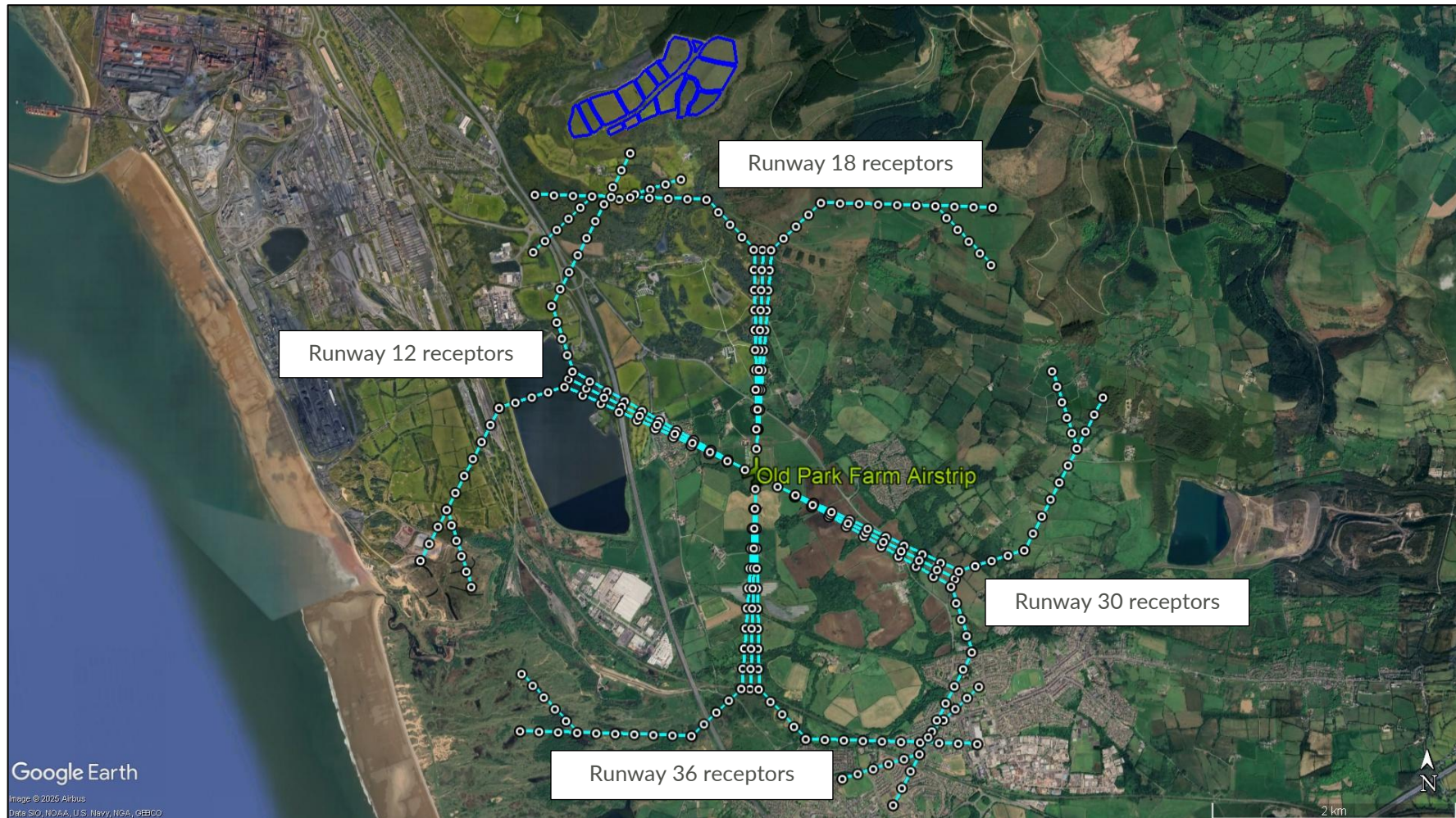


Figure 3 1-mile splayed approach path and final sections of visual circuit/join receptors – aerial image

4 IDENTIFICATION OF GROUND-BASED RECEPTORS

4.1 Overview

There is no formal guidance with regard to the maximum distance at which glint and glare should be assessed. From a technical perspective, there is no maximum distance for potential reflections. The significance of a reflection, however, decreases with distance because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases. Terrain and shielding by vegetation are also more likely to obstruct an observer's view at longer distances.

The above parameters and extensive experience over a significant number of glint and glare assessments undertaken show that consideration of receptors within 1km of panel areas is appropriate for glint and glare effects on roads and dwellings. The panels are fixed south facing and solar reflections at ground level towards the north at this latitude are highly unlikely. Therefore, the area to the north of the northern-most solar panels has been excluded. The 1km assessment area is shown as the white polygon on the subsequent figures.

Potential receptors are identified based on mapping and aerial photography of the region. The initial judgement is made based on consideration of aerial photography and mapping i.e. receptors are excluded if it is clear from the outset that no visibility would be possible. A more detailed assessment is made if the modelling reveals a reflection would be geometrically possible.

4.2 Road Receptors

4.2.1 Overview

Road types can generally be categorised as:

- Major National – Typically a road with a minimum of two carriageways with a maximum speed limit of up to 70 mph. These roads typically have fast-moving vehicles with busy traffic.
- National – Typically a road with a one or more carriageways with a maximum speed limit of up to 60 mph or 70 mph. These roads typically have fast-moving vehicles with moderate to busy traffic density.
- Regional – Typically a single carriageway with a maximum speed limit of up to 60 mph. The speed of vehicles will vary with a typical traffic density of low to moderate.
- Local - Typically roads and lanes with the lowest traffic densities. Speed limits vary.

Technical modelling is not recommended for local roads, where traffic densities are likely to be relatively low. Any solar reflections from the Proposed Development that are experienced by a road user along a local road would be considered low impact in the worst case in accordance with the guidance presented in Appendix D. The analysis will consider any major national, national, and regional roads that:

- Are within the one-kilometre study area; and
- Have a potential view of the panels.

4.2.2 Identification

A total of 22 receptors have been identified distanced circa 100 m apart across two road sections. As the effects of the Proposed Development could differ along different stretches of the road, the assessment considers the potential effects for receptors at multiple locations along each road:

- A 1.69 km section of the M4 (road receptors 1 to 18);
- A 314 m section of the A4241 (road receptors 19 to 22).

These are shown in Figure 4 below.

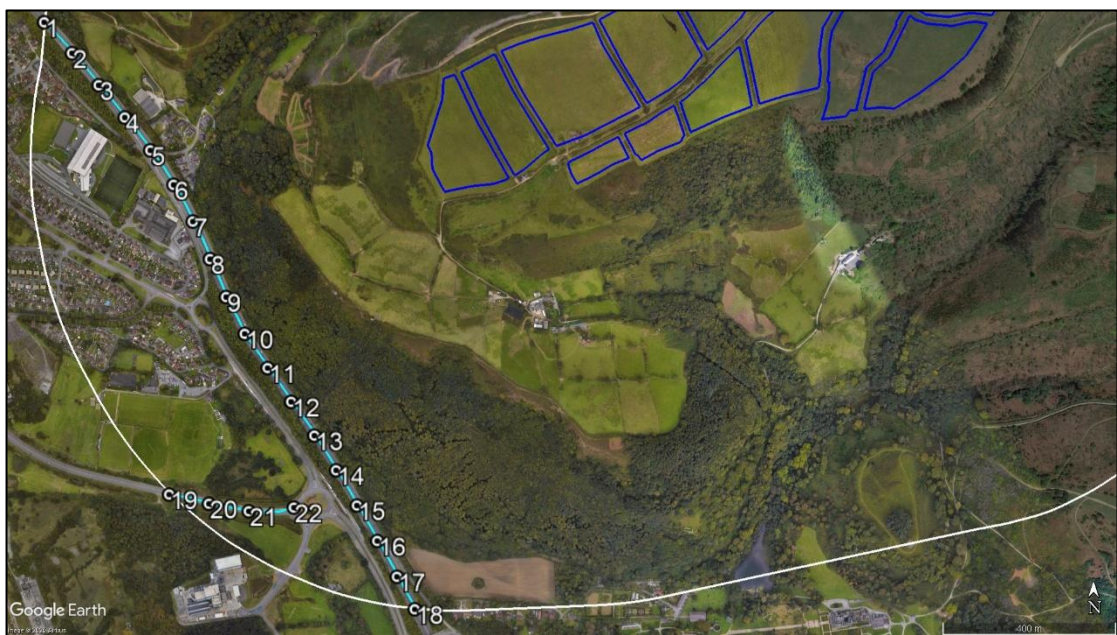


Figure 4 Overview of road receptors – aerial image

4.3 Dwelling Receptors

4.3.1 Overview

The analysis will consider dwellings that:

- Are within the 1-km study area; and
- Have a potential view of the panels.

In residential areas with multiple layers of dwellings, only the outer dwellings are considered for assessment. This is because they will mostly obscure views of the solar panels to the dwellings behind them, which will therefore not be impacted by the Proposed Development because line of sight will be removed, or they will experience comparable effects to the closest assessed dwelling.

In some cases, one physical structure is split into multiple separate addresses. In such cases, the results for the assessed location will be applicable to all associated addresses. The sampling resolution is sufficiently high to capture the level of effect for all potentially affected dwellings.

4.3.2 Identification

In total, 49 dwellings have been identified for assessment, these are shown in Figure 5 on the following page, and in more detail in Figures 7 to 11 on the following pages.



Figure 5 Overview of dwelling receptors – aerial image



Figure 6 Dwelling receptors 1 to 12 – aerial image



Figure 7 Dwelling receptors 13 to 26 – aerial image

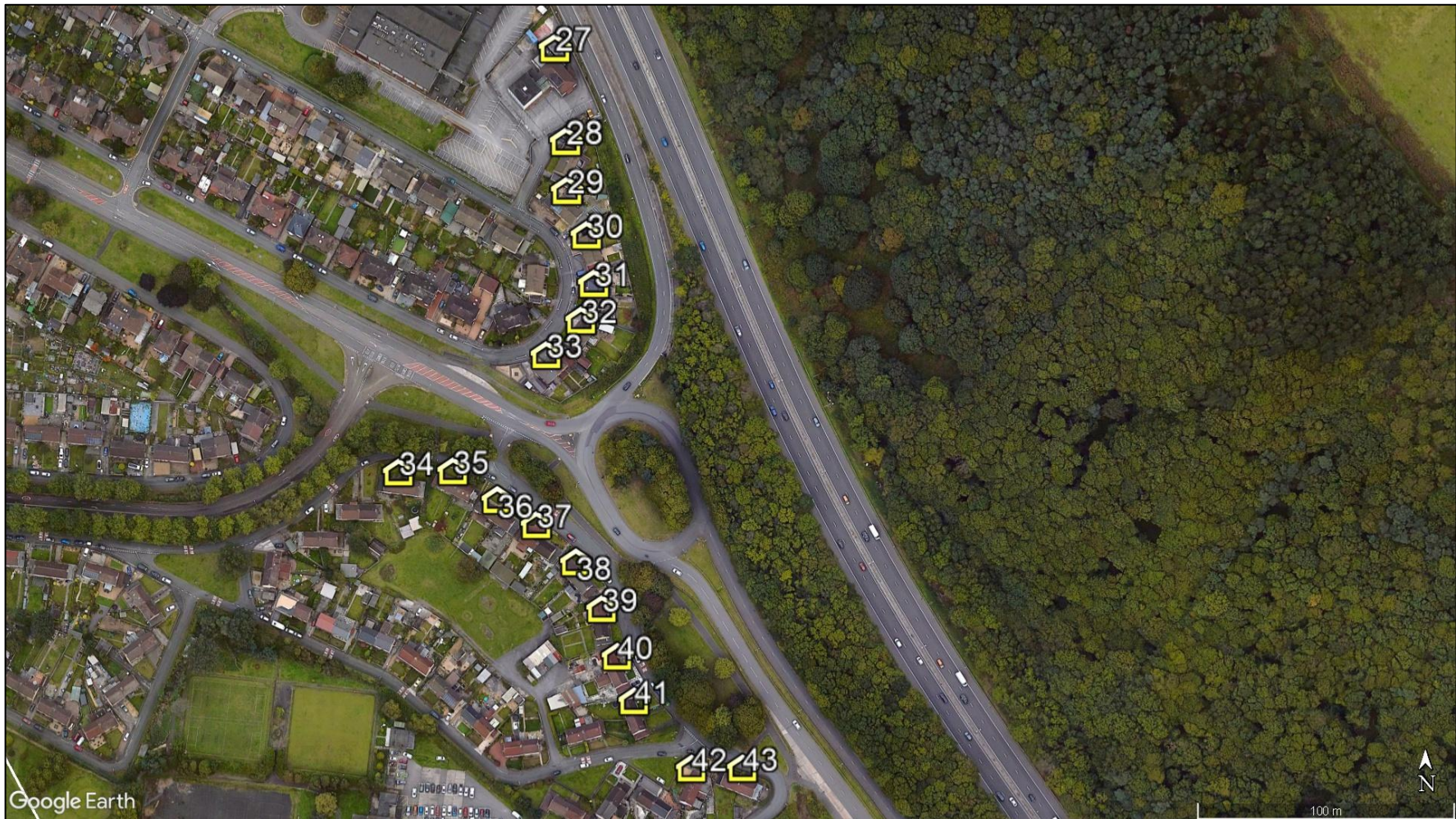


Figure 8 Dwelling receptors 27 to 43 – aerial image



Figure 9 Dwelling receptors 44 to 47 – aerial image



Figure 10 Dwelling receptors 48 to 49 – aerial image

APPENDIX A – OVERVIEW OF GLINT AND GLARE GUIDANCE

Overview

This section presents details regarding the relevant guidance and studies with respect to the considerations and effects of solar reflections from solar panels, known as ‘Glint and Glare’.

This is not a comprehensive review of the data sources, rather it is intended to give an overview of the important parameters and considerations that have informed this assessment.

UK Planning Policy

Renewable and Low Carbon Energy

The National Planning Policy Framework under the planning practice guidance for Renewable and Low Carbon Energy³ (specifically regarding the consideration of solar farms, paragraph 013) states:

‘What are the particular planning considerations that relate to large scale ground-mounted solar photovoltaic Farms?

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.

Particular factors a local planning authority will need to consider include:

...

- the proposal’s visual impact, the effect on landscape of glint and glare (see guidance on landscape assessment) 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;

...

The approach to assessing cumulative landscape and visual impact of large-scale solar farms is likely to be the same as assessing the impact of wind turbines. However, in the case of ground-mounted solar panels it should be noted that with effective screening and appropriate land topography the area of a zone of visual influence could be zero.’

³ [Renewable and low carbon energy](#), Ministry of Housing, Communities & Local Government, date: 18 June 2015, accessed on: 01/11/2021

National Policy Statement for Renewable Energy Infrastructure

The National Policy Statement for Renewable Energy Infrastructure (EN-3)⁴ sets out the primary policy for decisions by the Secretary of State for nationally significant renewable energy infrastructure. Sections 2.10.102-106 state:

- '2.10.102 Solar panels are specifically designed to absorb, not reflect, irradiation.⁵ However, solar panels may reflect the sun's rays at certain angles, causing glint and glare. Glint is defined as a momentary flash of light that may be produced as a direct reflection of the sun in the solar panel. Glare is a continuous source of excessive brightness experienced by a stationary observer located in the path of reflected sunlight from the face of the panel. The effect occurs when the solar panel is stationed between or at an angle of the sun and the receptor.*
- 2.10.103 Applicants should map receptors to qualitatively identify potential glint and glare issues and determine if a glint and glare assessment is necessary as part of the application.*
- 2.10.104 When a quantitative glint and glare assessment is necessary, applicants are expected to consider the geometric possibility of glint and glare affecting nearby receptors and provide an assessment of potential impact and impairment based on the angle and duration of incidence and the intensity of the reflection.*
- 2.10.105 The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and design. This may need to account for 'tracking' panels if they are proposed as these may cause differential diurnal and/or seasonal impacts.*
- 2.10.106 When a glint and glare assessment is undertaken, the potential for solar PV panels, frames and supports to have a combined reflective quality may need to be assessed, although the glint and glare of the frames and supports is likely to be significantly less than the panels.'*

The EN-3 does not state which receptors should be considered as part of a quantitative glint and glare assessment. Based on Pager Power's extensive project experience, typical receptors include residential dwellings, road users, aviation infrastructure, and railway infrastructure.

Sections 2.10.134-136 state:

- '2.10.134 Applicants should consider using, and in some cases the Secretary of State may require, solar panels to comprise of (or be covered with) anti-glare/anti-reflective coating with a specified angle of maximum reflection attenuation for the lifetime of the permission.*
- 2.10.135 Applicants may consider using screening between potentially affected receptors and the reflecting panels to mitigate the effects.*

⁴ National Policy Statement for Renewable Energy Infrastructure (EN-3), Department for Energy Security & Net Zero, date: January 2024, accessed on: 17/01/2024.

⁵ Most commercially available solar panels are designed with anti-reflective glass or are produced with anti-reflective coating and have a reflective capacity that is generally equal to or less hazardous than other objects typically found in the outdoor environment, such as bodies of water or glass buildings.

2.10.136 Applicants may consider adjusting the azimuth alignment of or changing the elevation tilt angle of a solar panel, within the economically viable range, to alter the angle of incidence. In practice this is unlikely to remove the potential impact altogether but in marginal cases may contribute to a mitigation strategy.'

The mitigation strategies listed within the EN-3 are relevant strategies that are frequently utilised to eliminate or reduce glint and glare effects towards surrounding observers. The most common form of mitigation is the implementation of screening along the site boundary.

Sections 2.10.158-159 state:

2.10.158 Solar PV panels are designed to absorb, not reflect, irradiation. However, the Secretary of State should assess the potential impact of glint and glare on nearby homes, motorists, public rights of way, and aviation infrastructure (including aircraft departure and arrival flight paths).

2.10.159 Whilst there is some evidence that glint and glare from solar farms can be experienced by pilots and air traffic controllers in certain conditions, there is no evidence that glint and glare from solar farms results in significant impairment on aircraft safety. Therefore, unless a significant impairment can be demonstrated, the Secretary of State is unlikely to give any more than limited weight to claims of aviation interference because of glint and glare from solar farms.

The EN-3 goes some way in acknowledging that the issue is more complex than presented in the early draft issues; though, this is still unlikely to be welcomed by aviation stakeholders, who will still request a glint and glare assessment on the basis that glare may lead to an impact upon aviation safety.

Finally, the EN-3 relates solely to nationally significant renewable energy infrastructure and therefore does not apply to all planning applications for solar farms.

Assessment Process – Ground-Based Receptors

No process for determining and contextualising the effects of glint and glare has been determined when assessing the impact of solar reflections upon surrounding roads and dwellings. Therefore, the Pager Power approach is to determine whether a reflection from the proposed solar development is geometrically possible and then to compare the results against the relevant guidance/studies to determine whether the reflection is significant.

The Pager Power approach has been informed by the policy presented above, current studies (presented in Appendix B) and stakeholder consultation. Further information can be found in Pager Power's Glint and Glare Guidance document⁶ which was produced due to the absence of existing guidance and a specific standardised assessment methodology.

⁶ Solar Photovoltaic Development Glint and Glare Guidance, Fourth Edition, March 2022. Pager Power.

Assessment Process – Railways

Railway operations is not mentioned specifically within this guidance however it is stated that a developer will need to consider ‘*the proposal’s visual impact, the effect on landscape of glint and glare and on neighbouring uses...*’. In the UK, Network Rail is a statutory consultee when a development is located in close proximity to its infrastructure.

No process for determining and contextualising the effects of glint and glare are, however, provided. Therefore, the Pager Power approach is to determine whether a reflection from a development is geometrically possible and then to compare the results against the relevant guidance/studies to determine whether the reflection is significant.

Railway Assessment Guidelines

The following section provides an overview of the relevant railway guidance with respect to the siting of signals on railway lines. Network Rail is the stakeholder of the UK’s railway infrastructure. Whilst the guidance is not strictly applicable in other countries, the general principles within the guidance is expected to apply.

A railway operator’s concerns would likely to relate to the following:

1. The development producing solar glare that affects train drivers; and
2. The development producing solar reflections that affect railway signals and create a risk of a phantom aspect signal.

Railway guidelines are presented on the following pages. These relate specifically to the sighting distance for railway signals.

Reflections and Glare

The extract below and on the following page is taken from Section A5 – Reflections and glare (pages 64-65) of the ‘Signal Sighting Assessment Requirements’⁷ which details the requirement for assessing glare towards railway signals.

Reflections and glare

Rationale

Reflections can alter the appearance of a display so that it appears to be something else.

Guidance

A5 is present if direct glare or reflected light is directed into the eyes or into the lineside signalling asset that could make the asset appear to show a different aspect or indication to the one presented.

A5 is relevant to any lineside signalling asset that is capable of presenting a lit signal aspect or indication.

⁷ Source: Signal Sighting Assessment Requirements, June 2016. Railway Group Guidance Note. Last accessed 18.10.2016.

The extent to which excessive illumination could make an asset appear to show a different signal aspect or indication to the one being presented can be influenced by the product being used. Requirements for assessing the phantom display performance of signalling products are set out in GKRT0057 section 4.1.

Problems arising from reflection and glare occur when there is a very large range of luminance, that is, where there are some objects that are far brighter than others. The following types of glare are relevant:

- a) Disability glare, caused by scattering of light in the eye, can make it difficult to read a lit display.*
- b) Discomfort glare, which is often associated with disability glare. While being unpleasant, it does not affect the signal reading time directly, but may lead to distraction and fatigue.*

Examples of the adverse effect of disability glare include:

- a) When a colour light signal presenting a lit yellow aspect is viewed at night but the driver is unable to determine whether the aspect is a single yellow or a double yellow.*
- b) Where a colour light signal is positioned beneath a platform roof painted white and the light reflecting off the roof can make the signal difficult to read.*

Options for mitigating against A5 include:

- a) Using a product that is specified to achieve high light source: phantom ratio values.*
- b) Alteration to the features causing the glare or reflection.*
- c) Provision of screening.*

Glare is possible and should be assessed when the luminance is much brighter than other light sources. Glare may be unpleasant and therefore cause distraction and fatigue, or may make the signal difficult to read and increase the reading time.

Determining the Field of Focus

The extract on the following pages is taken from Appendix F - Guidance on Field of Vision (pages 98-101) of the 'Signal Sighting Assessment Requirements'⁸ which details the visibility of signals, train drivers' field of vision and the implications with regard to signal positioning.

Asset visibility

The effectiveness of an observer's visual system in detecting the existence of a target asset will depend upon its:

- a) Position in the observer's visual field.*
- b) Contrast with its background.*
- c) Luminance properties.*

⁸ Source: Signal Sighting Assessment Requirements, June 2016. Railway Group Guidance Note. Last accessed 28.08.2020.

d) The observer's adaptation to the illumination level of the environment.

It is also influenced by the processes relating to colour vision, visual accommodation, and visual acuity. Each of these issues is described in the following sections.

Field of vision

The field of vision, or visual field, is the area of the visual environment that is registered by the eyes when both eyes and head are held still. The normal extent of the visual field is approximately 135° in the vertical plane and 200° in the horizontal plane.

The visual field is usually described in terms of central and peripheral regions: the central field being the area that provides detailed information. This extends from the central point (0°) to approximately 30° at each eye. The peripheral field extends from 30° out to the edge of the visual field.

F.6.3 Objects positioned towards the centre of the observer's field of vision are seen more quickly and identified more accurately because this is where our sensitivity to contrast is the highest. Peripheral vision is particularly sensitive to movement and light.

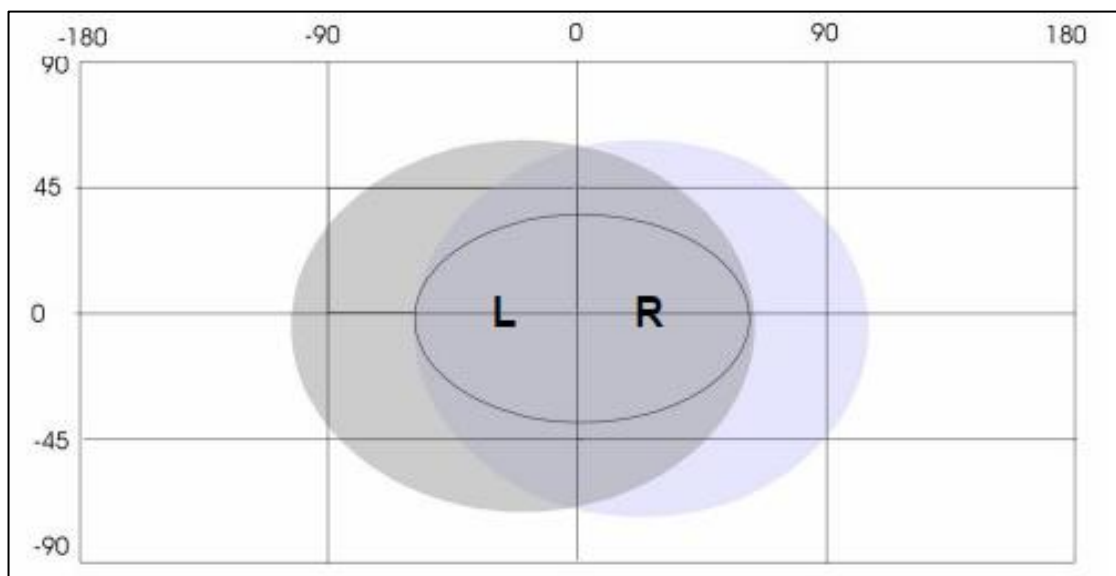


Figure G 21 - Field of view

In Figure G 21, the two shaded regions represent the view from the left eye (L) and the right eye (R) respectively. The darker shaded region represents the region of binocular overlap. The oval in the centre represents the central field of vision.

Research has shown that drivers search for signs or signals towards the centre of the field of vision.

Signals, indicators and signs should be positioned at a height and distance from the running line that permits them to be viewed towards the centre of the field of vision. This is because:

- a) As train speed increases, drivers become increasingly dependent on central vision for asset detection. At high speeds, drivers demonstrate a tunnel vision effect and focus only on objects in a field of $\pm 8^\circ$ from the direction of travel.

- b) Sensitivity to movement in the peripheral field, even minor distractions can reduce the visibility of the asset if it is viewed towards the peripheral field of vision. The presence of clutter to the sides of the running line can be highly distracting (for example, fence posts, lamp-posts, traffic, or non-signal lights, such as house, compatibility factors or security lights).

Figure G 22 and Table G 5 identify the radius of an 80 cone at a range of close-up viewing distances from the driver's eye. This shows that, depending on the lateral position of a stop signal, the optimal (normal) train stopping point could be as far as 25 m back from the signal to ensure that it is sufficiently prominent.

The dimensions quoted in Table G 5 assume that the driver is looking straight ahead. Where driver-only operation (DOO) applies, the drivers' line of sight at the time of starting the train is influenced by the location of DOO monitors and mirrors. In this case it may be appropriate to provide supplementary information alongside the monitors or mirrors using one of the following:

- a) A co-acting signal.
- b) A miniature banner repeater indicator.
- c) A right away indicator.
- d) A sign to remind the driver to check the signal aspect.

In order to prevent misreading by trains on adjacent lines, the co-acting signal or miniature banner repeater may be configured so that the aspect or indication is presented only when a train is at the platform to which it applies.

'Car stop' signs should be positioned so that the relevant platform starting signals and / or indicators can be seen in the driver's central field of vision.

If possible, clutter and non-signal lights in a driver's field of view should be screened off or removed so that they do not cause distraction.

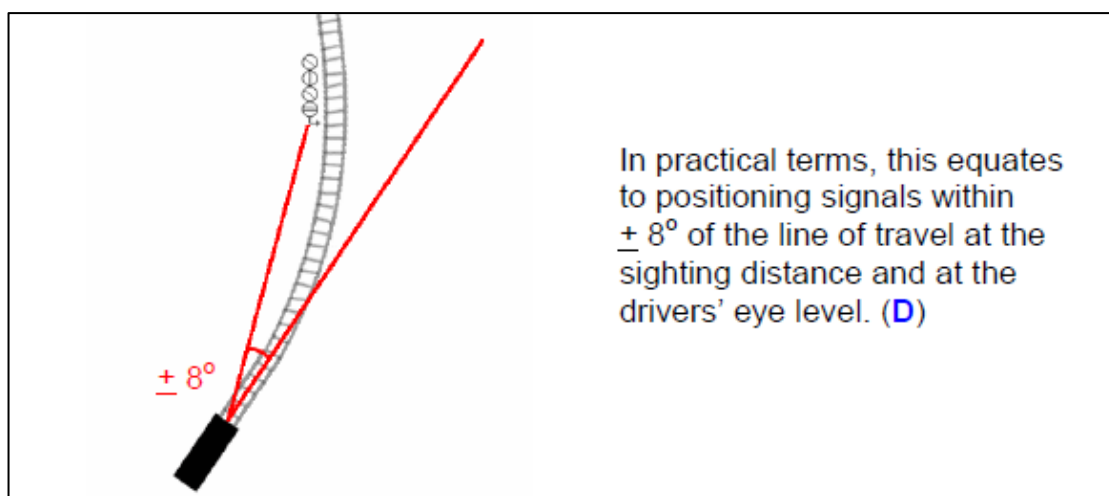


Figure G 22 - Signal positioning

'A' (m)	'B' (m)	Typical display positions
5	0.70	-
6	0.84	-
7	0.98	-
8	1.12	-
9	1.26	-
10	1.41	-
11	1.55	-
12	1.69	-
13	1.83	-
14	1.97	-
15	2.11	<i>A stop aspect positioned 3.3 m above rail level and 2.1 m from the left hand rail is within the 8° cone at 15.44 m in front of the driver</i>
16	2.25	-
17	2.39	-
18	2.53	<i>A stop aspect positioned 5.1 m above rail level and 0.9 m from the left hand rail is within the 8° cone at 17.93 m in front of the driver</i>
19	2.67	-
20	2.81	-
21	2.95	-
22	3.09	-
23	3.23	-
24	3.37	-
25	3.51	<i>A stop aspect positioned 3.3 m above rail level and 2.1 m from the right hand rail is within the 8° cone at 25.46 m in front of the driver</i>

Table G 5 – 8° cone angle co-ordinates for close-up viewing

The distance at which the 8° cone along the track is initiated is dependent on the minimum reading time and distance which is associated to the speed of trains along the track. This is discussed below.

Determining the Assessed Minimum Reading Time

The extract below is taken from section B5 (pages 8-9) of the 'Guidance on Signal Positioning and Visibility' which details the required minimum reading time for a train driver when approaching a signal.

'B5.2.2 Determining the assessed minimum reading time

GE/RT8037

The assessed minimum reading time shall be no less than eight seconds travelling time before the signal.

The assessed minimum reading time shall be greater than eight seconds where there is an increased likelihood of misread or failure to observe. Circumstances where this applies include, but are not necessarily limited to, the following:

- a) the time taken to identify the signal is longer (for example, because the signal being viewed is one of a number of signals on a gantry, or because the signal is viewed against a complex background)*
- b) the time taken to interpret the information presented by the signal is longer (for example, because the signal is capable of presenting route information for a complex layout ahead)*
- c) there is a risk that the need to perform other duties could cause distraction from viewing the signal correctly (for example, the observance of lineside signs, a station stop between the caution and stop signals, or DOO (P) duties)*
- d) the control of the train speed is influenced by other factors (for example, anticipation of the signal aspect changing).*

The assessed minimum reading time shall be determined using a structured format approved by the infrastructure controller.'

The distance at which a signal should be clearly viewable is determined by the maximum speed of the trains along the track. If there are multiple signals present at a location then an additional 0.2 seconds reading time is added to the overall viewing time.

Signal Design and Lighting System

Many railway signals are now LED lights and not filament (incandescent) bulbs. The benefits of an LED signal over a filament bulb signal with respect to possible phantom aspect illuminations are as follows:

- An LED railway signal produces a more intense light making them more visible to approaching trains when compared to the traditional filament bulb technology⁹;
- No reflective mirror is present within the LED signal itself unlike a filament bulb. The presence of the reflective surfaces greatly increases the likelihood of incoming light being reflecting out making the signal appear illuminated.

Many LED signal manufacturers^{10,11,12} claim that LED signal lights significantly reduce or completely remove the likelihood of a phantom aspect illumination occurring.

⁹ Source: Wayside LED Signals – Why it's Harder than it Looks, Bill Petit.

¹⁰ Source: http://www.unipartdorman.co.uk/assets/unipart_dorman_rail_brochure.pdf. (Last accessed 21.02.18).

¹¹ Source: <http://www.vmstech.co.uk/downloads/Rail.pdf>. (Last accessed 21.02.18).

¹² Source: Siemens, Sigmaguard LED Tri-Colour L Signal – LED Signal Technology at Incandescent Prices. Datasheet 1A-23. (Last accessed 22.02.18).

APPENDIX B – OVERVIEW OF GLINT AND GLARE STUDIES

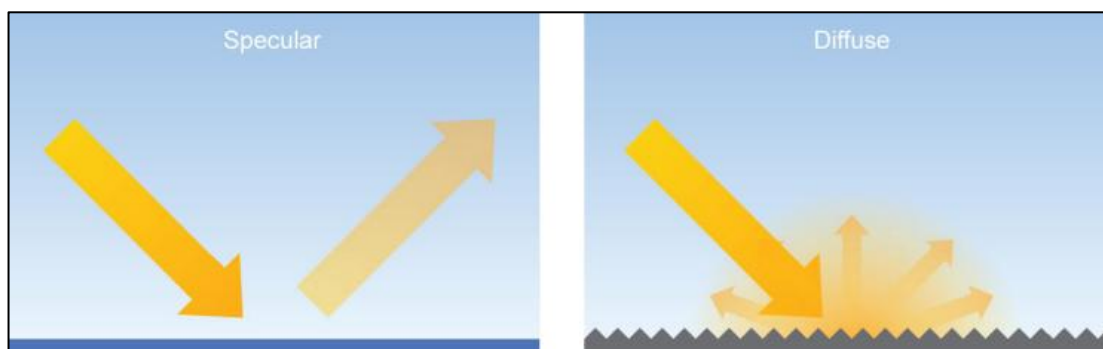
Overview

Studies have been undertaken assessing the type and intensity of solar reflections from various surfaces including solar panels and glass. An overview of these studies is presented below.

The guidelines presented are related to aviation safety. The results are applicable for the purpose of this analysis.

Reflection Type from Solar Panels

Based on the surface conditions reflections from light can be specular and diffuse. A specular reflection has a reflection characteristic similar to that of a mirror; a diffuse will reflect the incoming light and scatter it in many directions. The figure below, taken from the FAA guidance¹³, illustrates the difference between the two types of reflections. Because solar panels are flat and have a smooth surface most of the light reflected is specular, which means that incident light from a specific direction is reradiated in a specific direction.



Specular and diffuse reflections

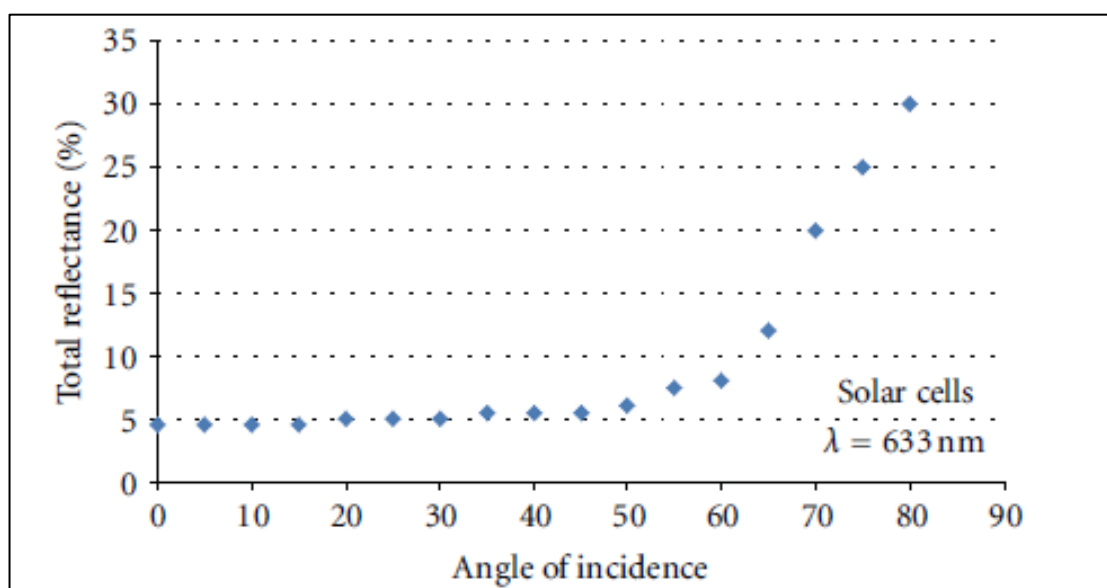
¹³Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 19/12/2023.

Solar Reflection Studies

An overview of content from identified solar panel reflectivity studies is presented in the subsections below.

Evan Riley and Scott Olson, “A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems”

Evan Riley and Scott Olson published in 2011 their study titled: A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems¹⁴. They researched the potential glare that a pilot could experience from a 25 degree fixed tilt PV system located outside of Las Vegas, Nevada. The theoretical glare was estimated using published ocular safety metrics which quantify the potential for a postflash glare after-image. This was then compared to the postflash glare after-image caused by smooth water. The study demonstrated that the reflectance of the solar cell varied with angle of incidence, with maximum values occurring at angles close to 90 degrees. The reflectance values varied from approximately 5% to 30%. This is shown on the figure below.



Total reflectance % when compared to angle of incidence

The conclusions of the research study were:

- The potential for hazardous glare from flat-plate PV systems is similar to that of smooth water;
- Portland white cement concrete (which is a common concrete for runways), snow, and structural glass all have a reflectivity greater than water and flat plate PV modules.

¹⁴ Evan Riley and Scott Olson, “A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems,” ISRN Renewable Energy, vol. 2011, Article ID 651857, 6 pages, 2011. doi:10.5402/2011/651857

FAA Guidance – “Technical Guidance for Evaluating Selected Solar Technologies on Airports”¹⁵

The 2010 FAA Guidance included a diagram which illustrates the relative reflectance of solar panels compared to other surfaces. The figure shows the relative reflectance of solar panels compared to other surfaces. Surfaces in this figure produce reflections which are specular and diffuse. A specular reflection (those made by most solar panels) has a reflection characteristic similar to that of a mirror. A diffuse reflection will reflect the incoming light and scatter it in many directions. A table of reflectivity values, sourced from the figure within the FAA guidance, is presented below.

Surface	Approximate Percentage of Light Reflected ¹⁶
Snow	80
White Concrete	77
Bare Aluminium	74
Vegetation	50
Bare Soil	30
Wood Shingle	17
Water	5
Solar Panels	5
Black Asphalt	2

Relative reflectivity of various surfaces

Note that the data above does not appear to consider the reflection type (specular or diffuse).

An important comparison in this table is the reflectivity compared to water which will produce a reflection of very similar intensity when compared to that from a solar panel. The study by Riley and Olsen study (2011) also concludes that still water has a very similar reflectivity to solar panels.

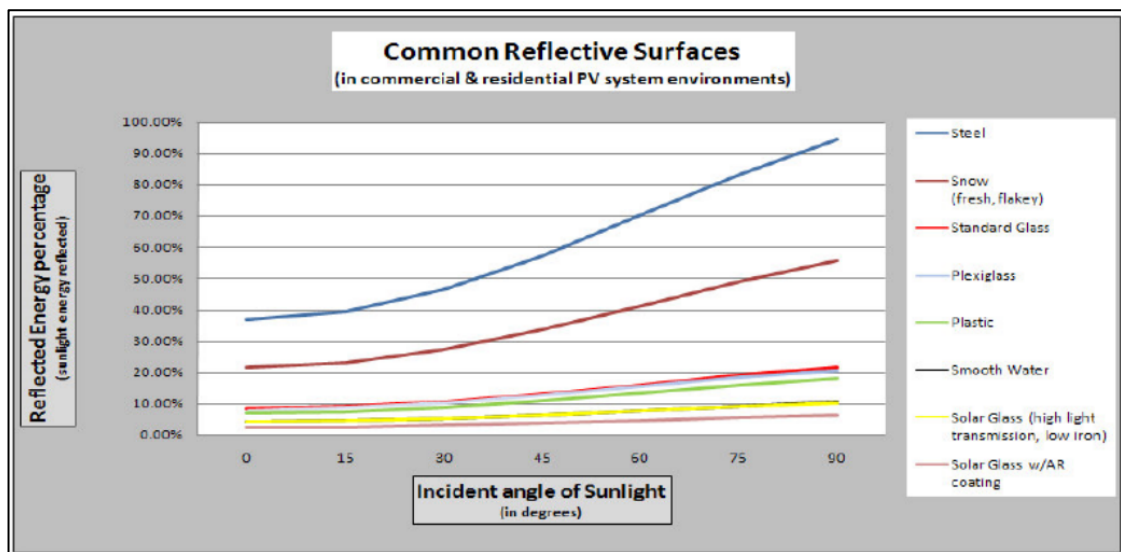
¹⁵ [Technical Guidance for Evaluating Selected Solar Technologies on Airports](#), Federal Aviation Administration (FAA), date: 04/2018, accessed on: 19/12/2023.

¹⁶ Extrapolated data, baseline of 1,000 W/m² for incoming sunlight.

SunPower Technical Notification (2009)

SunPower published a technical notification¹⁷ to 'increase awareness concerning the possible glare and reflectance impact of PV Systems on their surrounding environment'.

The figure presented below shows the relative reflectivity of solar panels compared to other natural and manmade materials including smooth water, standard glass and steel.



Common reflective surfaces

The results, similarly to those from Riley and Olsen study (2011) and the FAA (2010), show that solar panels produce a reflection that is less intense than those of 'standard glass and other common reflective surfaces'.

With respect to aviation and solar reflections observed from the air, SunPower has developed several large installations near airports or on Air Force bases. It is stated that these developments have all passed FAA or Air Force standards with all developments considered "No Hazard to Air Navigation". The note suggests that developers discuss any possible concerns with stakeholders near proposed solar farms.

¹⁷ Source: Technical Support, 2009. SunPower Technical Notification – Solar Module Glare and Reflectance.

APPENDIX C – OVERVIEW OF SUN MOVEMENTS AND RELATIVE REFLECTIONS

The Sun's position in the sky can be accurately described by its azimuth and elevation. Azimuth is a direction relative to true north (horizontal angle i.e. from left to right) and elevation describes the Sun's angle relative to the horizon (vertical angle i.e. up and down).

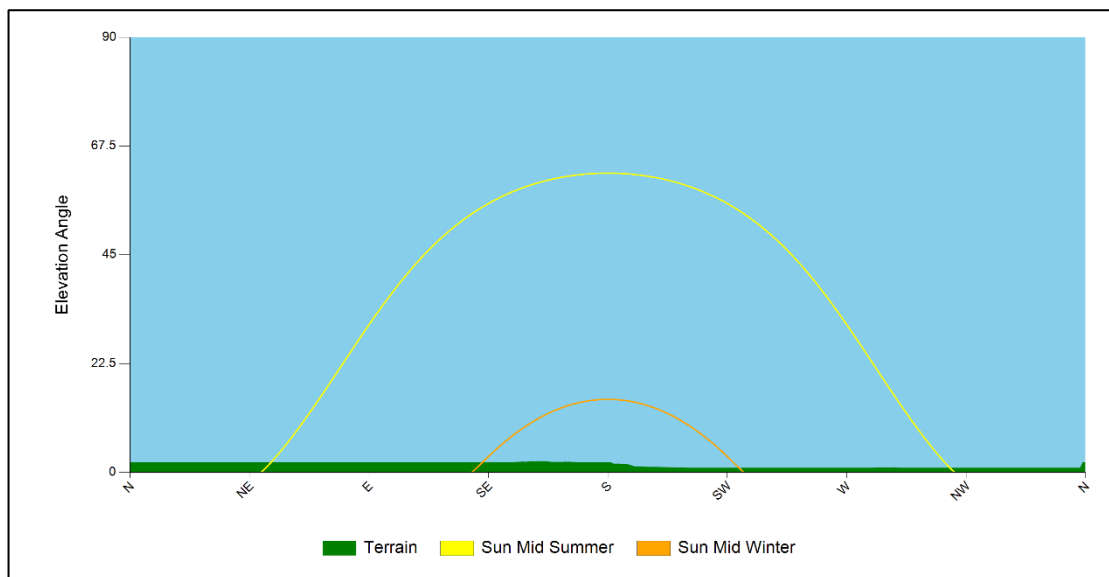
The Sun's position can be accurately calculated for a specific location. The following data being used for the calculation:

- Time;
- Date;
- Latitude;
- Longitude.

The following is true at the location of the solar development:

- The Sun is at its highest around midday and is to the south at this time;
- The Sun rises highest on 21 June (longest day);
- On 21 December, the maximum elevation reached by the Sun is at its lowest (shortest day).

The combination of the Sun's azimuth angle and vertical elevation will affect the direction and angle of the reflection from a reflector. The figure below shows terrain at the horizon from the proposed development location as well as the sunrise and sunset curves throughout the year.



Sunrise and sunset curves

APPENDIX D – GLINT AND GLARE IMPACT SIGNIFICANCE

Overview

The significance of glint and glare will vary for different receptors. The following section presents a general overview of the significance criteria with respect to experiencing a solar reflection.

Impact Significance Definition

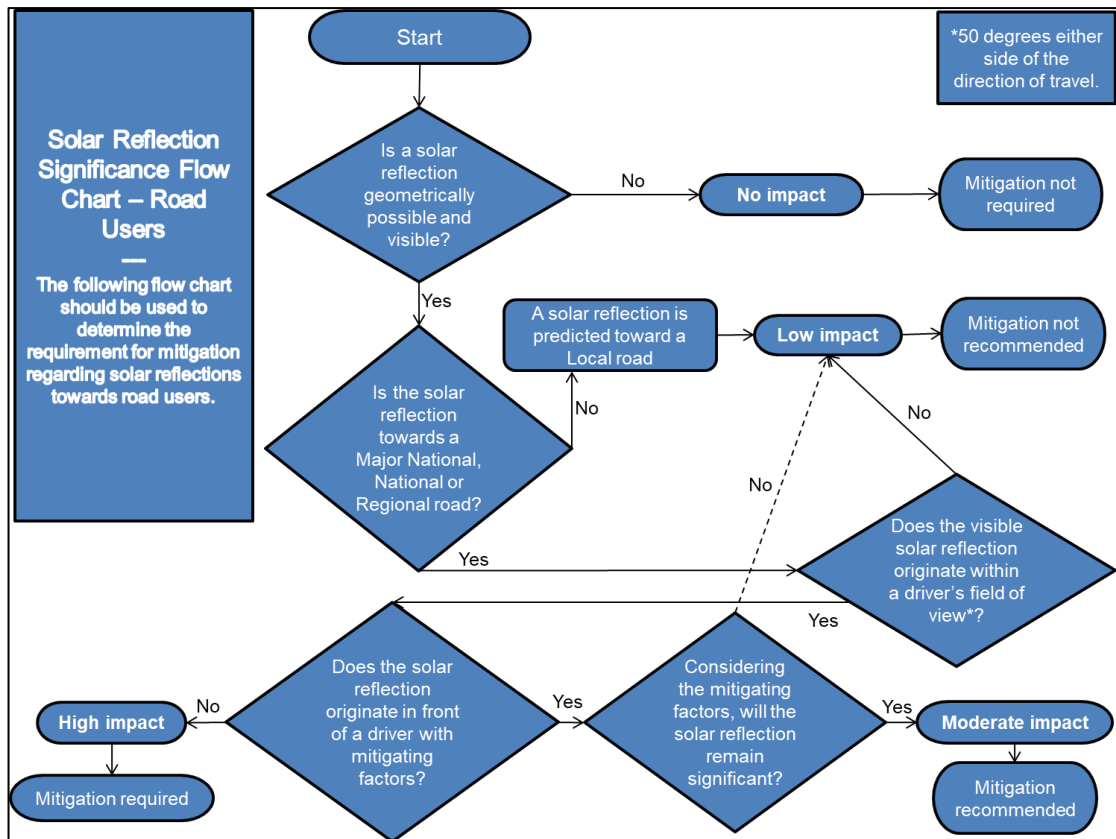
The table below presents the recommended definition of 'impact significance' in glint and glare terms and the requirement for mitigation under each.

Impact Significance	Definition	Mitigation
No Impact	A solar reflection is not geometrically possible or will not be visible from the assessed receptor.	No mitigation required.
Low	A solar reflection is geometrically possible however any impact is considered to be small such that mitigation is not required e.g. intervening screening will limit the view of the reflecting solar panels significantly.	No mitigation recommended.
Moderate	A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case given individual receptor criteria.	Mitigation recommended.
High	A solar reflection is geometrically possible and visible under worst-case conditions that will produce a significant impact given individual receptor criteria	Mitigation will be required if the proposed development is to proceed.

Impact significance definition

Impact Significance Determination for Road Receptors

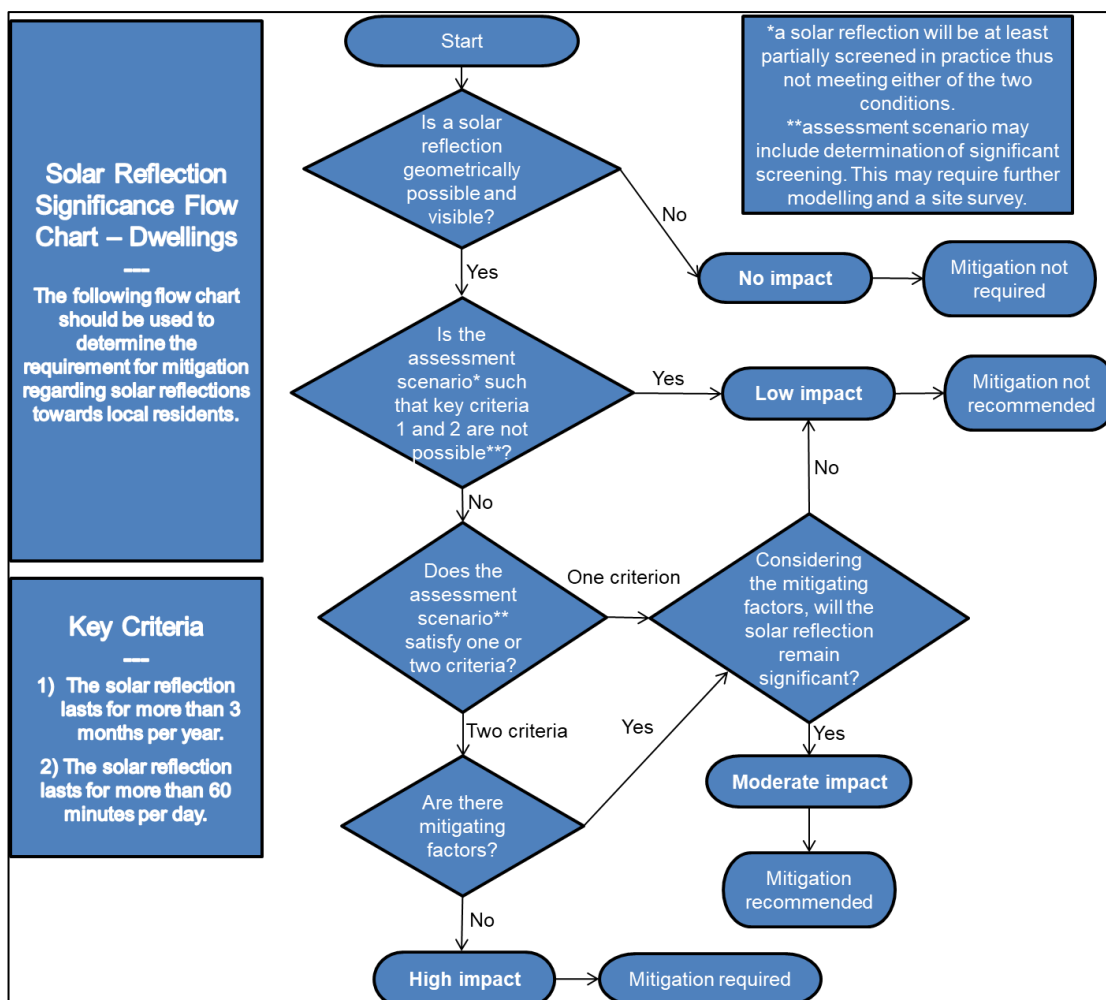
The flow chart presented below has been followed when determining the impact significance for road receptors.



Road user impact significance flow chart

Impact Significance Determination for Dwelling Receptors

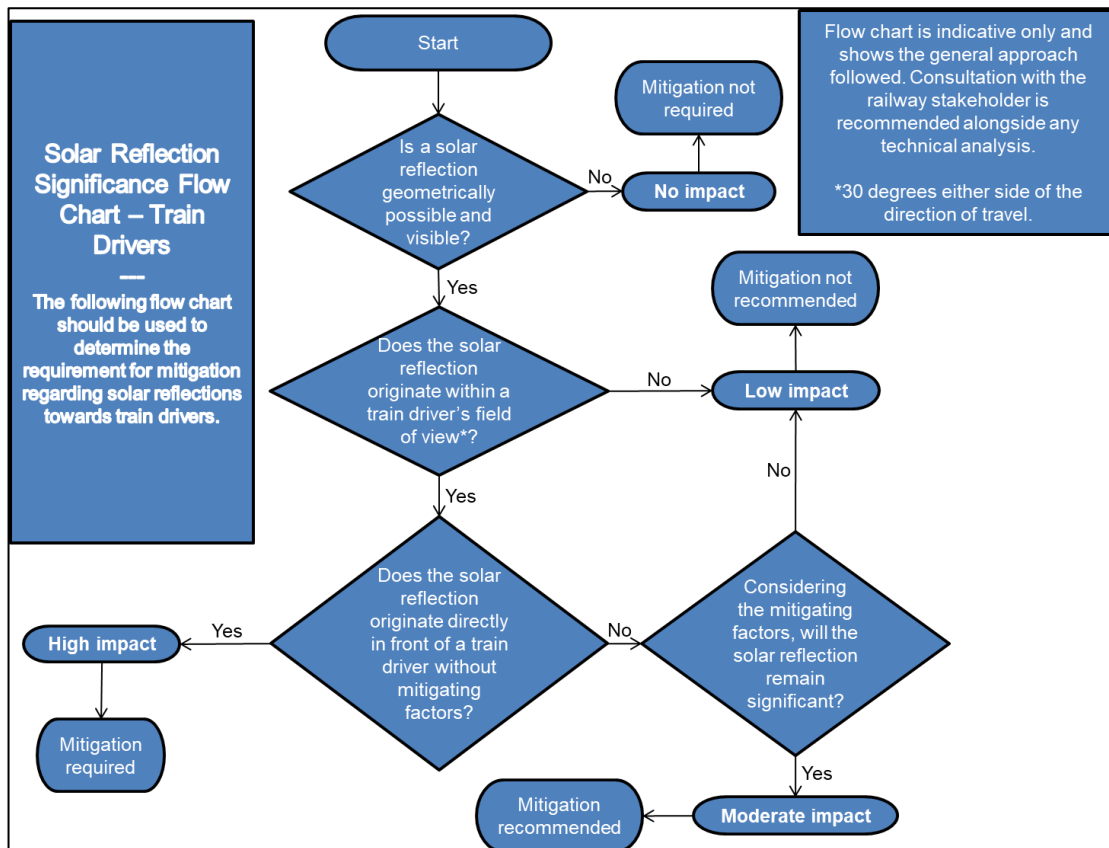
The flow chart presented below has been followed when determining the impact significance for dwelling receptors.



Dwelling impact significance flow chart

Impact Significance Determination for Train Drivers

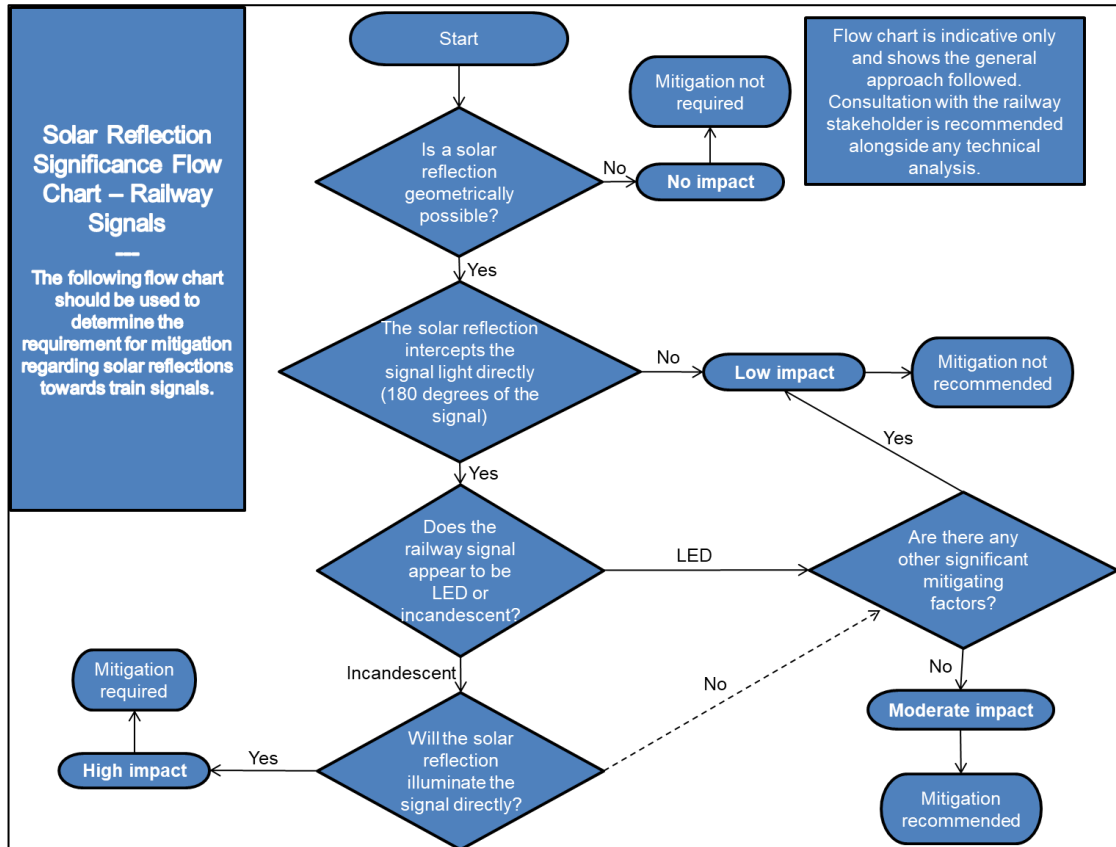
The flow chart presented below has been followed when determining the impact significance and mitigation requirement for train drivers.



Train Driver impact significance flow chart

Impact Significance Determination for Railway Signals

The flow chart presented below has been followed when determining the impact significance mitigation requirement for railway signals.



Railway signal impact significance flow chart

APPENDIX E – RECEPTOR DETAILS

Overview

Coordinate data and terrain heights are ascertained from OSGB 50 DTM data.

Aviation Receptor Details

Runway threshold information for Old Park Farm Airfield are given in the table below. Full receptor details are available upon request.

Runway Threshold	Longitude (°)	Latitude (°)	Elevation (m amsl)
12	-3.718576	51.547316	38.63
30	-3.714713	51.546075	42.26
18	-3.717215	51.548867	48.1
36	-3.717350	51.545914	37.71

Old Park Farm Airfield

Road Receptor Details

The road receptors details are presented in the table below.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
1	-3.753291	51.575745	13	-3.743912	51.566730
2	-3.752324	51.575075	14	-3.743148	51.565965
3	-3.751400	51.574382	15	-3.742416	51.565189
4	-3.750491	51.573682	16	-3.741693	51.564409
5	-3.749607	51.572969	17	-3.740996	51.563621
6	-3.748804	51.572221	18	-3.740365	51.562906
7	-3.748141	51.571422	19	-3.749103	51.565422
8	-3.747546	51.570602	20	-3.747693	51.565218
9	-3.746984	51.569772	21	-3.746272	51.565055
10	-3.746337	51.568968	22	-3.744842	51.565097
11	-3.745544	51.568216			

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
12	-3.744725	51.567474			

Road receptor locations

Dwelling Receptor Details

The dwelling receptors details are presented in the table below.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
1	-3.753579	51.574710	26	-3.748180	51.572243
2	-3.753397	51.574621	27	-3.748448	51.571046
3	-3.753168	51.574532	28	-3.748380	51.570673
4	-3.752935	51.574395	29	-3.748375	51.570476
5	-3.753015	51.574272	30	-3.748247	51.570296
6	-3.753156	51.574053	31	-3.748200	51.570100
7	-3.752562	51.574183	32	-3.748303	51.569957
8	-3.752440	51.574106	33	-3.748537	51.569814
9	-3.752309	51.573998	34	-3.749534	51.569326
10	-3.752625	51.573878	35	-3.749169	51.569331
11	-3.752156	51.573764	36	-3.748874	51.569210
12	-3.751847	51.573691	37	-3.748611	51.569106
13	-3.748836	51.573660	38	-3.748348	51.568949
14	-3.748497	51.573934	39	-3.748174	51.568753
15	-3.747413	51.574027	40	-3.748071	51.568552
16	-3.747356	51.573870	41	-3.747958	51.568364
17	-3.747561	51.573652	42	-3.747572	51.568077
18	-3.747771	51.573218	43	-3.747226	51.568077
19	-3.748113	51.572906	44	-3.743078	51.563337
20	-3.748104	51.572794	45	-3.738886	51.562890
21	-3.748107	51.572658	46	-3.732331	51.563462

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
22	-3.748682	51.572710	47	-3.731778	51.563315
23	-3.748544	51.572572	48	-3.735670	51.569694
24	-3.748415	51.572429	49	-3.724818	51.570696
25	-3.748288	51.572328			

Dwelling receptor locations

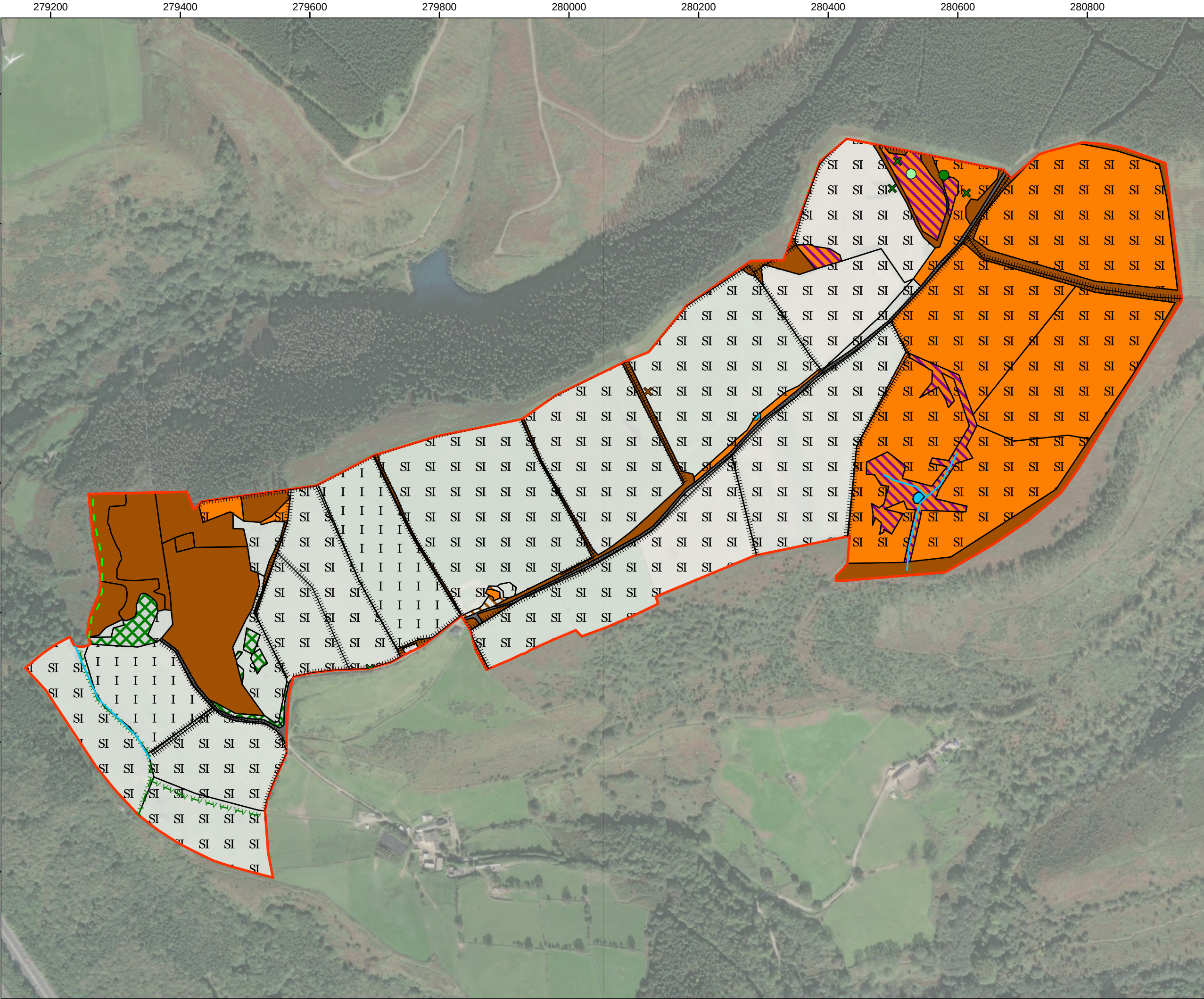


Pager Power Limited
Stour Valley Business Centre
Sudbury
Suffolk
CO10 7GB

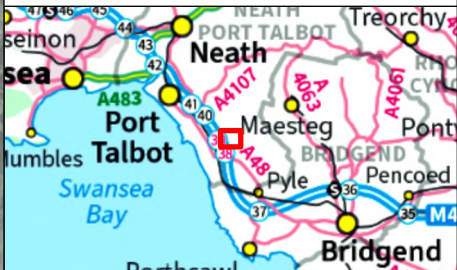
Tel: +44 1787 319001 **Email:** info@pagerpower.com **Web:** www.pagerpower.com

APPENDIX J

PHASE 1 HABITAT PLAN (MAIN DEVELOPMENT AREA)



- Legend:**
- PV development area
 - Neutral grassland - semi-improved
 - Improved grassland
 - Marsh/ marshy grassland
 - Poor semi-improved grassland
 - Scrub - dense/ continuous
 - Bracken - continuous
 - Other tall herb and fen - ruderal
 - Other tall herb and fen - non-ruderal
 - Pond
 - Bare ground
 - Hardstanding
 - Defunct hedge- species-poor
 - Defunct hedge - scattered trees
 - Ditch
 - Dry ditch
 - Fence
 - Broadleaved parkland/ scattered trees broadleaved
 - Coniferous parkland/ scattered trees
 - Scrub - scattered
 - Bracken - scattered

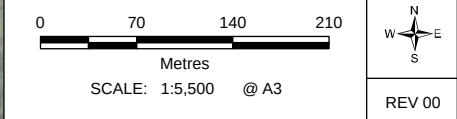


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Port Talbot Solar Farm



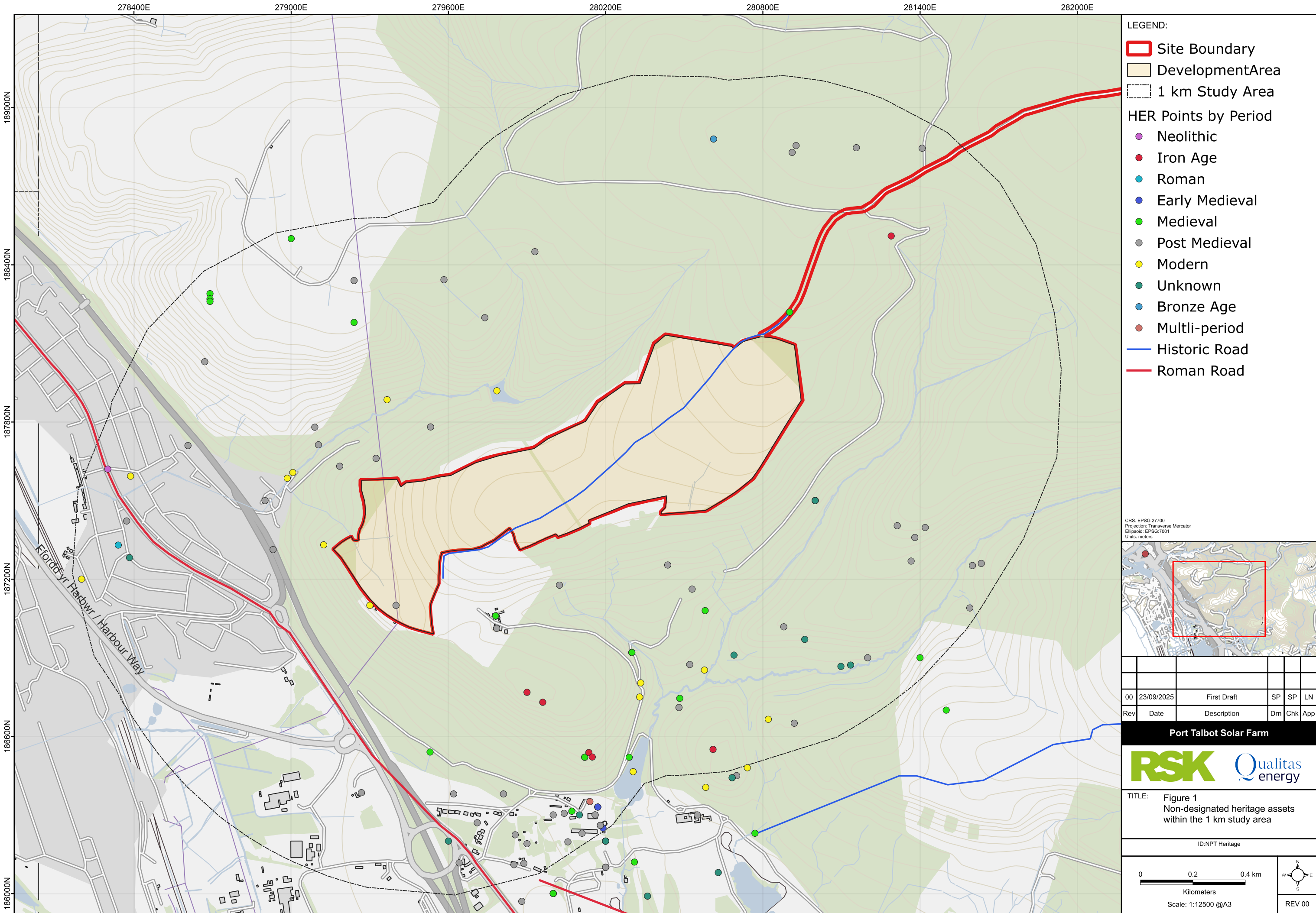
TITLE: Figure 1:
Development Area Phase 1 Habitats



APPENDIX K

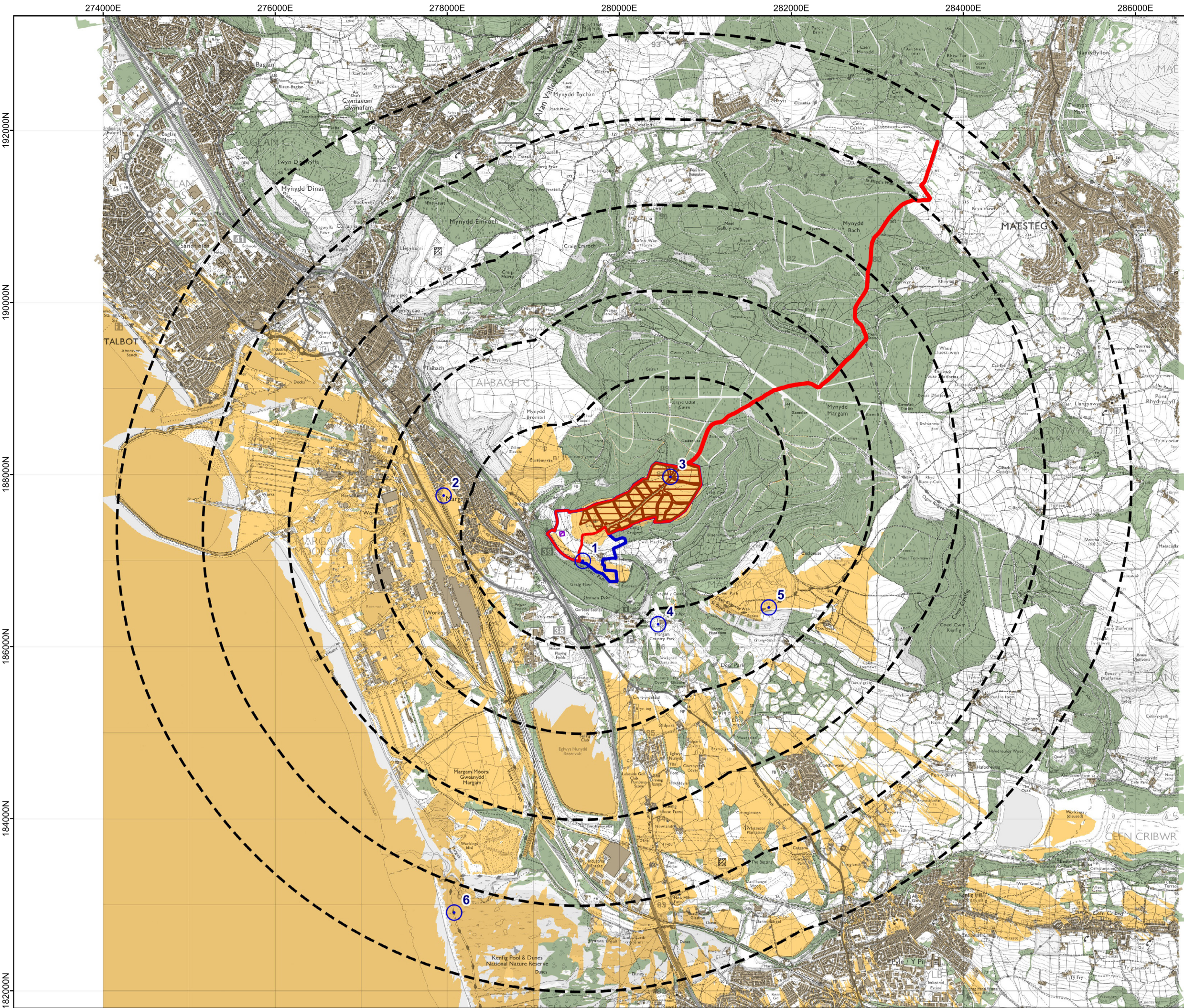
NON-DESIGNATED HERITAGE ASSETS

FIGURE



APPENDIX L

LANDSCAPE AND VISUAL FIGURES



LEGEND:

- Site Boundary
- Land Ownership Boundary
- PV Panel Areas
- Substation
- Distance Radii From Site (1-5km)
- Viewpoints
- Existing Woodland
- Existing Buildings
- Zone of Theoretical Visibility**
- Panels (3m high) may be visible

FIGURE DATA:
This figure has been based on the following data:

Layout file: D001-obvs-panels-T5-8km.shp
Terrain data: T5-DSM.asc
Viewer's eye height: 2m above ground level
Calculation grid size: 5m

NOTES:
This drawing is based upon computer generated Zone of Theoretical Visibility (ZTV) studies produced using the Viewshed routine in the Visibility Analysis plugin for QGIS.

The areas shown are the maximum theoretical visibility, taking into account topography, principal woodlands and buildings.

A digital surface model (DSM) has been derived from OS Terrain 5 DTM height data with the locations of buildings and woodland taken from the OS Open Map Local dataset. Buildings have been modelled with an assumed height of 7.5m and woodland an assumed height of 10m, representing a conservative estimate of average heights within the study area.

The model does not take into account some localised features such as small copses, hedgerows or individual trees and therefore still gives an exaggerated impression of the extent of visibility. The actual extent of visibility on the ground will be less than that suggested by this plan.

The ZTV includes an adjustment that allows for Earth's curvature and light refraction. It is based on a derived DSM and has a 5m² resolution.

CRS: EPSG:27700
Projection: Transverse Mercator
Ellipsoid: EPSG:7001
Units: meters



Rev	Date	Description	Drm	Chk	App
01	04/09/2025	Client Comments	MP	DL	DL
00	21/08/2025	First Draft	KW	MP	DL

Port Talbot Solar Farm

Qualitas
energy

RSK

TITLE: Figure 1
Zone of Theoretical Visibility of
Proposed Solar Array

ID:1 Solar Array ZTV

0 0.5 1 km
Kilometers
Scale: 1:42000 @A3



REV 01