Plas Power Solar and Energy Storage Project

4.3 Environmental Statement Volume 3: Appendices

Part 8 of 14

February 2024

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Schedule of appendices included in this document

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Appendix 4.8
Coal Mining Risk Assessment and Minerals Resource Assessment

COAL MINING RISK ASSESSMENT AND MINERAL ASSESSMENT

Plas Power Solar and Energy Storage Project

JER8537
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Document status

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1 INTRODUCTION

1.1 Scope of Works

1.1.1 RPS Consulting Services Ltd (RPS) was commissioned by RPS Planning on behalf of Lightsource bp to undertake a Coal Mining Risk Assessment and Mineral Resource Assessment of a proposed temporary solar farm and Battery Energy Storage (BESS) development at Plas Power Estate, Ruthin Road, Wrexham LL11 3BS (the Application Site). The report has been commissioned to provide information in support of a planning application for a temporary solar farm and Battery Energy Storage (BESS) development as detailed in Section 2.2. An Indicative Site Layout Plan (ref GBR_Plas Power_LP2 - PDL_13) is presented as **Drawing 1**, and the site is herein referred to as the Application Site.

1.1.2 The Application Site covers approximately 136 hectares (ha) and is located wholly within the administrative boundary of Wrexham County Borough Council. The Application Site is approximately 2.5 km to the west of Wrexham town centre. A site location plan is presented as **Figure 1**. The Application Site consists of two main areas, the smaller area on the north side of the A525 and the larger area to the south of the A525 and west of the A483. For the purpose of this report, the northern area is referred to as Area 1 and the larger southern area as Area 2.

1.1.3 It should be noted that the Application Site boundary, as presented in **Drawing 1**, includes the likely cable route for the Proposed Development, which is to be routed below ground linking to the Legacy Substation located approximately 600 m to the south-west of the site, north of the B5246 Bronwylfa Road.

1.1.4 Reference to the Coal Authority confirms that part of the Application Site is within a Coal Mining High Risk Area. At the time of writing the local authority legislative guidance regarding minerals is contained within the Wrexham Unitary Development Plan 1996-2011 which indicates that the eastern part of Area 1 and the extreme north-east and east of Area 2 of the Application Site are within an area of safeguarded mineral reserves.

1.2 Objectives

1.2.1 This report presents a desk-based assessment of the risk from coal mining, and a desk-based assessment of potential mineral reserves affected by the temporary Proposed Development of the Application Site.

1.2.2 The objective of the report is to use all available desk-based information to assess potential risk to the Proposed Development from past coal mining activities undertaken at or directly adjacent to the Application Site, and to identify constraints associated with mineral safeguarding policies applicable to the Application Site (principally policy) that may require further consideration to support the planning application for a proposed non-mineral development.

1.3 Limitations

1.3.1 This report is limited to the desk-based information available at the time of preparation and does not include any intrusive investigation.

1.4 Report Structure

1.4.1 The subsequent report structure is as follows:

- *Section 2: Site Setting* – Provides a summary of key aspects of the site setting, including a description of the geological, hydrological and hydrogeological context for the later assessments.

- *Section 3: Coal Mining Risk Assessment* – Provides a desk-based risk assessment of the risk to the Application Site presented by historical underground and opencast coal mining activities and mine entries.

- *Section 4*: *Minerals Resource Assessment* - Provides a summary of the national, regional and local planning policy context in relation to minerals. It also provides commentary on any supplementary planning documents relating to minerals. Provides the mineral resource assessment for the Application Site in terms of likely quantity and quality of mineral reserves and likely constraints on mineral extraction and an evaluation against mineral planning policies.

- *Section 5: Summary and Conclusions* – Summary of coal mining risk assessment, potential resulting development constraints, mineral resource assessment and evaluation of potential constraints for development resulting from criteria outlined in the planning context applicable for the Application Site.

2 SITE SETTING

2.1 Site Description

2.1.1 The location of the Application Site is at Plas Power Estate, south of Ruthin Road, and directly west of A483, approximately 3.4 km west of Wrexham town centre, LL11 3BS. The Ordnance Survey National Grid Reference (NGR) for the centre of the Application Site is approximately 330326 E, 350087 N. It is irregular in shape and occupies an area of approximately 145 ha. Access to Area 1 can be gained from Barn Hill Farm to the south and Area 2 from Home Farm to the north.

The Site

2.1.2 A targeted site walkover was undertaken at the Application Site on 21st April 2023 following review of the available historical maps. The walkover survey was limited to the further assessment of potential contamination sources identified from historical and current Ordnance Survey mapping.

2.1.3 The Application Site comprised multiple undeveloped fields/pasture used for grazing. There was a floor slab remaining from former development in the east of Area 2 and hardcore access roads/tracks in the south-east of Area 2.

The Surrounding Area

2.1.4 The Application Site is located in an area of currently predominantly agricultural land use. At the time of the site inspection, neighbouring land consisted of the following:

Table 2-1 – Neighbouring Land Uses

Direction	Description
North:	Area 1 - Fields, woodland, Adwy Grange and Higher Berse Road. Area 2 – A525, Home Farm, woodland (Cil Hendre).
East:	Area 1 – Agricultural land and covered reservoir. Area 2 – A483 (T).
South:	Area 1 – A525, Barn Hill Cottage (possible scrapyard noted – Plate 14), Barn Hill Farm (including Integrated Bulk Container (IBC) chemical storage – Plate 20) and Area 2. Area 2 – Woodland 'Big Wood', isolated properties and farm buildings.
West:	Area 1 – Fields beyond which are residential properties. Area 2 – Fields and grounds/buildings of Plas Power Park.

2.2 Proposed Development

2.2.1 The Proposed Development includes the construction and operation of a solar photovoltaic electricity generating station ('solar farm'), a Battery Energy Storage System ('BESS') and associated ancillary development. The solar element of the Proposed Development is anticipated to have an export capacity of 57MWac and the BESS will have an installed capacity of 57MWac..

2.2.2 An Indicative Site Layout Plan is provided as **Drawing 1**. This indicates that Area 1 will comprise two main areas of PV panels each with transformers, inverters and switchgear substation with access roads linking these features to the access point from the A425. Area 2 is identified as comprising twelve areas of PV panels, again each with transformers, inverters and switchgear substations. In the extreme south alongside Big Wood is a proposed maintenance area comprising a Distribution Network Operator (DNO) substation, monitoring house, switchgear substation, Glass Reinforced Plastic (GRP) cabinet, auxiliary transformer and storage facility. The BESS is to be located in the south of Area 2, close to a site access point.

2.2.3 The preferred method of foundation support and anchoring of the solar panels has not been confirmed however typically this is by the use of pre-formed small displacement steel sections driven into the ground at regular intervals along the length of panel frames.

2.2.4 The Proposed Development will connect to the Legacy Substation located approximately 600 m to the south-west of the site, north of the B5246 Bronwylfa Road. The cable route is indicated to follow existing roads westwards from the southern extremity of Area 2 with options to divert to the north or south of Cadwgan Hall.

2.2.5 During construction and decommissioning temporary site compounds will be required to provide staff welfare facilities, take deliveries of components and store plant and equipment securely while not in use. The locations of compounds are currently unknown, however temporary construction access to Area 2 is shown as being on the north-eastern boundary.

2.3 Geological and Mining Setting

2.3.1 The 1:50,000 geological map for the area (Sheet 121), 1:10,000 scale maps SJ 24 NE, SJ 25 SE, SJ 34 NW and SJ 35 SW and the online BGS Geoindex have been reviewed to establish the general sequence of geology at the Application Site and in the surrounding area. In addition, borehole records held by the BGS have been reviewed (BGS Geoindex Onshore). A summary of the expected geological sequence across the Application Site is provided in **Table 2.2**, a more detailed assessment of the Pennine Coal Measures and coal seams within is presented in Section 3 of this report.

Table 2-2 – General Geological Sequence

Stratum	Description	Coal Seams	Thickness (m)
Artificial Ground			
Worked Ground – Much of east of Area 2	There are three areas of worked out ground shown across the eastern part of Area 2 as shown in Figure 1. This is identified as worked ground/Made Ground from opencast coal areas and backfilled pits.	N/A	7.60 – 25.00 m from depth of BGS opencast borehole records
Superficial Deposits			
Glacial Till – across most of Area 1 and Area 2	Typically comprises poorly sorted clay, silt, sand and gravel in a matrix of silt/clay or sand. Will have been excavated in Area 2 where there has been past opencast workings.	N/A	Approx 6.00 m across Area 1. Approx 3.00 m for Area 2 from SJ35SW/46.
Glaciofluvial Deposits – localised to the east of Area 1 and north-east and east of Area 2	Typically comprises unconsolidated sand and gravel.	N/A	Approx 2.50 m in Area 1. Unconfirmed for Area 2.
Bedrock			
Bettisfield Formation (now identified as Pennine Lower Coal Measures Formation and Pennine Middle Coal Measures Formation	Bersham Yard Group – Productive Coal Measures	Alpha Rider Alpha Coal Beta Rider Beta Coal Gamma Coal Delta Coal	0.68 0.10-1.27 1.50 1.50 – 3.70 0.80 0.50-0.60

Stratum	Description	Coal Seams	Thickness (m)
(undifferentiated) – Across the central section of Area 1 and south and east of Area 2.		Delta Bench Coal	0.40 – 0.90
	Cefn Rock -Quartzose sandstone with subordinate and impersistent beds of mudstone and thin coal. Outcrops sub-drift in western half of Area 1 only	Thin coal – unproductive seam	0-0.35
	Productive Coal Measures -interbedded grey mudstones, siltstones, coals, seatearths and sandstones	Gwersyllt Little Upper Stinking Cannel Coal Warras Coal John O Gate Lower Stinking Smith's Coal Drowsell Powell Hollin Crank Quaker Black Bed Main Lower Bench Crown	0 -1.47 0.61 – 2.31 0 – 0.94 0.25 – 0.51 0 – 0.69 0.51 – 1.78 0.63 – 1.04 0.71 – 1.22 0.51 – 1.21 1.12 – 3.00 0.63 – 0.86 1.14 – 1.52 0.38 – 0.63 1.82 – 4.09 0.38 – 0.61 0.46 – 0.91
Pennine Lower Coal Measures Formation and Pennine Middle Coal Measures Formation (undifferentiated) – Sandstone. This is identified across the south-east of Area 1 and north-west of Area 2.	Predominantly sandstone dominated strata.	-	-

2.3.2 Approximately 170 borehole records are indicated on BGS sources for Area 2, these are predominantly identified as being for Plas Power Opencast Site and range in depth from 7.60 m to 25.00 m. A singular borehole identified as Pool Covert o/c site (SJ35SW/46) is located in the south-east of Area 2. All of these records bar one have an added note that they have been 'transferred to the Opencast Collection' and are not available for inspection. Where specified the dates for these borings are indicated as 1945.

2.3.3 Three borehole records are identified on Area 1, two of which are identified as for Plas Maelor and Higher Berse Opencast Sites dating from 1944 and 1950 and are 12 m and 17 m in depth. Again, these records are not available for inspection. The available records, as referenced above (SJ25SE/42 and SJ35SW/46) are included in **Appendix C.**

2.3.4 BGS borehole log (Ref SJ35SW/46) located in Area 2 to the north-west of the rectangular pond indicates coal between 3.00 m and 4.60 m below ground level (BGL). Interbedded sequences of sandstone, siltstone and mudstone are identified with increased depth with a deeper coal seam recorded at depth of in excess of 100 m BGL (two leaves). This boring dates from 1979, sunk by the National Coal Board (now the Coal Authority) to 'prove coal measures'.

2.3.5 The BGS borehole log SJ25SE/46 also identifies evidence of deeper coal seams as follows:

- Coal between 101.80 m and 102.40 m BGL; and
- Coal between 103.00 m and 103.90 m BGL with a 8° dip.

2.3.6 In summary, the published BGS 1;10,000 scale maps (SJ 34 NW, SJ 24 NE, SJ 35 SW and SJ 25 SE) and 1:50,00 scale map (Sheet 121) indicates the Application Site to be located on easterly/south-easterly dipping productive coal measures strata of the Bettisfield Formation, part of the Westphalian Coal Measures, present beneath a variable cover of superficial deposits proven to up to 6 m in thickness over the Application Site. There is mapped evidence of sub-drift outcropping coal seams on Area 2, and these have been worked by opencast methods.

2.3.7 The BGS records indicate the majority of Area 2 falls within secondary opencast coal resource areas whilst the north-eastern corner falls within a primary opencast resource area. The areas of former opencast working are designated by the Coal Authority (CA) as Coal Mining Development High Risk Areas and are shown on **Figure 1** below.

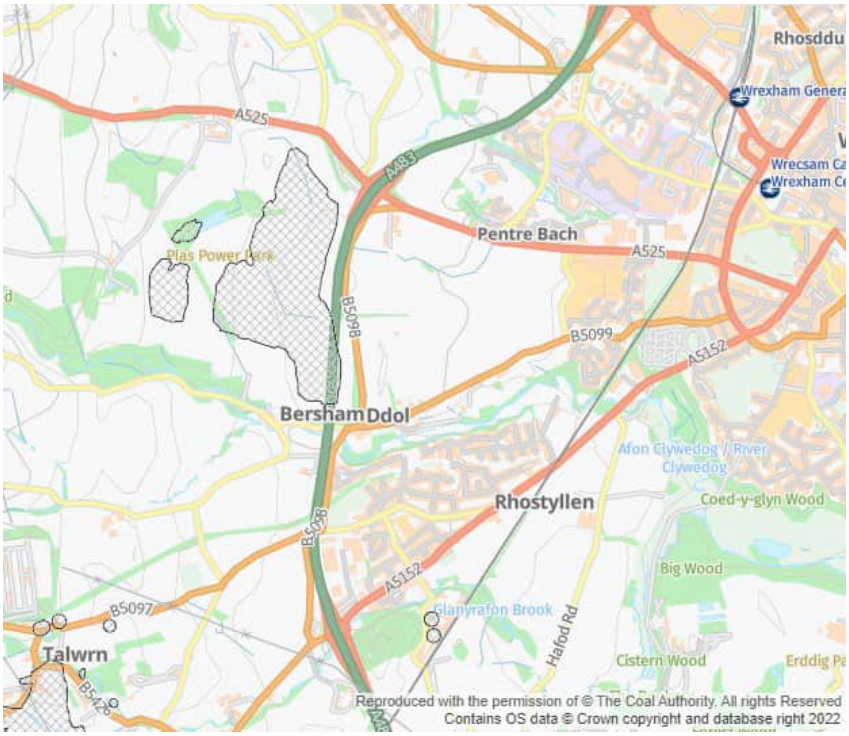

Figure 1 – Identified areas of former opencast working (Source: Coal Authority - Coal Mining Development High Risk Area)

2.4 Topography

2.4.1 An appraisal of the topography of the Application Site has been made from the survey data shown on the Preliminary Layout Plan included as Drawing 1.

2.4.2 Area 1 generally slopes eastwards from an elevation of approximately 175 m Above Ordnance Datum (AOD) on the western boundary to 124 m AOD on the eastern boundary. There are localised mounds in the central area to the north-east of Little Berse Farm.

2.4.3 Area 2 has a more variable topography ranging from approximately 159 m AOD on the western boundary generally sloping to the east and north-east and locally to the south-east to 110 m AOD on the eastern boundary, however there are a number of localised minor hills in the north-west and centre.

2.5 Hydrogeology

2.5.1 The site is located above Secondary A Aquifers relating to the bedrock and localised Glaciofluvial Sheet Deposits across both areas.

- Secondary A Aquifer: These formations are formed of permeable layers capable of supporting water supplies at a local scale, in some cases forming an important source of base flow to rivers.

2.5.2 The Glacial Till designation is Secondary Undifferentiated.

- Secondary Undifferentiated Aquifer: These formations have varying characteristics in different locations.

2.5.3 According to Environment Agency (EA) data, the Application Site is not located in a groundwater Source Protection Zone (SPZ).

2.5.4 Information provided by the EA indicates that there are no records of active licensed groundwater abstractions within 500 m of the Application Site.

2.6 Hydrology

2.6.1 There are two watercourses within 500 m of the Application Site which are classified within a River Basin Management Plan published by the EA under the European Water Framework Directive (2000). These are as follows:

Table 2-3 – Nearby Watercourses and Water Bodies

Watercourse / Body	Quality Classification	Approx. Distance and Direction from Site
River Clywedog – Conf. Black Bk. Erddig Pk-Conf.Trib	GQA River Quality – A (2000)	40 m south of Area 2
River Gwenfro – Hospital – Conf. Trib. Nr. South Sea	GQA River Quality – B (2000)	191 m north-east of Area 2

2.6.2 In addition to the above there are minor watercourses (drains/ditches) identified in the Envirocheck report in the north-east and south-east of Area 2 and on the southern boundary of Area 1 adjacent to the A525.

2.6.3 Information provided by the EA indicates that there are records of three active licensed surface water abstractions within 500 m of the site, all from the River Gwenfro or a tributary of this river. The details of these are as follows:

Table 2-4 – Licensed Surface Water Abstractions

Licence Holder/Licence No	Use	Approx. Distance and Direction from Site
Mr N Morris 24/67/7/0135	General Agriculture: Spray Irrigation - Direct	106 m north-east of Area 2 (Lower Berse Farm)
Wrexham County Borough 24/67/7/0181	Water Supply Related: Effluent/Slurry Dilution	200 m north-east of Area 2

Licence Holder/Licence No	Use	Approx. Distance and Direction from Site
Mr N Morris 24/67/7/0135	General Agriculture: Spray Irrigation - Direct	249 m north-east of Area 2

2.6.4 According to the EA flood map neither area of the Application Site is located within an area considered to be at risk from flooding or extreme flooding from rivers without defences (Zone 2 or Zone 3 flood risk area).

2.7 Environmental Sensitivity

2.7.1 Natural Resources Wales (NRW) data indicates there are a number of ecologically sensitive sites, which constitute environmental receptors as defined within Table 1 of the DEFRA Environmental Protection Act 1990: Part 2A – Contaminated Land Statutory Guidance (2012), located within a 500 m radius of the Application Site. These are listed in **Table 2-5.**

Table 2-5 – Ecologically Sensitive Sites

Designation	Approximate Distance and Direction from Site	Details
Ancient Woodland		
Ancient and Semi-natural Woodland	Immediately south of Area 2	Big Wood
Ancient and Semi-natural Woodland	Immediately west of Area 2	Plas Power Park
Plantation on Ancient Woodland	Immediately north-east of Area 2	Plas Power Park
Restored Ancient Woodland Site	Immediately north of Area 2	Cil Hendre
Restored Ancient Woodland Site	10 m south of Area 2	Woodland alongside A525

3 COAL MINING DATA REVIEW

3.1 General

3.1.1 In the context of the site setting described in Section 2 the following data is reviewed in this section:

- Groundsure CON29M Coal Mining Search (Area 1);
- Cornwall Mining Services Ltd (CMS) CON29M Commercial Coal Mining Search (Area 2);
- Coal Authority Consultants Coal Mining Report Ref 51003352311001 (Area 2);
- BGS 1:50,000 geological map Sheet No 121;
- BGS 1:10,000 geological maps SJ 34 NW, SJ 24 NE, SJ 35 SW and SJ 25 SE;
- BGS Technical Report WA/91/4; 'Applied Geological Mapping in the Wrexham Area: Geology and land use planning'; and
- BGS Sheet Memoir 'The geology of the country around Wrexham: Explanation of one-inch geological sheet 121' (1927).

3.2 Data Limitations

3.2.1 It should be noted that it has only been compulsory for mine plans to be lodged at the time of abandonment with the Mines Inspectorate since 1872 and, therefore, there may be unrecorded older workings, or mine entries present in the area of which the CA are unaware.

3.2.2 The limitations on the CON29 Coal Mining Reports are listed on the documents as provided in **Appendix A** and **Appendix B**.

3.3 Area 1

Groundsure CON29M Coal Mining Search (Area 1)

3.3.1 A Coal Authority Non-Residential Mining Report (CON29M) was obtained from Groundsure Ltd for Area 1 and is provided in **Appendix A.**

3.3.2 The report indicates that Area 1 is within the potential zone of influence of recorded workings in six seams of coal at depths of between 35 m and 190 m. The report states that any ground movement associated with these workings should have ceased. There are no recorded mine entries on or within 20 m of Area 1. There is no evidence of potential shallow coal workings from the coal mining search report findings.

3.3.3 Area 1 does not lie within the boundaries of any former opencast workings, within 200 m of any current opencast workings or within 800 m of any proposed future opencast workings.

3.3.4 It is noted that there was a claim made for coal mining subsidence damage in 1995 for the agricultural land some 18 m to the north-east. The claim was subsequently rejected; however, it is reported that in the event of coal mining settlement or subsidence occurring the property will benefit from the protection of the Coal Mining Subsidence Acts of 1991 and as amended 1994.

3.4 Area 2

Cornwall Mining Services Ltd (CMS) CON29M Commercial Coal Mining Search (Area 2)

3.4.1 The Client purchased a CON29M report from Cornwall Mining Services Ltd for Area 2, which has been provided to RPS for inclusion in this assessment and is presented within **Appendix B**. It should be noted that since the acquisition of the CON29M report, dated July 2020, the site area as covered by the report has been superseded and no longer includes the parcel of land to the south of the River Clywedog.

3.4.2 The report states that Area 2 is in an area that could be affected by underground mining in 7 coal seams at shallow depth to 350 m below surface, last date of working stated as 1972.

3.4.3 The report states that the Application Site is not recorded to be within a surface area that could be affected by present underground mining or where there are plans to grant a license to remove coal in the future.

3.4.4 The report states that there are no recorded mine entries on or within 20 m of the Application Site boundary.

3.4.5 The Application Site is indicated to lie within the boundary of an opencast site, from which coal was removed by opencast methods prior to the issue of licencing from the CA (pre-1994). There are no current opencast workings within 200 m or proposed future opencast workings within 800 m.

3.4.6 The report indicates there has been no recorded damage arising from geological faults or other lines of weakness activated by coal mining at the Application Site nor is there any evidence of a damage notice or subsidence claim for the Application Site since 31st October 1994.

3.4.7 The report states there are no records to indicate the Application Site is affected by the release of mine gas from historic workings.

3.4.8 The report does state that the Application Site lies within an area where a notice of entitlement to withdraw support has been published (a historical notice informing landowners that the coal beneath their property was going to be worked). Notices were issued in 1946, 1967, 1974 and 1976.

Coal Authority Consultants Coal Mining Report (Area 2)

3.4.9 Area 2 includes a Coal Authority Coal Mining Development High Risk Area (former opencast locations), therefore for this part of the Application Site a Consultants Coal Mining Report was also obtained to provide further information to assist with clarification of the level of risk posed by the identified former mining activities. This is presented in **Appendix D.**

3.4.10 The report confirms that the key coal seams worked by underground methods are as follows:

Table 3-1 – CA Recorded Coal Seams worked by underground mining beneath Area 2

Coal Seam Name	Depth (m)	Dip angle (degrees)	Direction of workings	Maximum Thickness Worked (m)	Date of last workings
Powell	155 - 210	5.0 - 8.0	East	1.20	1938
Crank	203- 255	1.9 - 2.7	North-east or south-east	0.80	1935

Coal Seam Name	Depth (m)	Dip angle (degrees)	Direction of workings	Maximum Thickness Worked (m)	Date of last workings
Quaker	211 - 252	4.2 – 7.1	East or south-east	1.30 – 1.50	1890 - 1937
Main	204 -270	5.3 - 6.5	South-east	2.50	1900-1933
Wall and Bench	347 - 401	5.4 – 8.5	South-east	1.07	1969-1971
Ruabon Yard (Soft 5 Quarters)	370	5.6	South-east	0.80	1972

3.4.11 The Consultant Report indicates there are unlikely to be any unrecorded shallow workings beneath Area 2.

3.4.12 There are no spine roadways recorded at shallow depth beneath Area 2.

3.4.13 There are no recorded mine entries within 100 m of the boundary of Area 2.

3.4.14 The summary of findings map (as included below) indicates that there are both north-south and east-west trending faults beneath Area 2.

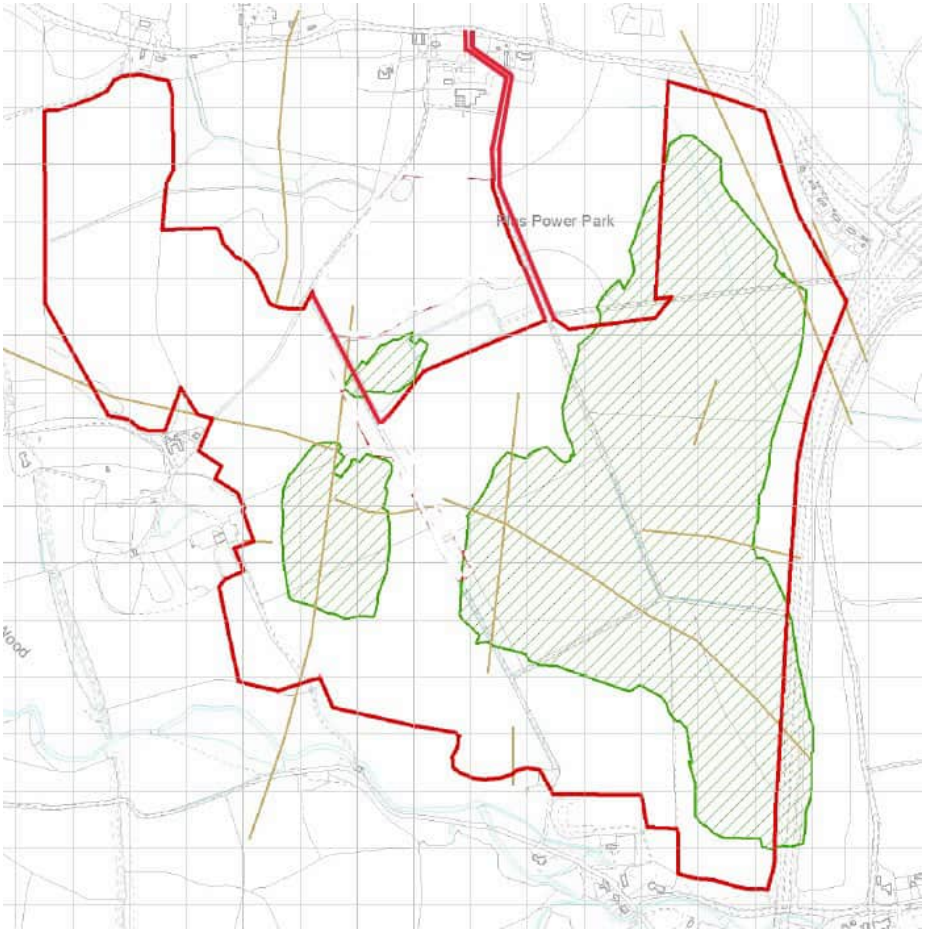

Figure 2 – Area 2 - Consultants Report Summary of Findings (opencast and fault lines)

3.5 Summary of Relevant Information

3.5.1 The 1927 BGS sheet memoir for published 1:50,000 scale map 121 identified that in the vicinity of Plas Power Park there is extensive drift cover and little or no trace of former mining operations at the surface. The memoir identifies that the Main Seam is historically the most important worked seam in the area although by the time of publication of the memoir the reserves had been predominantly exhausted. The Wall and Bench (Queen) Seam underlying the Main Coal was the lowest worked seam in this part of the coalfield. There is no additional information on the opencast workings known to have occurred on Area 2, the memoir having been published before these works commenced.

3.5.2 There is no evidence of recorded mine entries in either Area 1 or Area 2 or within 20 m of the boundaries of the Application Site. No historical map evidence of potential mine entries has been determined.

3.5.3 The 1:10,000 scale BGS maps indicate that the former opencast workings on Area 2 targeted the easterly dipping seams of the Bersham Yard Group located above the Cefn Rock in the Bettesfield Formation sequence, a variable group of up to seven coals denoted by letters of the Greek alphabet. The upper seams (Alpha and Beta) are split and also have an associated Rider. The Alpha is up to 1.27 m in thickness with the Alpha Rider up to 0.68 m thick. The Beta Coal is a thicker seam varying between 1.5 m and 3.7m in thickness spread between several leaves and the Beta Rider up to 1.50 m in thickness. Beneath this is the Gamma Coal (approximately 0.80 m thick) and the Delta Coal (0.50-0.60m thick) and the Delta Bench Coal (two leaves up to 0.90 m thick). Overall, the Bersham Yard Group is approximately 30 m in thickness.

3.5.4 The smaller areas of opencast working in the central part of Area 2 are shown as being on the eastern side of the outcropping Delta and Delta Bench Seams and are likely to have been limited to the extraction of these two coals only. The larger area in the east would appear to have included workings throughout the seams of the Bersham Yard Group.

3.6 Coal Mining Risk Assessment

3.6.1 Objectives of the coal mining risk assessment are to provide a desk-based assessment of available geological and mining information relating to the Application Site (and wider area) and to use this information to identify risks present to the development from the legacy of mining. An assessment of the identified risks relating to both Area 1 and Area 2 has been undertaken and presented below.

Area 1

Risk from Recorded Workings

3.6.2 No recorded shallow underground coal mining or past opencast workings beneath Area 1. Worked seams are at a depth that is unlikely to be a constraint to the Proposed Development. **Low** risk considered applicable.

Risk from Unrecorded Workings

3.6.3 The CON29 report for Area 1 does not identify any probable shallow coal mine workings across Area 1 or coal outcrops that would indicate a risk of possible unrecorded shallow workings or opencast workings. Risk considered to be **low**.

Risk from Recorded/Unrecorded Mine Entries

3.6.4 There are no identified former mine entries on or within 20 m of the boundaries of Area 1. It is considered that the risk to the Proposed Development from collapse of mine entries or as a pathway for mine gas migration is **low**.

Area 2

Risk from Recorded Workings

3.6.5 The information obtained has identified that the coals worked by underground mining are at depth, in excess of 100 m and therefore present a **low** risk of ground instability as a result of the Proposed Development.

3.6.6 The extent of former opencast workings associated with the eastern and central areas of Area 2 are clearly defined on both CA and BGS sources and should be considered as a potential **moderate** risk. These may be characterised as localised areas of poorly compacted backfill and also represent a constraint to foundations or heavily loaded infrastructure forming part of the Proposed Development.

Risk from Unrecorded Workings

3.6.7 The Consultants Report obtained for Area 2 has indicated a **low** risk of unrecorded shallow workings beneath Area 2.

Risk from Recorded/Unrecorded Mine Entries

3.6.8 There are no identified former mine entries on or within 20 m of the boundaries of Area 2. The possible presence of small-scale bell pits that could have worked seams of the Bersham Yard Group cannot be discounted entirely although it is likely that if present these would have been removed by the more recent opencast workings. It is considered that the risk to the Proposed Development from collapse of mine entries or as a pathway for mine gas migration is **low**.

3.7 Conclusions

3.7.1 The coal mining risk assessment undertaken has identified no significant risks to the Proposed Development from historical underground mining or mine entries associated with underground mining. The review identified recorded underground mine workings in relation to multiple coal seams beneath both Area 1 and Area 2 of the Application Site but at depths unlikely to constitute a ground instability or constraint risk to the Proposed Development. Should there be changes to the nature or layout of the Proposed Development, then the findings of this risk assessment should be reassessed accordingly.

3.7.2 Other shallower coal seams across Area 2, identified as belonging to the Bersham Yard Group, have been worked extensively by opencast methods at three locations seemingly from historical map evidence between the 1960s and 1970s. The former quarries have been restored on completion of the opencast workings, likely to comprise natural overburden materials although this is not confirmed by available information.

3.7.3 The extent of former opencast workings may represent localised areas of poorly compacted backfilled pits and also represent a constraint to foundations or heavily loaded infrastructure. Specifically in the areas of more heavily loaded or enclosed structures further investigation is recommended to:

- Determine the depth and nature of backfill of opencast workings;

- Provide geotechnical information in support of design of foundations/anchors.

3.7.4 It should be noted that consultation with and approval by the CA will be required for any intrusive investigation of former mine workings / coal assets.

3.7.5 The above recommendations are based on the premise that the Proposed Development, once complete, will not increase the risks associated with voids and therefore the Proposed Development does not materially increase the level of risk of catastrophic collapse. The developer should consider the risks during the redevelopment process in accordance with the Construction, Design and Management Regulations (2015). Whilst the solar arrays are exempt with respects to planning it should be noted that the responsibility for safe development resides with the developer.

4 MINERALS RESOURCE ASSESSMENT

4.1 Overview

4.1.1 This Minerals Resource Assessment (MRA) has utilised available geological and site setting information to evaluate the constraint that mineral resources, present on the Application Site, are likely to place on the Proposed Development given local mineral planning policy. The MRA provides a resource assessment that defines the extent of viable (extractable) mineral resources present on the Application Site, principally in relation to designated Mineral Safeguarding Areas (MSAs) defined by Wrexham County Borough Council. The available mineral resource is then evaluated against the mineral planning policy for the Application Site, with the viability and practicability of extraction and practicability of prior extraction of the safeguarded resources considered.

4.2 Data Sources

4.2.1 It should be noted that no site-specific intrusive investigation has been undertaken to inform this assessment. The data utilised has been determined from a variety of publicly available sources and has previously been summarised in the Desk Top Study & Preliminary Risk Assessment (DTS & PRA) report prepared for the Application Site by RPS (Ref JER8537 (2023)). It is recommended that this report and supporting factual data is read in conjunction with this assessment.

4.2.2 In addition to the DTS & PRA report, the following documents of local and national legislation have been reviewed relating to mineral planning policies;

- Welsh Government (2021): Planning Policy Wales, Edition 11; and
- Wrexham County Borough Council (2023): Local Development Plan 2013-2028.

4.2.3 In the absence of any site investigation reports provided by the Client or previous intrusive investigation by RPS, published borehole logs for the Application Site held by the BGS have been reviewed to assist with determination of the extent and thickness of identified mineral reserves. Copies of these logs are presented in **Appendix C**.

4.3 Review of Mineral Planning Policy

Mineral Planning Policy Context

4.3.1 For Wales the key national planning policies for minerals are set out in the Planning Policy Wales (PPW), a document supported by a series of Technical Advice Notes (TAN) to provide a national planning policy framework for Wales. The primary objective of the PPW is to ensure that the planning system contributes towards delivering sustainable development.

4.3.2 One of the key aspects of the PPW is ensuring that mineral resources which may be needed in the future are safeguarded and the adequate supply of a diverse range of minerals is available over a long-term period. The document also recognises the productive and enterprising contribution presented by locally available minerals in reduction of energy from transport and in the provision of economic infrastructure from land use.

4.3.3 The PPW discourages the use of energy minerals for power generation, e.g. fossil fuels such as coal, in favour of reduction of greenhouse gas emissions and promotion of decarbonisation through encouragement of alternative energy sources. It is emphasised that potential construction related

minerals are particularly important to Wales and a 'steady and adequate supply of minerals with the protection of the amenity and the environment' is necessary.

4.3.4 For planning purposes mineral extraction and related development 'includes all minerals and substances in, on or under land extracted either by underground or surface working'. It is stated in the PPW that the access to mineral resources should be safeguarded by local planning policies to ensure that they are not sterilised by other types of ***permanent*** development and identified on relevant LDP maps. Safeguarding indicates that the location and quality of the mineral is known and that environmental constraints associated with extraction including potential for extraction of mineral resources prior to undertaking other forms of development have been considered.

Wrexham Local Development Plan 2013-2028

4.3.5 This document forms the currently adopted Local Development Plan. Policy SP16 specifies that minerals will be sustainably managed through: the protection of minerals from unnecessary sterilisation by directing new development away from areas underlain by mineral of importance or where this is not possible, through the requirement to extract mineral prior to the non-mineral development in accordance with the requirements of Policy MW1; and avoiding conflict between mineral working and sensitive development through the use of buffer zones; and contributing towards meeting the regional need for aggregate minerals in collaboration with Flintshire County Council; and supporting proposals for mineral extraction within the County Borough which contribute towards maintaining an adequate supply of minerals in sustainable locations including the delivery of high quality restoration and aftercare programmes which enhance and provide linkages with the natural environment.

4.3.6 Policy MW1 states that non-mineral development within Mineral Safeguarding Areas as defined on the proposals map will only be permitted where it can be demonstrated that the mineral underlying the site does not merit extraction; or the need for the non-mineral development outweighs the need to protect the resource; or the mineral can be satisfactorily extracted prior to the non-mineral development; or the development is of a temporary nature or can be removed within the timescales within which the mineral is likely to be needed; or essential infrastructure that supports the supply of minerals would not be compromised or would be provided elsewhere. Policy MW2 requires that development in the mineral buffer zones as identified on the Proposals Map will only be permitted where it can be demonstrated that it would not compromise current or planned mineral extraction.

Safeguarded Mineral Resources

4.3.7 The safeguarded mineral resources are assumed to be the remaining Glaciofluvial Deposits (GFD) outside of the areas of former opencast coal working in the east of Area 2 and localised to the extreme north of Area 1. BGS records indicate that the deposits are typically sand and gravel of quartzite, sandstone, and siltstone.

Site Specific Geology

4.3.8 In the absence of site-specific data, BGS borehole records are used where available. There are two available BGS boreholes within 100 m of the Application Site which have been drilled in the GFD, ref. SJ34NW30 – located on the eastern border, drilled in 1980, and SJ34NW273 – also located on the eastern border, drilled in 1967. The borehole records indicate a sequence of interbedded bands of Boulder Clay (Glacial Till) of up to 8.50 m BGL over GFD to 14.30 m BGL in turn overlying Boulder Clay again to 18.00 m BGL over GFD to 22.00 m BGL over Boulder Clay to 24.00 m.

4.3.9 To gain a better understanding of the relatively localised GFD, other boreholes that have been drilled within 500 m of the GFD have been reviewed and are summarised in **Table 4-1.**

Table 4-1 – Summary of Recorded Glaciofluvial Deposits within 500 m of the Application Site

Borehole Reference	Distance / Direction from Application Site	Description of Glaciofluvial Deposits	Thickness (m)	Overburden Thickness (m)
SJ34NW24	64.50 m SE	Fine to coarse gravel with fine to coarse sand	9.80	8.30 (Boulder Clay)
SJ35SW1108	481.70 m N	Silty Sand and Gravel	6.40	1.21 (Clay)
SJ35SW37	372 m NE	Fine to coarse gravel with some cobbles of subrounded quartzite and fine, medium and coarse sand	9.90	5.50 (Boulder Clay)

4.4 Mineral Resource Assessment

Extent of Potentially Viable Mineral Reserves

Total Volume of Safeguarded Mineral Reserves

4.4.1 The available BGS logs reviewed in the previous section, demonstrate the presence of significant superficial deposits comprising of sand and gravel. Based on the extent of mapped superficial deposits by BGS, provided as **Figure 3** below, it suggests that approximately 197,127 m^2 (or approximately 13 %) of the site is underlain by GFD. The remainder of superficial cover is Glacial

Till which is typically sand and gravel within a clay matrix, and it not considered of commercial interest nor is it safeguarded.

4.4.2 As discussed earlier in this report there has been extensive opencast coal working undertaken in the east of Area 2, leaving a thin strip of assumed in-situ GFD alongside the road to the east as shown in **Figure 3**.

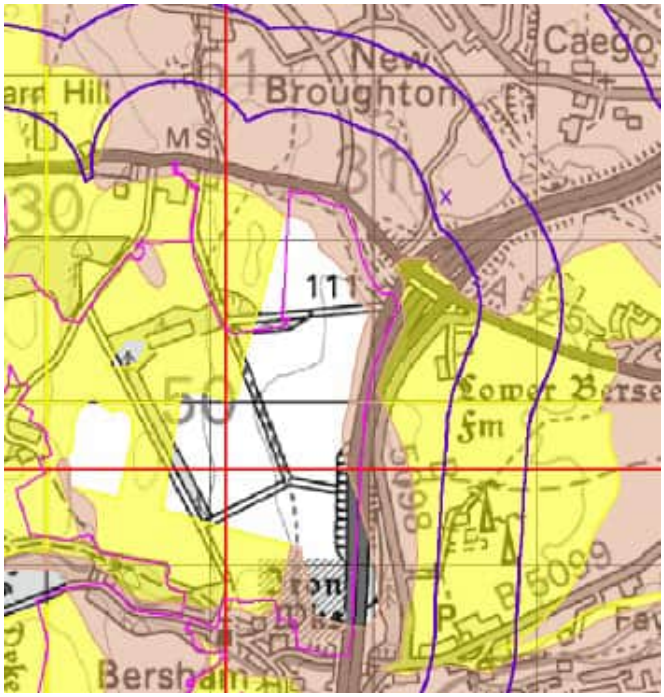

Figure 3 – Extent of superficial deposits (Glaciofluvial Deposits in brown) – source Envirocheck Report 291151542_1_1

4.4.3 Based on the above, an estimate of the volume of potentially viable mineral resource on the Application Site has been estimated and summarised in **Table 4-2.**

Table 4-2 – Volume of Potentially Viable Mineral Resource

Site Area	Estimated Area (m^2)	Average Sand and Gravel Thickness (m)	Volume of Resource (m^3)	Volume of Resource Less 'Lost Resource' (m^3)*
Total Area of Application Site	1,470,000			
Viable Mineral Resource (% of total area with sand and gravel cover)	197,127 (13.4%)	7.5	1,478,452.50	1,439,027.1

*Based on assumption that up to 20 cm of lost resource (i.e. 20 cm of resource below overburden)

4.4.4 The calculations in **Table 4-2** suggest there is approximately 1,478,452.50 m^3 of potentially viable (i.e. extractable) sand and gravel mineral resource on the Application Site. Of this, 1,230,871.42 m^3 lies within buffer zones (outlined in section 4.4.6) leaving 247,581m^3 of extractable mineral, albeit under a considerable thickness of Glacial Till cover.

4.4.5 BGS records indicate that the GFD are separated by layers of Glacial Till, the approximate average overburden of this is 0.7 m to the first layer of GFD and 8.2 m to the second layer of GFD. It is estimated that 82,602.6 m^3 of overburden material would need to be removed in order to extract 247,581 m^3 of potential resource beneath. Although the potential resource is of considerable volume, it is considered unlikely that it will be of commercial interest to specialist extractors of aggregate given the volume of overburden.

Buffer Zones and Constraints on Mineral Extraction

4.4.6 The estimate of potentially viable sand and gravel resource provided in **Table 4-2** does not account for other limitations to mineral extraction which are reasonably expected to apply given the site setting and nature of extraction process. As described in Planning Policy Wales the Welsh Government takes the view that minimum distances should be adopted unless there are clear and justifiable reasons for reducing the distance: Buffer Zones limit the area of potentially extractable resource, by defining the areas where the extraction of safeguarded mineral resources would not be expected due to:

- Strategic Infrastructure including:
  - Road and Highways.
  - Above and below ground utilities and services.
- Proximity to existing sensitive development that could be adversely affected by the effects of extraction (i.e. dust, noise and vibration as per paragraph 5.14.44 of PPW, 2021) most notably:
  - Residential areas.
  - Hospitals.
  - Schools
- Geotechnical and operational considerations associated with mineral excavation, most notably securing a geotechnically sound site boundary.

4.4.7 The requirement to protect sensitive environmental receptors protected under paragraphs 5.14.2 and 5.14.37 of PPW (2021) that could be impacted by extraction include:

- Designated sites (e.g. Site of Special Scientific Interest and National Nature Reserves).
- Ancient woodland.

4.4.8 It is noted that industry guidance does provide some indication of possible standoffs that may be required, for example, the Environmental Effects of Dust from Surface Mineral Workings (Department of the Environment Minerals Division, 1995) states that in the absence of a quantitative dust assessment, a minimum standoff of 100 – 200 m is recommended from significant dust sources. The Welsh Government takes the view that the following minimum distances should be adopted unless there are clear and justifiable reasons for reducing the distance (Mineral Planning Policy (Wales): Mineral Technical Advice Note (Wales) – 1. Aggregates)):

- Sand and gravel (and others where no blasting is permitted): **100 metres**; and
- Hard rock quarries: **200 metres**.

4.4.9 For the purpose of this MRA the following buffer zones are considered reasonable and have been initially applied to further evaluate the distribution, extent and volume of viable mineral resource and its associated economic viability as a resource:

- 25 m standoff to protect mineral excavation boundary structural integrity.
- Existing residential development: 100 m buffer zone;
- Designated Ancient Woodland: 50 m buffer zone;
- Major road infrastructure i.e. A525 and A483: 100 m buffer zone; and
- Minor roads immediately north of the Application Site: 50 m buffer zone.

4.4.10 Given the spatial distribution of sand and gravel on the Application Site, all of the above buffers are applied.

Potentially Extractable Mineral Resources on the Application Site

4.4.11 By applying the buffers outlined above and the impact of prior removal of overburden for opencast coal mining, the area of possible mineral extraction on the Application Site is substantially reduced and hence the volume of viable resource is also reduced. Most notably, the eastern side of the site, which is in close proximity to highly sensitive receptors including the major road, A483 and dense ancient woodland and is within the footprint of the former opencast workings. With the application of the buffer zones as listed above, remaining potential areas of extractable minerals are limited to three areas, one in Area 1 and two in Area 2.

4.4.12 The sum of the area of the three light blue shaded areas in Figure 4 is estimated to be approximately 33,000 m^2 or 2 % of the Application Site area.

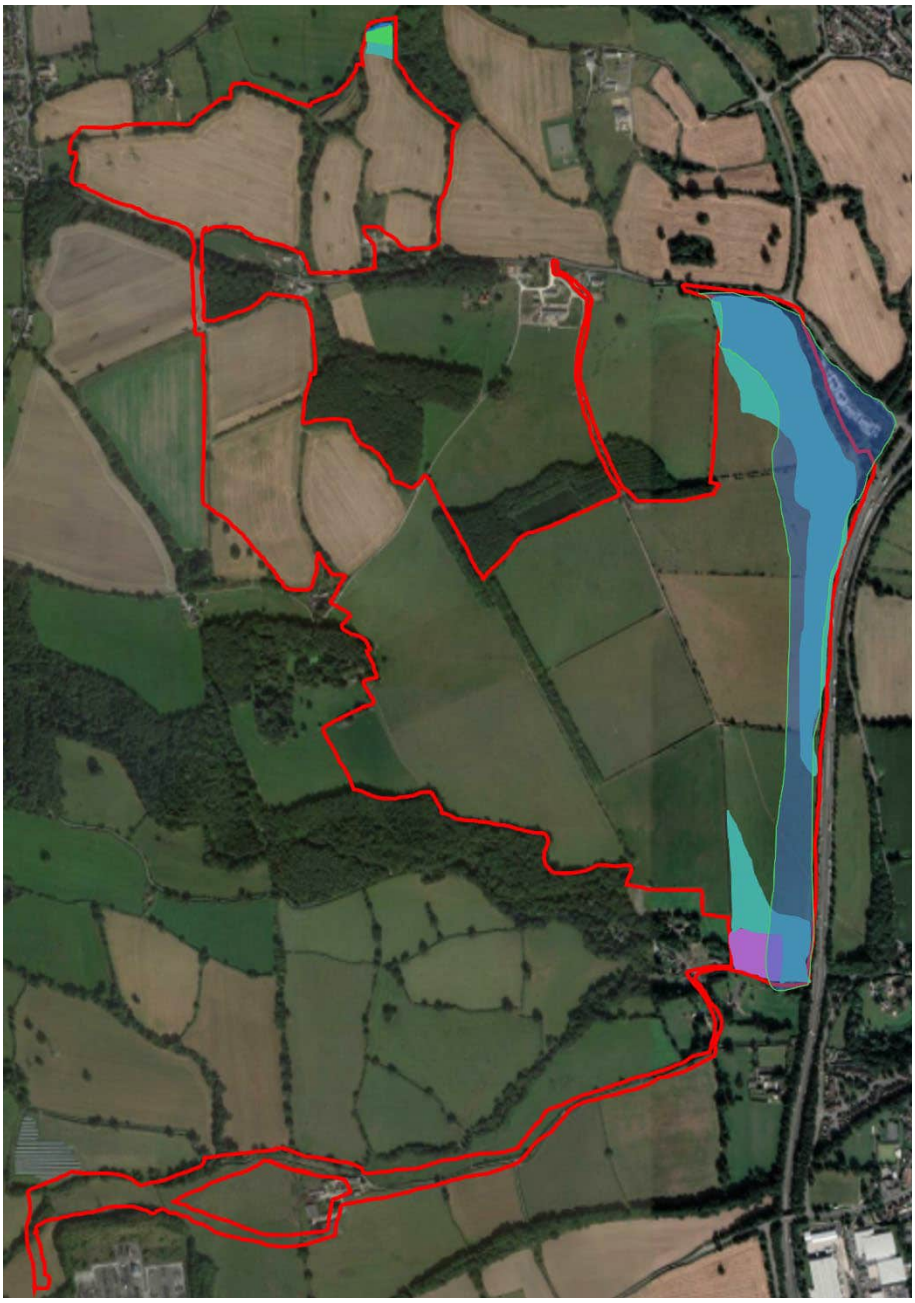

Figure 4 – Area of potentially extractable mineral resource following inclusion of buffer zones (light blue).

4.4.13 The purple shaded area represents areas where a 50 m buffer has been applied for the ancient woodland on/bordering the Application Site. The dark-blue shaded area represents the remaining area of the Application Site which falls within applied buffers for the roads and residential properties.

4.4.14 With a potential workable area of approximately 33,000 m^2, and average thickness of 7.50 m sand and gravel, the estimated workable volume is 247,500 m^3, and less loss resource, approximately 240,900 m^3.

4.4.15 It is noted that the remaining areas coincide with the proposed temporary layout of solar panels rather than any permanent structures, therefore there will not be any permanent sterilisation of the limited reserves.

4.5 Practicability of Prior Extraction

4.5.1 In spite of the assessment of the extent of potential resource on the Application Site and the economic viability for its commercial extraction, the practicability of the prior extraction of safeguarded mineral reserves, in advance of any Proposed Development, must also be considered. Prior extraction could involve either:

- Full extraction of safeguarded reserves in advance of, or in parallel with, construction.
- Incidental extraction – the extraction of safeguarded reserves by virtue of activities required as part of development construction activities.

Full Prior Extraction

4.5.2 The prior extraction of sand and gravel is not considered practicable on the Application Site considering:

- The low economic viability of the calculated resource outside of applied buffer zones given the small volume of viable sand and gravel resource and high cost associated with the need to remove overburden material, excavation backfill and restoration to previous ground level using imported infill materials of an appropriate quality to enable development, particularly given that this development is to be temporary, with a maximum time frame of 40 years.
- High sensitivity of proximal receptors, including the ancient woodland and river at the south of the Application Site, and the residential developments and road layout to the north, north-east and east.
- The potential volume of mineral resource does not take into account variations within the nature of the deposit given the absence of site-specific data, so it is likely that this volume is an overestimate and that there will be presence of inferior quality reserves with a clay/silt content.

Incidental Extraction

4.5.3 The Indicative Site Layout Plan provided as **Figure 5**, demonstrates that construction across the majority of the Application Site, including within the area of safeguarded sand and gravel reserves. will comprise temporary installation of solar panels, which are anticipated to be mounted on racks and driven or bored to a depth of 1 to 2 metres below ground level or supported at surface on concrete footings where required.

Figure 5 – Plas Power Indicative Site Layout Plan

4.5.4 It is possible that some limited incidental extraction of safeguarded sand and gravel resources will occur during the construction phase for placement of cable routes for example. If relatively 'clean' aggregate is excavated during construction, then the relatively small volume of mineral resource could potentially be reused on the Application Site or sold on for other parties to use.

4.6 Assessment against Planning Policies

4.6.1 The findings of the MRA presented above have been evaluated against the mineral planning policies relevant to the Application Site and described in Section 3. This assessment is presented below.

- Policy SP16 – minerals will be sustainably managed through:
  - i. The protection of minerals from unnecessary sterilisation by directing new development away from areas underlain by mineral of importance or where this is not possible, through the requirement to extract mineral prior to the non-mineral development in accordance with the requirements of Policy MW1; and
  - ii. Avoiding conflict between mineral working and sensitive development through the use of buffer zones; and
  - iii. Contributing towards meeting the regional need for aggregate minerals in collaboration with Flintshire County Council; and
  - iv. Supporting proposals for mineral extraction within the County Borough which contribute towards maintaining an adequate supply of minerals in sustainable locations including the delivery of high-quality restoration and aftercare programmes which enhance and provide linkages with the natural environment.

- Policy MW1 – non-mineral development within Mineral Safeguarding Areas as defined on the proposals map will only be permitted where it can be demonstrated that the mineral underlying the site does not merit extraction; or the need for the non-mineral development outweighs the need to protect the resource; or the mineral can be satisfactorily extracted prior to the non-mineral development; or the development is of a temporary nature or can be removed within the timescales within which the mineral is likely to be needed; or essential infrastructure that supports the supply of minerals would not be compromised or would be provided elsewhere.

- Policy MW2 – development in the mineral buffer zones as identified on the Proposals Map will only be permitted where it can be demonstrated that it would not compromise current or planned mineral extraction.

4.6.2 This MRA has been undertaken in accordance with the requirements of SP16, MW1 and MW2. It is not clear from the LDP as to what the current land bank requirements are or for how long the current demand will be met by the existing extraction sites, therefore an estimation of area and volume of available reserves has been made as part of this assessment.

4.6.3 From the assessment of the environmental setting undertaken it is evident that the safeguarded reserves established as present on the Application Site would potentially impact on the local landscape, highways and sensitive land uses, therefore the addition of buffer zones has been considered during assessment of viable reserves. This has indicated that there are minimal sand and gravel reserves present that would be economically viable to extract and that in the vicinity of the Application Site the sand and gravel reserves are associated with lenses and layers of Glacial Till which will result in significant overburden removal and also variability in quality of the sand and gravel reserves.

4.6.4 Whilst the Application Site does lie within an area designated for protection of sand and gravel reserves, it is considered that this is unlikely to restrict development of the Application Site for the reasons set out above regarding economic viability of extraction and the defined temporary nature of the Proposed Development, therefore, the land will be restored on cessation to its previous use thus not sterilising the identified limited mineral reserves.

5 REFERENCES

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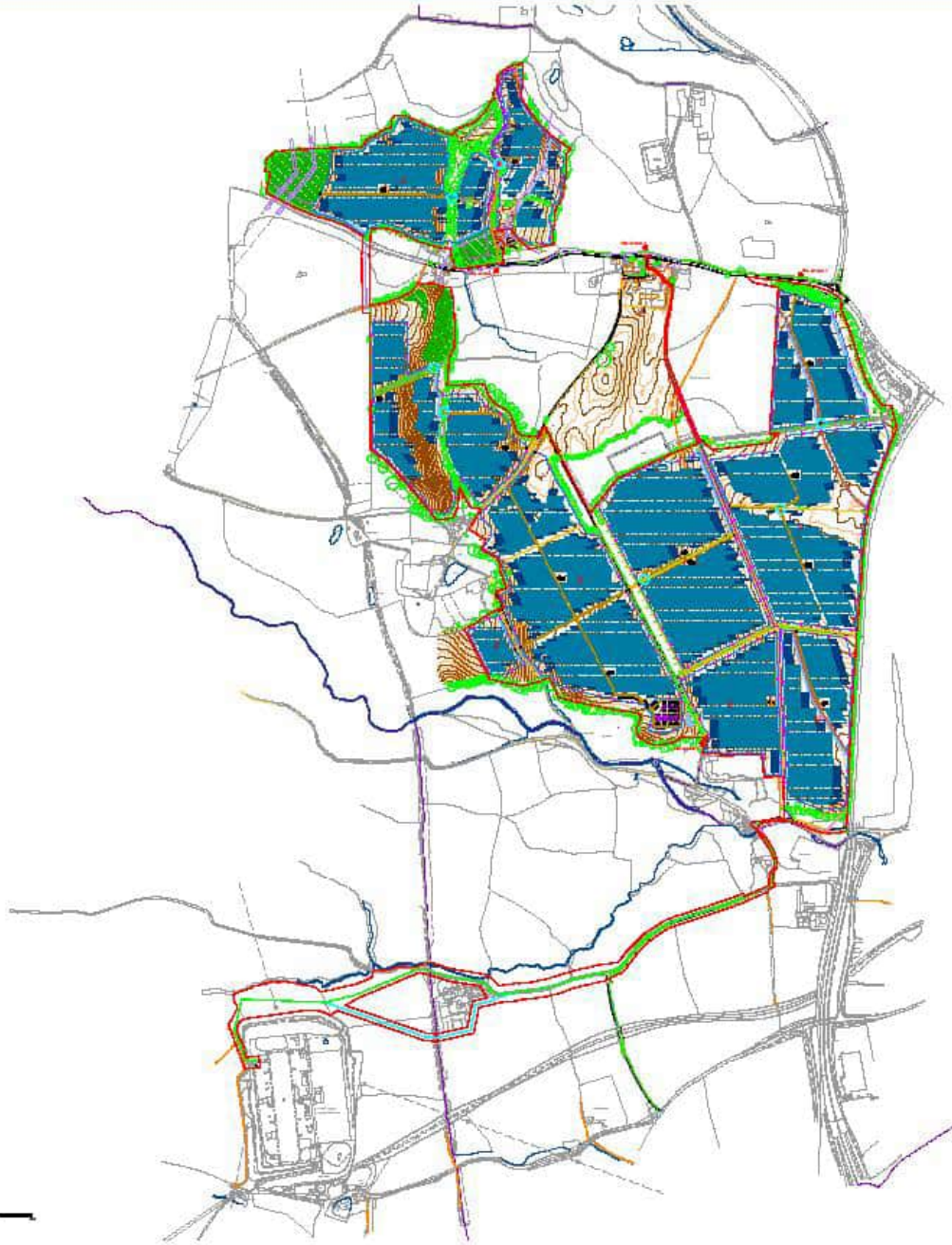
DRAWINGS

Drawing 1 GBR_Plas Power Solar & Battery Project_LP2 – Indicative Site Layout_11

GBR_Plas Power Solar & Battery Project_LP2 - Indicative Site layout_13

Area 1,355,959 m2 (335.06 acres)



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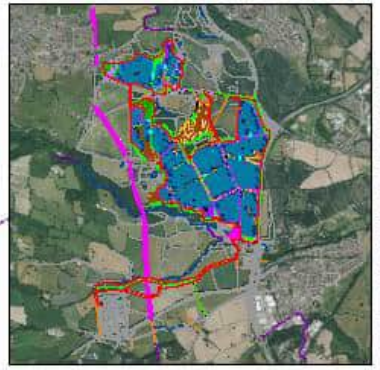

- Site Boundary
- Site Access
- Security Fence
- Module Table 30 x 2
- Module Table 15 x 2
- Transformer
- Switchgear Substation
- PV Intake Substation
- Customer Substation
- Access Road
- Access Gates
- CCTV
- BESS Enclosure x 4
- Twin MV Skid
- Backup Generator
- BESS Intake Substation
- BESS Security Fence
- Preferred Cable Route Option
- Cable Route
- Existing PRoW
- Proposed PRoW diversion
- Cable Sealing End

DA			13.02.2024
DRAWN	CHECKED	APPROVED	DATE

PROJECT NAME & ADDRESS:
Location: Plas Power Estate, Rhosrobin
Postcode: Caego, Wrexham, Wales

NOTES:
-
-
-
-

Paper Size:	Scale:	Sheet:
A3	1:12500	1

CAPACITY:

DRAWING TITLE:
GBR_Plas Power Solar & Battery Project_LP2 - Indicative Site Layout_13

DRAWING NUMBER:	STATUS:
LP2-PDL	Pre-application Consultation

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ISO full bleed A3 (420.00 x 297.00 MM)

Appendix A
CON29 MINING REPORT (AREA 1)

Groundsure
LOCATION INTELLIGENCE

CON29M
OFFICIAL COAL MINING SEARCH

Plas Power Solar Farm Area 1,

Professional opinion

Inc. integrated mine entry interpretive assessment

POTENTIAL RISK

Site plan

Search results

Coal mining (CON29M) assessment

We consider there to be a potential risk to the property from past coal mining activity. For further details refer to: Coal mining subsidence claims.

Coal mining

Subsidence claims

A subsidence claim has been identified within 50m of the property. Whilst no further searches are required, it should be noted that in the event of coal mining settlement or subsidence occurring the property will benefit from the protection of the Coal Mining Subsidence Acts of 1991 and as amended 1994.

Next steps for consideration:

- A visual inspection of the property by a suitably qualified and experienced person may be of value in identifying any currently identifiable mining related settlement or subsidence effects.

Coal Mining Subsidence Act 1991

If any coal mining subsidence damage has occurred, as determined by the appropriate persons/bodies, the property will benefit from the protection of the Coal Mining Subsidence Acts of 1991 and as amended 1994.

This Act, however, does not apply where coal was worked or gotten by virtue of the grant of a gale in the Forest of Dean, or any other part of the Hundred of St. Briavels in the county of Gloucester. In this instance it would be prudent to have the property visually inspected for signs of mining related settlement or subsidence by a suitably qualified and experienced person, who could be sought through https://www.ricsfirms.com/.

The Coal Authority provide a call out service on 01623 646 333 to take remedial action concerning the movement or collapse of any coal entries or coal mining surface hazards. Further details can be found on www.groundstability.com.

CON29M reports are a requirement for conveyancing and are recommended throughout the official Coal Mining Reporting Area. This is the area within which it is deemed prudent to clarify the risk presented by coal mining, using the questions laid out in the Law Society's CON29M form. The need for a CON29M does not always translate to an identification of risk, and reports will often be assessed as free from risk or 'Passed' even though they are within the official Coal Mining Reporting Area.

Contact us with any questions at:
info@groundsure.com
01273 257 755

Coal mining (CON29M)

Site Outline

Search buffers in metres (m)

Mine entries

- Adits
- Shafts
- Calculated 'zone of influence'

Subsidence claims

- Awaiting decision
- Rejected
- Admitted
- Deferred
- Settled
- Withdrawn

- Probable shallow coal mine workings
- Coal outcrops
- Past shallow coal mine workings

Coal mining (CON29M)

The map above shows relevant, mappable hazards identified that could constitute a risk to the property. It does not necessarily show all features or potential issues identified in this report. Further details of any features shown indicating the location of Mine Entries or Subsidence Claims can be found in the relevant sections of this report (4 and 9 respectively).

Responses to the Law Society CON29M Coal Mining search enquiries are produced using official Coal Authority data and the expert interpretation of Groundsure. This report is prepared in accordance with The Law Society CON29M (2018) Guidance Notes. Additional interpretation and calculation of mine entry zones of influence has also been carried out by Groundsure using Coal Authority and British Geological Survey data.

Please read this report carefully, and in particular any sections flagged with an amber 'i'.

Contact us with any questions at:
info@groundsure.com
01273 257 755

The Law Society

1. Past underground coal mining

Is the property within the zone of likely physical influence on the surface of past underground coal workings?

- **The property lies within the potential zone of influence of recorded workings in 6 seam(s) of coal. The most recent underground working in the area was in 1938. These workings lie between 35 metres and 190 metres. Any ground movement due to this coal mining activity should have stopped.**

2. Present underground coal mining

Is the property within the zone of likely physical influence on the surface of present underground coal workings?

- **The property does not lie within the boundary of an underground site from which coal is being removed by underground methods.**

3. Future underground coal mining

(a) Is the property within any geographical area for which the Coal Authority is determining whether to grant a licence to remove coal by underground methods?

- **The property does not lie within the boundary of an underground site for which the Coal Authority is determining whether to grant a licence to remove coal by underground methods.**

(b) Is the property within any geographical area for which a licence to remove coal by underground methods has been granted?

- **The property does not lie within the boundary of an underground site for which a licence to remove coal by underground methods has been granted.**

(c) Is the property within the zone of likely physical influence on the surface of planned future underground coal workings?

- **The property does not lie within the zone of likely physical influence on the surface of planned future underground workings.**

(d) Has any notice of proposals relating to underground coal mining operations been given under section 46 of the Coal Mining Subsidence Act 1991?

- **No notices have been given under Section 46 of the Coal Mining Subsidence Act 1991 stating that the land is at risk of subsidence.**

4. Shafts and adits (mine entries)

Are there any shafts and adits or other entries to underground coal mine workings within the property or within 20 metres of the boundary of the property?

- **No coal mine entries are recorded to lie within 20 metres of the property.**

5. Coal mining geology

Is there any record of any fault or other line of weakness due to coal mining at the surface within the boundary of the property that has made the property unstable?

- **No damage arising from geological faults or other lines of weakness activated by coal mining are recorded within the property.**

6. Past opencast coal mining

Is the property situated within the geographical boundary of an opencast site from which coal has been removed in the past by opencast methods?

- **The property does not lie within the boundary of an opencast site from which coal was removed by opencast methods.**

7. Present opencast coal mining

Is the property within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods?

- **The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.**

8. Future opencast coal mining

(a) Is the property within 800 metres of the boundary of an opencast site for which the Coal Authority are determining whether to grant a licence to remove coal by opencast methods?

- **The property does not lie within 800 metres of the boundary of an opencast site for which the Coal Authority are determining whether to grant a licence to remove coal by opencast methods.**

(b) Is the property within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted?

- **The property does not lie within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.**

9. Coal mining subsidence claims

(a) Has any damage notice or claim for alleged coal mining subsidence damage to the property been given, made or pursued since 31st October 1994?

- **We have evidence of a damage notice or subsidence claim for the property or within 50m of the property since 31st October 1994.**

Distance	Type	Reference	Address	Claim date	Status	Status reason	Claim value
18 m	TCA	S36184-CI	AGRICULTURAL LAND OFF SMITHY ROAD SOUTHSEA WREXHAM CLWYD	19/10/1995	02 - Rejected	-	-

(b) In respect of any such notice or claim has the responsible person given notice agreeing that there is a remedial obligation or otherwise accepted that a claim would lie against them?

- **Responsible persons have not given notice agreeing that there is a remedial obligation or accepted that a claim would lie against them.**

(c) In respect of any such notice or acceptance has the remedial obligation or claim been discharged?

- **Remedial obligation or claims have not been discharged.**

(d) Does any current "Stop Notice" delaying the start of remedial works or repairs affect the property?

- **There are no current Stop Notices delaying the start of remedial works or repairs to the property.**

(e) Has any request been made under Section 33 of the 1991 Act to execute preventive works before coal is worked, which would prevent the occurrence or reduce the extent of subsidence damage to any buildings, structures or works and, if yes, has any person withheld consent or failed to comply with any such request to execute preventive works?

- **There is no record of a request that has been made to carry out preventive works before coal is worked under Section 33 of the Coal Mining Subsidence Act 1991.**

NB. Records of damage notices or subsidence claims before 31st October 1994 are excluded from The Coal Authority data from which this search is compiled.

10. Mine gas emissions

Does the Coal Authority have record of any mine gas emission within the boundary of the property being reported that subsequently required action by the Authority to mitigate the effects of the mine gas emission?

- **No mine gas emissions are recorded within the boundary of the property.**

11. Emergency Surface Hazard Call Out incidents

Have the Coal Authority carried out any work on or within the boundaries of the property following a report of an alleged hazard related to coal mining under the Authority's Emergency Surface Hazard Call Out procedures?

- **No Emergency Surface Hazard Call Out procedures are recorded against the property.**

12. Withdrawal of support

(a) Does the land lie within a geographical area in respect of which a notice of entitlement to withdraw support has been published?

- **The property does not lie in an area where the right to withdraw support has been granted.**

(b) Does the land lie within a geographical area in respect of which a revocation notice has been given under section 41 of the Coal Industry Act 1994?

- **The property does not lie within a geographical area in which a revocation notice has been given under section 41 of the Coal Industry Act 1994.**

13. Working facilities orders

Is the property within a geographical area subject to an order in respect of the working of coal under the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof?

- **The property is not in an area where a court order has been issued.**

Contact us with any questions at:
info@groundsure.com
01273 257 755

14. Payments to owners of former copyhold land

(a) Has any relevant notice, which may affect the property, been given?

- **The property does not lie within former copyholder land.**

(b) If yes, has any notice of retained interests in coal and coal mines been given?

- **No notices of retained interests in coal and coal mines been given.**

(c) If yes, has any acceptance notice or rejection notice been served?

- **No acceptance or rejection notices have been served.**

(d) If any such acceptance notice has been served, has any compensation been paid to a claimant?

- **No compensation has been paid to a claimant.**

CON29M notes and guidance

This report is prepared in accordance with The Law Society Guidance Notes 2018; under which all replies to these enquiries are made. Groundsure's Terms and Conditions are applicable at the time the report was produced.

Property owners have the benefit of statutory protection (under the Coal Mining Subsidence Act 1991). This contains provision for the making good, to the reasonable satisfaction of the owner, of physical damage from disused coal mine workings including disused coal mine entries. A leaflet setting out the rights and obligations of either the Coal Authority or other responsible persons under the 1991 Act can be obtained by telephoning 0345 762 6848. Further information can be found on their website: www.groundstability.com.

The Coal Authority, regardless of responsibility and in conjunction with other public bodies, provide an emergency call out facility in coalfield areas to assess the public safety implications of mining features (including disused mine entries).

The Coal Authority emergency telephone number at all times is 01623 646333.

Responses to The Law Society CON29M (2018) Coal Mining Search enquiries and associated findings and recommendations relating to coal mining risk have been provided by Groundsure Ltd. Groundsure Ltd have additionally provided information relating to the Cheshire Brine Compensation Area, and have compiled all information into this report.

Queries should be made of Groundsure Ltd on 01273 257 755, or via email: info@groundsure.com.

CON29M report limitations

This CON29M (2018) Coal Mining Report has been carried out with reference to all available official Coal Authority licensed data, an extensive collection of abandoned mine plans, maps and records. From this material, we have endeavoured to provide as accurate a report as possible. Any and all analysis and interpretation of licensed Coal Authority data in this report is made by Groundsure

The information provided in this report by Groundsure Ltd has been compiled in response to The Law Society CON29M (2018) Coal Mining search enquiries. The scope of the assessment is limited to interpretation of past, present and future extraction of coal, and does not consider the impact from non-coal mining hazards and/or natural ground stability hazards. The Law Society's Guidance Notes 2018 recommends separate enquiries to the appropriate sources are made with regard to other minerals.

The Report is created by a remote investigation and reviews only information provided by the client (address and site location boundaries) and from the databases of publicly available and/or licensable information that enable a desk-based assessment of the Site. The Report does not include a Site Investigation, nor does Groundsure Ltd make additional specific information requests of the regulatory authorities for any relevant information they may hold.

This report is concerned solely with the Site searched and should not be used in connection with nearby properties, as only known coal mining features that could potentially have a direct influence upon the Site searched are considered relevant; other features present in the general area may have been omitted for ease of reference.

This report is confidential to the client, the client's legal advisor and the client's Mortgage lender, as defined in the Groundsure terms & conditions, and as such may be used by them for conveyancing or related purposes. Groundsure has no liability toward any person or organisation not party to commissioning this report. This report or any part of it is not permitted to be reproduced, copied, altered or in any other way distributed by any other person or organisation.

Additional mine entry assessment is based on and limited to the data supplied by the Coal Authority at the time of production. In order to determine whether a property is within the likely zone of influence of a disused coal mine entry the following is considered: the actual or plotted position of the mine entry, its known or assumed diameter and the thickness of superficial deposits above rockhead. Where these figures are not known, assumptions based on established estimations have been made.

CON29M report licensing

This report contains Data provided by the Coal Authority. Any and all analysis and interpretation of Coal Authority Data in this report is made by Groundsure Limited and is in no way supported, endorsed or authorised by the Coal Authority. The use of the data is restricted to the terms and provisions contained in this report. Data reproduced in this report may be the copyright of the Coal Authority and permission should be sought from Groundsure Limited prior to any re-use. Due to data collection methods and processing time, there may be a period of up to 1 week between the Coal Authority updating their data and it appearing within the Groundsure report.

The Law Society CON29M Coal Mining search enquiries are protected by copyright owned by The Law Society of 113 Chancery Lane, London WC2A 1PL.

This report may contain public sector information licensed under the Open Government Licence v3.0.

This report may contain plans and records held by the Coal Authority and made publicly available at the time of inspection which may include British Geological Survey and Ordnance Survey data.

Contact us with any questions at:
info@groundsure.com
01273 257 755

Conveyancing Information Executive and our terms & conditions

IMPORTANT CONSUMER PROTECTION INFORMATION

This search has been produced by Groundsure Ltd, Nile House, Nile Street, Brighton, BN1 1HW. Tel: 01273 257 755. Email: info@groundsure.com. Groundsure adheres to the Conveyancing Information Executive Standards.

The Standards

- Conveyancing Information Executive Members shall act in a professional and honest manner at all times in line with the Conveyancing Information Executive Standards and carry out the delivery of the Search with integrity and due care and skill.
- Compliance with the Conveyancing Information Executive Standards will be a condition within the Conveyancing Information Executive Member's Terms and Conditions.
- Conveyancing Information Executive Members will promote the benefits of and deliver the Search to the agreed standards and in the best interests of the customer and associated parties.

Complaints Advice

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure.

If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award up to £5,000 to you if the Ombudsman finds that you have suffered actual financial loss and/or aggravation, distress or inconvenience as a result of your search provider failing to keep to the Standards.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs.

COMPLAINTS PROCEDURE: If you want to make a complaint, we will:

- acknowledge it within 5 working days of receipt
- normally deal with it fully and provide a final response, in writing, within 20 working days of receipt
- liaise, at your request, with anyone acting formally on your behalf

Complaints should be sent to:
Operations Director, Groundsure Ltd, Nile House, Nile Street, Brighton, BN1 1HW. Tel: 01273 257 755. Email: info@groundsure.com If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk We will co-operate fully with the Ombudsman during an investigation and comply with their final decision.

Groundsure's Terms and Conditions can be viewed online at this link: https://www.groundsure.com/terms-and-conditions-april-2023/

Important consumer protection information

All of the advice and reports that Groundsure produces are covered by a comprehensive Remediation Contribution policy to ensure customers are protected, see https://www.groundsure.com/remediation for full details.

Data providers

Groundsure works with respected data providers to bring you the most relevant and accurate information in your report. To find out who they are and their areas of expertise see https://www.groundsure.com/sources-reference.

Coal Mining Report Insurance Policy

ZURICH

Coal Mining Report Insurance Policy

The Schedule

Policy Number: The Reference contained in the **Coal Mining Search Report**

Premium: £1.40 inclusive of Insurance Premium Tax at 12%

Property: The property which is the subject of the **Coal Mining Search Report**

Limit of Indemnity: £100,000 increasing by 10% compound per annum on each anniversary of and for the first 10 years following the **Commencement Date**

Commencement Date: The date of the **Coal Mining Search Report**

You/Your:
1. A purchaser of the **Property**
2. A lender providing a **Mortgage** in connection with a purchase of the **Property**
3. A lender providing a **Mortgage** by way of a re-mortgage of the **Property**

Definitions

Where a word is defined below or in the schedule it shall carry the same meaning wherever it appears in bold text in this policy

Insured Use: The continued use of the **Property** as a single house or flat or a single commercial premises

Market Value: The value as determined by a surveyor appointed by agreement between **You** and **Us** or (in default of agreement) the President for the time being of the Royal Institution of Chartered Surveyors

Mortgage: A mortgage or charge secured on the **Property** by an institutional mortgage lender

Coal Mining Search Report: The coal mining search report attached to this policy

Search: An official search comprising a search in form CON29M (2018) being mining searches relating to coal and brine in the area in which the **Property** is situated

We/Our/Us:
Zurich Insurance plc. A public limited company incorporated in Ireland. Registration No. 13460. Registered Office: Zurich House, Ballsbridge Park, Dublin 4, Ireland. UK Branch registered in England and Wales Registration No. BR7985. UK Branch Head Office: The Zurich Centre, 3000 Parkway, Whiteley, Fareham, Hampshire PO15 7JZ.

Zurich Insurance plc is authorised by the Central Bank of Ireland and authorised and subject to limited regulation by the Financial Conduct Authority. Details about the extent of our authorisation by the Financial Conduct Authority are available from us on request. Our FCA Firm Reference Number is 203093.

Communications may be monitored or recorded to improve our service and for security and regulatory purposes.

Your Policy

This is a legal document and should be kept in a safe place.

This policy is an agreement between **You** and **Us** and cover is provided subject to the payment of the **Premium**.

You must read this policy and its conditions, exclusions, schedule and any endorsements as one contract. Please read all of them to make sure that they provide the cover **You** require. If they do not, please contact **Us** or **Your** insurance adviser who arranged the policy for **You**.

When **You** take out and make changes to the cover provided by this policy, **You** must take reasonable care to ensure that **You** accurately answer any questions which **We** ask of **You** and that any information **You** give **Us** is accurate. If **You** are taking out this policy for purposes which are mainly related to **Your** trade, business or profession, **You** must also let **Us** know about all facts which are material to **Our** decision to provide **You** with insurance. Failure to meet these obligations could result in this policy being invalidated, a claim not being paid, or an additional premium being charged.

Fair presentation of the risk

a) At inception of this policy and also whenever changes are made to it at **Your** request You must:

i) where **You** have taken out this policy for purposes which are wholly or mainly related to **Your** trade, business or profession, disclose to **Us** all material facts in a clear and accessible manner and not misrepresent any material facts, and
ii) where **You** have taken out this policy for purposes which are wholly or mainly unrelated to **Your** trade, business or profession, take reasonable care not to misrepresent any material facts.

b) If **You** do not comply with clause a) of this condition **We** may:

i) avoid this policy which means that **We** will treat it as if it had never existed and refuse all claims where any non-disclosure or misrepresentation by **You** is proven by **Us** to be deliberate or reckless in which case **We** will not return the premium paid by **You**; and
ii) recover from **You** any amount **We** have already paid for any claims including costs or expenses **We** have incurred.

c) If You do not comply with clause a) of this condition and the non-disclosure or misrepresentation is not deliberate or reckless this policy may be affected in one or more of the following ways depending on what **We** would have done if **We** had known about the facts which **You** failed to disclose or misrepresented:

i) if **We** would not have provided **You** with any cover **We** will have the option to:
1. avoid the policy which means that **We** will treat it as if it had never existed and repay the premium paid; and
2. recover from **You** any amount **We** have already paid for any claims including costs or expenses **We** have incurred
ii) if **We** would have applied different terms to the cover **We** will have the option to treat this policy as if those different terms apply. **We** may recover any payments made by **Us** on claims which have already been paid to the extent that such claims would not have been payable had such additional terms been applied
iii) if **We** would have charged **You** a higher premium for providing the cover **We** will charge **You** the additional premium which **You** must pay in full.

d) If any insured person, other than **You**, is responsible for a misrepresentation or failure to make a fair presentation of the risk, **We** will invoke the remedies available to **Us** under this condition as against that particular person as if a separate insurance contract had been issued to them leaving the remainder of the policy unaffected.

NB: For the purposes of the duty of disclosure stated in paragraphs a) i) and ii) above the content of the **Coal Mining Search Report** will be deemed to satisfy **Your** disclosure obligations.

Cover

1. **You** are in the process of purchasing the **Property** relying on the **Coal Mining Search Report** and/or
2. **You** (being a lender) have agreed to provide a **Mortgage** in connection with **Your** borrower's purchase or re-mortgage of the **Property** relying on the **Coal Mining Search Report**.

We will pay the following losses sustained by **You** arising out of the **Property** being affected by any matter which would have been revealed by a **Search** had one been carried out on the date of the **Coal Mining Search Report** but which was not revealed by the **Coal Mining Search Report**:

1. any reduction in **Market Value** of the **Property** calculated at the date **You** become aware of the matter(s) and/or loss in connection with a **Mortgage** as a result of such reduction.
2. all other costs and expenses including out of court settlement costs incurred by **Us** or by **You** with **Our** prior written agreement.

Waiver of Breach of Policy Condition

We will not exercise **Our** right to avoid **Our** liability to **You** in respect of loss where **You** have inadvertently breached any term or condition of the policy provided that such breach does not prejudice **Our** rights and remedies under the policy or otherwise directly or indirectly result in or increase the amount of any loss.

Protection for Mortgagees and Successors in Title

We will not avoid **Our** liability to make a payment to **You** solely because another person breaches the terms and conditions of this policy, provided such breach was not committed on **Your** behalf or with **Your** agreement, and **We** will invoke the remedies available to **Us** under the Policy as against that other person as if a separate insurance contract had been issued to them leaving the remainder of the policy unaffected.

Joint Insured

Any party insured under this policy standing in the relation of parent company, subsidiary company, associated company, branch office or joint venture partner to each other will be deemed to be joint insured for the purposes of this policy and jointly liable and responsible for any breach of any terms and conditions of this policy. If there is any inconsistency between this clause and any other term of this policy, this clause shall prevail.

Exclusions

We will not pay for any:

1. amount in excess of the **Limit of Indemnity**.
2. loss which would be recoverable under a household buildings insurance policy.
3. loss arising from any matter that **You** were aware of at the **Commencement Date**.
4. loss if the **Property** is used for any purpose other than the **Insured Use**.

Claims Conditions and How to Claim

1. **You** must:

i) give **Us** written notice as soon as possible of any potential or actual claim or any circumstances likely to result in a claim. Please provide the policy number, **Your** name, the full address of the **Property** and a brief description of the incident that has occurred. Notifications should be sent to: Speciality Lines Claims Team, Zurich Insurance, 8th Floor, 70 Mark Lane, London, EC3R 7NQ. Email: claims@uk.zurich.com, Enquiry line: telephone 0207 648 3523
ii) pass all court documents and/or other communications to **Us** as soon as possible after receipt
iii) not deal with, make any admission of liability or attempt to settle a claim without **Our** prior written agreement.
iv) agree to and carry out at **Our** expense all things necessary to minimise any loss.
v) provide all information and assistance that **We** may require to help defend and settle the claim.

2. **We** are entitled to:

i) decide how to settle or defend a claim and may carry out proceedings in the name of any person insured under this policy, including proceedings for recovering any claim.
ii) pay to **You** at any time, an amount equal to the **Limit of Indemnity** or any lower amount for which the claim can be settled, after deduction of any sum already paid. **We** may then give up control of and have no further liability in connection with the claim.

3. If **We** admit liability for a claim but there is a dispute as to the amount to be paid the dispute will be referred to an arbitrator. The arbitrator will be appointed jointly by **You** and **Us** in accordance with the law at the time. **You** may not take any legal action against **Us** over the dispute before the arbitrator has reached a decision.

4. If **You** or anyone acting on Your behalf:

a) makes a fraudulent or exaggerated claim under this policy; or
b) uses fraudulent means or devices including the submission of false or forged documents in support of a claim whether or not the claim is itself genuine; or
c) makes a false statement in support of a claim whether or not the claim is itself genuine; or
d) submits a claim under this policy for loss or damage which **You** or anyone acting on **Your** behalf or in connivance with **You** deliberately caused; or
e) realises after submitting what **You** reasonably believed was a genuine claim under this policy and then fails to tell **Us** that **You** have not suffered any loss or damage; or
f) suppresses information which **You** know would otherwise enable **Us** to refuse to pay a claim under this policy

We will be entitled to refuse to pay the whole of the claim and recover any sums that **We** have already paid in respect of the claim.

If any fraud is perpetrated by or on behalf of an insured person and not on behalf of **You** this condition should be read as if it applies only to that insured person's claim and references to this policy should be read as if they were references to the cover effected for that person alone and not to the policy as a whole.

5. If any claim is covered by any other insurance, **We** will not pay for more than **Our** share of that claim.

6. The most **We** will pay for any loss (or all losses in the aggregate), including costs and expenses agreed by **Us** is the **Limit of Indemnity**. Once **We** have paid a loss or losses equal to the amount of the **Limit of Indemnity, We** will have no further liability under this policy.

General Conditions

1. Neither **You** (nor anyone acting on **Your** behalf) must disclose the existence of this policy to any other party except **Your** legal and other professional advisers, prospective purchasers, lessees and tenants of the **Property**, their respective mortgagees, legal and other professional advisers.

2. In the UK the law allows both **You** and **Us** to choose the law applicable to the contract. This contract will be subject to the relevant law of England and Wales, Scotland, Northern Ireland, the Isle of Man or the Channel Islands depending upon the Property address stated in the Schedule. If there is any dispute as to which law applies it will be English law. The parties agree to submit to the exclusive jurisdiction of the English courts.

3. Notwithstanding any other terms of this policy **We** will be deemed not to provide cover nor will **We** make any payment or provide any service or benefit to **You** or any other party to the extent that such cover, payment, service, benefit and/or any business or activity of **Yours** would violate any applicable trade or economic sanctions law or regulation.

Cancellation Clause

If **You** have taken out this policy for purposes which are wholly or mainly unrelated to **Your** trade, business or profession, **You** may cancel this policy within 14 days of receiving the policy by writing to **Us** and in such event **We** may, at **Our** discretion, charge **You** for the time that **You** have been on cover. Any refund will be made to the party who paid the premium. If **You** do cancel, **You** may be in breach of the terms of **Your** mortgage or the terms of the contract for the sale of **Your** property. If **You** are in doubt, **You** may wish to seek legal advice prior to cancellation.

Fair Processing and Complaints Procedure
Our Complaints Procedure

Our commitment to customer service

We are committed to providing a high level of customer service. If you feel we have not delivered this, we would welcome the opportunity to put things right for you.

Who to contact in the first instance

Many concerns can be resolved straight away. Therefore in the first instance, please get in touch with your usual contact at Zurich or your broker or insurance intermediary, as they will generally be able to provide you with a prompt response to your satisfaction.

Contact details will be provided on correspondence that we or our representatives have sent you.

Many complaints can be resolved within a few days of receipt

If we can resolve your complaint to your satisfaction within the first few days of receipt, we will do so. Otherwise, we will keep you

updated with progress and will provide you with our decision as quickly as possible.

Next steps if you are still unhappy

If you are not happy with the outcome of your complaint, you may be able to ask the Financial Ombudsman Service to review your case.

We will let you know if we believe the ombudsman service can consider your complaint when we provide you with our decision. The service they provide is free and impartial, but you would need to contact them within 6 months of the date of our decision.

More information about the ombudsman and the type of complaints they can review is available via their website www.financial-ombudsman.org.uk.

You can also contact them as follows:

Post: Financial Ombudsman Service, Exchange Tower, London, E14 9SR
Telephone: 08000 234567 (free on mobile phones and landlines)
Email: complaint.info@financial-ombudsman.org.uk

If the Financial Ombudsman Service is unable to consider your complaint, you may wish to obtain advice from the Citizens Advice Bureau or seek legal advice.

The Financial Services Compensation Scheme (FSCS)

We are covered by the Financial Services Compensation Scheme (FSCS) which means that you may be entitled to compensation if we are unable to meet our obligations to you. Further information is available on www.fscs.org.uk or by contacting the FSCS directly on 0800 678 1100.

How we use your information

Who controls your personal information

This notice tells you how Zurich Insurance plc ('Zurich'), as data controller, will deal with your personal information. Where Zurich introduces you to a company outside the group, that company will tell you how your personal information will be used.

You can ask for further information about our use of your personal information or complain about its use in the first instance, by contacting our Data Protection Officer at: Zurich Insurance Group, Tri-centre 1, Newbridge Square, Swindon, SN1 1HN or by emailing the Data Protection Officer at GBZ.General.Data.Protection@uk.zurich.com.

If you have any concerns regarding our processing of your personal information, or are not satisfied with our handling of any request by you in relation to your rights, you also have the right to make a complaint to the Information Commissioner's Office. Their address is: First Contact Team, Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, SK9 5AF.

What personal information we collect about you

We will collect and process the personal information that you give us by phone, e-mail, filling in forms, including on our website, and when you report a problem with our website. We also collect personal information from your appointed agent such as your trustee, broker, intermediary or financial adviser in order to provide you with the services you have requested and from other sources, such as credit reference agencies and other insurance companies, for verification purposes. We will also collect information you have volunteered to be in the public domain and other industry-wide sources. We will only collect personal information that we require to fulfil our contractual or legal requirements unless you consent to provide additional information. The type of personal information we will collect includes; basic personal information (i.e. name, address and date of birth), occupation and financial details, health and family information, claims and convictions information and where you have requested other individuals be included in the arrangement, personal information about those individuals.

If you give us personal information on other individuals, this will be used to provide you with a quotation and/or contract of insurance and/or provision of financial services. You agree you have their permission to do so. Except where you are managing the contract on another's behalf, please ensure that the individual knows how their personal information will be used by Zurich. More information about this can be found in the 'How we use your personal information' section.

How we use your personal information

We and our selected third parties will only collect and use your personal information (i) where the processing is necessary in connection with providing you with a quotation and/or contract of insurance and/or provision of financial services that you have requested; (ii) to meet our legal or regulatory obligations; or (iii) for our 'legitimate interests'. It is in our legitimate interests to collect

your personal information as it provides us with the information that we need to provide our services to you more effectively including providing you with information about our products and services. We will always ensure that we keep the amount of information collected and the extent of any processing to the absolute minimum to meet this legitimate interest. Examples of the purposes for which we will collect and use your personal information are:

1. to provide you with a quotation and/or contract of insurance;
2. to identify you when you contact us;
3. to deal with administration and assess claims;
4. to make and receive payments;
5. to obtain feedback on the service we provide to you;
6. to administer our site and for internal operations including troubleshooting, data analysis, testing, research, statistical and survey purposes;
7. for fraud prevention and detection purposes.

We will contact you to obtain consent prior to processing your personal information for any other purpose, including for the purposes of targeted marketing unless we already have consent to do so.

Who we share your personal information with

Where necessary, we will share the personal information you gave us for the purposes of providing you with the goods and services you requested with the types of organisations described below:

associated companies including reinsurers, suppliers and service providers;
introducers and professional advisers;
regulatory and legal bodies;
survey and research organisations;
credit reference agencies;
healthcare professionals, social and welfare organisations; and
other insurance companies

Or, in order to meet our legal or regulatory requirements, with the types of organisations described below:

regulatory and legal bodies;
central government or local councils;
law enforcement bodies, including investigators;
credit reference agencies; and
other insurance companies

How we use your personal information for websites and email communications

When you visit one of our websites we may collect information from you such as your email address or IP address. This helps us to track unique visits and monitor patterns of customer website traffic, such as who visits and why they visit.

We use cookies and/or pixel tags on some pages of our website. A cookie is a small text file sent to your computer. A pixel tag is an invisible tag placed on certain pages of our website but not on your computer. Pixel tags usually work together with cookies to assist us to provide you with a more tailored service. This allows us to monitor and improve our email communications and website. Useful information about cookies, including how to remove them, can be found on our websites.

How we transfer your personal information to other countries

Where we transfer your personal information to countries that are outside of the UK and the European Union (EU) we will ensure that it is protected and that the transfer is lawful. We will do this by ensuring that the personal information is given adequate safeguards by using 'standard contractual clauses' which have been adopted or approved by the UK and the EU, or other solutions that are in line with the requirements of European data protection laws.

A copy of our security measures for personal information transfers can be obtained from our Data Protection Officer at: Zurich Insurance Group, Tri-centre 1, Newbridge Square, Swindon, SN1 1HN, or by emailing the Data Protection Officer at GBZ.General.Data.Protection@uk.zurich.com.

How long we keep your personal information for

We will retain and process your personal information for as long as necessary to meet the purposes for which it was originally

collected. These periods of time are subject to legal, tax and regulatory requirements or to enable us to manage our business.

Your data protection rights

You have a number of rights under the data protection laws, namely:

to access your data (by way of a subject access request);
to have your data rectified if it is inaccurate or incomplete;
in certain circumstances, to have your data deleted or removed;
in certain circumstances, to restrict the processing of your data;
a right of data portability, namely to obtain and reuse your data for your own purposes across different services;
to object to direct marketing;
not to be subject to automated decision making (including profiling), where it produces a legal effect or a similarly significant effect on you;
to claim compensation for damages caused by a breach of the data protection legislation.
if we are processing your personal information with your consent, you have the right to withdraw your consent at any time.

We will, for the purposes of providing you with a contract of insurance, processing claims, reinsurance and targeted marketing, process your personal information by means of automated decision making and profiling where we have a legitimate interest or you have consented to this.

What happens if you fail to provide your personal information to us

If you do not provide us with your personal information, we will not be able to provide you with a contract or assess future claims for the service you have requested.

Fraud prevention and detection

In order to prevent and detect fraud we may at any time:

check your personal data against counter fraud systems
use your information to search against various publicly available and third party resources
use industry fraud tools including undertaking credit searches and to review your claims history
share information about you with other organisations including but not limited to the police, the Insurance Fraud Bureau (IFB), other insurers and other interested parties.

If you provide false or inaccurate information and fraud is identified, the matter will be investigated and appropriate action taken. This may result in your case being referred to the Insurance Fraud Enforcement Department (IFED) or other police forces and fraud prevention agencies. You may face fines or criminal prosecution. In addition, Zurich may register your name on the Insurance Fraud Register, an industry-wide fraud database.

Claims history

We may pass information relating to claims or potential claims to any relevant database. We and other insurers may search these databases when you apply for insurance, when claims or potential claims are notified to us or at time of renewal to validate your claims history or that of any other person or property likely to be involved in the policy or claim.

This helps to check information provided and prevent fraudulent claims.

Appendix B
CON29 MINING REPORT (AREA 2)

CON29M (2018) Commercial Coal Mining Search

Passed

Search Acumen
The Maidstone Studios
New Cut Road Vinters Park
Maidstone
Kent ME14 5NZ

Mining Searches UK
Highburrow Lane
Wilson Way
Pool Industrial Estate
Redruth
Cornwall
TR15 3RN

T: 01209 218861
E: search@miningsearchesuk.com
W: www.miningsearchesuk.com

Date: July 17 2020
Our Reference: SO220192
Your Reference: 12534157

LAND AT PLAS BUCKLEY NULL, BERSHAM, WREXHAM, LL14 4LW

OPINION

Mining Searches UK considers the property to be acceptably free from coal mining related risk.

No further action is required with regards to past coal mining.

1. PAST UNDERGROUND COAL MINING

The property lies within the potential zone of influence of recorded workings in 7 seam(s) of coal. The most recent underground working in the area was in 1972. These workings lie between approximately 35 and 350 metres below surface

2. PRESENT UNDERGROUND COAL MINING

The property does not lie within the boundary of an underground site from which coal is being removed by underground methods.

3. FUTURE UNDERGROUND COAL MINING

The property does not lie within the boundary of an underground site for which a licence to remove coal by underground methods has been granted.

No notices have been given, under Section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

4. SHAFTS AND ADITS (MINE ENTRIES)

No coal mine entries are recorded to lie within 20 metres of the property.

5. COAL MINING GEOLOGY

No damage arising from geological faults or other lines of weakness activated by coal mining are recorded within the property.

6. PAST OPENCAST COAL MINING

The property is indicated to lie within the boundary of an opencast site from which coal was removed by opencast methods prior to the issue of licencing from the Coal Authority (pre-1994).

7. PRESENT OPENCAST COAL MINING

The property does not lie within, or within 200 metres of the boundary of current opencast site

8. FUTURE OPENCAST COAL MINING

The property does not lie within, or within 800 metres of the boundary of a future site for which a licence to remove coal by opencast methods has been granted.

9. COAL MINING SUBSIDENCE CLAIMS

Mining Searches UK have no evidence of a damage notice or subsidence claim for the property since 31st October 1994.

Mining Searches UK have no evidence of damage notices or subsidence claims within 50 meters of the property boundary since 31st October 1994.

There are no current Stop Notices delaying the start of remedial works or repairs to the property.

Records of damage notices or subsidence claims before 31st October 1994 are excluded from The Coal Authority data from which this search is compiled.

10. MINE GAS EMISSIONS

No mine gas emissions are recorded within the property.

11. EMERGENCY SURFACE HAZARD CALL OUT INCIDENTS

No Emergency Surface Hazard Call Out procedures are recorded against the property.

12. WITHDRAWAL OF SUPPORT

The property lies within an area where a notice of entitlement to withdraw support has been published. Notices were issued in 1946, 1967, 1974 and 1976.

13. WORKING FACILITIES ORDERS

The property is not in an area where a court order has been issued.

14. PAYMENTS TO OWNERS OF FORMER COPYHOLD LAND

The property does not lie within Former Copyhold Land.

NOTES AND GUIDANCE

This search is based on, and limited to, the data supplied by the Coal Authority at the time of production.

These enquiries are the Law Society's CON29M Coal Mining search enquiries and are used with permission of the Law Society.

The Law Society's CON29M Coal Mining search enquiries are protected by copyright owned by the Law Society of 113 Chancery Lane, London, WC2A 1PL.

The Law Society has no responsibility for information provided in response to CON29M Coal Mining search enquiries within this report or otherwise.

As with all mining records there is no guarantee or assurance of reliability or accuracy. Mining Searches UK cannot be held responsible for any omissions or errors in the information upon which our interpretation has been based.

Mining records vary in document age, reliability, reproduction, quality of the original record, the reason for the production of the original document, skill of the original surveyor and accounting for the accuracy of the available surveying equipment at the time of production. It must be accepted that the information is subject to interpretation. Alternative interpretations may be possible.

In any area, sporadic, un-surveyed and ancient mine workings can exist, and unrecorded mine workings can never be ruled out. Mining Searches UK cannot be held responsible for any settlement or subsidence problems as a result of a property being affected by unrecorded mining features.

If the property is subject to future development it would be prudent to seek appropriate technical advice concerning past coal mining activity before any works are undertaken.

The Coal Authority should be consulted before any work is undertaken that intersects, disturbs or in any other way interferes with any coal, coal mines or coal mine entries.

Developers should be aware that the investigation or disturbance of coal seams, coal mine entries or former coal mines has the potential to generate and/or displace underground gasses and these present a risk both under and adjacent to the development.

The Coal Authority should be consulted before any work is undertaken that intersects, disturbs or in any other way interferes with any coal, coal mines or coal mine entries.

Developers should be aware that the investigation or disturbance of coal seams, coal mine entries or former coal mines has the potential to generate and/or displace underground gasses and these present a risk both under and adjacent to the development.

If the property is subject to development, a suitable mining investigation may be required to satisfy planning or building regulation conditions. If development is being considered, contact Mining Searches UK for further advice.

This report is suitable for conveyancing purposes and is undertaken on behalf of the client, their mortgagees and legal advisers.

This mining search only considers the coal extraction risk. It is not considered to be an environmental, ecological, contaminated land, archaeological survey or natural ground hazard assessment.

Property owners have the benefit of statutory protection (under the Coal Mining Subsidence Act 1991). This contains provision for the making good, to the reasonable satisfaction of the owner, of physical damage from disused coal mine workings including disused coal mine entries. A DTI leaflet setting out the rights and obligations of either the Coal Authority or other responsible persons under the 1991 Act can be obtained by telephoning 0845 762 6848.

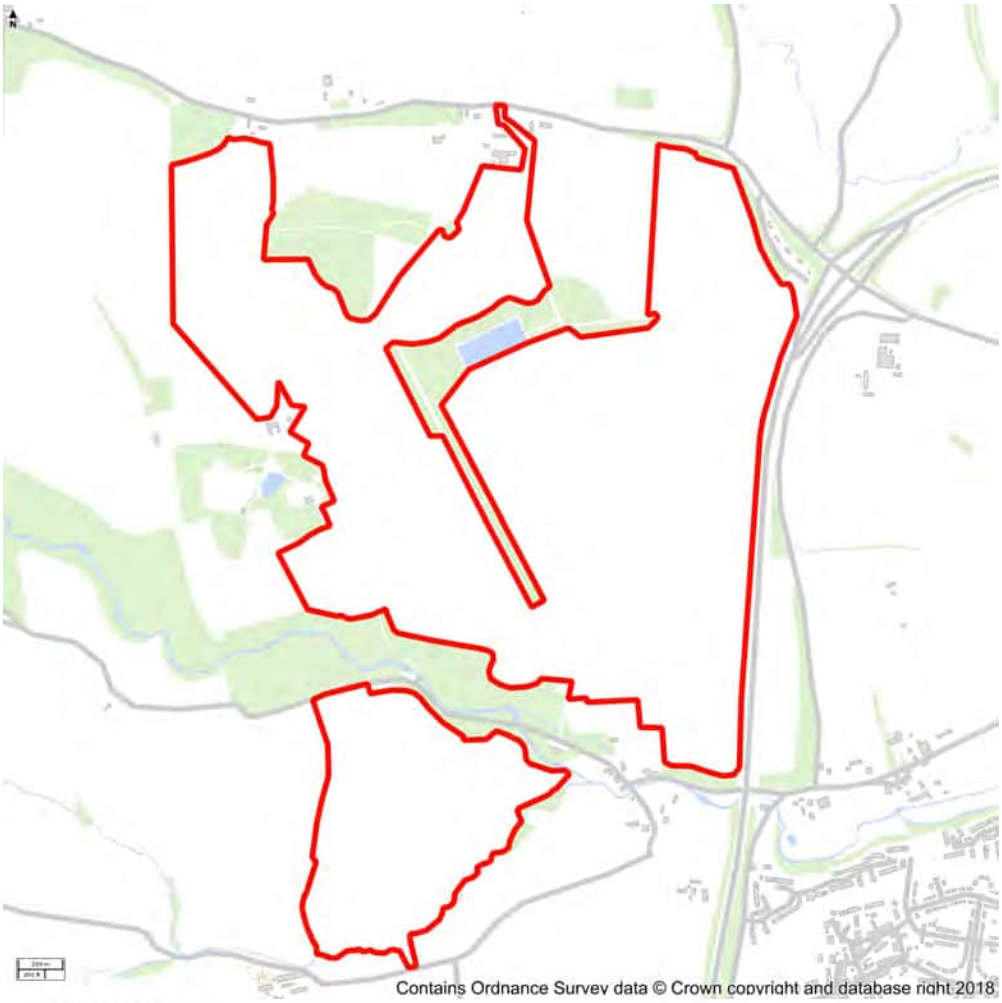
The Coal Authority, regardless of responsibility and in conjunction with other public bodies, provide an emergency call out facility in coalfield areas to assess the public safety implications of mining features (including disused mine entries).

The Coal Authority emergency telephone number at all times is 01623 646333

SEARCH PLAN

Address:
LAND AT PLAS BUCKLEY NULL
BERSHAM
WREXHAM
LL14 4LW

Search Information
Reference: SO220192
Author: Benjamin Oldcorn
Date: 2020-07-17



Legend:

Property

Coal Mining Data

Subsidence claim
Indicated shallow underground coal workings
Recorded shallow underground coal workings
Coal crop

Mine entries

Adit
Shaft

Background OS:

Road
Building
Woodland
Landform

CONSUMER INFORMATION WITH COMPLAINTS PROCEDURE

IMPORTANT CONSUMER PROTECTION INFORMATION

This search has been produced by Cornwall Mining Services Limited, trading as Mining Searches UK, Highburrow Lane, Wilson Way, Pool Industrial Estate, Redruth, Cornwall, TR15 3RN, 01209 218861, search@miningsearchesuk.com which is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information
- included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practice and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

COMPLAINTS

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award up to £5,000 to you if the Ombudsman finds that you have suffered actual financial loss and/or aggravation, distress or inconvenience as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs Contact Details:

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Email: admin@tpos.co.uk
You can get more information about the PCCB from www.propertycodes.org.uk.

PLEASE ASK YOUR SEARCH PROVIDER IF YOU WOULD LIKE A COPY OF THE SEARCH CODE COMPLAINTS PROCEDURE.

If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

Complaints should be sent to: Paul Raglan, Managing Director, Mining Searches UK, Highburrow Lane, Wilson Way, Pool Industrial Estate, Redruth, Cornwall, TR15 3RN, Tel: 01209 218861, Email: search@miningsearchesuk.com.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision. Highburrow Lane, Wilson Way, Pool Industrial Estate, Redruth, Cornwall, TR15 3RN, 01209 218861, search@miningsearchesuk.com.

Coal Mining Report Insurance Policy

The Schedule

Policy Number:	Z1810039
Premium:	£1.40 inclusive of Insurance Premium Tax at 12%
Property:	The property which is the subject of the attached **Coal Mining Report**
Limit of Indemnity:	£100,000 increasing by 10% compound per annum on each anniversary of and for the first 10 years following the **Commencement Date**
Commencement Date:	
You/Your:	**1.** A purchaser of the **Property** **2.** A lender providing a **Mortgage** in connection with a purchase of the **Property** **3.** A lender providing a **Mortgage** by way of a re-mortgage of the **Property**

Definitions

Where a word is defined below or in the schedule it shall carry the same meaning wherever it appears in bold text in this policy.

Insured Use:	The continued use of the **Property** as a single house or flat or a single commercial premises
Market Value:	the value as determined by a surveyor appointed by agreement between **You** and **Us** or (in default of agreement) the President for the time being of the Royal Institution of Chartered Surveyors.
Mortgage:	a mortgage or charge secured on the **Property** by an institutional mortgage lender.
Coal Mining Report:	the coal mining report attached to this policy
Search:	an official search comprising a search in form CON29M (or other officially substituted forms) being mining searches relating to coal and brine in the area in which the **Property** is situated.

We/Our/Us: Zurich Insurance plc
A public limited company incorporated in Ireland. Registration No. 13460.
Registered Office: Zurich House, Ballsbridge Park, Dublin 4, Ireland.
UK Branch registered in England and Wales Registration No. BR7985.
UK Branch Head Office: The Zurich Centre, 3000 Parkway, Whiteley, Fareham, Hampshire PO15 7JZ.

Zurich Insurance plc is authorised by the Central Bank of Ireland and authorised and subject to limited regulation by the Financial Conduct Authority. Details about the extent of our authorisation by the Financial Conduct Authority are available from us on request. Our FCA Firm Reference Number is 203093.

Communications may be monitored or recorded to improve our service and for security and regulatory purposes.

Your Policy

This is a legal document and should be kept in a safe place.
This policy is an agreement between **You** and **Us** and cover is provided subject to the payment of the **Premium**.

You must read this policy and its conditions, exclusions, schedule and any endorsements as one contract. Please read all of them to make sure that they provide the cover **You** require. If they do not, please contact **Us** or **Your** insurance adviser who arranged the policy for **You**.
When **You** take out and make changes to the cover provided by this policy, **You** must take reasonable care to ensure that **You** accurately answer any questions which **We** ask of **You** and that any information **You** give **Us** is accurate. If **You** are taking out this policy for purposes which are mainly related to **Your** trade, business or profession, **You** must also let **Us** know about all facts which are material to **Our** decision to provide **You** with insurance. Failure to meet these obligations could result in this policy being invalidated, a claim not being paid, or an additional premium being charged.

Fair presentation of the risk

a) At inception of this policy and also whenever changes are made to it at **Your** request **You** must:
   i) where **You** have taken out this policy for purposes which are wholly or mainly related to **Your** trade, business or profession, disclose to **Us** all material facts in a clear and accessible manner and not misrepresent any material facts, and
   ii) where You have taken out this policy for purposes which are wholly or mainly unrelated to Your trade, business or profession, take reasonable care not to misrepresent any material facts.

b) If **You** do not comply with clause a) of this condition **We** may:
   i) avoid this policy which means that **We** will treat it as if it had never existed and refuse all claims where any non-disclosure or misrepresentation by **You** is proven by **Us** to be deliberate or reckless in which case **We** will not return the premium paid by **You**; and
   ii) recover from **You** any amount **We** have already paid for any claims including costs or expenses **We** have incurred.

c) If **You** do not comply with clause a) of this condition and the non-disclosure or misrepresentation is not deliberate or reckless this policy may be affected in one or more of the following ways depending on what **We** would have done if **We** had known about the facts which **You** failed to disclose or misrepresented:
   i) if **We** would not have provided **You** with any cover **We** will have the option to:
      1) avoid the policy which means that **We** will treat it as if it had never existed and repay the premium paid; and
      2) recover from **You** any amount **We** have already paid for any claims including costs or expenses **We** have incurred
   ii) if **We** would have applied different terms to the cover **We** will have the option to treat this policy as if those different terms apply. **We** may recover any payments made by **Us** on claims which have already been paid to the extent that such claims would not have been payable had such additional terms been applied
   iii) if **We** would have charged **You** a higher premium for providing the cover **We** will charge **You** the additional premium which **You** must pay in full.

d) If any insured person, other than **You,** is responsible for a misrepresentation or failure to make a fair presentation of the risk, **We** will invoke the remedies available to **Us** under this condition as against that particular person as if a separate insurance contract had been issued to them leaving the remainder of the policy unaffected.

Cover

1. **You** are in the process of purchasing the **Property** relying on the **Coal Mining Report** and/or
2. **You** (being a lender) have agreed to provide a **Mortgage** in connection with **Your** borrower's purchase or re-mortgage of the **Property** relying on the **Coal Mining Report**.

We will pay the following losses sustained by **You** arising out of the **Property** being affected by any matter which would have been revealed by a **Search** had one been carried out on the date of the **Coal Mining Report** but which was not revealed by the **Coal Mining Report**:

1. any reduction in **Market Value** of the **Property** calculated at the date **You** become aware of the matter(s) and/or loss in connection with a **Mortgage** as a result of such reduction.
2. all other costs and expenses including out of court settlement costs incurred by **Us** or by **You** with **Our** prior written agreement.

Our Right to Cancel for Non Payment of Premium

If the **Premium** due under this policy has not been paid in accordance with the premium payment and settlement terms notified to **You** or the insurance adviser who arranged the policy for **You We** will have the right to cancel this policy by notifying **You** in writing either directly or via such insurance adviser. In the event of cancellation, premium equal to 50% of the full policy

Premium will be due to **Us** for the period that **We** are on risk. However, in the event of a loss or occurrence prior to the date of termination which gives rise to a valid claim under this policy, the full policy **Premium** will be payable to **Us** and we will not pay any claims until the full policy **Premium** has been paid to **Us**.

Waiver of Breach of Policy Condition

We will not exercise **Our** right to avoid **Our** liability to **You** in respect of loss where **You** have inadvertently breached any term or condition of the policy provided that such breach does not prejudice **Our** rights and remedies under the policy or otherwise directly or indirectly result in or increase the amount of any loss.

Protection for Mortgagees and Successors in Title

We will not avoid **Our** liability to make a payment to **You** solely because another person breaches the terms and conditions of this policy, provided such breach was not committed on **Your** behalf or with **Your** agreement, and **We** will invoke the remedies available to **Us** under the Policy as against that other person as if a separate insurance contract had been issued to them leaving the remainder of the policy unaffected.

Joint Insured

Any party insured under this policy standing in the relation of parent company, subsidiary company, associated company, branch office or joint venture partner to each other will be deemed to be joint insured for the purposes of this policy and jointly liable and responsible for any breach of any terms and conditions of this policy. If there is any inconsistency between this clause and any other term of this policy, this clause shall prevail.

Exclusions

We will not pay for any:

1. amount in excess of the **Limit of Indemnity**.
2. loss which would be recoverable under a household buildings insurance policy.
3. loss arising from any matter that **You** were aware of at the **Commencement Date**.
4. loss if the **Property** is used for any purpose other than the **Insured Use**.

Claims Conditions and How to Claim

1. **You** must:
   i) give **Us** written notice as soon as possible of any potential or actual claim or any circumstances likely to result in a claim. Please provide the policy number, **Your** name, the full address of the **Property** and a brief description of the incident that has occurred. Notifications should be sent to: Speciality Lines Claims Team, Zurich Insurance, 8th Floor, 70 Mark Lane, London, EC3R 7NQ. Email: claims@uk.zurich.com, Enquiry line: telephone 0207 648 3523
   ii) pass all court documents and/or other communications to **Us** as soon as possible after receipt
   iii) not deal with, make any admission of liability or attempt to settle a claim without **Our** prior written agreement.
   iv) agree to and carry out at **Our** expense all things necessary to minimise any loss.
   v) provide all information and assistance that **We** may require to help defend and settle the claim.
2. **We** are entitled to:
   i) decide how to settle or defend a claim and may carry out proceedings in the name of any person insured under this policy, including proceedings for recovering any claim.
   ii) pay to **You** at any time, an amount equal to the **Limit of Indemnity** or any lower amount for which the claim can be settled, after deduction of any sum already paid. **We** may then give up control of and have no further liability in connection with the claim.
3. If **We** admit liability for a claim but there is a dispute as to the amount to be paid the dispute will be referred to an arbitrator. The arbitrator will be appointed jointly by **You** and **Us** in accordance with the law at the time. **You** may not take any legal action against **Us** over the dispute before the arbitrator has reached a decision.
4. If **You** or anyone acting on **Your** behalf:
   a) makes a fraudulent or exaggerated claim under this policy; or
   b) uses fraudulent means or devices including the submission of false or forged documents in support of a claim whether or not the claim is itself genuine; or
   c) makes a false statement in support of a claim whether or not the claim is itself genuine; or
   d) submits a claim under this policy for loss or damage which **You** or anyone acting on **Your** behalf or in connivance with **You** deliberately caused; or

e) realises after submitting what **You** reasonably believed was a genuine claim under this policy and then fails to tell **Us** that **You** have not suffered any loss or damage; or

f) suppresses information which **You** know would otherwise enable **Us** to refuse to pay a claim under this policy

We will be entitled to refuse to pay the whole of the claim and recover any sums that **We** have already paid in respect of the claim.

If any fraud is perpetrated by or on behalf of an insured person and not on behalf of **You** this condition should be read as if it applies only to that insured person's claim and references to this policy should be read as if they were references to the cover effected for that person alone and not to the policy as a whole.

5. If any claim is covered by any other insurance, **We** will not pay for more than **Our** share of that claim.
6. The most **We** will pay for any loss (or all losses in the aggregate), including costs and expenses agreed by **Us** is the **Limit of Indemnity**. Once **We** have paid a loss or losses equal to the amount of the **Limit of Indemnity**, **We** will have no further liability under this policy.

General Conditions

1. Neither **You** (nor anyone acting on **Your** behalf) must disclose the existence of this policy to any other party except **Your** legal and other professional advisers, prospective purchasers, lessees and tenants of the **Property**, their respective mortgagees, legal and other professional advisers.
2. In the UK the law allows both **You** and **Us** to choose the law applicable to the contract. This contract will be subject to the relevant law of England and Wales, Scotland, Northern Ireland, the Isle of Man or the Channel Islands depending upon the Property address stated in the Schedule. If there is any dispute as to which law applies it will be English law. The parties agree to submit to the exclusive jurisdiction of the English courts.
3. Notwithstanding any other terms of this policy **We** will be deemed not to provide cover nor will **We** make any payment or provide any service or benefit to **You** or any other party to the extent that such cover, payment, service, benefit and/or any business or activity of **Yours** would violate any applicable trade or economic sanctions law or regulation.

Cancellation Clause

If **You** have taken out this policy for purposes which are wholly or mainly unrelated to **Your** trade, business or profession, **You** may cancel this policy within 14 days of receiving the policy by writing to **Us** and in such event **We** may, at **Our** discretion, charge **You** for the time that **You** have been on cover. Any refund will be made to the party who paid the premium. If **You** do cancel, **You** may be in breach of the terms of **Your** mortgage or the terms of the contract for the sale of **Your** property. If **You** are in doubt, **You** may wish to seek legal advice prior to cancellation.

Fair Processing and Complaints Procedure

Our Complaints Procedure

Our commitment to customer service

We are committed to providing a high level of customer service. If you feel we have not delivered this, we would welcome the opportunity to put things right for you.

Who to contact in the first instance

Many concerns can be resolved straight away. Therefore in the first instance, please get in touch with your usual contact at Zurich or your broker or insurance intermediary, as they will generally be able to provide you with a prompt response to your satisfaction.

Contact details will be provided on correspondence that we or our representatives have sent you.

Many complaints can be resolved within a few days of receipt
If we can resolve your complaint to your satisfaction within the first few days of receipt, we will do so. Otherwise, we will keep you updated with progress and will provide you with our decision as quickly as possible.

Next steps if you are still unhappy

If you are not happy with the outcome of your complaint, you may be able to ask the Financial Ombudsman Service to review your case.

We will let you know if we believe the ombudsman service can consider your complaint when we provide you with our decision. The service they provide is free and impartial, but you would need to contact them within 6 months of the date of our decision.

More information about the ombudsman and the type of complaints they can review is available via their website www.financial-ombudsman.org.uk.

You can also contact them as follows:
Post: Financial Ombudsman Service, Exchange Tower, London, E14 9SR
Telephone: 08000 234567 (free on mobile phones and landlines)
Email: complaint.info@financial-ombudsman.org.uk

If the Financial Ombudsman Service is unable to consider your complaint, you may wish to obtain advice from the Citizens Advice Bureau or seek legal advice.

The Financial Services Compensation Scheme (FSCS)
We are covered by the Financial Services Compensation Scheme (FSCS) which means that you may be entitled to compensation if we are unable to meet our obligations to you. Further information is available on www.fscs.org.uk or by contacting the FSCS directly on 0800 678 1100.

How we use your information

Who controls your personal information

This notice tells you how Zurich Insurance plc ('Zurich'), as data controller, will deal with your personal information. Where Zurich introduces you to a company outside the group, that company will tell you how your personal information will be used.

You can ask for further information about our use of your personal information or complain about its use in the first instance, by contacting our Data Protection Officer at: Zurich Insurance Group, Tri-centre 1, Newbridge Square, Swindon, SN1 1HN or by emailing the Data Protection Officer at GBZ.General.Data.Protection@uk.zurich.com.

If you have any concerns regarding our processing of your personal information, or are not satisfied with our handling of any request by you in relation to your rights, you also have the right to make a complaint to the Information Commissioner's Office. Their address is: First Contact Team, Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, SK9 5AF.

What personal information we collect about you

We will collect and process the personal information that you give us by phone, e-mail, filling in forms, including on our website, and when you report a problem with our website. We also collect personal information from your appointed agent such as your trustee, broker, intermediary or financial adviser in order to provide you with the services you have requested and from other sources, such as credit reference agencies and other insurance companies, for verification purposes. We will also collect information you have volunteered to be in the public domain and other industry-wide sources.
We will only collect personal information that we require to fulfil our contractual or legal requirements unless you consent to provide additional information. The type of personal information we will collect includes; basic personal information (i.e. name, address and date of birth), occupation and financial details, health and family information, claims and convictions information and where you have requested other individuals be included in the arrangement, personal information about those individuals.

If you give us personal information on other individuals, this will be used to provide you with a quotation and/or contract of insurance and/or provision of financial services. You agree you have their permission to do so. Except where you are managing the contract on another's behalf, please ensure that the individual knows how their personal information will be used by Zurich. More information about this can be found in the 'How we use your personal information' section.

How we use your personal information

We and our selected third parties will only collect and use your personal information (i) where the processing is necessary in connection with providing you with a quotation and/or contract of insurance and/or provision of financial services that you have requested; (ii) to meet our legal or regulatory obligations; or (iii) for our "legitimate interests". It is in our legitimate interests to collect your personal information as it provides us with the information that we need to provide our services to you more effectively including providing you with information about our products and services. We will always ensure that

we keep the amount of information collected and the extent of any processing to the absolute minimum to meet this legitimate interest. Examples of the purposes for which we will collect and use your personal information are:

1. to provide you with a quotation and/or contract of insurance;
2. to identify you when you contact us;
3. to deal with administration and assess claims;
4. to make and receive payments;
5. to obtain feedback on the service we provide to you;
6. to administer our site and for internal operations including troubleshooting, data analysis, testing, research, statistical and survey purposes;
7. for fraud prevention and detection purposes.

We will contact you to obtain consent prior to processing your personal information for any other purpose, including for the purposes of targeted marketing unless we already have consent to do so.

Who we share your personal information with

Where necessary, we will share the personal information you gave us for the purposes of providing you with the goods and services you requested with the types of organisations described below:

- associated companies including reinsurers, suppliers and service providers;
- introducers and professional advisers;
- regulatory and legal bodies;
- survey and research organisations;
- credit reference agencies;
- healthcare professionals, social and welfare organisations; and
- other insurance companies

Or, in order to meet our legal or regulatory requirements, with the types of organisations described below:

- regulatory and legal bodies;
- central government or local councils;
- law enforcement bodies, including investigators;
- credit reference agencies; and
- other insurance companies

How we use your personal information for websites and email communications

When you visit one of our websites we may collect information from you such as your email address or IP address. This helps us to track unique visits and monitor patterns of customer website traffic, such as who visits and why they visit.

We use cookies and/or pixel tags on some pages of our website. A cookie is a small text file sent to your computer. A pixel tag is an invisible tag placed on certain pages of our website but not on your computer. Pixel tags usually work together with cookies to assist us to provide you with a more tailored service. This allows us to monitor and improve our email communications and website. Useful information about cookies, including how to remove them, can be found on our websites.

How we transfer your personal information to other countries

Where we transfer your personal information to countries that are outside of the UK and the European Union (EU) we will ensure that it is protected and that the transfer is lawful. We will do this by ensuring that the personal information is given adequate safeguards by using 'standard contractual clauses' which have been adopted or approved by the UK and the EU, or other solutions that are in line with the requirements of European data protection laws.

A copy of our security measures for personal information transfers can be obtained from our Data Protection Officer at: Zurich Insurance Group, Tri-centre 1, Newbridge Square, Swindon, SN1 1HN, or by emailing the Data Protection Officer at GBZ.General.Data.Protection@uk.zurich.com.

How long we keep your personal information for

We will retain and process your personal information for as long as necessary to meet the purposes for which it was originally collected. These periods of time are subject to legal, tax and regulatory requirements or to enable us to manage our business.

Your data protection rights

You have a number of rights under the data protection laws, namely:

- to access your data (by way of a subject access request);
- to have your data rectified if it is inaccurate or incomplete;
- in certain circumstances, to have your data deleted or removed;
- in certain circumstances, to restrict the processing of your data;
- a right of data portability, namely to obtain and reuse your data for your own purposes across different services;
- to object to direct marketing;
- not to be subject to automated decision making (including profiling), where it produces a legal effect or a similarly significant effect on you;
- to claim compensation for damages caused by a breach of the data protection legislation.
- if we are processing your personal information with your consent, you have the right to withdraw your consent at any time.

We will, for the purposes of providing you with a contract of insurance, processing claims, reinsurance and targeted marketing, process your personal information by means of automated decision making and profiling where we have a legitimate interest or you have consented to this.

What happens if you fail to provide your personal information to us

If you do not provide us with your personal information, we will not be able to provide you with a contract or assess future claims for the service you have requested.

Fraud prevention and detection

In order to prevent and detect fraud we may at any time:

- check your personal data against counter fraud systems
- use your information to search against various publicly available and third party resources
- use industry fraud tools including undertaking credit searches and to review your claims history
- share information about you with other organisations including but not limited to the police, the Insurance Fraud Bureau (IFB), other insurers and other interested parties.

If you provide false or inaccurate information and fraud is identified, the matter will be investigated and appropriate action taken. This may result in your case being referred to the Insurance Fraud Enforcement Department (IFED) or other police forces and fraud prevention agencies. You may face fines or criminal prosecution. In addition, Zurich may register your name on the Insurance Fraud Register, an industry-wide fraud database.

Claims history
We may pass information relating to claims or potential claims to any relevant database.
We and other insurers may search these databases when you apply for insurance, when claims or potential claims are notified to us or at time of renewal to validate your claims history or that of any other person or property likely to be involved in the policy or claim.

This helps to check information provided and prevent fraudulent claims.

Appendix C

BGS BOREHOLE RECORDS

FORM P 70
SERIES 680

Section of PLAS POWER PREX BOREHOLE

Purpose TO PROVE COAL MEASURES

Exact Site E 330 138·0
N 350 214·0

Level at which ~~shaft~~ bore ~~drift~~ commenced relative to O.D. 125·73 m or ~~ft~~

Date of sinking or boring AUGUST – SEPTEMBER 1979

Sinker or borer NCB.

6-INCH MAP	B/H REGD. No.
SJ35SW (County, Sheet and Qtr.)	46
SJ 35 SW (Nat. Grid, Sheet & Qtr.)	502

Attach tracing from a map or sketch map if possible

CONFIDENTIAL
This borehole is now released
SSG
21/10/92

*Delete as appropriate

GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS ~~m~~ or ft*	THICKNESS ~~cm~~ or in*	DEPTH ~~m~~ or ft*	DEPTH ~~cm~~ or in*
	NO SAMPLES	10	–	10	–
	COAL 80%, black smooth mudstone 20%	5	–	15	–
	Sand coarse angular light grey gravelly sand with 10% COAL	5	–	20	–
	Sand coarse angular grey gravel with trace COAL	5	–	25	–
	Sandstone light grey, medium grained, with a little of COAL fragments in top 15'	50	–	75	–
	Siltstone medium grey, medium grained	5	–	80	–
	Mudstone medium grey, slightly silty	5	–	85	–
	Mudstone light and medium grey, slightly silty	5	–	90	–
	Sandstone light grey, fine grained	5	–	95	–
	Mudstone medium grey, silty	5	–	100	–
	Siltstone medium grey, fine grained	5	–	105	–
	Sandstone light grey, medium grained	20	–	125	–
	Mudstone medium grey, slightly silty	15	–	140	–
	Sandstone light grey, medium grained	10	–	150	–
	Siltstone medium grey, medium grained	5	–	155	–
	Mudstone medium grey, slightly silty 20% COAL fragments	5	–	160	–
	Mudstone medium grey, slightly silty	10	–	170	–

FORM P 71
SERIES 680

6-INCH MAP	B/H
SJ35SW	46

*Delete as appropriate

Section of PLAS POWER PARK BOREHOLE

GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS ~~m~~ or ft*	THICKNESS ~~cm~~ or in*	DEPTH ~~m~~ or ft*	DEPTH ~~cm~~ or in*
	Brought forward			170	
	Sandstone light grey, medium grained	5	–	175	–
	Siltstone medium grey, fine grained	10	–	185	–
	Sandstone light grey, medium grained	10	–	195	–
	CORES START @ 199'4"				

FORM P 71
SERIES 680

6-INCH MAP	B -
SJ35SW	46

Section of PLAS POWER PARK BOREHOLE

*Delete as appropriate

GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS ft*	THICKNESS in*	DEPTH ft*	DEPTH in*
	CORES START @			199	4
Sandstone	light grey, medium grained, massive and strong	3	8	203	00
Siltstone	medium to dark grey, laminated,	–	5	203	5
Sandstone	light grey, medium grained, massive, with some occasional silty wisps and laminae	17	3	220	8
Sandstone	light grey medium grained, carbonaceous with large silty mudstone clasts,	2	4	223	00
Sandstone	light grey, medium grained, massive,	5	7	228	7
Siltstone	medium to dark grey, medium grained, laminated,	1	3	229	10
Sandstone	light grey, medium grained, massive, with some occasional dark grey carbonaceous laminae and thin coaly threads below 255'	43	2	273	00
Siltstone	dark grey, fine grained, firm, with rare plant fragments and some mudstone alterations below 275'	6	1	279	01
Mudstone	medium grey, smooth, weak, highly fissured,	–	11	280	00
Seatearth	Mudstone, medium grey, with a faint tinge, smooth, with numerous distinct surfaces and numerous roots,	1	8	281	8
Seatearth	Mudstone medium grey with a faint tinge, slightly silty, occasional silty surfaced, numerous roots and ironstone nodules,	1	6	283	2
Mudstone	medium grey, silty, firm and rather poorly bedded with some roots, with a 6" massive splaroidal ironstone band @ 286'3" with a strong splaroidal ironstone band 6" @ 287'4", passing into:	4	10	288	00

FORM P 71
SERIES 680

Section of PLAS POWER PARK BOREHOLE

6-INCH MAP	B/H
SJ35SW	H6

*Delete as appropriate

GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS ~~m~~ or ft*	THICKNESS ~~cm~~ or in*	DEPTH ~~m~~ or ft*	DEPTH ~~cm~~ or in*
	Brought Forward			288	00
Mudstone	medium grey, silty, moderately well bedded, into some large ironstone tentacles bellow 290'6",	5	4	293	4
Mudstone	dark grey, slightly silty, with some pistric impressions	1	2	294	6
Mudstone	medium to dark grey, slightly silty to silty, with some plant fragments, becoming silty towards base and passing into:	2	6	297	00
Siltstone	medium grey, fine to medium grained, faintly laminated, with some comminuted plant debris, with uneven small ironstone tentacles and nodules i band 5"	11	8	308	8
Siltstone	dark grey coarse grained, strongly laminated,	—	8	309	4
Siltstone	medium to dark grey, fine grained with occasional diffuse ironny tentacles with occasional large plants and some thin sandy wisps with a 1" seatstone band @ 317'7" passing into @	10	8	320	00
Mudstone	dark grey, silty, with some plant fragments	2	3	322	3
Siltstone	dark grey, fine to medium grained, with dark grey carbonaceous laminae and comminuted plant debris	5	4	327	7
Mudstone	dark grey, slightly silty with uneven pyritic nits and spherules and tubules for 5" @328'3"	1	2	328	9
Mudstone	dark grey, smooth, with uneven pale yellow speckles and pyritic tubules, EUPHEMITES @ 329'8" EUPHEMITES @ 330'2" and @ 331'3" and @ 332'0" and @ 332'3" with numerous ironstone tentacles below 333'0"	5	10	334	7

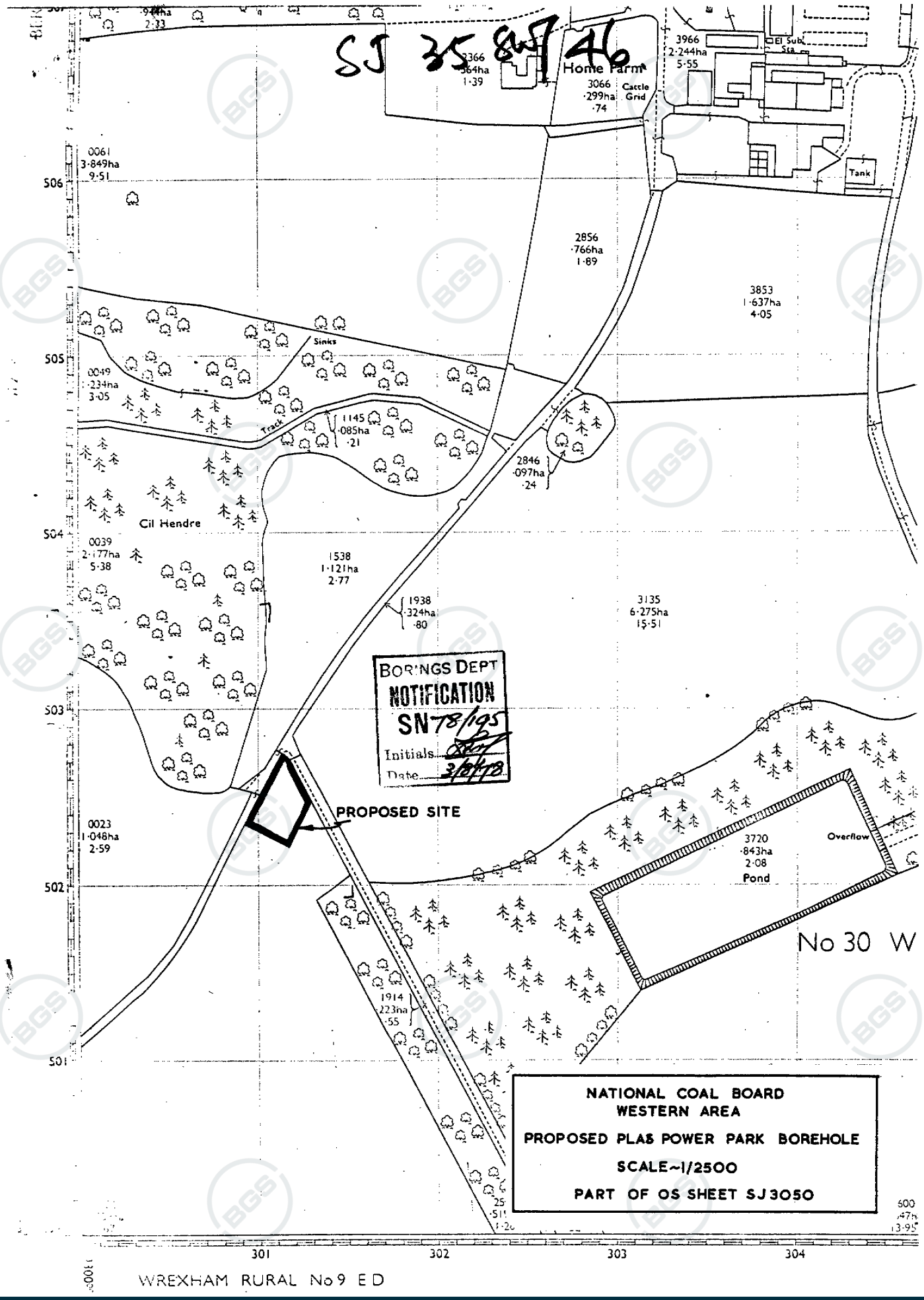
FORM P 71
SERIES 680

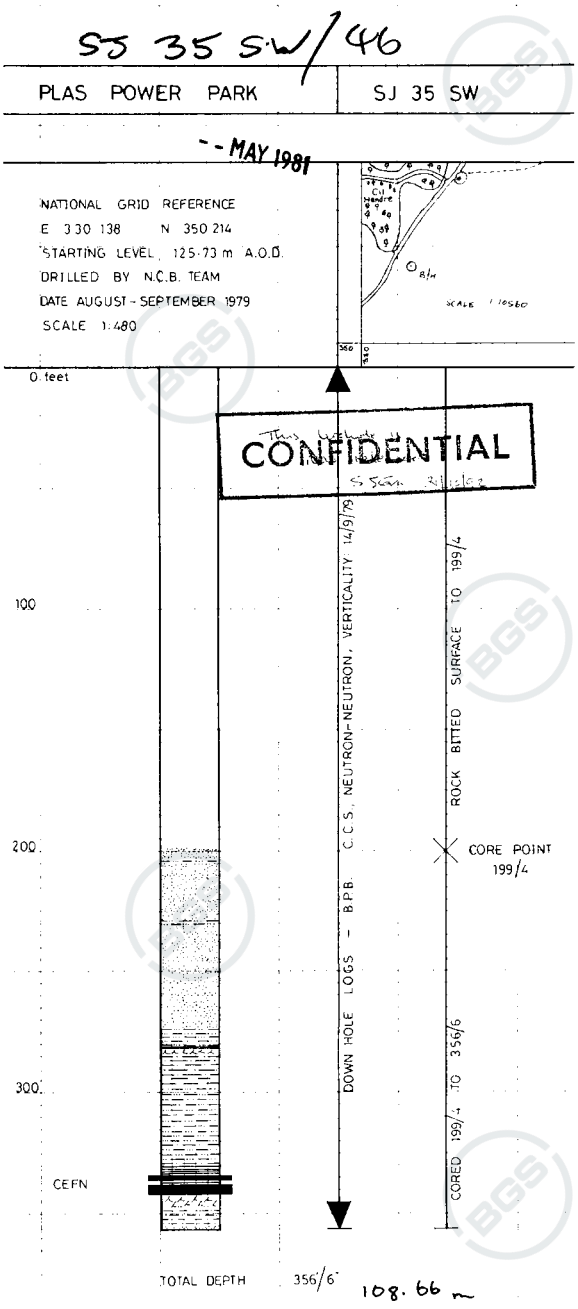
6-INCH MAP	B/H
SJ35SW	H10

*Delete as appropriate

Section of PLAS POWER PARK BOREHOLE

GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS ft	THICKNESS in	DEPTH ft	DEPTH in
	Brought forward			334	7
	COAL Inferior, part, fractured and slightly frequently	1	9	336	4
CEFN	Mudstone black, carbonaceous slightly silty, with rare FISH debris	2	1	338	5
	COAL Inferior, part Dip 8°	3	0	341	5
	Seatearth Mudstone medium brown grey smooth, weak and bituminated	—	5	341	10
	Seatearth Mudstone medium grey, slightly silty	3	6	345	4
	Seatearth Siltstone medium grey, fine to medium grained, passing into:	—	8	346	00
	Siltstone medium grey, medium grained, finely laminated,	—	9	346	9
	Mudstone medium grey, silty, moderately firm, finely micaceous, passing into:	3	3	352	00
	Siltstone medium grey, fine grained with some large plant fragments and rare ironstone nodules	1	11	354	11
	Sandstone light grey, fine and massive	1	7	356	6
	TOTAL DEPTH			356	6
	Borehole sealed in accordance with PI 1977/9 with 36 bags Shallow Oilwell cement and 6 bags baryte				


SJ 35 SW 46
Home Farm
Cattle Grid
Tank
El Sub Sta
Sinks
Track
Cil Hendre
PROPOSED SITE
Overflow
Pond
BORINGS DEPT
NOTIFICATION
SN78/195
Initials
Date
NATIONAL COAL BOARD
WESTERN AREA
PROPOSED PLAS POWER PARK BOREHOLE
SCALE~1/2500
PART OF OS SHEET SJ3050
No 30 W
WREXHAM RURAL No 9 E D


SJ 35 SW/46
PLAS POWER PARK
SJ 35 SW
MAY 1981
NATIONAL GRID REFERENCE
E 330 138 N 350 214
STARTING LEVEL 125·73 m A.O.D.
DRILLED BY N.C.B. TEAM
DATE AUGUST - SEPTEMBER 1979
SCALE 1:480
O feet
CONFIDENTIAL
100
200
300
DOWN HOLE LOGS - B.P.B. C.C.S. NEUTRON-NEUTRON, VERTICALITY 14/9/79
ROCK BITTED SURFACE TO 199/4
CORE POINT 199/4
CORED 199/4 TO 356/6
CEFN
TOTAL DEPTH 356/6'
108.66 m

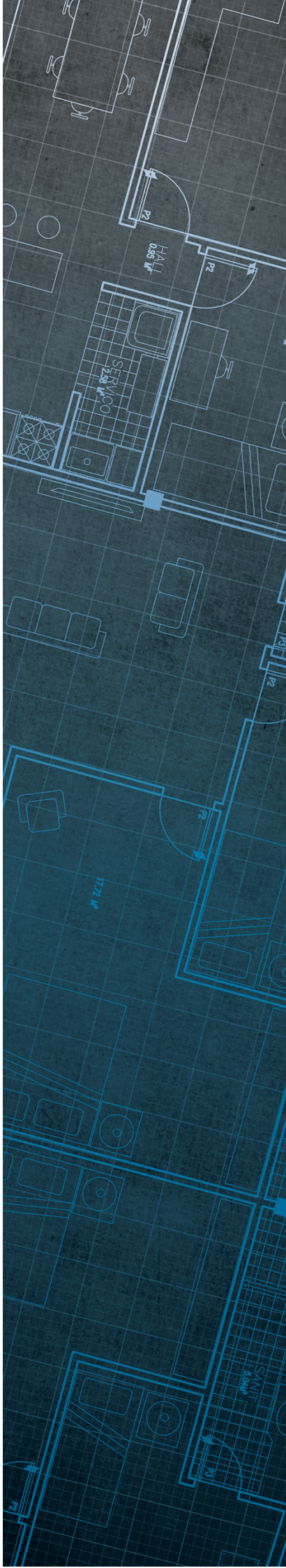
Appendix D
CONSULTANTS MINING REPORT (AREA 1)

The Coal Authority

Consultants

Coal Mining Report

330326,350087,
Wrexham



Date of enquiry:	**28 April 2023**
Date enquiry received:	**28 April 2023**
Issue date:	**28 April 2023**
Our reference:	**51003352311001**
Your reference:	

Consultants

Coal Mining Report

This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

GROUNDSURE LIMITED

Enquiry address

330326,350087,
Wrexham

Approximate position of property

How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

@coalauthority
/company/the-coal-authority
/thecoalauthority
/thecoalauthority

Section 1 – Mining activity and geology

Past underground mining

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
unnamed	POWELL	Coal	3U27	155	Beneath Property	5.0	East	120	1938
unnamed	POWELL	Coal	3U28	164	Beneath Property	7.0	East	120	1938
unnamed	QUAKER	Coal	3U5V	172	Beneath Property	5.3	South-East	140	1937
unnamed	POWELL	Coal	3VKQ	184	North	6.7	East	120	1938
unnamed	TWO YARD	Coal	3U34	191	North-West	7.0	East	100	1915
unnamed	CRANK	Coal	3U4C	193	South-West	8.0	South-East	80	1935
unnamed	QUAKER	Coal	3U5D	193	North	6.0	South-East	130	1907
unnamed	CRANK	Coal	3U4H	196	North-East	4.4	East	70	1932
unnamed	QUAKER	Coal	3U5U	197	West	4.5	East	140	1937
unnamed	CRANK	Coal	3U47	200	North	6.5	South-East	70	1932
unnamed	QUAKER	Coal	3U63	202	North-East	6.0	South-East	130	1907
unnamed	CRANK	Coal	3U4E	203	Beneath Property	2.7	North-East	80	1935
unnamed	MAIN	Coal	3V39	204	Beneath Property	5.3	South-East	180	1933
unnamed	POWELL	Coal	3U2A	210	Beneath Property	8.0	East	120	1938
unnamed	QUAKER	Coal	3U5W	211	Beneath Property	4.2	East	140	1937
unnamed	QUAKER	Coal	3U57	213	North	7.1	East	140	1937
unnamed	MAIN	Coal	7OMJ	218	Beneath Property	5.8	East	180	1933
unnamed	MAIN	Coal	3V47	224	North	6.0	East	200	1932
unnamed	CRANK	Coal	3U42	229	North	3.3	East	80	1935
unnamed	MAIN	Coal	3V4F	231	North-East	4.6	East	200	1900
unnamed	QUAKER	Coal	3U56	233	North	8.0	East	140	1937
unnamed	QUAKER	Coal	3U5Y	242	Beneath Property	5.3	South-East	140	1937

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
unnamed	QUAKER	Coal	3U60	243	Beneath Property	7.1	East	130	1890
unnamed	MAIN	Coal	7OM9	243	East	7.0	East	250	1920
unnamed	MAIN	Coal	3V30	246	North	6.4	South-East	180	1933
unnamed	POWELL	Coal	3VKR	248	North-West	48.2	North-East	120	1938
unnamed	QUAKER	Coal	3U5Z	252	Beneath Property	4.9	East	150	1923
unnamed	POWELL	Coal	3V29	252	East	5.5	South-East	110	1958
unnamed	MAIN	Coal	3V49	254	Beneath Property	6.5	East	250	1909
unnamed	CRANK	Coal	3U4G	255	Beneath Property	1.9	South-East	80	1935
unnamed	POWELL	Coal	3U2B	255	South	4.4	South	110	1955
unnamed	CRANK	Coal	3U4F	263	South-East	1.9	South-East	80	1935
unnamed	MAIN	Coal	3V4A	270	Beneath Property	6.2	South-East	250	1900
unnamed	QUAKER	Coal	3U6J	273	South	4.8	South	150	1910
unnamed	QUAKER	Coal	3U5X	274	South-West	6.6	South-East	150	1910
unnamed	QUAKER	Coal	3U5C	279	North-West	6.0	South-East	140	1937
unnamed	MAIN	Coal	7OMG	280	North-West	6.0	East	180	1932
unnamed	MAIN	Coal	3V4B	308	East	2.5	South-East	250	1920
unnamed	MAIN	Coal	3V48	312	South	3.1	East	240	1900
unnamed	MAIN	Coal	3V4G	338	South-East	3.1	East	240	1900
unnamed	MAIN	Coal	3V4P	343	South	6.6	South	240	1900
unnamed	WALL AND BENCH	Coal	3VIC	347	Beneath Property	7.3	South-East	107	1971
unnamed	WALL AND BENCH	Coal	3VIE	350	Beneath Property	5.4	South-East	107	1970
unnamed	WALL AND BENCH	Coal	3VID	356	Beneath Property	8.5	South-East	100	1969
unnamed	RUABON YARD (SOFT 5 QTRS)	Coal	3U7A	370	Beneath Property	5.6	South-East	80	1972
unnamed	WALL AND BENCH	Coal	3VIF	383	Beneath Property	5.9	South-East	105	1970
unnamed	RUABON YARD (SOFT 5 QTRS)	Coal	3U7H	393	South	6.0	South-East	80	1972

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
unnamed	WALL AND BENCH	Coal	3VIU	399	South	4.5	South-East	92	1969
unnamed	WALL AND BENCH	Coal	3VIG	401	Beneath Property	5.6	South-East	104	1970
unnamed	WALL AND BENCH	Coal	3VIV	415	South	3.5	South-East	100	1970
unnamed	WALL AND BENCH	Coal	3VIH	430	South-East	3.9	East	90	1967

Probable unrecorded shallow workings

None.

Spine roadways at shallow depth

No spine roadway recorded at shallow depth.

Mine entries

None recorded within 100 metres of the enquiry boundary.

Abandoned mine plan catalogue numbers

The following abandoned mine plan catalogue numbers intersect with some, or all, of the enquiry boundary:

12014	NW656	NW1471
NW698	12361	10902
NW578	11880	NW222

Our records show we have more plans than those shown above which could affect the enquiry boundary.

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

Outcrops

No outcrops recorded.

Geological faults, fissures and breaklines

Please refer to the 'Summary of findings' map (on separate sheet) for details of any geological faults, fissures or breaklines either within or intersecting the enquiry boundary.

Faults under or close to the property recorded.

Opencast mines

Please refer to the “Summary of findings” map (on separate sheet) for details of any opencast areas within 500 metres of the enquiry boundary.

Coal Authority managed tips

None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations
None recorded within 50 metres of the enquiry boundary.

Remediated sites
None recorded within 50 metres of the enquiry boundary.

Coal mining subsidence
The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas
None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes
None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining
None recorded.

Coal mining licensing
None recorded within 200 metres of the enquiry boundary.

Court orders
None recorded.

Section 46 notices
No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

Withdrawal of support notices
The property is in an area where notices to withdraw support were given in 1967, 1974 and 1976.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

Payments to owners of former copyhold land
The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Section 4 – Further information

The following potential risks have been identified and as part of your risk assessment should be investigated further.

Future development

If development proposals are being considered, technical advice relating to both the investigation of coal and former coal mines and their treatment should be obtained before beginning work on site. All proposals should apply specialist engineering practice required for former mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or coal mines without first obtaining the permission of the Coal Authority.

MINE GAS: Please note, if there are no recorded instances of mine gas within 500m of the enquiry boundary, this does not mean that mine gas is not present within the vicinity. The Coal Authority Mine Gas data is limited to only those sites where a Mine Gas incident has been recorded. Developers should be aware that the investigation of coal seams, mine workings or mine entries may have the potential to generate and/or displace underground gases. Associated risks both to the development site and any neighbouring land or properties should be fully considered when undertaking any ground works. The need for effective measures to prevent gases migrating onto any land or into any properties, either during investigation or remediation work, or after development must also be assessed and properly addressed. In these instances, the Coal Authority recommends that a more detailed Gas Risk Assessment is undertaken by a competent assessor.

Development advice

The site is within an area of historical coal mining activity. Should you require advice and/or support on understanding the mining legacy, its risks to your development or what next steps you need to take, please contact us.

For further information on specific site or ground investigations in relation to any issues raised in Section 4, please call us on 0345 762 6848 or email us at groundstability@coal.gov.uk.

Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk.**

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

Opencast mines
Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips
Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations
Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites
Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence
Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas
Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission. Please note, if there are no recorded instances of mine gas reported, this does not mean that mine gas is not present within the vicinity. The Coal Authority Mine Gas data is limited to only those sites where a Mine Gas incident has been recorded.

Mine water treatment schemes
Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining
Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing
Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders
Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices
Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices
Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land
Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

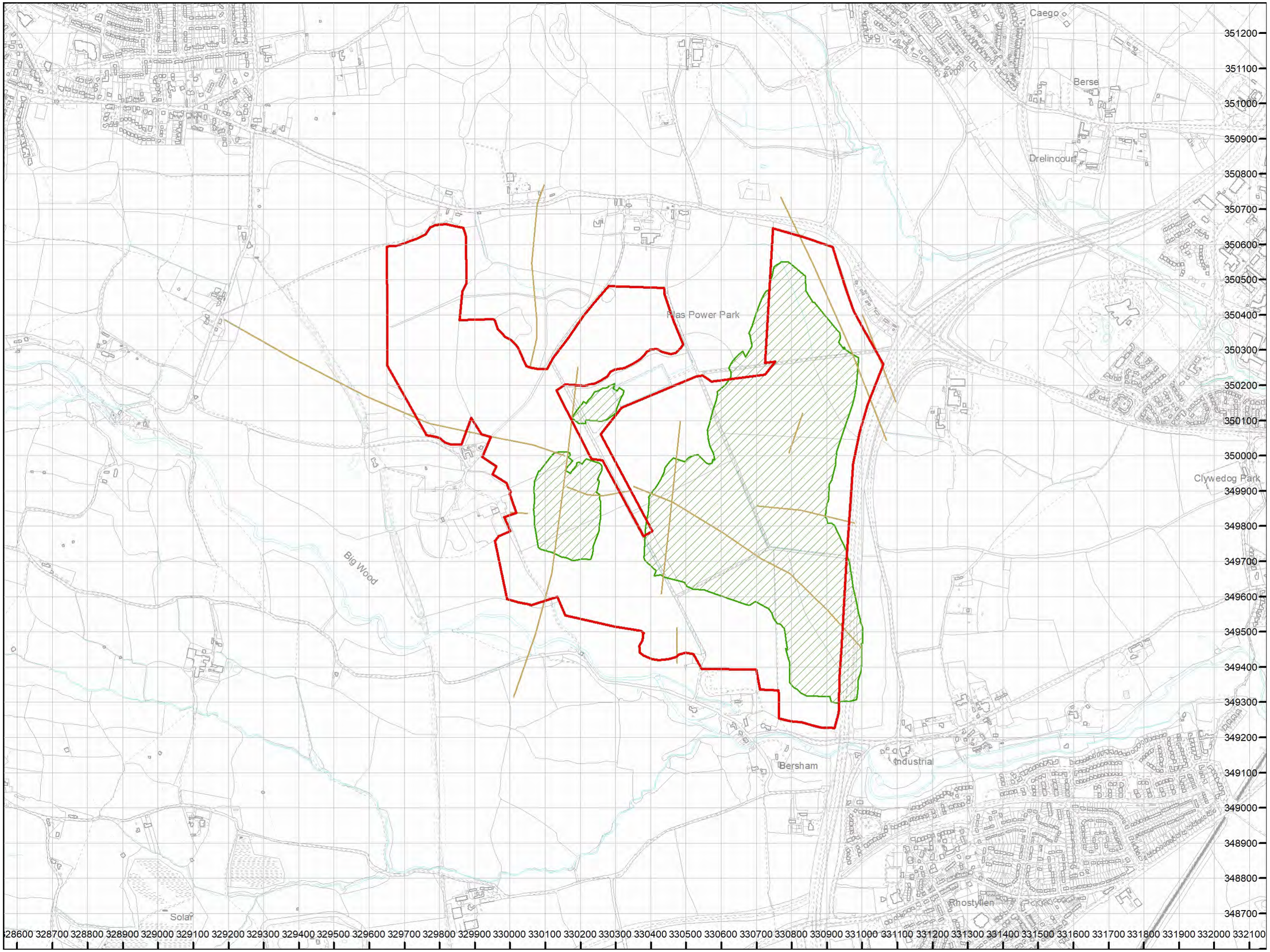
The Coal Authority

Summary of findings

The map highlights any specific surface or subsurface features within or near to the boundary of the site.

Key

- Approximate position of the enquiry boundary shown
- Geological faults
- Unlicensed opencast site



How to contact us
0345 762 6848 (UK)
+44 (0)1623 637 000 (International)
www.groundstability.com

COAL MINING RISK ASSESSMENT AND MINERAL ASSESSMENT

Plas Power Solar and Energy Storage Project

Contact

90 Victoria Street
Bristol
BS1 6DP
T +44 1454 853 000

Appendix 5.1
Glint and Glare Assessment (Part 1 of 2)

PAGERPOWER
Urban & Renewables

Solar Photovoltaic Glint and Glare Study

RPS Group PLC

Plas Power Estate

October 2023





PLANNING SOLUTIONS FOR:

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ADMINISTRATION PAGE

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Issue	Date	Detail of Changes
1	23rd December 2022	Initial issue
2	18th October 2023	Modelling of updated layout
3	1st November 2023	Minor administrative amendments

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the possible effects of glint and glare from a proposed solar photovoltaic (PV) development located at Plas Power Estate, Wrexham, Wales. The glint and glare assessment pertains to the possible impact upon surrounding road safety, residential amenity, and identified ZTV viewpoints.

Conclusions

No significant impacts are predicted on surrounding road safety, residential amenity, and observers located at the identified viewpoints in the surrounding area. Mitigation is not recommended.

Guidance and Studies

There is no existing planning guidance for the assessment of solar reflections from solar panels towards roads and nearby dwellings. Pager Power has however produced guidance for glint and glare and solar photovoltaic developments, which was published in early 2017, with the fourth edition published in 2022[1]. The guidance document sets out the methodology for assessing roads and dwellings with respect to solar reflections from solar panels.

Pager Power's approach is to undertake geometric reflection calculations and, where a solar reflection is predicted, consider the screening (existing and/or proposed) between the receptor and the reflecting solar panels. The scenario in which a solar reflection can occur for all receptors is then identified and discussed, and a comparison is made against the available solar panel reflection studies to determine the overall impact.

The available studies have measured the intensity of reflections from solar panels with respect to other naturally occurring and manmade surfaces. The results show that the reflections produced are of intensity similar to or less than those produced from still water and significantly less than reflections from glass and steel[2].

Assessment Results

Roads

The modelling has shown that solar reflections are geometrically possible towards a 1.5km section of the A483, a 3.6km section of the A525, and a 0.4km section of Heritage Way.

No significant impacts are predicted on any of the modelled road sections due to the following:

- Solar reflections are possible from panels **outside** of a road user's primary horizontal field of view (50 degrees either side of the direction of travel);

[1]Pager Power Glint and Glare Guidance, Fourth Edition, September 2022.

[2]Source: SunPower, 2009, SunPower Solar Module Glare and Reflectance (appendix to Solargen Energy, 2010).

- There is significant screening such that views of reflecting panels are not expected to be possible in practice; and/or
- There is screening such that reflections will be filtered and only marginal/fleeting views of reflecting panels are expected to be possible.

Dwellings

The modelling has shown that solar reflections are geometrically possible towards 145 of the 251 assessed dwelling locations.

No significant impacts are predicted on the assessed dwellings due to the following:

- Solar reflections are possible for **less** than 60 minutes on any given day and for **less** than 3 months of the year;
- There is significant screening such that views of reflecting panels are not expected to be possible in practice;
- There is screening such that reflections will be filtered and only marginal views of reflecting panels are expected to be possible; and/or
- There is a significant clearance distance between dwelling observer and closest reflecting panel.

ZTV Viewpoints

The modelling has shown that solar reflections are geometrically possible towards 10 of the 13 assessed ZTV viewpoints.

In Pager Power's experience, significant impacts to pedestrians/observers at ZTV viewpoints are not possible due to glint and glare effects from PV developments. The reasoning is due to the sensitivity of the receptors (in terms of amenity and safety) being concluded to be of low significance. This is because:

- The typical density of pedestrians located at these points is low in a rural environment;
- Any resultant effect is much less serious and has far lesser consequences than, for example, solar reflections experienced towards a road network whereby the resultant impacts of a solar reflection can be much more serious;
- Glint and glare effects towards an observer are transient, and time and location sensitive whereby a pedestrian could move beyond the solar reflection zone with ease with little impact upon safety or amenity;

Any observable solar reflection towards an observer would be of similar intensity to those experienced whilst navigating the natural and built environment (such as bodies of water) on a regular basis.

No significant impacts are predicted on the assessed ZTV viewpoints.

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Urban & Renewables

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 58 countries internationally.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems.

Over the years, the company has expanded into numerous fields including:

- Renewable energy projects.
- Building developments.
- Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

1 INTRODUCTION

1.1 Overview

Pager Power has been retained to assess the possible effects of glint and glare from a proposed solar photovoltaic (PV) development located at Plas Power Estate, Wrexham, Wales. The glint and glare assessment pertains to the possible impact upon surrounding road safety, residential amenity, and identified ZTV viewpoints. This report contains the following:

- Solar development details.
- Explanation of glint and glare.
- Overview of relevant guidance and studies.
- Overview of Sun movement.
- Assessment methodology.
- Identification of receptors.
- Glint and glare assessment for identified receptors.
- Results discussion.

Following this, a summary of findings and overall conclusions and recommendations from the desk-based analysis is presented.

1.2 Pager Power's Experience

Pager Power has undertaken over 1,100 Glint and Glare assessments in the UK and internationally. The studies have included assessment of civil and military aerodromes, railway infrastructure and other ground-based receptors including roads and dwellings.

1.3 Glint and Glare Definition

The definition of glint and glare is as follows[3]:

- Glint – a momentary flash of bright light typically received by moving receptors or from moving reflectors.
- Glare – a continuous source of bright light typically received by static receptors or from large reflective surfaces.

The term 'solar reflection' is used in this report to refer to both reflection types.

[3] These definitions are aligned with those presented within the UK Draft National Policy Statement for Renewable Energy Infrastructure (EN-3) – published by the Department for Business, Energy & Industrial Strategy in March 2023 and the Federal Aviation Administration in the USA.

2 PROPOSED DEVELOPMENT LOCATION AND DETAILS

2.1 Site Layout (Latest)

Figure 1[4] below shows the latest site layout plan. The blue areas denote the solar panel locations.

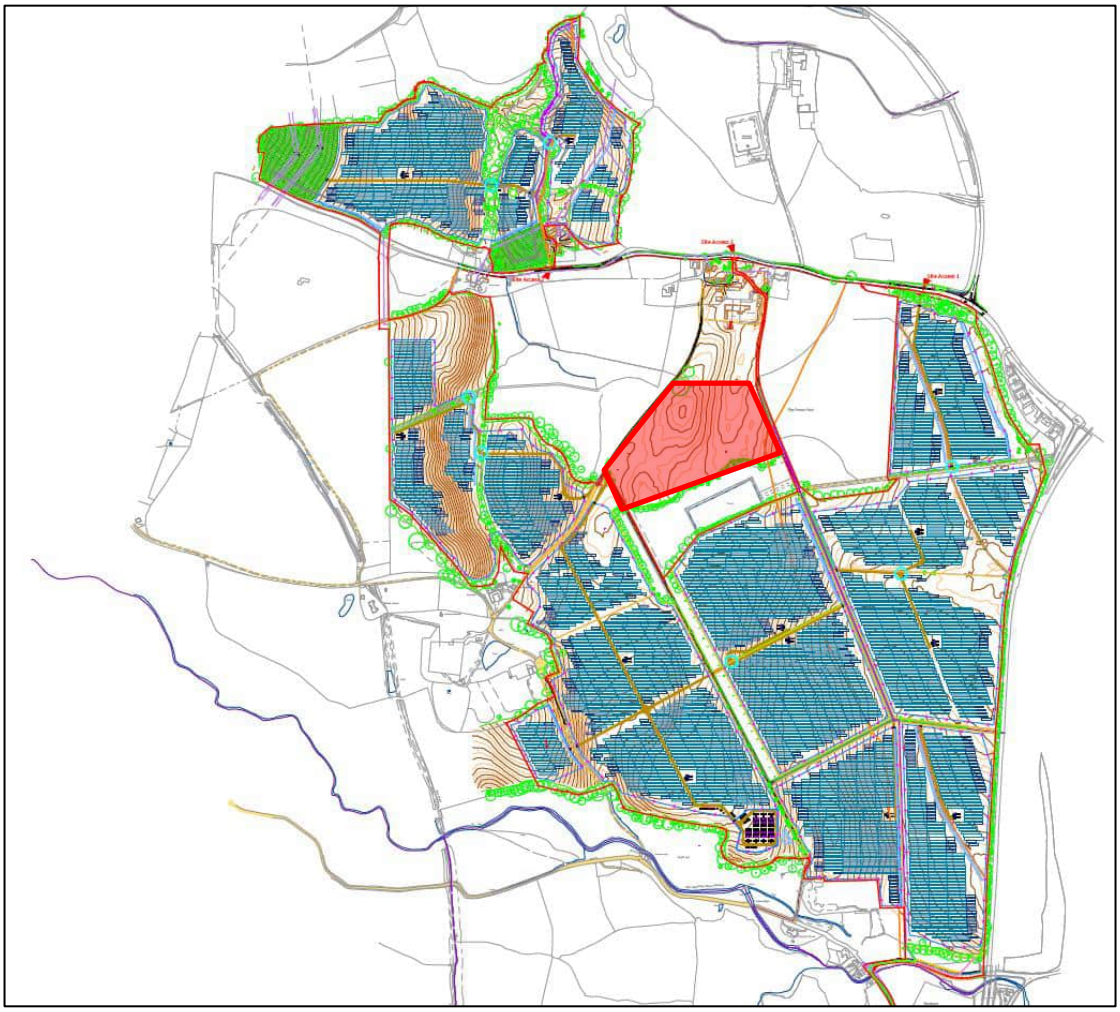

Figure 1 *Site Layout Plan*

[4]Source: GBR_Plas Power_LP2-PDL-PL_11-A3 Layout (planning).dwg (cropped). The area filled and outlined in red previously contained panels and this is shown in the layout plan in Figure 2 on the following page that was modelled within this report. The removal of the panel area does not require remodelling as the assessment undertaken in this report represents a more worst-case scenario than the currently proposed development.

2.2 Site Layout (Modelled)

Figure 2[5] below shows the site layout plan that was modelled within this report. The blue areas denote the solar panel locations.

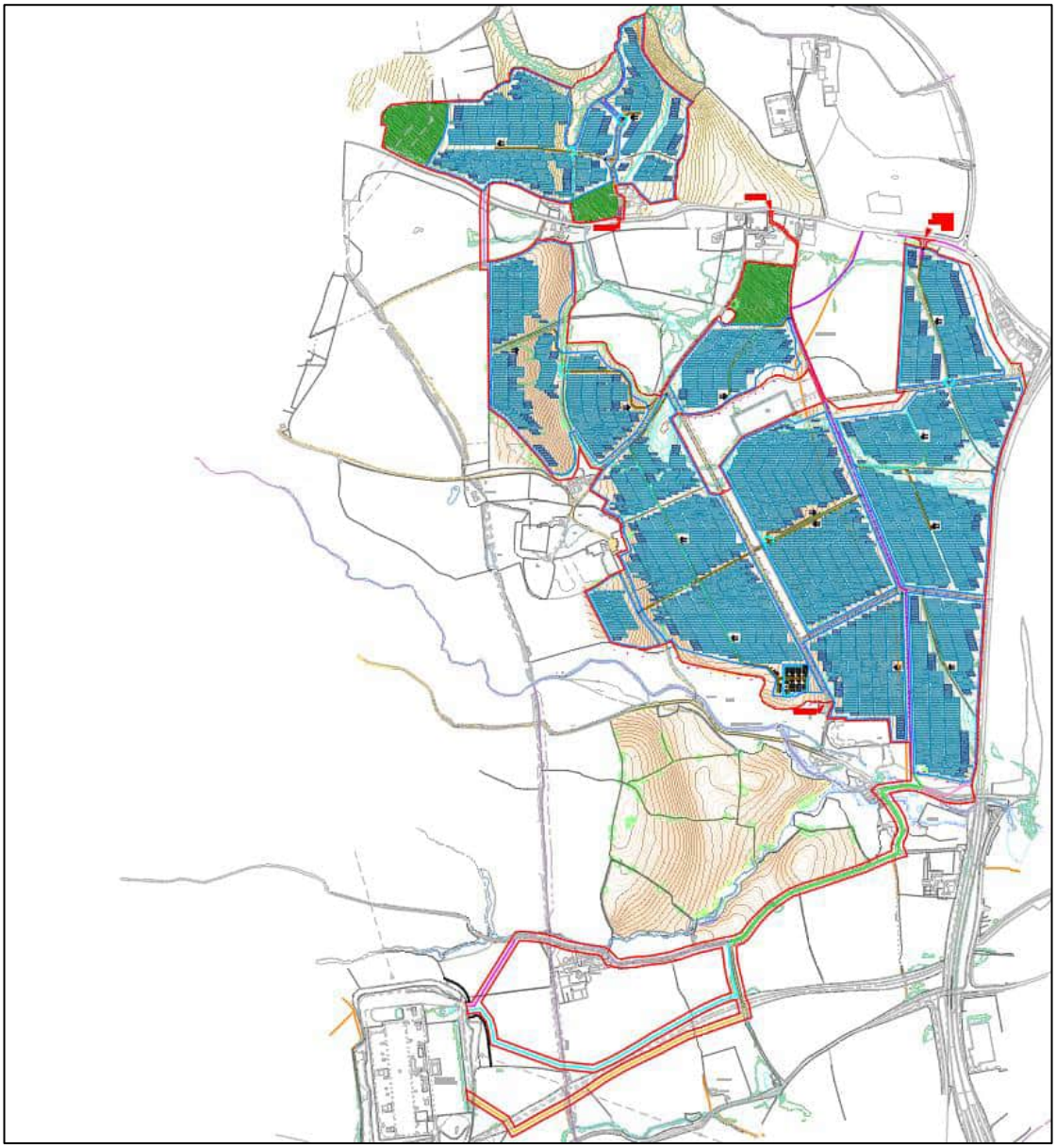

Figure 2 *Site Layout Plan*

[5] Source: GBR_Plas Power_LP2-PDL-PL_10 (draft 4).dwg (cropped)

2.3 Photovoltaic Panel Mounting Arrangements and Orientation

The solar panel dimensions as assessed within this report are as follows:

- The maximum height of the solar panels is 3.06m above ground level (agl), the minimum height is 1m agl - assessed at a panel midpoint of 2.03m agl;
- Tilt: 25 degrees above the horizontal;
- Orientation: 180 degrees (south facing).

2.4 Reflector Areas

A resolution of 20m has been chosen for this assessment. This means that a geometric calculation is undertaken for each identified receptor from a point every 20m from within the defined areas. This resolution is sufficiently high to maximise the accuracy of the results, increasing the resolution further would not significantly change the modelling output. The number of modelled reflector points are determined by the size of the reflector area and the assessment resolution.

The bounding co-ordinates for the proposed solar development have been extrapolated from the site plans. The data can be found in Appendix G. The assessed panel areas are shown in Figure 3 below.

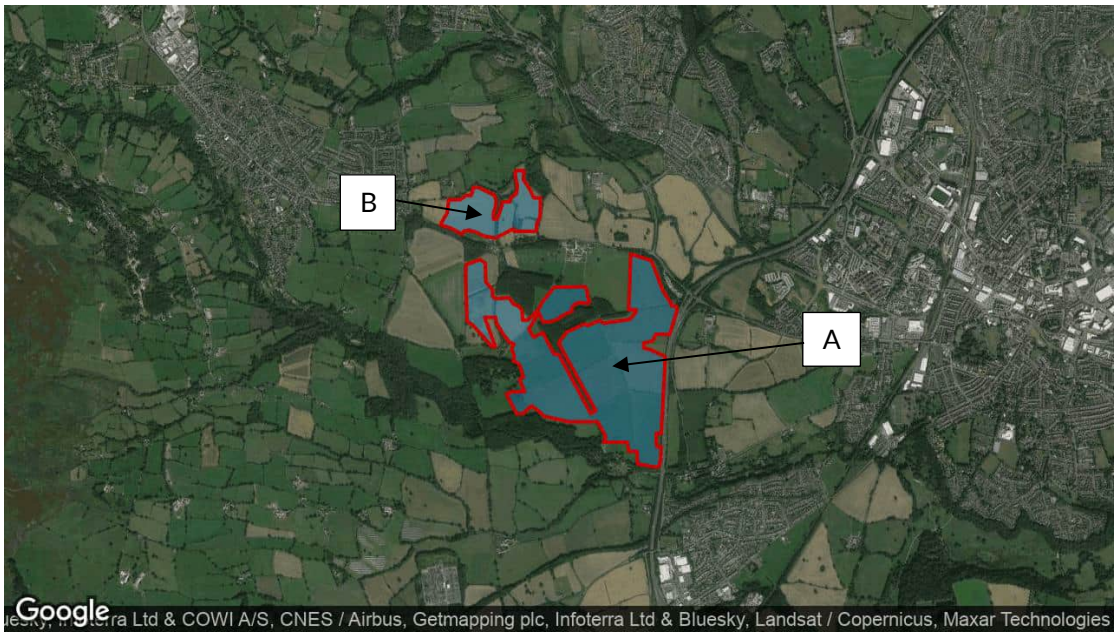

Figure 3 *Modelled solar panel areas*

3 GLINT AND GLARE ASSESSMENT METHODOLOGY

3.1 Guidance and Studies

Appendices A and B present a review of relevant guidance and independent studies with regard to glint and glare issues from solar panels. The overall conclusions from the available studies are as follows:

- Specular reflections of the Sun from solar panels are possible.
- The measured intensity of a reflection from solar panels can vary from 2% to 30% depending on the angle of incidence.
- Published guidance shows that the intensity of solar reflections from solar panels are equal to or less than those from water. It also shows that reflections from solar panels are significantly less intense than many other reflective surfaces, which are common in an outdoor environment.

3.2 Background

Details of the Sun's movements and solar reflections are presented in Appendix C.

3.3 Methodology

3.3.1 Pager Power's Methodology

The glint and glare assessment methodology has been derived from the information provided to Pager Power through consultation with stakeholders and by reviewing the available guidance and studies. The methodology for a glint and glare assessments is as follows:

- Identify receptors in the area surrounding the solar development.
- Consider direct solar reflections from the solar development towards the identified receptors by undertaking geometric calculations and intensity calculations where required.
- Consider the visibility of the panels from the receptor's location. If the panels are not visible from the receptor then no reflection can occur.
- Based on the results of the geometric calculations, determine whether a reflection can occur, and if so, at what time it will occur.
- Assess the glare intensity if applicable.
- Consider both the solar reflection from the solar development and the location of the direct sunlight with respect to the receptor's position.
- Consider the solar reflection with respect to the published studies and guidance.
- Determine whether a significant detrimental impact is expected in line with the process presented in Appendix D.

Within the Pager Power model, the solar development area is defined, as well as the relevant receptor locations. The result is a chart that states whether a reflection can occur, the duration and the panels that can produce the solar reflection towards the receptor.

3.3.2 Sandia National Laboratories' Methodology

Sandia National Laboratories developed the Solar Glare Hazard Analysis Tool (SGHAT) which is no longer freely available however it is now developed by Forge Solar. Pager Power uses this model where required for aviation receptors. Whilst strictly applicable in the USA and to solar photovoltaic developments only, the methodology is widely used by aviation stakeholders internationally.

Pager Power has undertaken many glint and glare assessments with both models (SGHAT and Pager Power's) producing similar results. In this study the Pager Power model was used exclusively.

3.4 Assessment Limitations

Further technical details regarding the methodology of the geometric calculations and limitations are presented in Appendix E and Appendix F.

4 IDENTIFICATION OF RECEPTORS

4.1 Ground-Based Receptors 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, shows that a 1km assessment area from the proposed panel area is appropriate for glint and glare effects on ground-based receptors (road users and dwellings). Reflections towards ground-based receptors to the north of the panels are not considered possible at this latitude for fixed panels facing south and therefore the areas to the north of the northernmost panels are removed from the assessment area.

Potential receptors are identified based on mapping and aerial photography of the region. The initial judgement is made based on a high-level 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.

Terrain elevation heights have been interpolated based on OS Terrain 50 DTM data. Receptor details can be found in Appendix G.

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 and fast-moving vehicles with busy traffic.
- National – Typically a road with a one or more carriageways and fast-moving vehicles with moderate to busy traffic density.
- Regional – Typically a single carriageway with a typical traffic density of low to moderate; and
- 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 considers any major national, national, and regional roads that:

- are within the one-kilometre study area; and
- have a potential view of the panels.

A height of 1.5 metres above ground level has been taken as a typical eye level for a road user[6]. This height has therefore been added to the ground height at each receptor location. Visibility and direction of travel is considered in the assessment of all receptors.

4.2.2 Identification

In total, 86 road receptor locations have been identified distanced circa 100m apart:

- A 3.1km section of the A483 (1-32)
- A 3.8km section of the A525 (33-71)
- A 0.6km section of Heritage Way (72-78); and
- A 0.7km section of the B5097 (79-86)

These are shown in Figure 4 on the following page.

[6]This height is chosen for modelling purposes, elevated drivers are considered in the results discussion where appropriate.

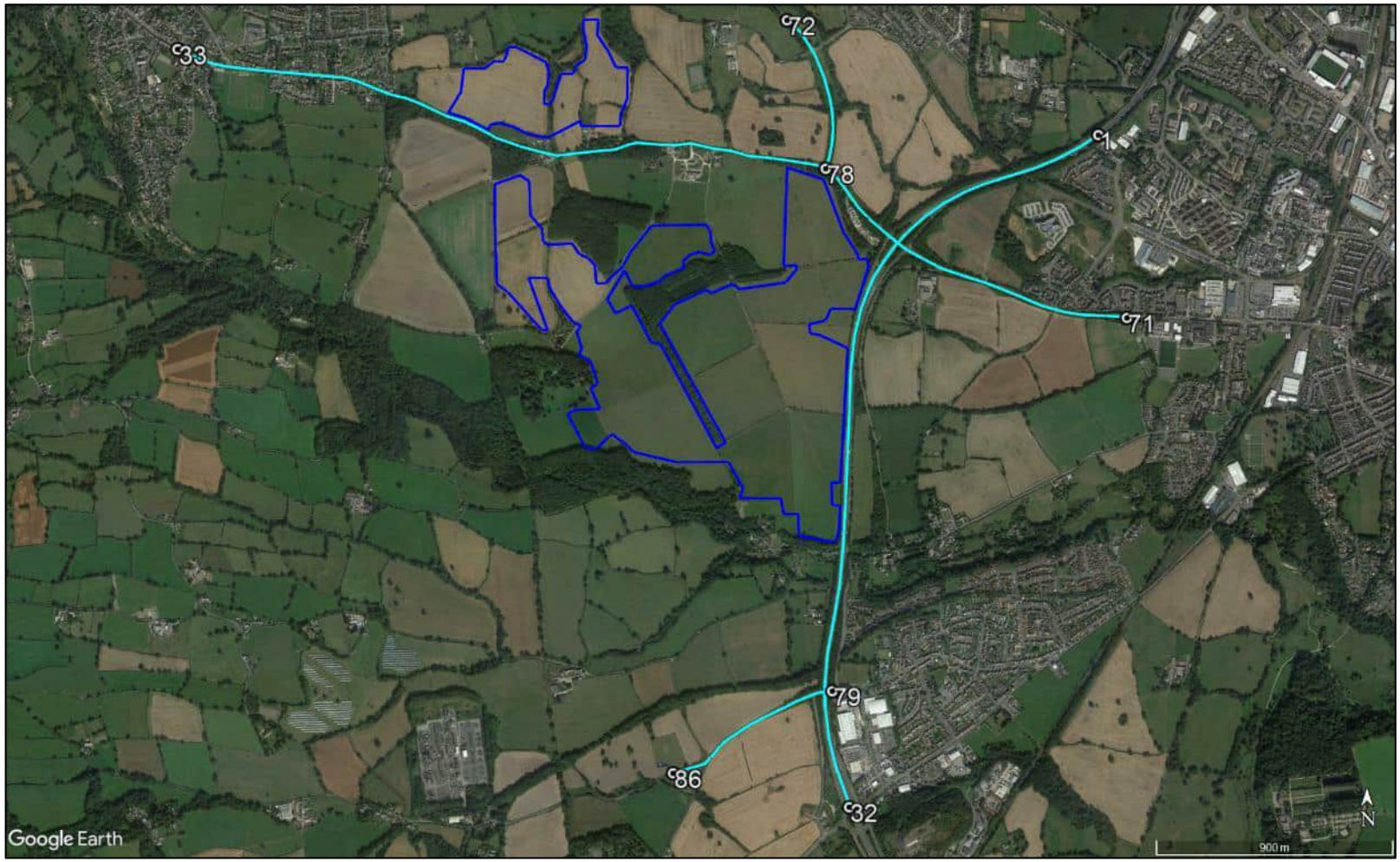

Figure 4 *Overview of road receptors*

4.3 Dwelling Receptors

4.3.1 Overview

The analysis has considered dwellings that:

- are within the one-kilometre study area; and
- have a potential view of the panels.

A height of 1.8 metres above ground level has been taken as typical eye level for an observer on the ground floor[7] of the dwelling since this is typically the most occupied floor of a dwelling throughout the day.

In residential areas with multiple layers of dwellings, only the outer dwellings have been 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 the line of sight will be removed, or they will experience comparable effects to the closest assessed dwelling. In addition, due to the density of the area, every other dwelling has been modelled; impacts will not change for individual dwellings in close proximity to each other and the locations will be assessed as opposed to individual dwellings where appropriate.

The dwellings, consist of buildings that are likely divided into multiple addresses. Modelling output has not been generated for every individual address independently. The sampling resolution is sufficiently high to capture the level of effect for all potentially affected dwellings.

4.3.2 Identification

In total, 251 dwellings were identified for assessment, as shown in Figure 4 on the following page. These are shown in more detail in Figure 6 to Figure 11 on the following pages.

[7] This fixed height for the dwelling receptors is for modelling purposes. Small changes to the modelling height by a few metres is not expected to significantly change the modelling results. Views above ground floor are considered in the results discussion where necessary.

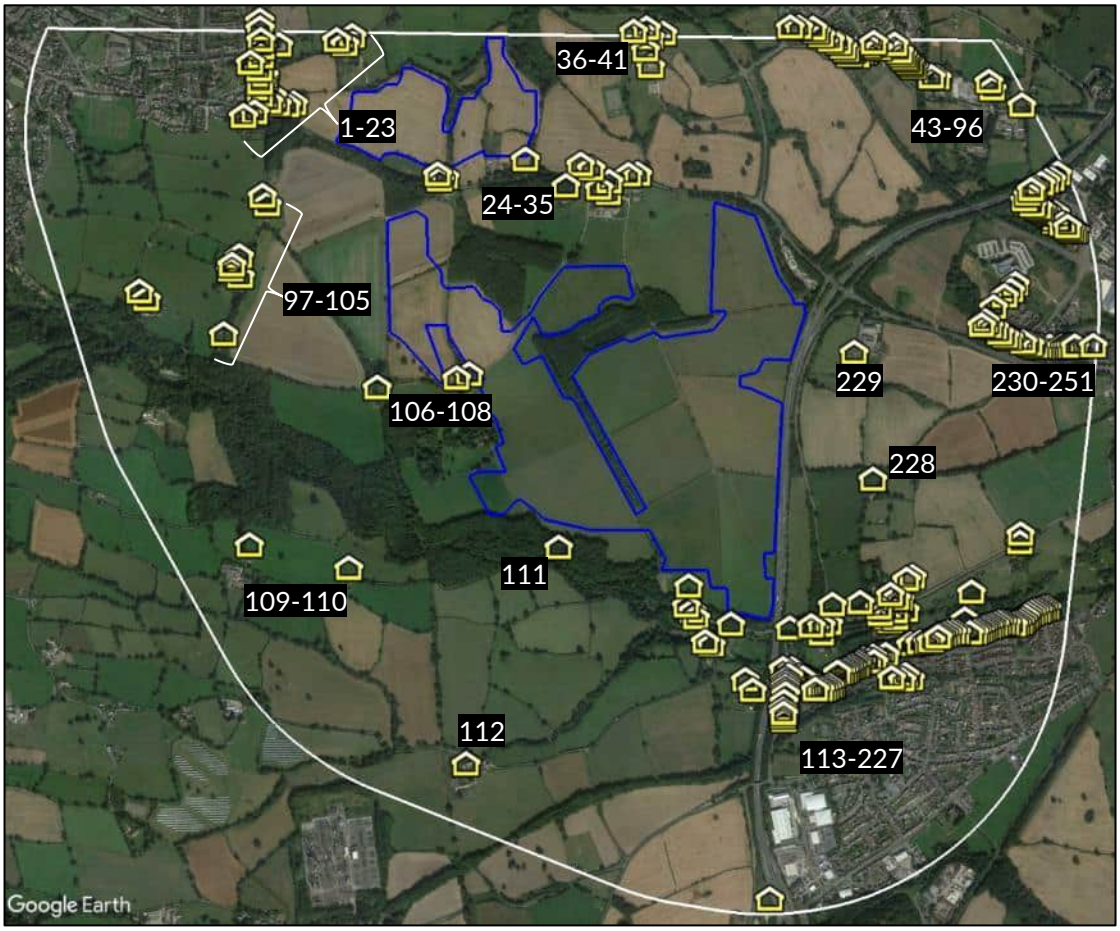

Figure 5 *Assessed dwelling locations*

Figure 6 *Dwelling receptors 1-23*

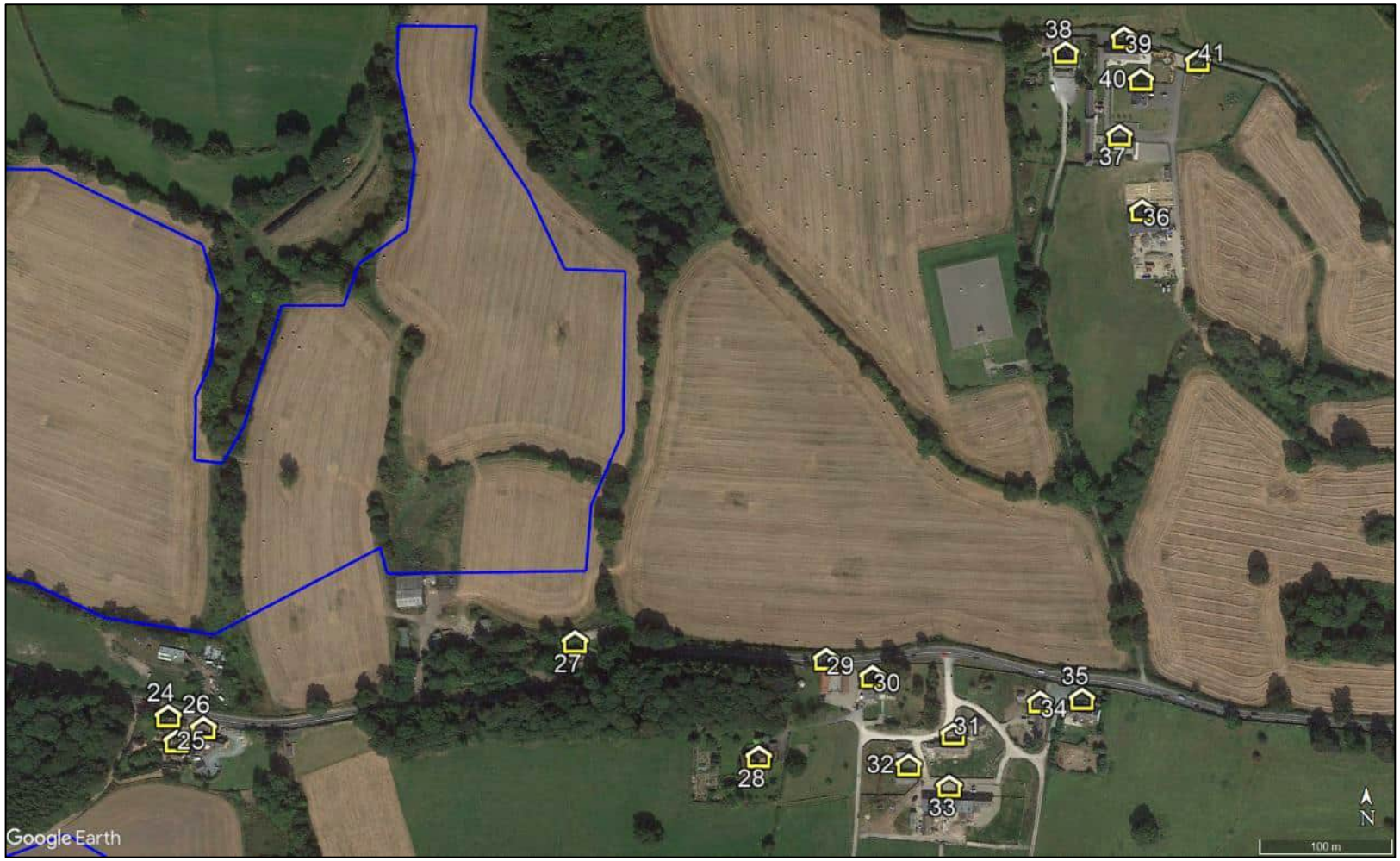

Figure 7 *Dwelling receptors 24-41*

Figure 8 *Dwelling receptors 42-72*

Figure 9 *Dwelling receptors 73-96*

Figure 10 *Dwelling receptors 97-108*

Figure 11 *Dwelling receptors 109-112*

Figure 12 *Dwelling receptors 229-251*

4.4 ZTV Viewpoints

The analysis has considered the 13 viewpoints marked in the ZTV[8]. Although not a typical requirement for assessment, these receptors have been taken forward for technical modelling at the request of the developer. The locations of these viewpoints are shown on aerial imagery in Figure 13 below. A height of 1.8 metres above ground level has been taken as typical eye level for an observer on the ground.

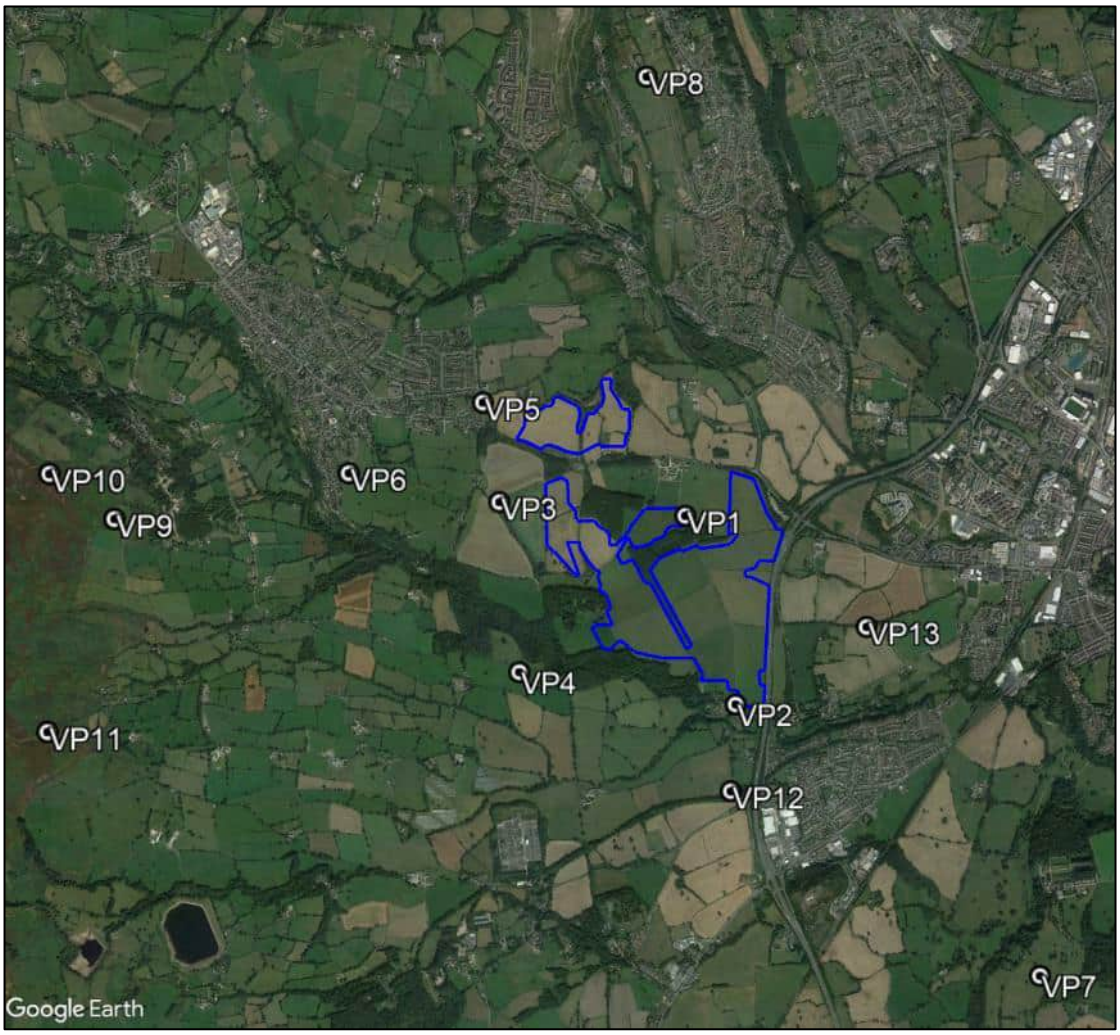

Figure 13 *Locations of ZTV viewpoints*

[8] Source: JSL3436_Fig 5.2 ZTV and Representative Viewpoints_E.pdf (cropped)

5 GEOMETRIC ASSESSMENT RESULTS AND DISCUSSION

5.1 Overview

The following sub-sections present the modelling results as well as the significance of any predicted impact in the context of existing screening, as well as the relevant criteria set out in the next subsection. The criteria are determined by the assessment process for each receptor, which are set out in Appendix D.

When determining the visibility of the reflecting panels for an observer, a conservative review of the available imagery is undertaken, whereby it is assumed views of the panels are possible if it cannot be reliably determined that existing screening will remove effects.

The modelling output showing the precise predicted times and the reflecting panel areas can be provided on request.

5.2 Roads

5.2.1 Impact Significance Methodology

The key considerations for road users along major national, national, and regional roads are:

- Whether a reflection is predicted to be experienced in practice; and
- The location of the reflecting panel relative to a road user's direction of travel.

Where the reflecting panels are predicted to be significantly obstructed from view, no impact is predicted, and mitigation is not required.

Where solar reflections are not experienced as a sustained source of glare, originate from outside of a road user's primary horizontal field of view (50 degrees either side of the direction of travel), or the closest reflecting panel is over 1km from the road user, the impact significance is low, and mitigation is not recommended.

Where sustained solar reflections are predicted to be experienced from inside of a road user's primary field of view, expert assessment of the following factors is required to determine the impact significance and mitigation requirement:

- Whether the solar reflection originates from directly in front of a road user – a solar reflection that is directly in front of a road user is more hazardous than a solar reflection to one side;
- Whether visibility is likely for elevated drivers (applicable to dual carriageways and motorways only) – there is typically a higher density of elevated drivers along dual carriageways and motorways compared to other types of road;
- The separation distance to the panel area – larger separation distances reduce the proportion of an observer's field of view that is affected by glare;
- The position of the Sun – effects that coincide with direct sunlight appear less prominent than those that do not.

If following consideration of the relevant factors, the solar reflections do not remain significant, the impact significance is low, and mitigation is not recommended.

If following consideration of the relevant factors, the solar reflections remain significant, then the impact significance is moderate, and mitigation is recommended.

Where solar reflections originate from directly in front of a road user and there are no mitigating factors, the impact significance is high, and mitigation is required.

5.2.2 Geometric Modelling Results

The modelling has shown that solar reflections are geometrically possible[9] towards a 1.5km section of the A483, a 3.6km section of the A525, and a 0.4km section of Heritage Way. These sections of roads are shown in orange in Figure 14 on the following page.

The modelling results for road receptors are presented in Table 1 on page 27.

[9] Only considering reflections from solar panels within 1km of the receptor. Reflections outside of 1km are not considered to be significant.

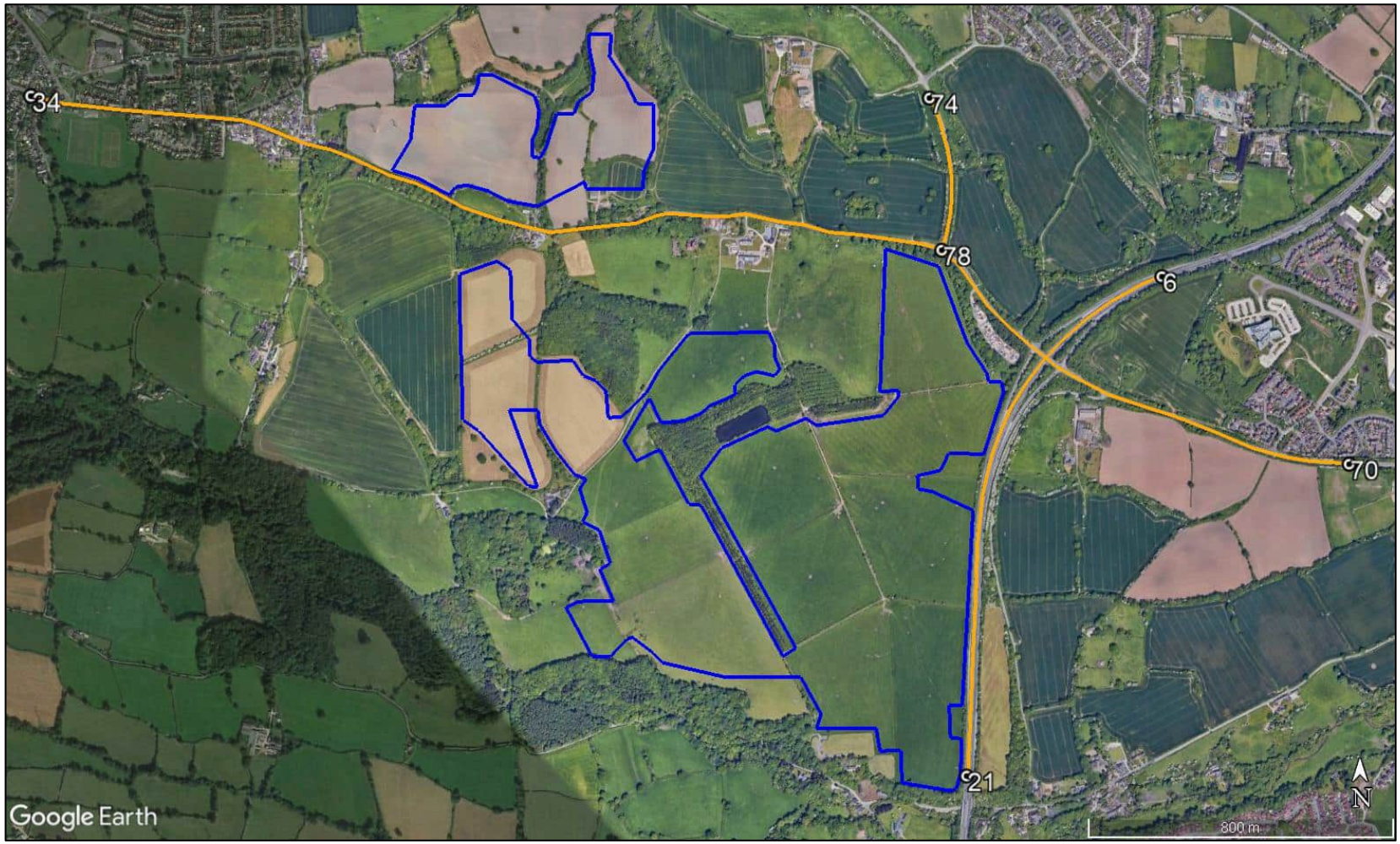

Figure 14 *Sections of roads towards which solar reflections are geometrically possible (orange) – aerial image*

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
1 - 5	Solar reflections are not geometrically possible	N/A	N/A	None	No
6 - 9	Solar reflections predicted to originate from **inside** of a road user's primary horizontal field of view	Reflecting panels are predicted to be screened by intervening terrain and vegetation	N/A	None	No
10 - 17	Solar reflections predicted to originate from **outside** of a road user's primary horizontal field of view	Reflecting panels are predicted to be screened by intervening vegetation	N/A	None	No
18 - 21	Solar reflections predicted to originate from **outside** of a road user's primary horizontal field of view	Reflecting panels are predicted to be mostly screened by intervening vegetation	N/A	Low	No
22 - 33	Solar reflections are not geometrically possible	N/A	N/A	None	No

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
34 - 41	Solar reflections predicted to originate from **inside** of a road user's primary horizontal field of view	Reflecting panels are predicted to be screened by intervening terrain, buildings, and vegetation	N/A	None	No
42 - 48	Solar reflections predicted to originate from **inside** of a road user's primary horizontal field of view	Reflecting panels are predicted to be screened by intervening terrain, and deciduous roadside vegetation during summer months During spring and autumn months, views of reflecting panels will be filtered such that significant reflections are not predicted	N/A	Low	No

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
49 - 70	Solar reflections predicted to originate from **inside** of a road user's primary horizontal field of view	Reflecting panels are predicted to be screened by intervening terrain and vegetation	N/A	None	No
71 - 73	Solar reflections are not geometrically possible	N/A	N/A	None	No
74 - 78	Solar reflections predicted to originate from **outside** of a road user's primary horizontal field of view	Reflecting panels are predicted to be screened by intervening terrain and vegetation	N/A	None	No
79 - 86	Solar reflections are not geometrically possible	N/A	N/A	None	No

Table 1 *Geometric modelling results, assessment of impact significance, and mitigation recommendation/requirement – road receptors*

5.2.3 Desk-Based Screening Review

Figure 15 *View towards reflecting panel area from road receptor 7 (level of screening is representative of receptors 6-9) – streetview image*

Figure 16 *View towards reflecting panel area from road receptor 10 (level of screening is representative of receptors 10-14) – streetview image*

Figure 17 *Roadside screening for road receptor 17 (level of screening is representative of receptors 14-17) – streetview image*

Figure 18 *View towards reflecting panel area from road receptor 20 (level of screening is representative of receptors 18-21) – streetview image*

Figure 19 *View towards reflecting panel area from road receptor 41 (level of screening is representative of receptors 34-41) – streetview image*

Figure 20 *Roadside screening (outlined in green) for road receptor 42 (level of screening is representative of receptors 42-43) – streetview image*

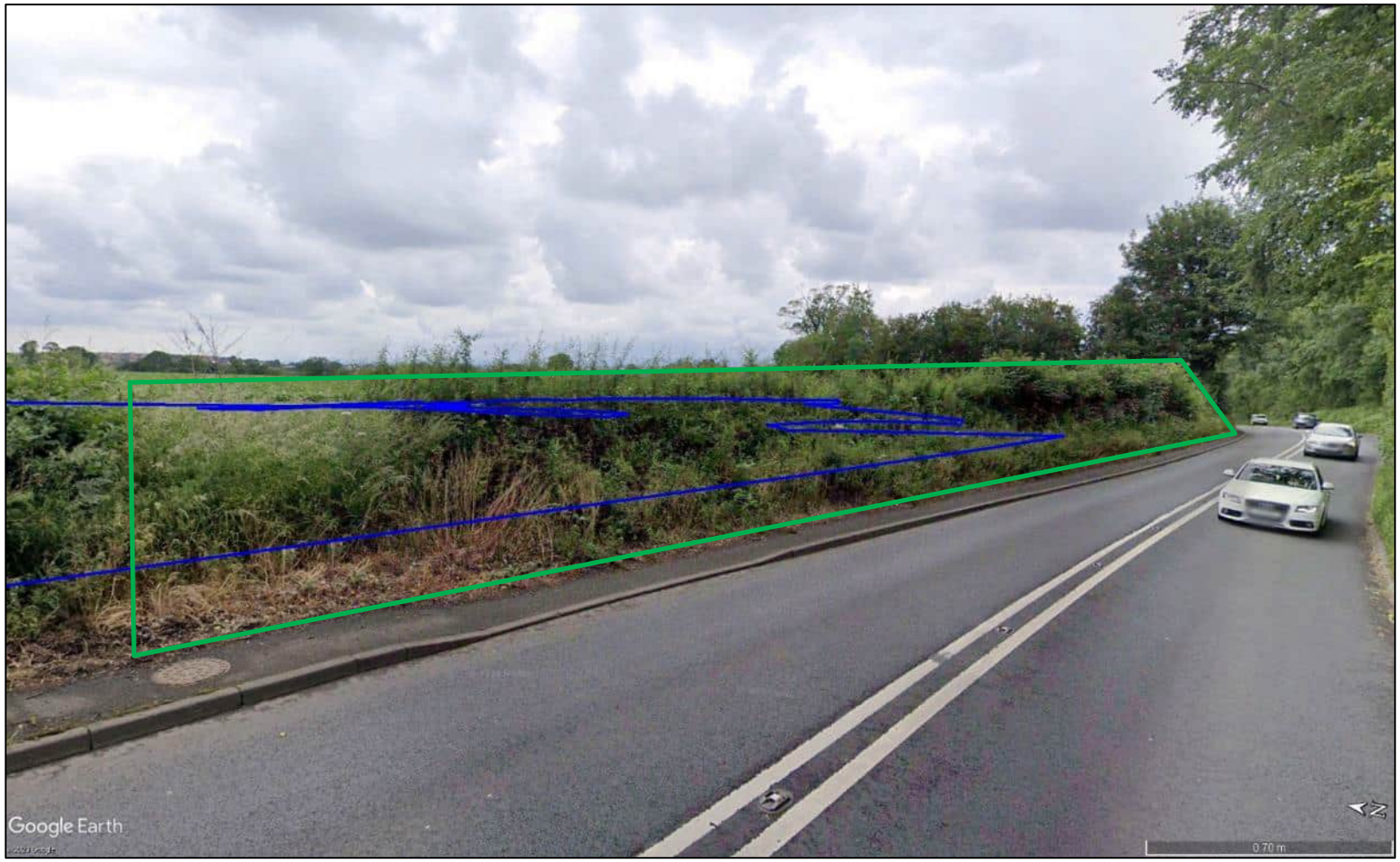

Figure 21 *Roadside screening (outlined in green) for road receptor 44 (level of screening is representative of receptors 44-45) – streetview image*

5.2.4 Conclusions

No significant impacts are predicted on any of the modelled road sections due to the following:

- Solar reflections are possible from panels **outside** of a road user's primary horizontal field of view (50 degrees either side of the direction of travel);
- There is significant screening such that views of reflecting panels are not expected to be possible in practice; and/or
- There is screening such that reflections will be filtered and only marginal/fleeting views of reflecting panels are expected to be possible.

5.3 Dwellings

5.3.1 Impact Significance Methodology

The key considerations for residential dwellings are:

- Whether a reflection is predicted to be experienced in practice;
- The duration of the predicted effects, relative to thresholds of:
    - 3 months per year;
    - 60 minutes on any given day.

Where solar reflections are not geometrically possible or the reflecting panels are predicted to be significantly obstructed from view, no impact is predicted, and mitigation is not required.

Where solar reflections are experienced for less than three months per year and less than 60 minutes on any given day, or the closest reflecting panel is over 1km from the dwelling, the impact significance is low, and mitigation is not recommended.

Where reflections are predicted to be experienced for more than three months per year **and/or** for more than 60 minutes on any given day, expert assessment of the following mitigating factors is required to determine the impact significance and mitigation requirement:

- Whether visibility is likely from all storeys – the ground floor is typically considered the main living space and has a greater significance with respect to residential amenity;
- The separation distance to the panel area – larger separation distances reduce the proportion of an observer's field of view that is affected by glare;
- Whether the dwelling appears to have windows facing the reflecting area – factors that restrict potential views of a reflecting area reduce the level of impact;
- The position of the Sun – effects that coincide with direct sunlight appear less prominent than those that do not.

If following consideration of the relevant factors, the solar reflections do not remain significant, the impact significance is low, and mitigation is not recommended. If following consideration of the relevant factors, the solar reflections remain significant, then the impact significance is moderate, and mitigation is recommended.

If effects last for more than three months per year and for more than 60 minutes on any given day, and there are no mitigating factors, the impact significance is high, and mitigation is required.

5.3.2 Geometric Modelling Results

The modelling has shown that solar reflections are geometrically possible[10] towards 145 of the 251 assessed dwelling receptors, as shown in Figure 22 on the following page. The modelling results for dwelling receptors are analysed in Table 2 on page 37.

[10] Only considering reflections from solar panels within 1km of the receptor. Reflections outside of 1km are not considered to be significant.

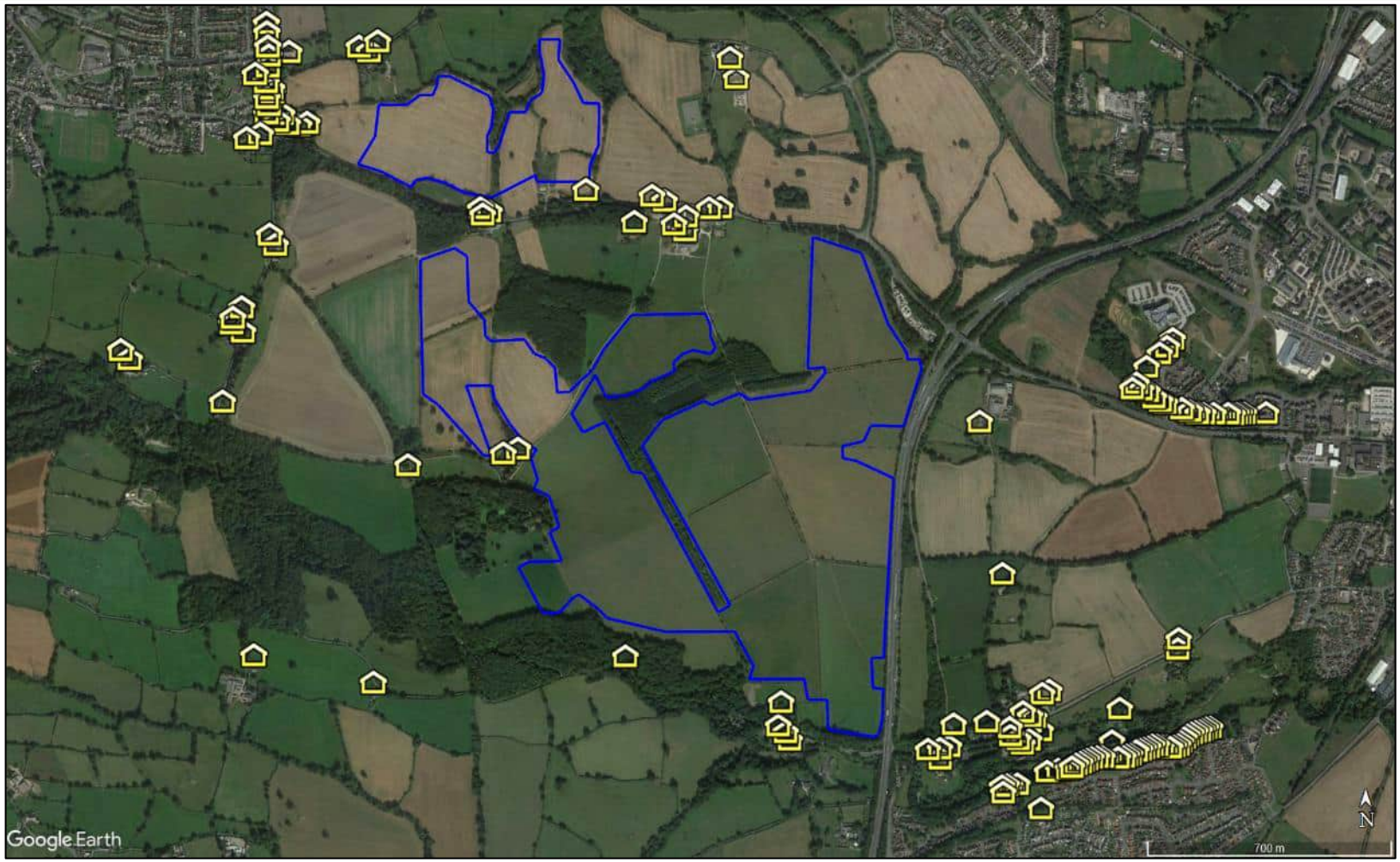

Figure 22 *Dwellings towards which solar reflections are geometrically possible – aerial image*

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
1-10	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation and/or terrain	N/A	None	No
11-23	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
24-26	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
27 - 31	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
32-33	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	Majority of reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain Views of reflecting panels to the east may be possible	Reflecting panels are at least 300m away	Low	No
34-35	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
36-37	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation and/or terrain	N/A	None	No
38-96	Solar reflections are not geometrically possible	N/A	N/A	None	No

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
97-102	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
103-104	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	Majority of reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain Views of reflecting panels to the east may be possible	Reflecting panels are at least 400m away	Low	No
105-106	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
107-108	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by proposed hedgerow planting maintained at 3m agl	N/A	None	No

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
109-111	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
112	Solar reflections are not geometrically possible	N/A	N/A	None	No
113-116	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
117-158	Solar reflections are not geometrically possible	N/A	N/A	None	No
159-164	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
165-166	Solar reflections are not geometrically possible	N/A	N/A	None	No

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
167	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
168	Solar reflections are not geometrically possible	N/A	N/A	None	No
169-203	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
204	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
205-224	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
225-226	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
227	Solar reflections are not geometrically possible	N/A	N/A	None	No
228-229	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
230-231	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No
232-244	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No

Receptor	Geometric modelling results (without consideration of screening)	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
245-251	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year	All reflecting panels are expected to be significantly screened by intervening vegetation, buildings, and/or terrain	N/A	None	No

Table 2 *Geometric modelling results, assessment of impact significance, and mitigation recommendation/requirement – dwelling receptors*

5.3.3 Desk-Based Screening Review

Figure 23 below depicts the cumulative reflector area (yellow area) relative to locations 107 and 108 and the proposed hedgerow planting at 3m above ground level (green lines). Figure 24 shows the relevant extract from the landscape mitigation plan.

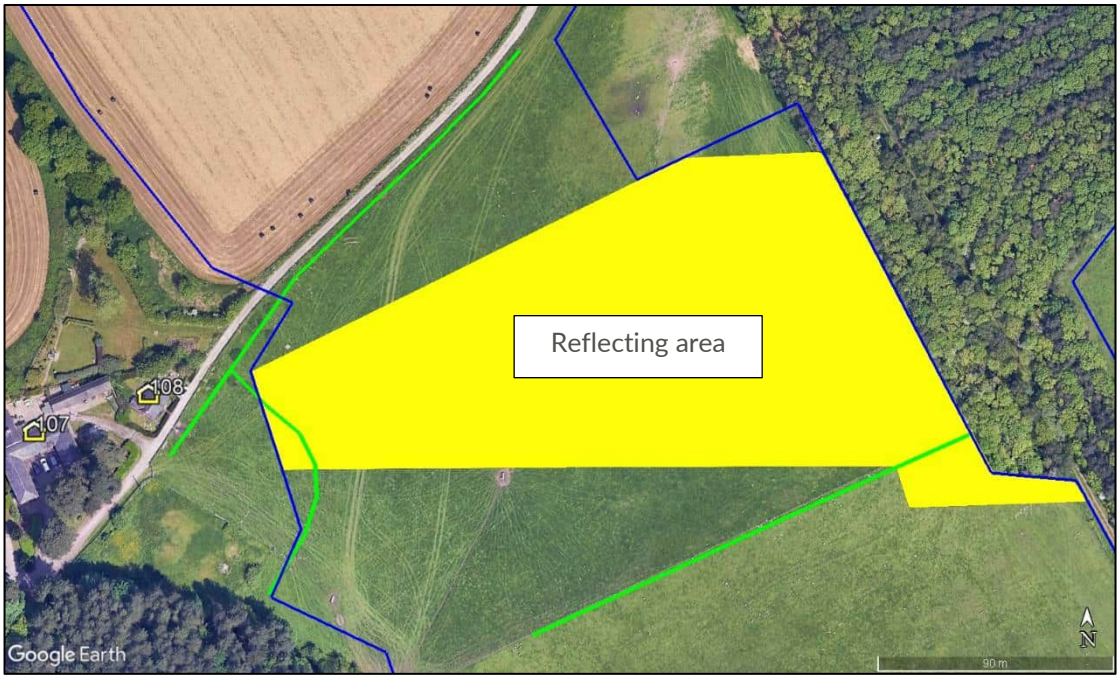

Figure 23 *Proposed hedgerow planting relative to the cumulative reflector area for dwellings 107 and 108*

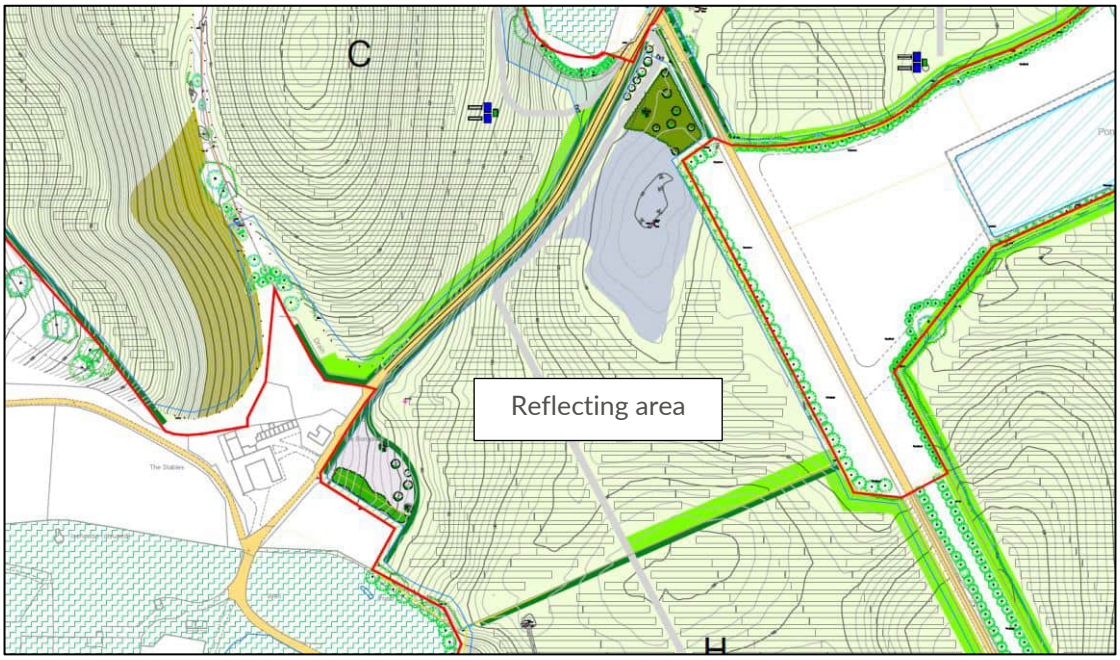

Figure 24 *Relevant extract from landscape mitigation plan for dwellings 107 and 108*

Figure 25 below depicts the cumulative reflector area (yellow area) relative to locations 123-206.

Figure 25 *Aerial image depicting locations 57-160, relative to the reflector area*

Figure 26 below depicts the cumulative reflector area (yellow area) relative to locations 228-251. This is the total area accounting for potential reflections throughout March-September.

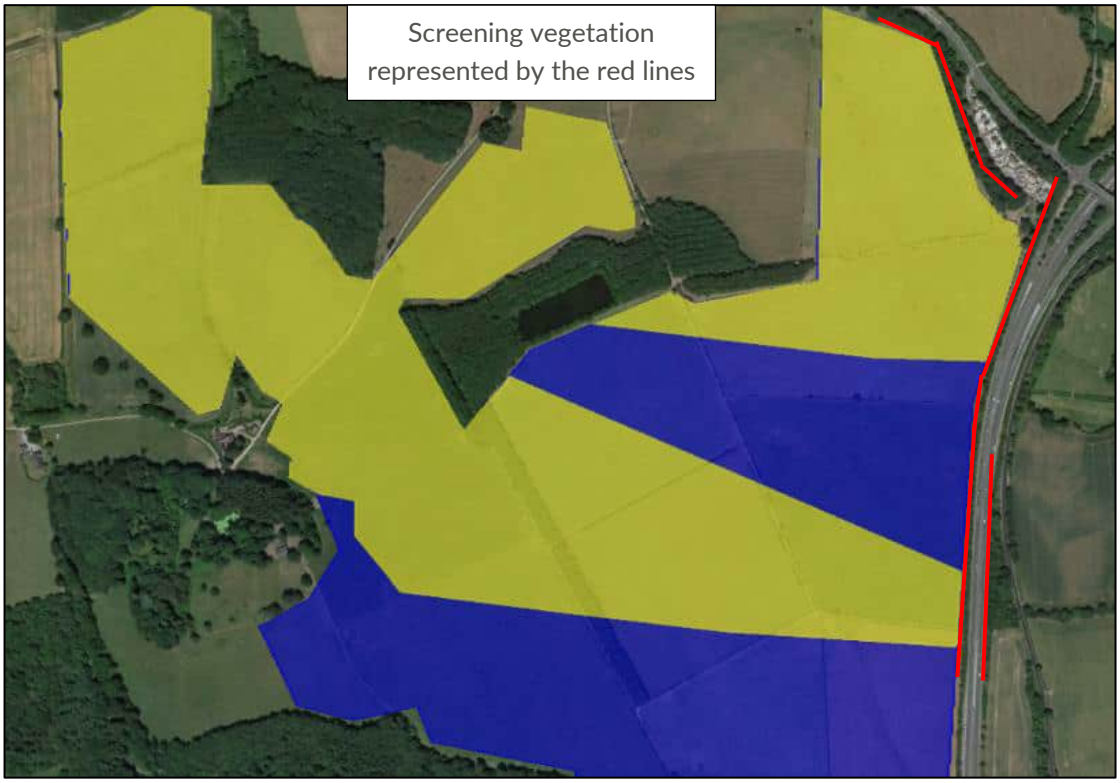

Figure 26 *Vegetation screening on the eastern boundary of the site for dwellings 228-251, relative to the cumulative reflector area*

5.3.4 Conclusions

No significant impacts are predicted on the assessed dwellings due to the following:

- Solar reflections are possible for **less** than 60 minutes on any given day and for **less** than 3 months of the year;
- There is significant screening such that views of reflecting panels are not expected to be possible in practice;
- There is screening such that reflections will be filtered and only marginal views of reflecting panels are expected to be possible; and/or
- There is a significant clearance distance between dwelling observer and closest reflecting panel.

5.4 ZTV Viewpoints

5.4.1 Impact Significance Methodology

There is no formal methodology for the assessment of the identified viewpoints.

In Pager Power's experience, significant impacts to pedestrians/observers at ZTV viewpoints are not possible due to glint and glare effects from PV developments. The reasoning is due to the sensitivity of the receptors (in terms of amenity and safety) being concluded to be of low significance. This is because:

- The typical density of pedestrians located at these points is low in a rural environment;
- Any resultant effect is much less serious and has far lesser consequences than, for example, solar reflections experienced towards a road network whereby the resultant impacts of a solar reflection can be much more serious;
- Glint and glare effects towards an observer are transient, and time and location sensitive whereby a pedestrian could move beyond the solar reflection zone with ease with little impact upon safety or amenity;
- Any observable solar reflection towards an observer would be of similar intensity to those experienced whilst navigating the natural and built environment on a regular basis.

5.4.2 Geometric Modelling Results

The modelling has shown that solar reflections are geometrically possible towards 10 of the 13 assessed ZTV viewpoints (VP1-VP6, VP9-VP11, and VP13). These are shown in Figure 27 below. The modelling output showing the precise predicted times and the reflecting panel areas are presented in Appendix H.

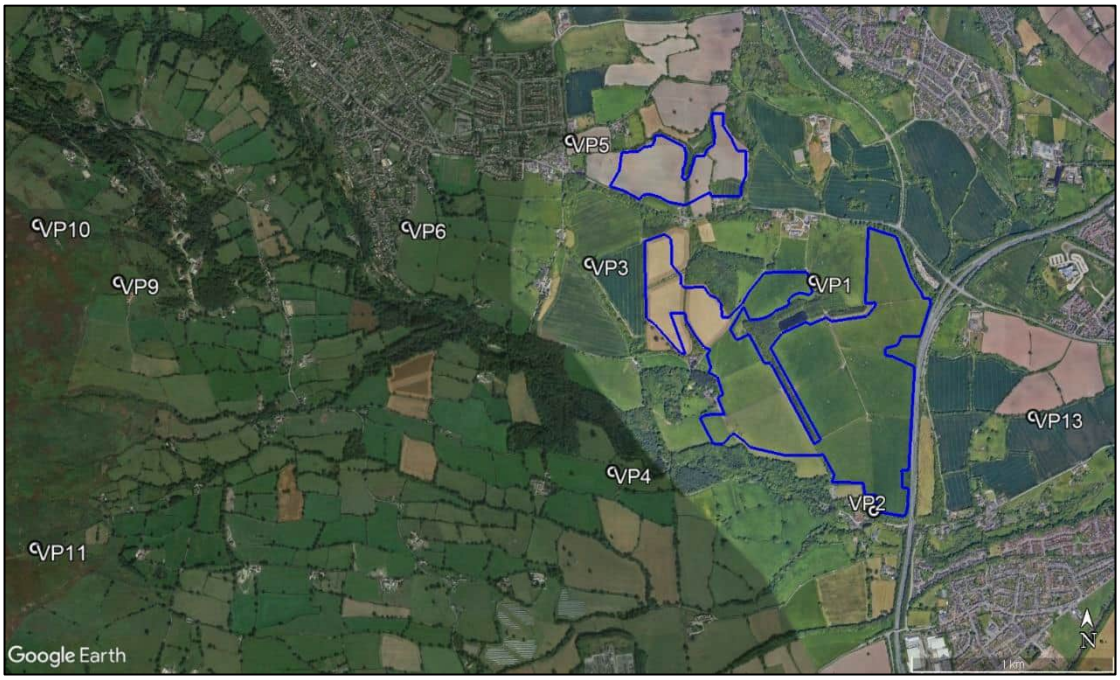

Figure 27 *ZTV viewpoints towards which solar reflections are geometrically possible – aerial image*

VP1 is predicted to have visibility of reflecting panels shown in Figure 28 below.

Figure 28 *Visible reflecting panel areas from VP1 – aerial image*

VP2 is predicted to be screened by proposed native hedgerow planting maintained at 3m above ground level.

VP3 is predicted to have visibility of reflecting panels in Figure 29 below with a minimum clearance distance of 250m.

Figure 29 *Visible reflecting panel area from VP3 – aerial image*

VP4, VP5, and VP13 are predicted to be screened by intervening vegetation.

VP6 is predicted to be screened by intervening buildings and vegetation.

VP9, VP10, and VP11 may have views of the Proposed Development.

For VP9, reflections are predicted for less than 60 minutes on any given day and for more than 3 months of the year, and the reflecting panels are at least 2.3km away (see Figure 30 below).

Figure 30 *Visible reflecting panel area from VP9 – aerial image*

For VP10, reflections are predicted for less than 60 minutes on any given day and for less than 3 months of the year, and the reflecting panels are at least 2.5km away (see Figure 31 below).

Figure 31 *Visible reflecting panel area from VP10 – aerial image*

For VP11, reflections are predicted for less than 60 minutes on any given day and for more than 3 months of the year, and the reflecting panels are at least 3km away (see Figure 32 below).

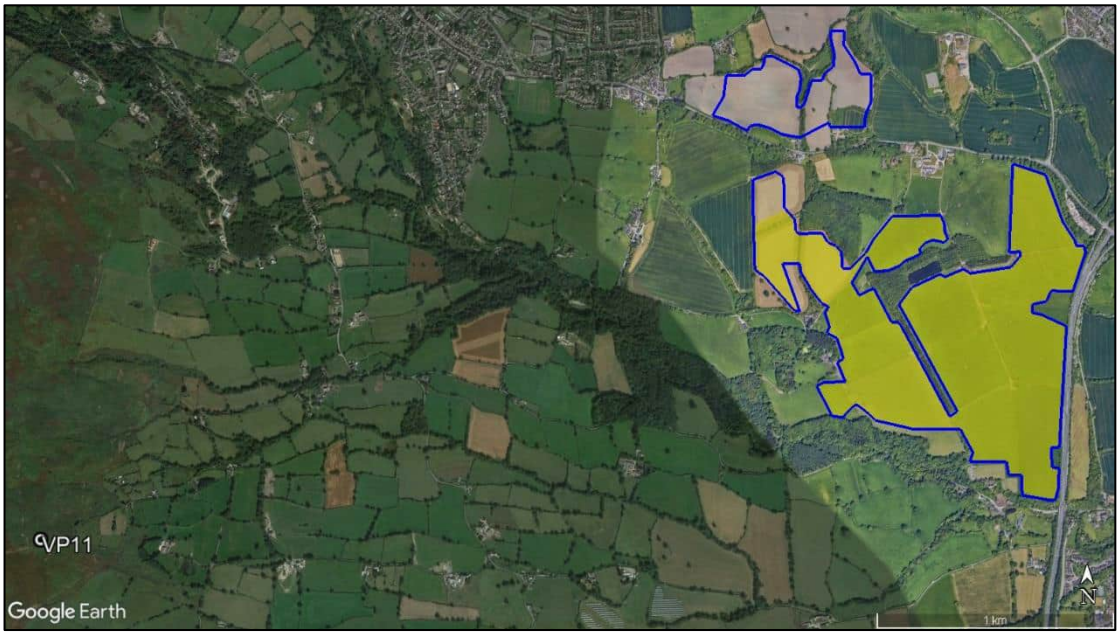

Figure 32 *Visible reflecting panel area from VP11 – aerial image*

Based on the impact significance methodology for a dwelling, which is a more significant receptor with respect to amenity, a low impact would be predicted on these three receptors, and mitigation would not be recommended.

5.4.3 Conclusions

No significant impacts are predicted on the assessed ZTV viewpoints.

6 CONCLUSIONS

6.1 Roads

The modelling has shown that solar reflections are geometrically possible towards a 1.5km section of the A483, a 3.6km section of the A525, and a 0.4km section of Heritage Way.

No significant impacts are predicted on any of the modelled road sections due to the following:

- Solar reflections are possible from panels **outside** of a road user's primary horizontal field of view (50 degrees either side of the direction of travel);
- There is significant screening such that views of reflecting panels are not expected to be possible in practice; and/or
- There is screening such that reflections will be filtered and only marginal/fleeting views of reflecting panels are expected to be possible.

6.2 Dwellings

The modelling has shown that solar reflections are geometrically possible towards 145 of the 251 assessed dwelling locations.

No significant impacts are predicted on the assessed dwellings due to the following:

- Solar reflections are possible for **less** than 60 minutes on any given day and for **less** than 3 months of the year;
- There is significant screening such that views of reflecting panels are not expected to be possible in practice;
- There is screening such that reflections will be filtered and only marginal views of reflecting panels are expected to be possible; and/or
- There is a significant clearance distance between dwelling observer and closest reflecting panel.

6.3 ZTV Viewpoints

The modelling has shown that solar reflections are geometrically possible towards 10 of the 13 assessed ZTV viewpoints.

In Pager Power's experience, significant impacts to pedestrians/observers at ZTV viewpoints are not possible due to glint and glare effects from PV developments. The reasoning is due to the sensitivity of the receptors (in terms of amenity and safety) being concluded to be of low significance. This is because:

- The typical density of pedestrians located at these points is low in a rural environment;
- Any resultant effect is much less serious and has far lesser consequences than, for example, solar reflections experienced towards a road network whereby the resultant impacts of a solar reflection can be much more serious;

- Glint and glare effects towards an observer are transient, and time and location sensitive whereby a pedestrian could move beyond the solar reflection zone with ease with little impact upon safety or amenity;
- Any observable solar reflection towards an observer would be of similar intensity to those experienced whilst navigating the natural and built environment on a regular basis.

No significant impacts are predicted on the assessed ZTV viewpoints.

6.4 Overall

No significant impacts are predicted on surrounding road safety, residential amenity, and observers located at the identified viewpoints in the surrounding area. Mitigation is not recommended.

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 Energy[11] (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.'

[11] Renewable and low carbon energy, UK Ministry of Housing, Communities & Local Government, date: 18 June 2015, last updated 14 August 2023, accessed on: 29/08/2023

Draft National Policy Statement for Renewable Energy Infrastructure

The Draft National Policy Statement for Renewable Energy Infrastructure (EN-3)[12] sets out the primary policy for decisions by the Secretary of State for nationally significant renewable energy infrastructure. Sections 3.10.93-97 state:

'3.10.93 Solar panels are specifically designed to absorb, not reflect, irradiation.[13] 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.

3.10.94 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.

3.10.95 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.

3.10.96 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.

3.10.97 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 3.10.125-127 state:

3.10.125 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.

3.10.126 Applicants may consider using screening between potentially affected receptors and the reflecting panels to mitigate the effects.

3.10.127 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.

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[12] Draft National Policy Statement for Renewable Energy Infrastructure (EN-3), Department for Energy Security & Net Zero, date: March 2023, accessed on: 05/04/2023.

[13] 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.

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 3.10.149-150 state:

3.10.149 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).

3.10.150 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 latest version of the draft EN-3 goes some way in referencing that the issue is more complex than presented in the previous issue; 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 impact upon aviation safety. It is possible that the final issue of the policy will change in light of further consultation responses from aviation stakeholders.

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 document[14] which was produced due to the absence of existing guidance and a specific standardised assessment methodology.

[14] Pager Power Glint and Glare Guidance, Fourth Edition, September 2022.

APPENDIX B – OVERVIEW OF GLINT AND GLARE STUDIES

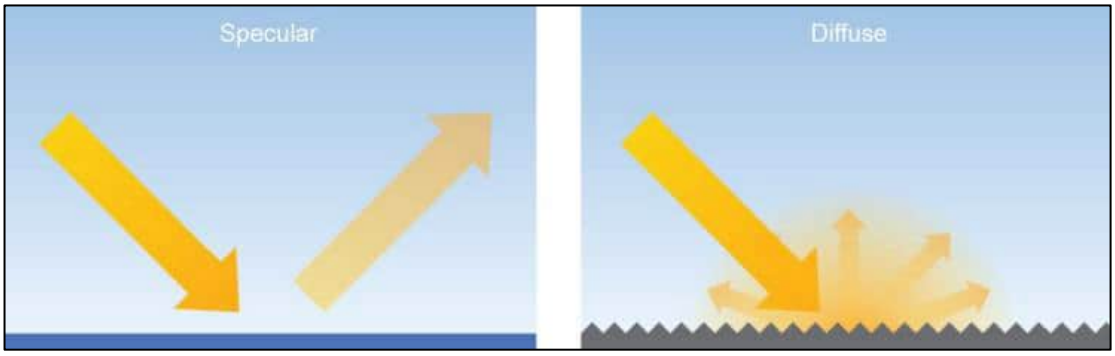
Overview

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 guidance[15], 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

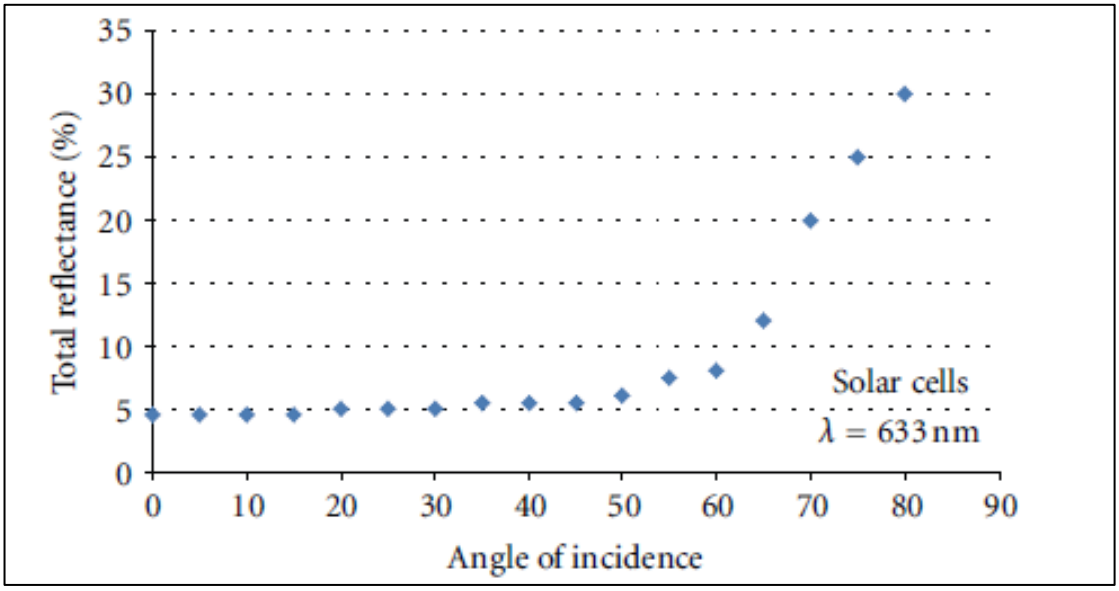
[15] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 08/12/2021.

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 Systems*[16]". 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.

[16] 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"[17]

The 2018 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[18]
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.

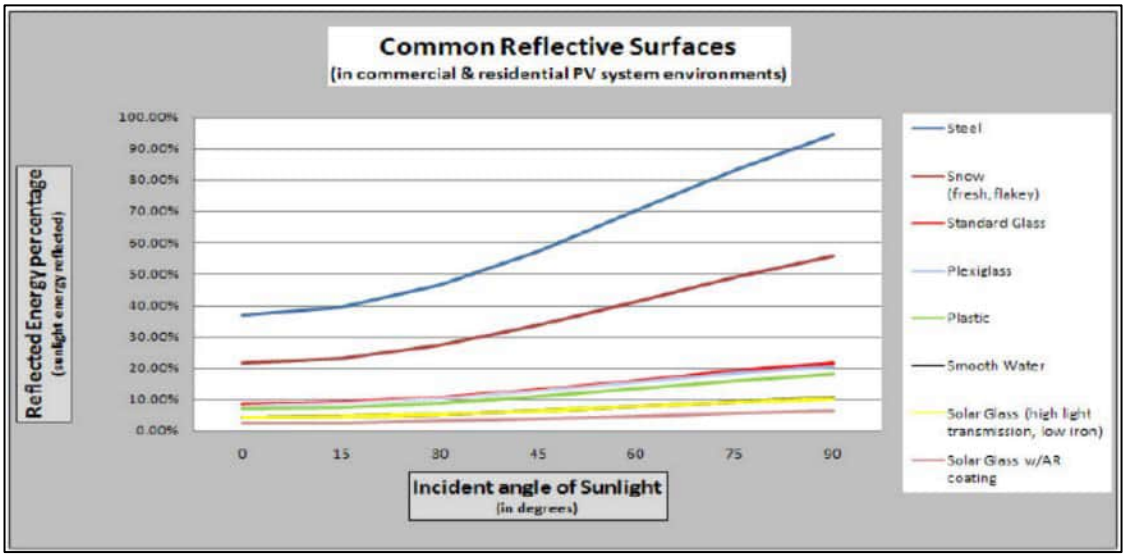
[17] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 08/12/2021.

[18] Extrapolated data, baseline of 1,000 W/m^2 for incoming sunlight.

SunPower Technical Notification (2009)

SunPower published a technical notification[19] 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.

[19] 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).

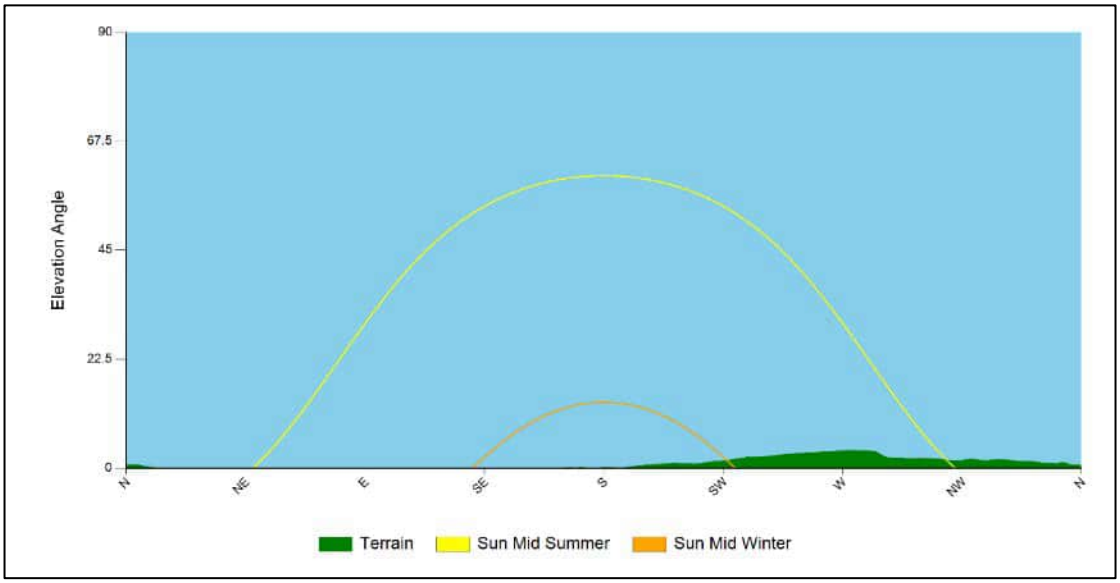
The Sun's position can be accurately calculated for a specific location. The following data being used for the calculation:

- 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 as well as the sunrise and sunset curves throughout the year from lon:-3.042463 lat:53.045415.



Terrain elevation at the horizon

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

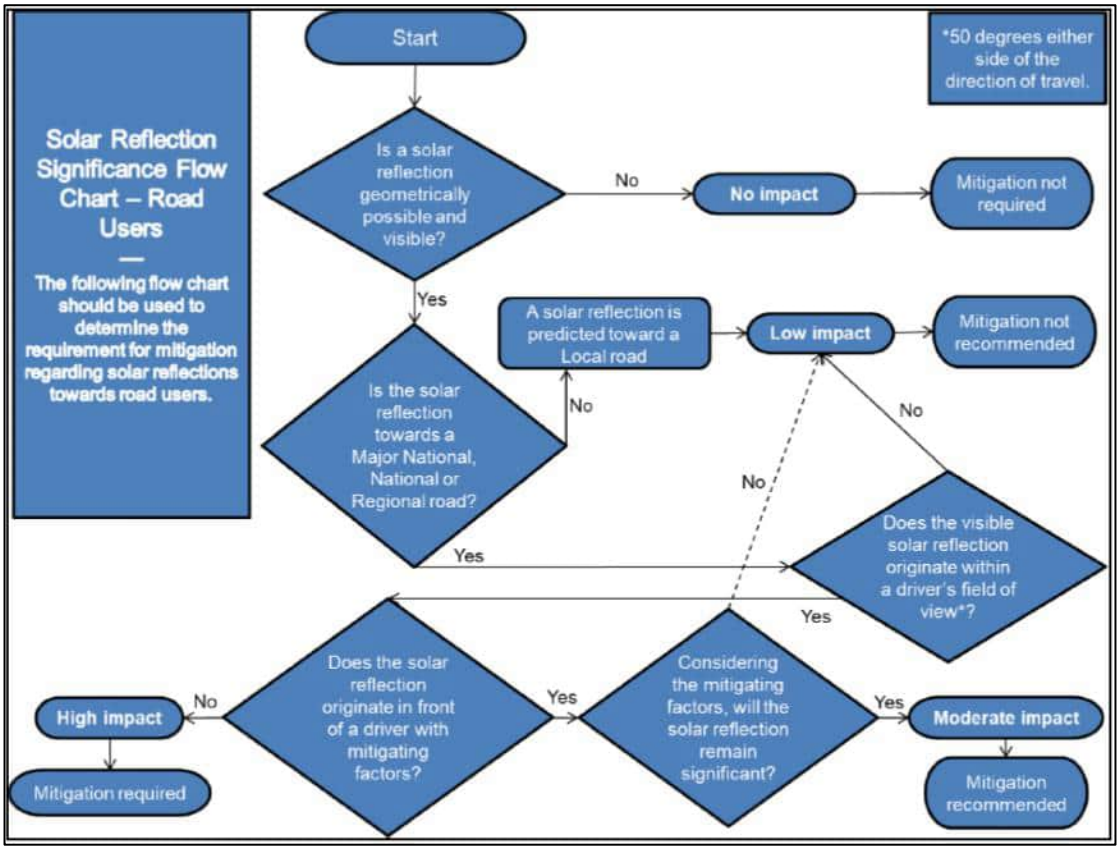
The table below presents the recommended definition of 'impact significance' in glint and glare terms and the requirement for mitigation under each.

Impact Significance	Definition	Mitigation Requirement
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.	No mitigation required.
Moderate	A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case.	Whilst the impact may be acceptable, consultation and/or further analysis should be undertaken to determine the requirement for mitigation.
Major	A solar reflection is geometrically possible and visible under conditions that will produce a significant impact. Mitigation and consultation is recommended.	Mitigation will be required if the proposed solar development is to proceed.

Impact significance definition

Assessment Process for Road Receptors

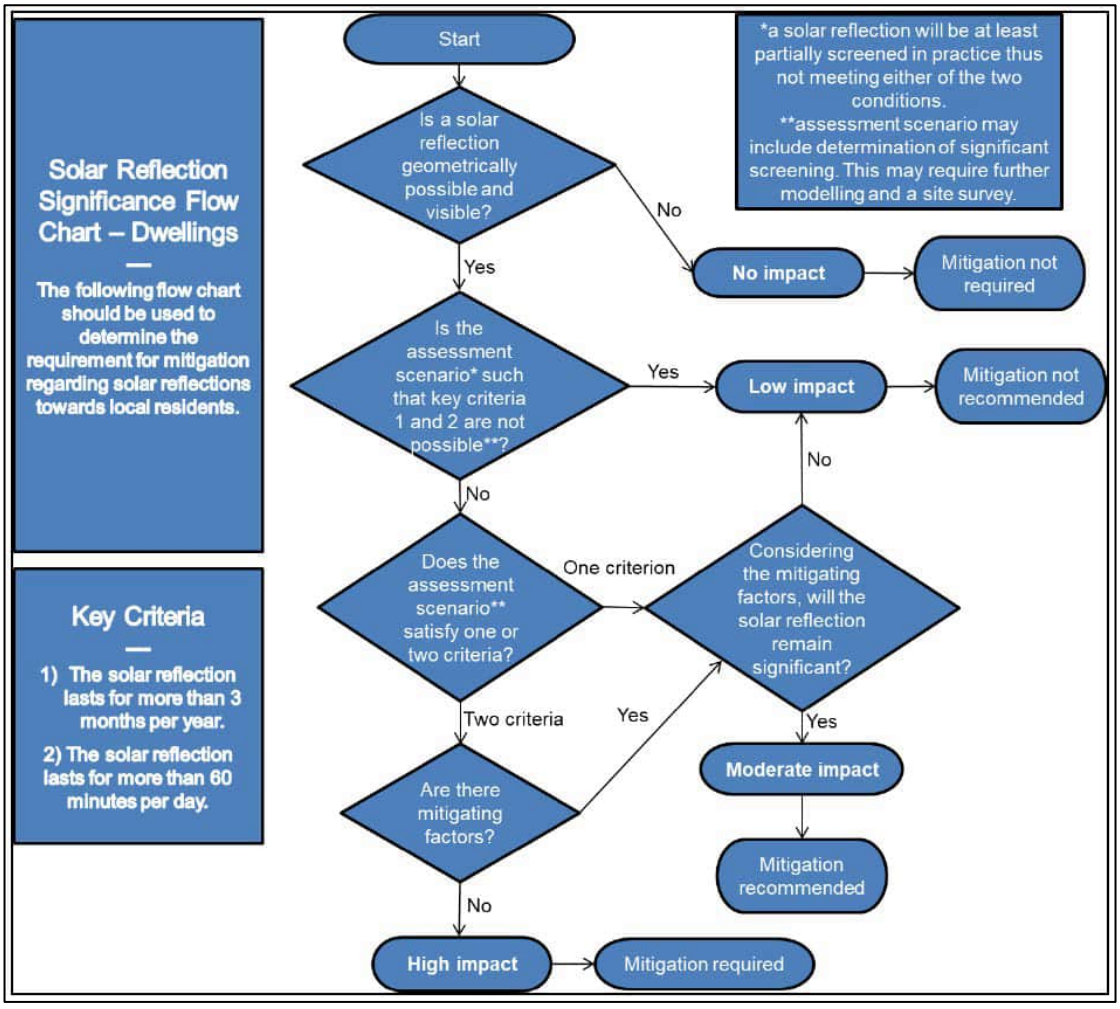
The flow chart presented below has been followed when determining the mitigation requirement for road receptors.



Road receptor mitigation requirement flow chart

Assessment Process for Dwelling Receptors

The flow chart presented below has been followed when determining the mitigation requirement for dwelling receptors.



Dwelling receptor mitigation requirement flow chart

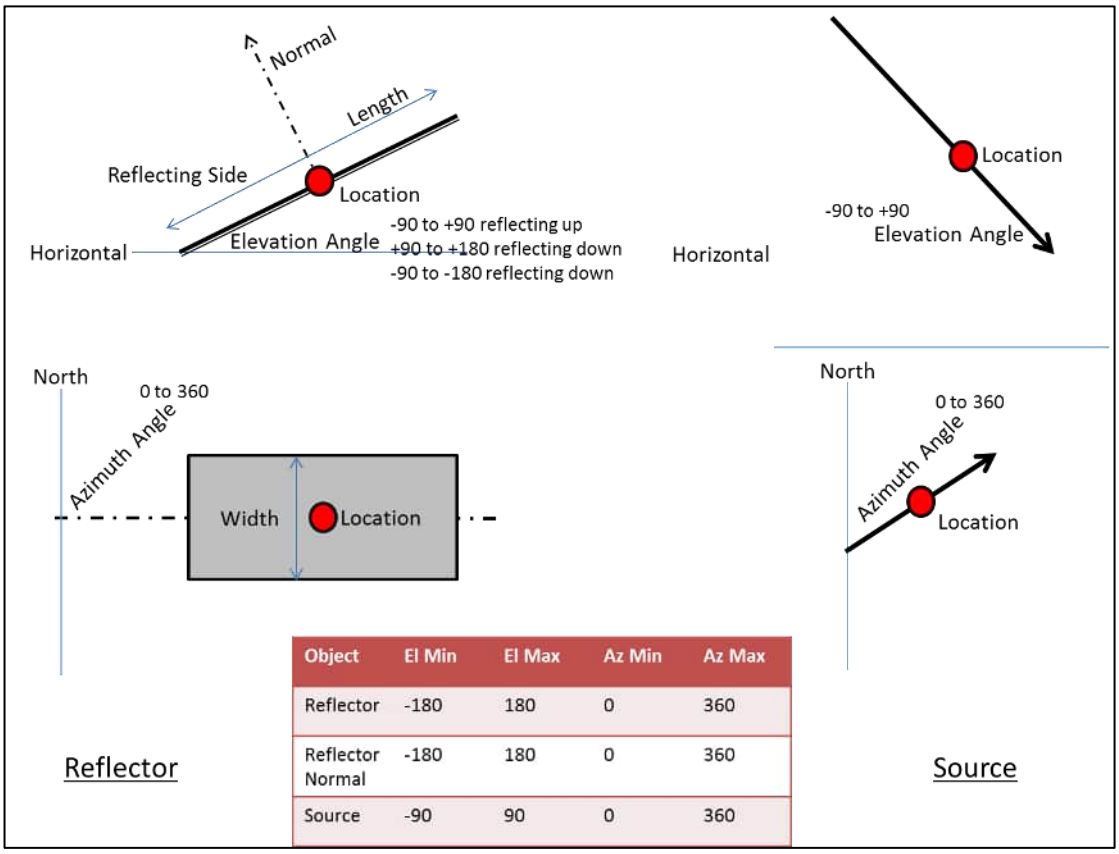
APPENDIX E – REFLECTION CALCULATIONS METHODOLOGY

Pager Power's Reflection Calculations Methodology

The calculations are three dimensional and complex, accounting for:

- The Earth's orbit around the Sun;
- The Earth's rotation;
- The Earth's orientation;
- The reflector's location;
- The reflector's 3D Orientation.

Reflections from a flat reflector are calculated by considering the normal which is an imaginary line that is perpendicular to the reflective surface and originates from it. The diagram below may be used to aid understanding of the reflection calculation process.



Object	El Min	El Max	Az Min	Az Max
Reflector	-180	180	0	360
Reflector Normal	-180	180	0	360
Source	-90	90	0	360

The following process is used to determine the 3D Azimuth and Elevation of a reflection:

- Use the Latitude and Longitude of reflector as the reference for calculation purposes;
- Calculate the Azimuth and Elevation of the normal to the reflector;
- Calculate the 3D angle between the source and the normal;

- If this angle is less than 90 degrees a reflection will occur. If it is greater than 90 degrees no reflection will occur because the source is behind the reflector;
- Calculate the Azimuth and Elevation of the reflection in accordance with the following:
    - The angle between source and normal is equal to angle between normal and reflection;
    - Source, Normal and Reflection are in the same plane.

APPENDIX F – ASSESSMENT LIMITATIONS AND ASSUMPTIONS

Pager Power's Model

The model considers 100% sunlight during daylight hours which is highly conservative.

The model does not account for terrain between the reflecting solar panels and the assessed receptor where a solar reflection is geometrically possible.

The model considers terrain between the reflecting solar panels and the visible horizon (where the sun may be obstructed from view of the panels)[20].

It is assumed that the panel elevation angle assessed represents the elevation angle for all of the panels within each solar panel area defined.

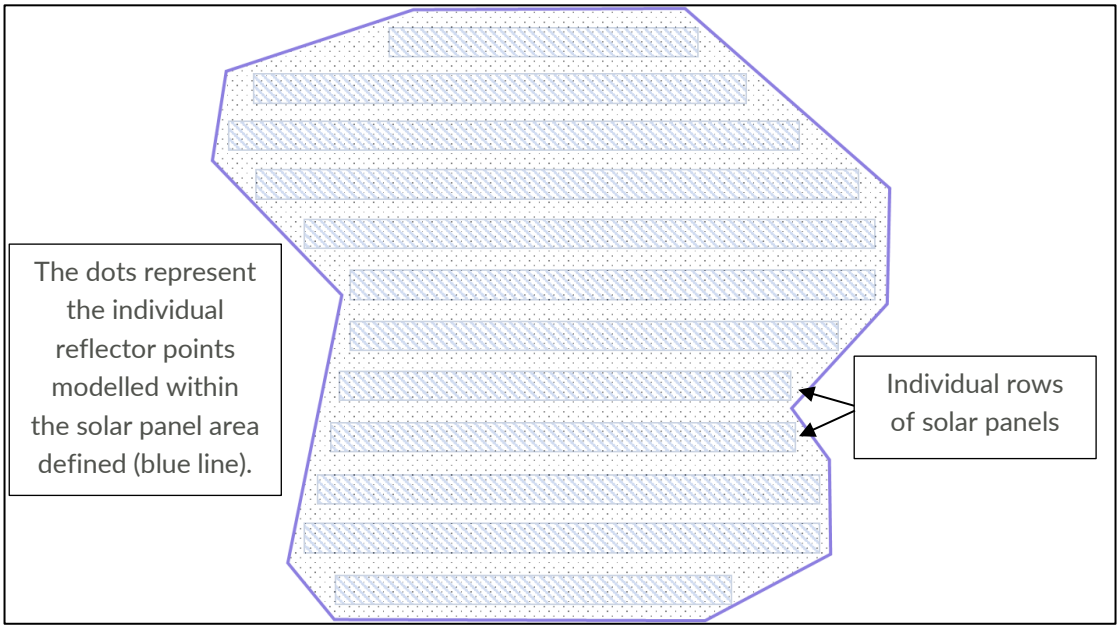
It is assumed that the panel azimuth angle assessed represents the azimuth angle for all of the panels within each solar panel area defined.

Only a reflection from the face of the panel has been considered. The frame or the reverse of the frame of the solar panel has not been considered.

The model assumes that a receptor can view the face of every panel (point, defined in the following paragraph) within the development area whilst in reality this, in the majority of cases, will not occur. Therefore any predicted solar reflection from the face of a solar panel that is not visible to a receptor will not occur in practice.

A finite number of points within each solar panel area defined is chosen based on an assessment resolution so that a comprehensive understanding of the entire development can be formed. This determines whether a solar reflection could ever occur at a chosen receptor. The model does not consider the specific panel rows or the entire face of the solar panel within the development outline, rather a single point is defined every 'x' metres (based on the assessment resolution) with the geometric characteristics of the panel. A panel area is however defined to encapsulate all possible panel locations. See the figure on the following page which illustrates this process.

[20] UK only.



Solar panel area modelling overview

A single reflection point is chosen for the geometric calculations. This suitably determines whether a solar reflection can be experienced at a receptor location and the time of year and duration of the solar reflection. Increased accuracy could be achieved by increasing the number of heights assessed however this would only marginally change the results and is not considered significant.

The available street view imagery, satellite mapping, terrain and any site imagery provided by the developer has been used to assess line of sight from the assessed receptors to the modelled solar panel area, unless stated otherwise. In some cases, this imagery may not be up to date and may not give the full perspective of the installation from the location of the assessed receptor.

Any screening in the form of trees, buildings etc. that may obstruct the Sun from view of the solar panels is not within the modelling unless stated otherwise. The terrain profile at the horizon is considered if stated.

APPENDIX G – RECEPTOR AND REFLECTOR AREA DETAILS

Terrain Height

Terrain Height was calculated from Pager Power's database (established on OS Panorama 50m DTM) based on the coordinates of the point of interest.

Road Receptor Data

The table below presents the coordinates and altitudes for the assessed road receptors.

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
1	53.049736	-3.016813	98.74
2	53.049248	-3.018069	101.50
3	53.04884	-3.019403	100.75
4	53.048513	-3.020797	100.10
5	53.048245	-3.022226	101.95
6	53.04796	-3.023645	104.19
7	53.047579	-3.024999	106.07
8	53.0471	-3.026263	108.50
9	53.046528	-3.027417	110.05
10	53.045871	-3.028436	111.46
11	53.045133	-3.02929	111.50
12	53.044327	-3.029948	110.36
13	53.04347	-3.030398	110.50
14	53.04259	-3.030691	110.50
15	53.041695	-3.030848	110.10
16	53.040795	-3.030893	109.27
17	53.039896	-3.030951	108.29
18	53.038997	-3.031015	108.22

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
19	53.038098	-3.031075	107.50
20	53.037198	-3.031136	107.87
21	53.0363	-3.031215	110.21
22	53.035402	-3.031316	101.08
23	53.034506	-3.031453	100.88
24	53.033619	-3.031707	103.84
25	53.032734	-3.031978	105.77
26	53.031845	-3.032197	107.95
27	53.030948	-3.032297	108.08
28	53.03005	-3.032226	108.03
29	53.029159	-3.032026	106.50
30	53.028287	-3.031656	105.33
31	53.027438	-3.03116	103.49
32	53.02697	-3.030879	102.40
33	53.052249	-3.067853	237.58
34	53.051869	-3.066498	230.38
35	53.051678	-3.065042	222.35
36	53.051589	-3.063552	217.86
37	53.05152	-3.062059	214.58
38	53.051454	-3.060566	211.39
39	53.051385	-3.059073	203.78
40	53.051136	-3.057643	193.59
41	53.050831	-3.056237	186.94
42	53.050569	-3.054808	180.10

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
43	53.050194	-3.053447	170.33
44	53.049902	-3.052034	166.58
45	53.049489	-3.050705	162.50
46	53.049195	-3.049291	152.35
47	53.048982	-3.047837	147.61
48	53.048982	-3.04636	145.91
49	53.049082	-3.044872	143.50
50	53.049273	-3.043422	139.74
51	53.049332	-3.041949	133.31
52	53.04932	-3.040455	129.38
53	53.049253	-3.038983	123.50
54	53.049113	-3.037507	122.64
55	53.048924	-3.03605	122.39
56	53.048821	-3.034563	121.08
57	53.048685	-3.033084	116.60
58	53.048296	-3.031763	113.50
59	53.047587	-3.030852	112.72
60	53.0469	-3.029892	113.50
61	53.046305	-3.02877	112.02
62	53.045762	-3.02758	110.03
63	53.045338	-3.02626	107.50
64	53.045008	-3.024872	104.50
65	53.044733	-3.023447	103.25
66	53.044418	-3.022045	101.95

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
67	53.044079	-3.020659	101.07
68	53.043798	-3.01924	100.33
69	53.043625	-3.017773	96.50
70	53.043578	-3.016278	94.50
71	53.043544	-3.015173	93.50
72	53.053562	-3.034395	121.36
73	53.052891	-3.03341	120.36
74	53.052106	-3.032687	117.34
75	53.051258	-3.032194	113.50
76	53.050378	-3.031891	113.47
77	53.049481	-3.031892	114.41
78	53.048564	-3.032214	114.50
79	53.030905	-3.03183	107.50
80	53.03069	-3.033276	109.50
81	53.030309	-3.03463	110.76
82	53.029921	-3.03598	112.10
83	53.029458	-3.037262	114.02
84	53.028883	-3.038398	115.50
85	53.028345	-3.039536	117.89
86	53.028156	-3.040787	119.50

Road Receptor Data

Dwelling Receptor Data

The table below presents the coordinates for the assessed dwelling receptors.

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
1	53.05299	-3.05248	175.70
2	53.05274	-3.05283	177.12
3	53.05285	-3.05323	179.74
4	53.05267	-3.05604	193.80
5	53.05338	-3.05696	195.72
6	53.05315	-3.05694	196.13
7	53.0528	-3.0569	196.67
8	53.05258	-3.05686	196.11
9	53.05231	-3.0569	195.48
10	53.05212	-3.05741	196.86
11	53.05193	-3.05698	193.78
12	53.05177	-3.05676	192.89
13	53.05168	-3.05673	192.49
14	53.05154	-3.05695	191.83
15	53.05137	-3.05687	191.53
16	53.05116	-3.05696	190.87
17	53.05115	-3.05636	188.09
18	53.05098	-3.05654	188.87
19	53.05091	-3.05613	187.47
20	53.05088	-3.05567	183.71
21	53.05094	-3.05534	184.06
22	53.05065	-3.05723	191.38
23	53.05054	-3.05777	193.70

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
24	53.04889	-3.0483	148.75
25	53.04873	-3.0482	147.37
26	53.04881	-3.04793	147.66
27	53.04936	-3.04392	141.50
28	53.04858	-3.04191	130.89
29	53.04923	-3.04117	131.40
30	53.04911	-3.04065	129.06
31	53.04872	-3.03975	125.80
32	53.04852	-3.04025	127.65
33	53.04837	-3.03979	125.54
34	53.04893	-3.03878	123.80
35	53.04895	-3.03831	123.66
36	53.05221	-3.03765	125.88
37	53.05271	-3.03791	129.10
38	53.05326	-3.03851	130.41
39	53.05336	-3.03786	127.16
40	53.05308	-3.03767	127.76
41	53.05321	-3.03703	125.06
42	53.05343	-3.03061	115.23
43	53.05342	-3.03018	114.50
44	53.05339	-3.02947	114.42
45	53.0533	-3.02931	114.16
46	53.05318	-3.02906	114.50
47	53.05304	-3.02858	114.71

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
48	53.05296	-3.02817	114.30
49	53.05283	-3.02796	114.06
50	53.05274	-3.02778	113.89
51	53.0527	-3.02773	113.90
52	53.05259	-3.02763	113.56
53	53.05256	-3.02725	113.80
54	53.05267	-3.02706	113.80
55	53.05267	-3.02686	114.17
56	53.05276	-3.02674	114.54
57	53.05286	-3.02664	115.11
58	53.05296	-3.0264	115.33
59	53.05279	-3.02614	114.83
60	53.05291	-3.02535	113.36
61	53.05269	-3.0251	112.80
62	53.0526	-3.02496	112.80
63	53.05251	-3.02484	112.80
64	53.05245	-3.02475	112.80
65	53.05237	-3.0246	112.41
66	53.05231	-3.02452	112.29
67	53.05223	-3.02439	111.80
68	53.05193	-3.02348	110.80
69	53.05191	-3.02319	110.80
70	53.0518	-3.02056	106.64
71	53.05158	-3.02039	106.10

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
72	53.05109	-3.01888	103.80
73	53.04902	-3.01707	98.99
74	53.04884	-3.01735	99.00
75	53.04879	-3.01764	99.81
76	53.04871	-3.01789	100.66
77	53.04858	-3.01827	100.52
78	53.04853	-3.01839	100.54
79	53.04839	-3.01856	100.57
80	53.04822	-3.01873	100.69
81	53.04806	-3.01834	99.80
82	53.048	-3.01803	99.80
83	53.04795	-3.0179	99.80
84	53.0479	-3.01777	99.10
85	53.04786	-3.01764	98.65
86	53.0478	-3.01749	97.80
87	53.04779	-3.01732	97.80
88	53.04782	-3.01717	97.80
89	53.04766	-3.01715	97.80
90	53.04754	-3.01719	97.80
91	53.04748	-3.01682	97.55
92	53.04742	-3.01667	97.74
93	53.0474	-3.01655	97.79
94	53.04733	-3.01641	97.58
95	53.04728	-3.01626	97.19

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
96	53.04727	-3.01615	97.07
97	53.04532	-3.063	189.74
98	53.0451	-3.06266	187.95
99	53.04598	-3.05844	184.80
100	53.04578	-3.05799	183.95
101	53.04612	-3.05839	184.80
102	53.04638	-3.05803	184.26
103	53.04818	-3.05689	183.39
104	53.04793	-3.05666	182.91
105	53.04405	-3.05883	182.16
106	53.04247	-3.05127	163.46
107	53.04276	-3.04736	142.12
108	53.04288	-3.04676	137.65
109	53.03774	-3.05764	165.59
110	53.03704	-3.05273	155.80
111	53.03765	-3.04229	121.08
112	53.03111	-3.04693	133.28
113	53.03647	-3.03575	114.96
114	53.03587	-3.03587	110.14
115	53.0357	-3.03556	108.89
116	53.03551	-3.03539	107.70
117	53.03478	-3.03492	110.34
118	53.03469	-3.03461	108.24
119	53.0353	-3.03362	101.18

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
120	53.03362	-3.03289	105.14
121	53.0333	-3.03252	105.88
122	53.02694	-3.03165	103.68
123	53.03239	-3.03093	106.80
124	53.03251	-3.03097	106.61
125	53.0326	-3.03095	106.42
126	53.03272	-3.03099	106.13
127	53.03296	-3.03093	105.60
128	53.03319	-3.03084	104.73
129	53.03328	-3.03086	104.67
130	53.0334	-3.03087	103.99
131	53.0335	-3.03086	103.72
132	53.0336	-3.03089	103.37
133	53.03395	-3.03098	102.44
134	53.03394	-3.03052	102.50
135	53.03373	-3.03068	102.81
136	53.03371	-3.03014	102.68
137	53.03367	-3.02998	102.54
138	53.03365	-3.02981	102.14
139	53.03364	-3.02967	102.15
140	53.03332	-3.02935	103.06
141	53.03332	-3.0291	102.95
142	53.03334	-3.02894	102.80
143	53.03338	-3.02879	102.72

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
144	53.03343	-3.02863	102.54
145	53.03344	-3.02851	102.52
146	53.03384	-3.02822	101.83
147	53.03385	-3.02806	101.88
148	53.03388	-3.0279	101.80
149	53.03392	-3.02778	101.80
150	53.03397	-3.02767	101.80
151	53.03401	-3.02755	101.80
152	53.03403	-3.02744	101.80
153	53.03407	-3.02728	101.80
154	53.03413	-3.02718	101.80
155	53.03415	-3.02703	101.98
156	53.03423	-3.02693	101.69
157	53.03423	-3.02675	101.75
158	53.03419	-3.02663	101.95
159	53.03416	-3.02638	102.28
160	53.03432	-3.02643	100.97
161	53.03435	-3.02623	100.65
162	53.03436	-3.02608	101.17
163	53.03437	-3.02593	101.32
164	53.03437	-3.02578	100.87
165	53.03367	-3.02548	103.80
166	53.03361	-3.02495	103.80
167	53.03376	-3.02479	103.80

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
168	53.03366	-3.02452	103.80
169	53.03469	-3.02452	93.94
170	53.03474	-3.02405	95.13
171	53.03476	-3.02364	96.60
172	53.0348	-3.02347	94.68
173	53.03487	-3.0233	94.27
174	53.03491	-3.02312	94.62
175	53.03495	-3.023	94.20
176	53.03499	-3.02284	93.47
177	53.03503	-3.02265	92.84
178	53.03505	-3.02241	92.19
179	53.03505	-3.02218	92.12
180	53.03503	-3.02152	92.58
181	53.03505	-3.02129	92.55
182	53.03509	-3.02115	92.52
183	53.03511	-3.021	92.31
184	53.03516	-3.02087	91.97
185	53.0352	-3.02074	91.83
186	53.03523	-3.02057	92.03
187	53.03526	-3.02042	92.18
188	53.03529	-3.02023	91.80
189	53.03534	-3.02006	91.80
190	53.03534	-3.01986	91.80
191	53.03532	-3.01964	91.80

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
192	53.03532	-3.01946	91.80
193	53.03528	-3.01929	91.80
194	53.03531	-3.01914	91.80
195	53.03535	-3.01896	91.80
196	53.03542	-3.01884	91.80
197	53.03552	-3.01869	91.80
198	53.03559	-3.01856	91.80
199	53.03564	-3.01839	91.80
200	53.03568	-3.01823	91.80
201	53.0357	-3.01805	91.80
202	53.03573	-3.01793	91.80
203	53.03577	-3.01778	91.80
204	53.03579	-3.0176	91.80
205	53.03804	-3.01892	92.58
206	53.03778	-3.01895	92.10
207	53.03627	-3.02141	91.09
208	53.03545	-3.02176	91.30
209	53.03674	-3.02443	102.27
210	53.03666	-3.02472	102.09
211	53.03609	-3.02523	101.81
212	53.03606	-3.02505	100.78
213	53.03572	-3.02477	91.41
214	53.03568	-3.02529	92.64
215	53.03548	-3.02526	90.69

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
216	53.03538	-3.02555	92.04
217	53.0355	-3.02573	98.09
218	53.0356	-3.02605	100.59
219	53.0358	-3.0261	101.16
220	53.0362	-3.02554	102.02
221	53.03596	-3.02708	102.09
222	53.0359	-3.02848	101.80
223	53.03533	-3.02866	100.57
224	53.03527	-3.02904	100.02
225	53.03501	-3.02903	100.13
226	53.03525	-3.02955	101.06
227	53.03518	-3.03064	100.10
228	53.03971	-3.02643	105.92
229	53.04356	-3.02738	109.22
230	53.04566	-3.01919	99.21
231	53.04546	-3.01943	99.59
232	53.04529	-3.01974	99.17
233	53.04495	-3.0203	99.80
234	53.04453	-3.02073	101.14
235	53.0444	-3.02091	101.44
236	53.04437	-3.02053	100.85
237	53.04433	-3.02026	100.62
238	53.04417	-3.01998	100.80
239	53.04408	-3.01971	100.10

Location	Latitude (°)	Longitude (°)	Assessed Altitude (m) (amsl)
240	53.04403	-3.01951	100.19
241	53.04389	-3.01879	98.65
242	53.04383	-3.01844	97.92
243	53.04377	-3.01812	96.80
244	53.04376	-3.01787	96.80
245	53.04376	-3.01744	95.80
246	53.04376	-3.01683	95.29
247	53.04374	-3.01663	94.80
248	53.04376	-3.01648	94.80
249	53.04376	-3.01634	94.80
250	53.04377	-3.01616	94.67
251	53.04378	-3.01523	93.80

Dwelling Receptor Data

ZTV Viewpoints

The table below presents the coordinates for the assessed ZTV viewpoints.

No.	Latitude (°)	Longitude (°)	Assessed Height (m) (amsl)
VP1	53.046289	-3.038354	121.92
VP2	53.036203	-3.033908	111.99
VP3	53.047012	-3.054691	174.10
VP4	53.037969	-3.053009	147.12
VP5	53.052283	-3.056083	192.50
VP6	53.048532	-3.067722	231.81
VP7	53.02164	-3.006803	94.19
VP8	53.069546	-3.041657	191.73
VP9	53.046107	-3.087512	335.08

No.	Latitude (°)	Longitude (°)	Assessed Height (m) (amsl)
VP10	53.048446	-3.092738	382.33
VP11	53.035036	-3.093124	355.78
VP12	53.031565	-3.034333	111.22
VP13	53.04034	-3.022246	102.60

ZTV Viewpoint Data

Modelled Panel Areas

The boundary coordinates of the modelled panel areas are presented in the tables below.

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
1	53.045247	-3.034630	55	53.044814	-3.048896
2	53.045287	-3.033922	56	53.044817	-3.047819
3	53.045148	-3.033896	57	53.044508	-3.047752
4	53.044697	-3.034503	58	53.043871	-3.047118
5	53.044467	-3.037093	59	53.043338	-3.046430
6	53.044627	-3.037512	60	53.043223	-3.045989
7	53.044335	-3.038669	61	53.042995	-3.046222
8	53.044433	-3.038995	62	53.042463	-3.045944
9	53.043944	-3.040761	63	53.042239	-3.046104
10	53.043298	-3.041577	64	53.042047	-3.045473
11	53.039293	-3.037897	65	53.041275	-3.045049
12	53.039108	-3.038398	66	53.041136	-3.045444
13	53.042617	-3.041558	67	53.040411	-3.044934
14	53.042643	-3.042040	68	53.040396	-3.046290
15	53.043907	-3.043148	69	53.040259	-3.046741
16	53.043644	-3.044063	70	53.039110	-3.045741
17	53.044114	-3.044527	71	53.039102	-3.045065

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
18	53.045091	-3.043550	72	53.039515	-3.044420
19	53.044525	-3.043090	73	53.039554	-3.044203
20	53.044576	-3.042231	74	53.039180	-3.043383
21	53.044744	-3.041562	75	53.038969	-3.043061
22	53.044937	-3.041190	76	53.038625	-3.040599
23	53.045070	-3.040642	77	53.038628	-3.037716
24	53.045197	-3.040228	78	53.037751	-3.036917
25	53.045406	-3.040271	79	53.037419	-3.037104
26	53.045615	-3.039891	80	53.037407	-3.034780
27	53.045713	-3.039443	81	53.036877	-3.034623
28	53.045678	-3.039155	82	53.036875	-3.033815
29	53.045616	-3.038715	83	53.036126	-3.033761
30	53.045774	-3.038520	84	53.035983	-3.032396
31	53.046049	-3.038715	85	53.035929	-3.031845
32	53.046335	-3.038732	86	53.035981	-3.031639
33	53.046635	-3.038943	87	53.036384	-3.031481
34	53.046595	-3.042028	88	53.037149	-3.031446
35	53.045732	-3.043185	89	53.037168	-3.031877
36	53.045216	-3.043663	90	53.037931	-3.031929
37	53.044656	-3.044631	91	53.037931	-3.031422
38	53.044648	-3.045130	92	53.042485	-3.031018
39	53.045253	-3.045211	93	53.042924	-3.032598
40	53.045498	-3.045586	94	53.042987	-3.033155
41	53.045612	-3.046070	95	53.043292	-3.033170

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
42	53.045969	-3.046471	96	53.043420	-3.032270
43	53.045926	-3.047848	97	53.043817	-3.031962
44	53.046050	-3.048109	98	53.043797	-3.030597
45	53.046443	-3.048128	99	53.045246	-3.029846
46	53.046910	-3.048788	100	53.045492	-3.029940
47	53.048041	-3.048849	101	53.045486	-3.030418
48	53.048238	-3.049355	102	53.045677	-3.030486
49	53.047934	-3.050753	103	53.046383	-3.031248
50	53.046868	-3.050752	104	53.048168	-3.032382
51	53.044594	-3.050646	105	53.048569	-3.034429
52	53.044342	-3.050053	106	53.048569	-3.034429
53	53.043072	-3.048165	107	53.045247	-3.034630
54	53.043044	-3.047825			

Modelled Panel Area A

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
1	53.053508	-3.045013	22	53.051774	-3.052447
2	53.053499	-3.045859	23	53.051000	-3.052604
3	53.053213	-3.045864	24	53.050298	-3.053292
4	53.052607	-3.045667	25	53.050115	-3.052301
5	53.052147	-3.045745	26	53.049745	-3.051140
6	53.051927	-3.046265	27	53.049931	-3.050935
7	53.051656	-3.046419	28	53.049978	-3.050479
8	53.051652	-3.047089	29	53.049850	-3.049686
9	53.050863	-3.047496	30	53.049627	-3.048959

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
10	53.050629	-3.047720	31	53.049513	-3.047820
11	53.050647	-3.048025	32	53.050076	-3.046026
12	53.051063	-3.048004	33	53.049909	-3.045949
13	53.051275	-3.047845	34	53.049920	-3.043801
14	53.051715	-3.047763	35	53.050351	-3.043745
15	53.052046	-3.047926	36	53.050839	-3.043395
16	53.052518	-3.049539	37	53.051888	-3.043375
17	53.052518	-3.050030	38	53.051898	-3.044034
18	53.052279	-3.050078	39	53.052410	-3.044436
19	53.052042	-3.050246	40	53.052987	-3.045075
20	53.052035	-3.050784	41	53.053508	-3.045013
21	53.051792	-3.051301			

Modelled Panel Area B

APPENDIX H – MODELLING RESULTS

Overview

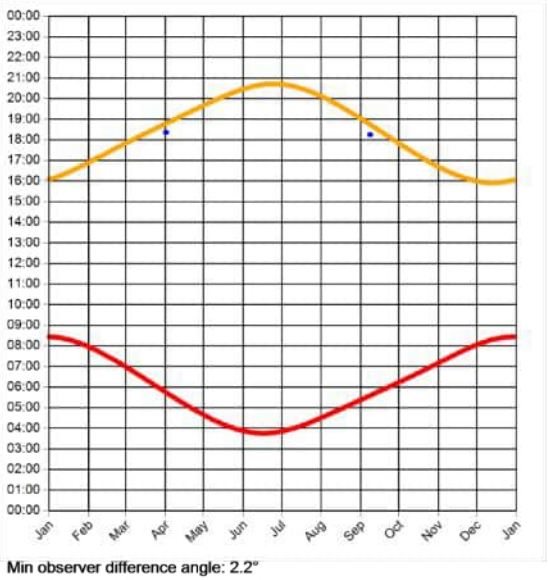
The charts for the receptors where a solar reflection is geometrically possible are shown in the following sections. Each chart shows:

- The receptor (observer) location – top right image. This also shows the azimuth range of the Sun itself at times when reflections are possible. If sunlight is experienced from the same direction as the reflecting panels, the overall impact of the reflection is reduced as discussed within the body of the report;
- The reflecting panels – bottom right image. The reflecting area is shown in yellow. If the yellow panels are not visible from the observer location, no issues will occur in practice. Additional obstructions which may obscure the panels from view are considered separately within the analysis;
- The reflection date/time graph – left hand side of the page. The blue line indicates the dates and times at which geometric reflections are possible. This relates to reflections from the yellow areas;
- The sunrise and sunset curves throughout the year (red and yellow lines).

Roads

Observer 6 Results

Reflection Date/Time (GMT) Graph



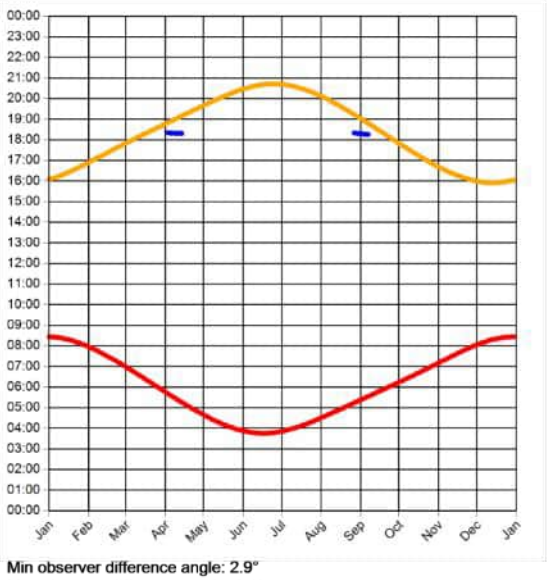
Min observer difference angle: 2.2°
Max observer difference angle: 2.4°

Observer Location — Sun azimuth range is 274.2° - 274.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 7 Results

Reflection Date/Time (GMT) Graph



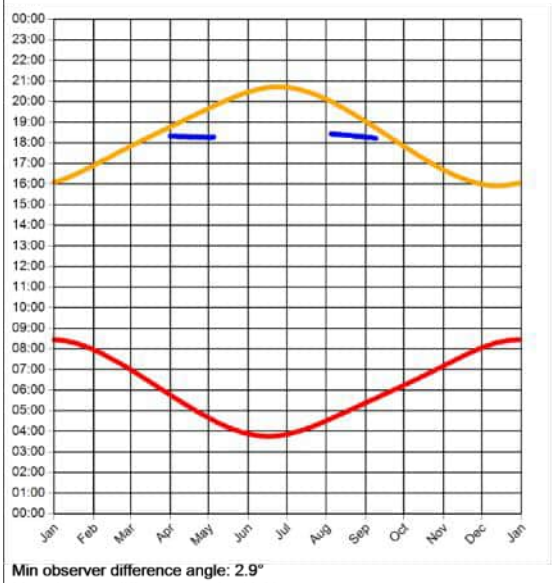
Min observer difference angle: 2.9°
Max observer difference angle: 6.1°

Observer Location — Sun azimuth range is 274.6° - 277.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 8 Results

Reflection Date/Time (GMT) Graph



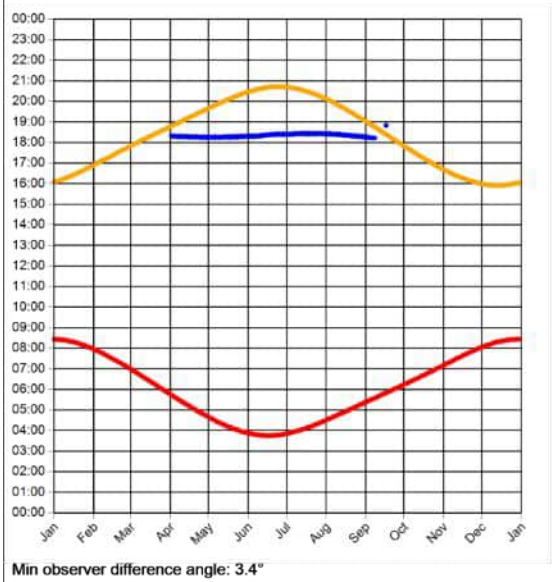
Min observer difference angle: 2.9°
Max observer difference angle: 12.2°

Observer Location — Sun azimuth range is 273.8° - 281.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 9 Results

Reflection Date/Time (GMT) Graph



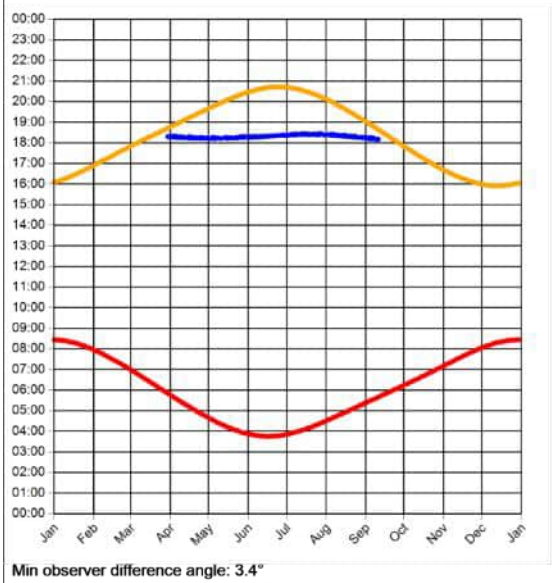
Min observer difference angle: 3.4°
Max observer difference angle: 17.9°

Observer Location — Sun azimuth range is 274° - 286.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 10 Results

Reflection Date/Time (GMT) Graph



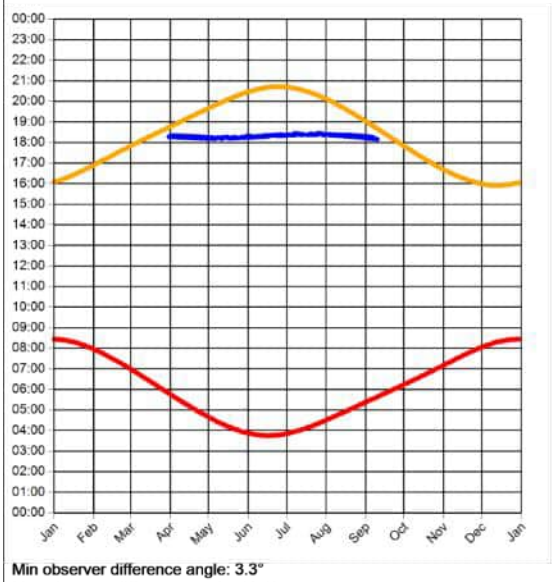
Min observer difference angle: 3.4°
Max observer difference angle: 18.7°

Observer Location — Sun azimuth range is 272.9° - 285.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 11 Results

Reflection Date/Time (GMT) Graph



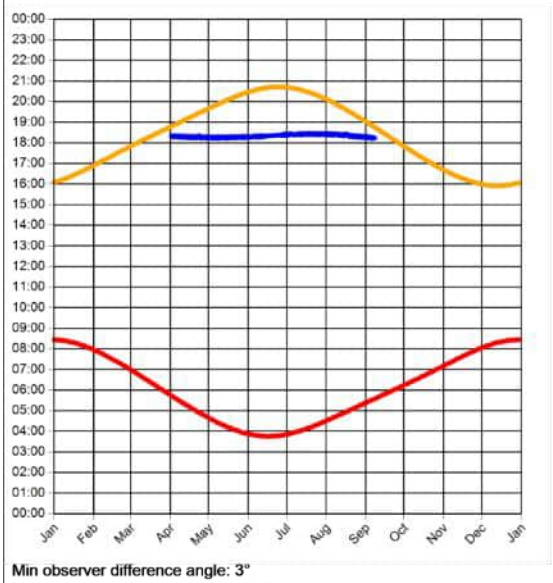
Min observer difference angle: 3.3°
Max observer difference angle: 19.1°

Observer Location — Sun azimuth range is 272.9° - 286.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 12 Results

Reflection Date/Time (GMT) Graph



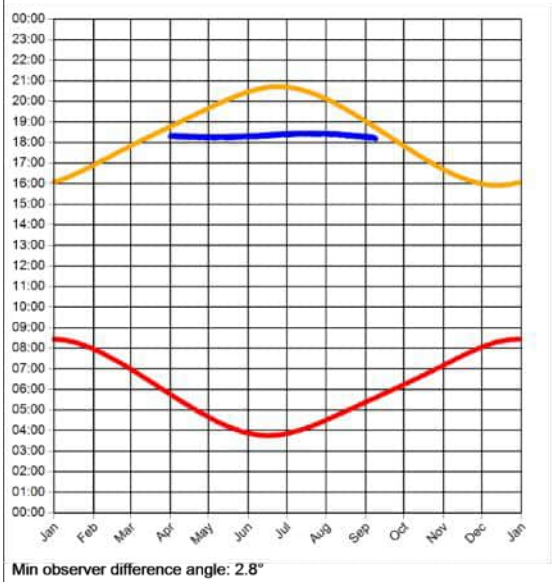
Min observer difference angle: 3°
Max observer difference angle: 18.7°

Observer Location — Sun azimuth range is 274° - 286.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 13 Results

Reflection Date/Time (GMT) Graph



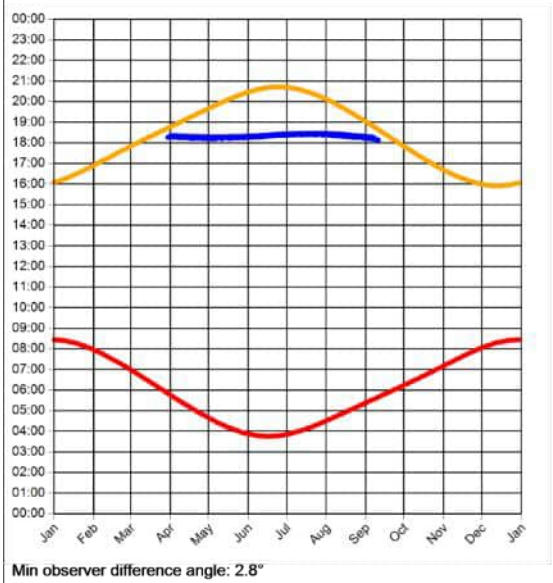
Min observer difference angle: 2.8°
Max observer difference angle: 18.8°

Observer Location — Sun azimuth range is 273.4° - 286.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 14 Results

Reflection Date/Time (GMT) Graph



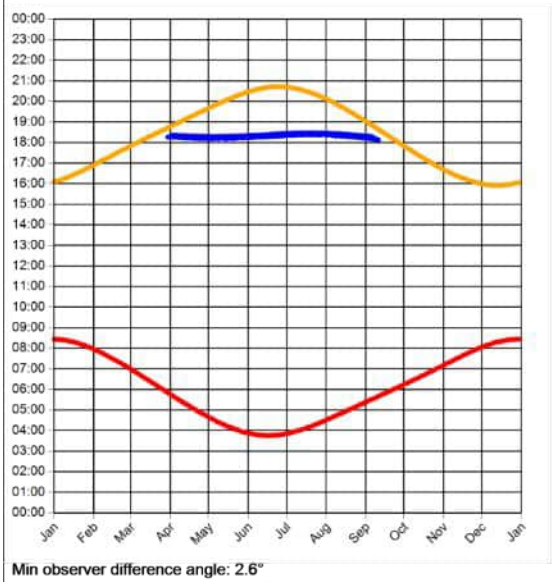
Min observer difference angle: 2.8°
Max observer difference angle: 18.8°

Observer Location — Sun azimuth range is 272.5° - 286.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 15 Results

Reflection Date/Time (GMT) Graph



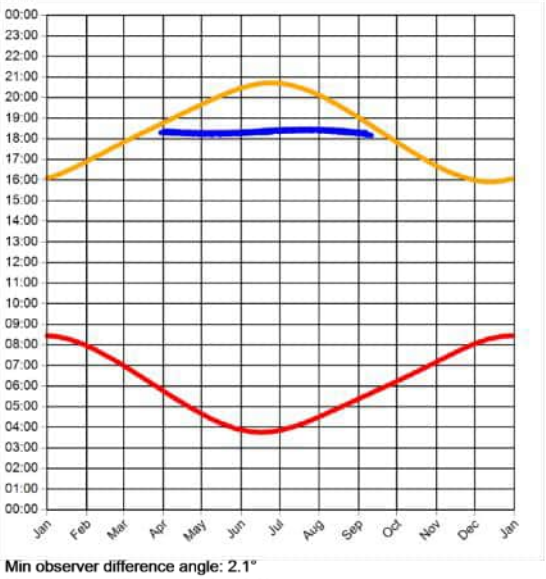
Min observer difference angle: 2.6°
Max observer difference angle: 19.7°

Observer Location — Sun azimuth range is 272.5° - 286.6° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 16 Results

Reflection Date/Time (GMT) Graph



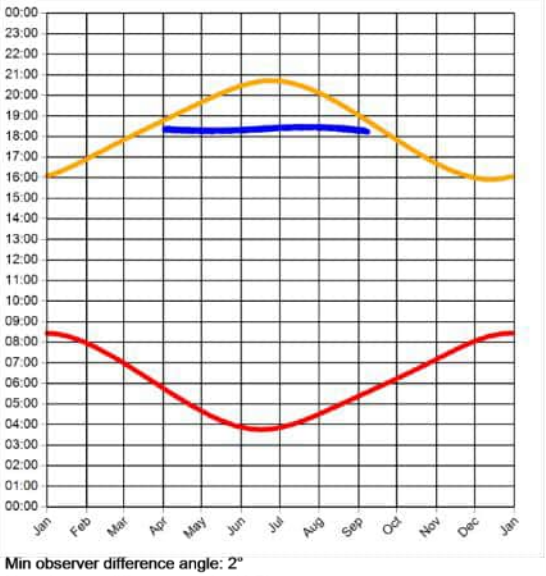
Min observer difference angle: 2.1°
Max observer difference angle: 19.6°

Observer Location — Sun azimuth range is 272.9° - 286.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 17 Results

Reflection Date/Time (GMT) Graph



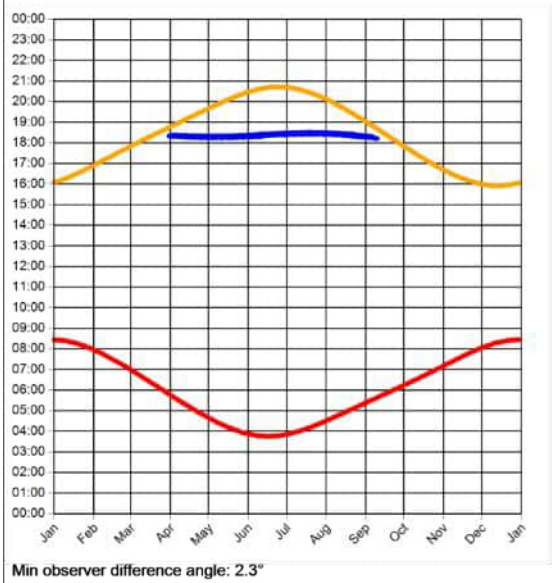
Min observer difference angle: 2°
Max observer difference angle: 18.7°

Observer Location — Sun azimuth range is 273.8° - 286.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 18 Results

Reflection Date/Time (GMT) Graph



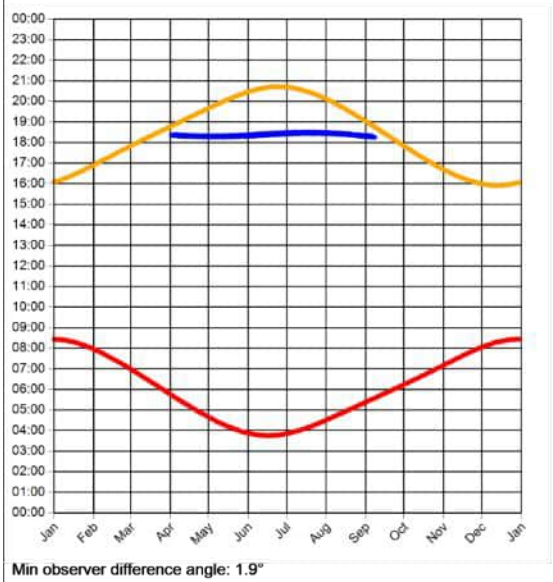
Min observer difference angle: 2.3°
Max observer difference angle: 18°

Observer Location — Sun azimuth range is 273.6° - 287° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 19 Results

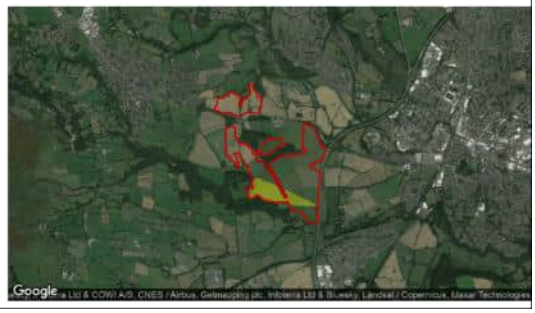
Reflection Date/Time (GMT) Graph



Min observer difference angle: 1.9°
Max observer difference angle: 17.7°

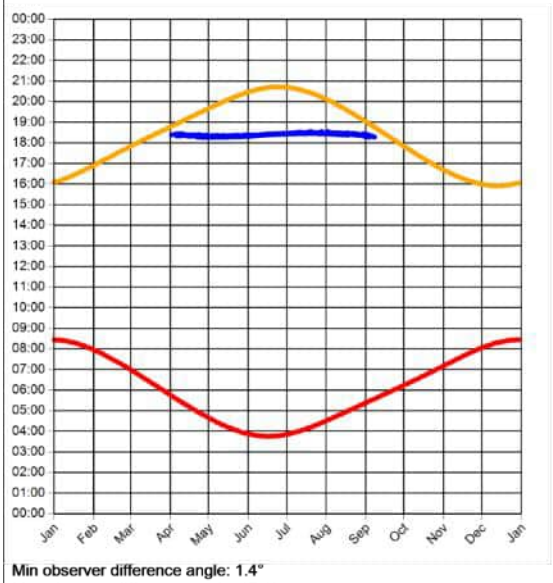
Observer Location — Sun azimuth range is 274.4° - 287.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 20 Results

Reflection Date/Time (GMT) Graph



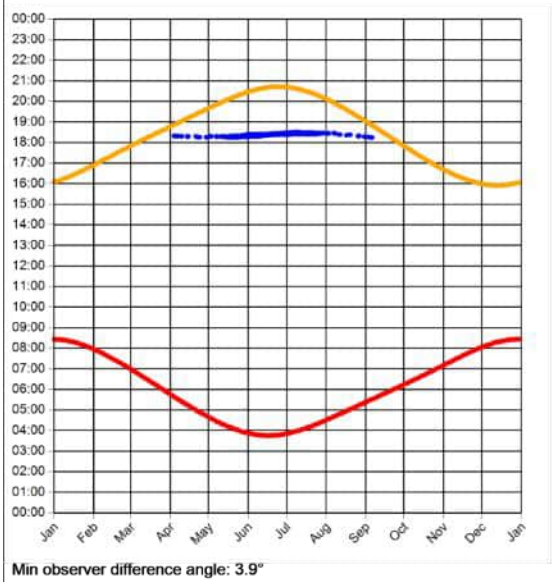
Min observer difference angle: 1.4°
Max observer difference angle: 17.4°

Observer Location — Sun azimuth range is 274.7° - 286.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 21 Results

Reflection Date/Time (GMT) Graph



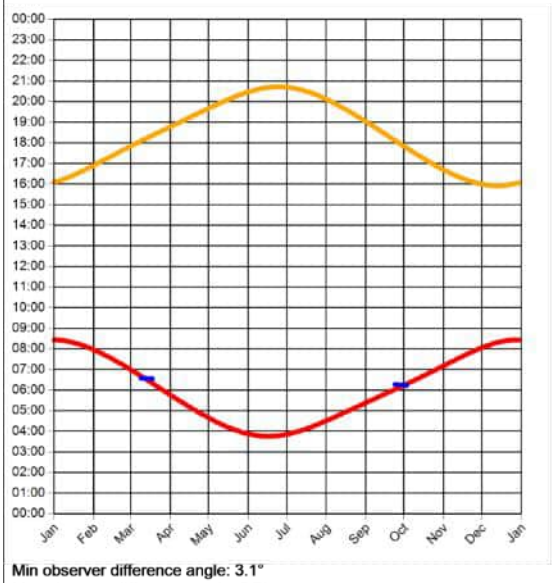
Min observer difference angle: 3.9°
Max observer difference angle: 18.1°

Observer Location — Sun azimuth range is 274.6° - 286.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 34 Results

Reflection Date/Time (GMT) Graph



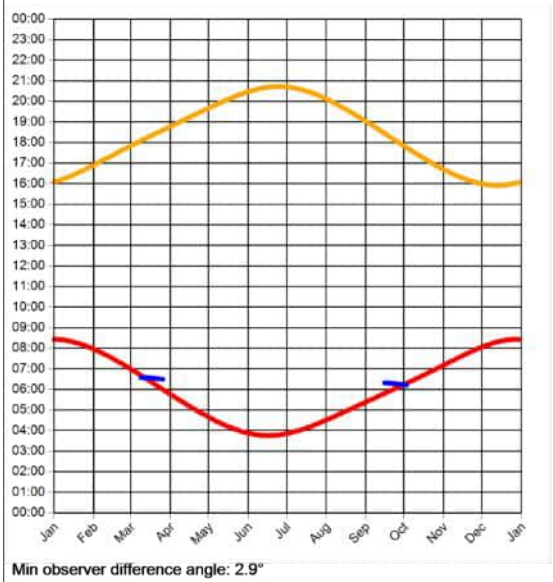
Min observer difference angle: 3.1°
Max observer difference angle: 5.7°

Observer Location — Sun azimuth range is 92.9° - 95.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 35 Results

Reflection Date/Time (GMT) Graph



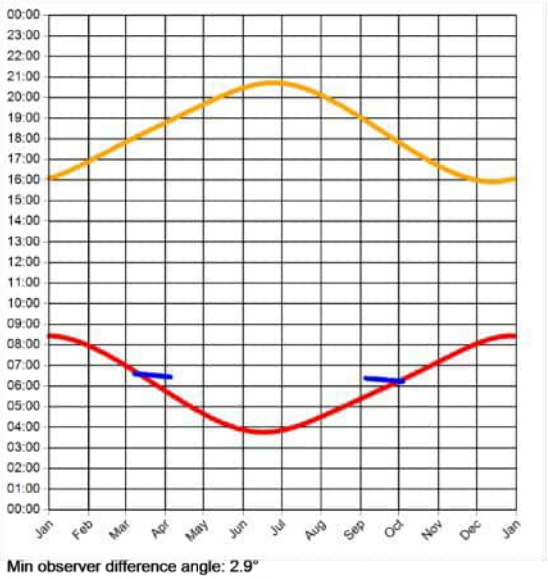
Min observer difference angle: 2.9°
Max observer difference angle: 8.1°

Observer Location — Sun azimuth range is 90.9° - 95° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 36 Results

Reflection Date/Time (GMT) Graph



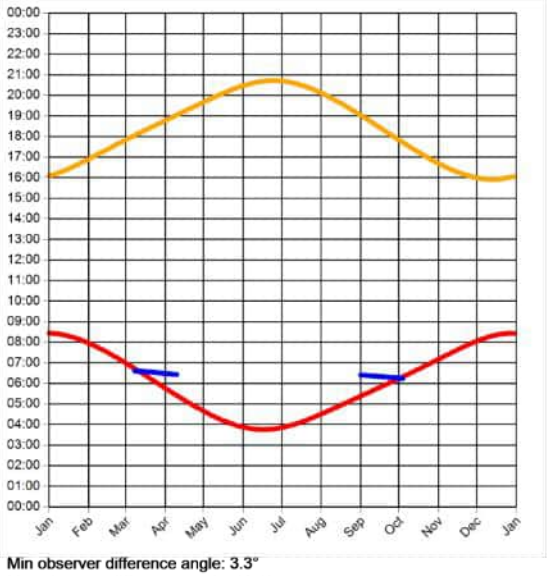
Min observer difference angle: 2.9°
Max observer difference angle: 11.8°

Observer Location — Sun azimuth range is 88.5° - 95.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 37 Results

Reflection Date/Time (GMT) Graph



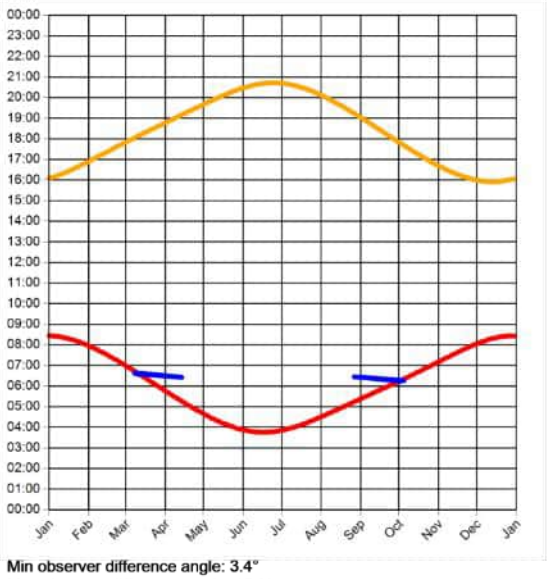
Min observer difference angle: 3.3°
Max observer difference angle: 13.4°

Observer Location — Sun azimuth range is 87.6° - 95.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 38 Results

Reflection Date/Time (GMT) Graph



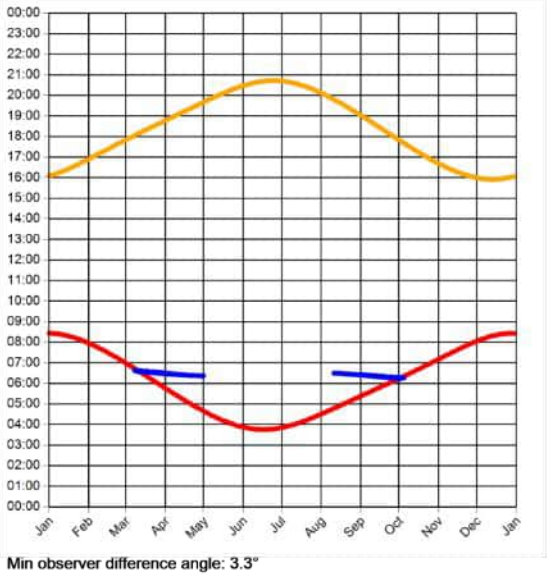
Min observer difference angle: 3.4°
Max observer difference angle: 15.3°

Observer Location — Sun azimuth range is 86.7° - 96.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 39 Results

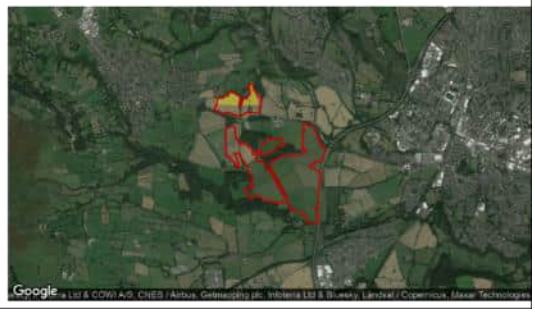
Reflection Date/Time (GMT) Graph



Min observer difference angle: 3.3°
Max observer difference angle: 20°

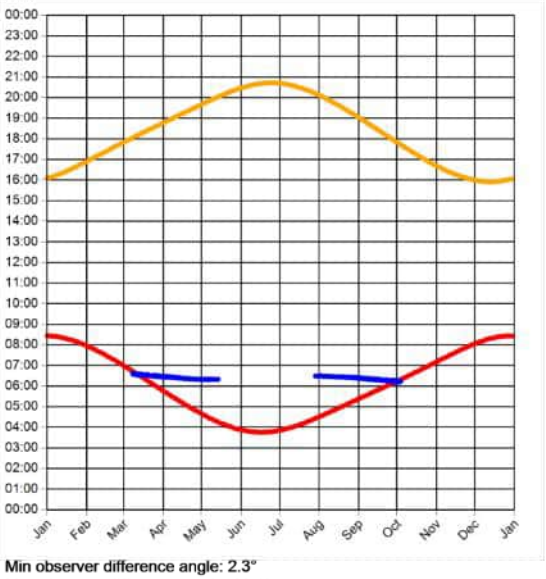
Observer Location — Sun azimuth range is 83.2° - 96° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 40 Results

Reflection Date/Time (GMT) Graph



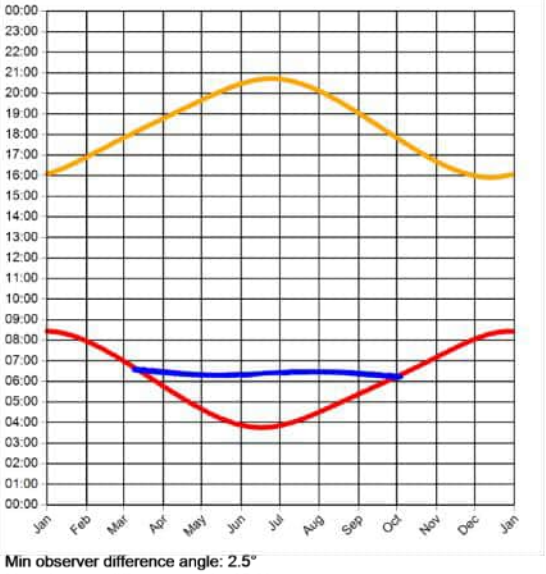
Min observer difference angle: 2.3°
Max observer difference angle: 22.4°

Observer Location — Sun azimuth range is 80.6° - 95.6° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 41 Results

Reflection Date/Time (GMT) Graph



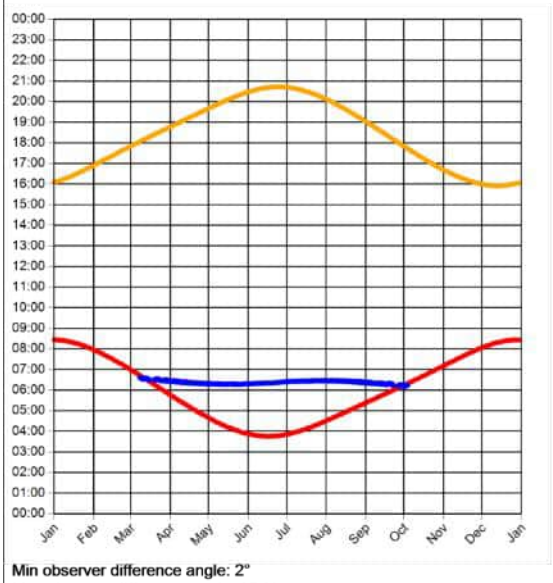
Min observer difference angle: 2.5°
Max observer difference angle: 25.9°

Observer Location — Sun azimuth range is 77.3° - 95.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 42 Results

Reflection Date/Time (GMT) Graph



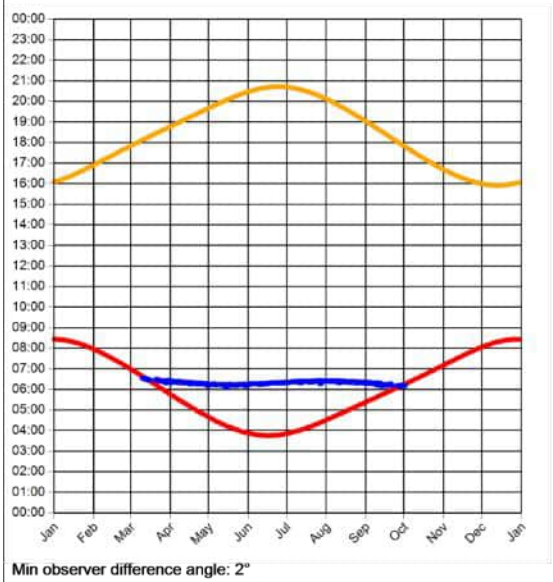
Min observer difference angle: 2°
Max observer difference angle: 25.2°

Observer Location — Sun azimuth range is 76.7° - 95.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 43 Results

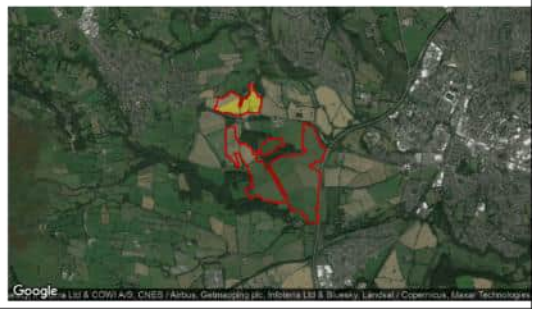
Reflection Date/Time (GMT) Graph



Min observer difference angle: 2°
Max observer difference angle: 24°

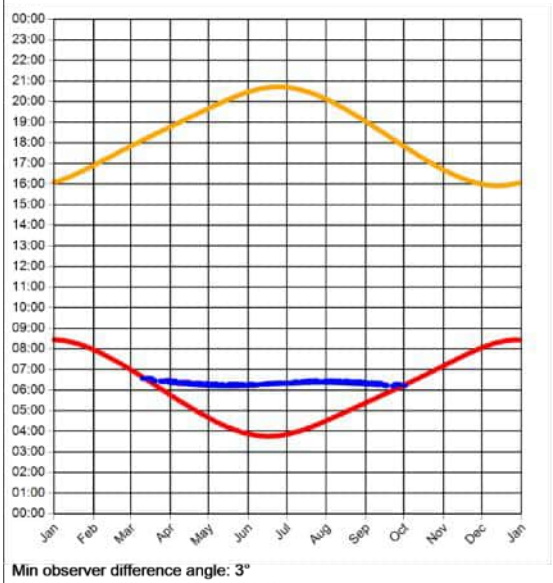
Observer Location — Sun azimuth range is 76° - 94.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 44 Results

Reflection Date/Time (GMT) Graph



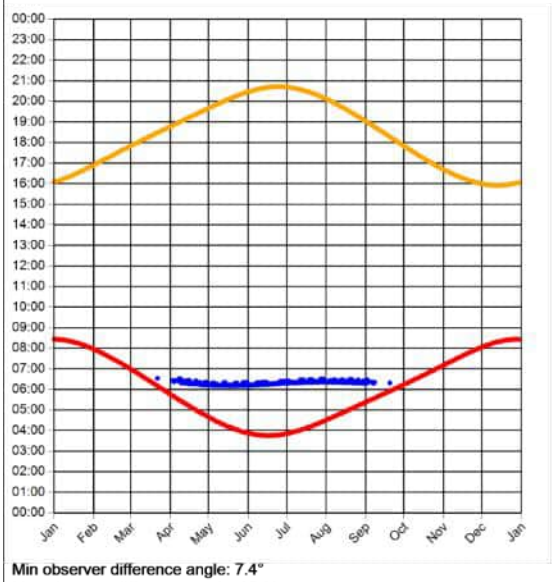
Min observer difference angle: 3°
Max observer difference angle: 24.4°

Observer Location — Sun azimuth range is 76.1° - 94.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 45 Results

Reflection Date/Time (GMT) Graph



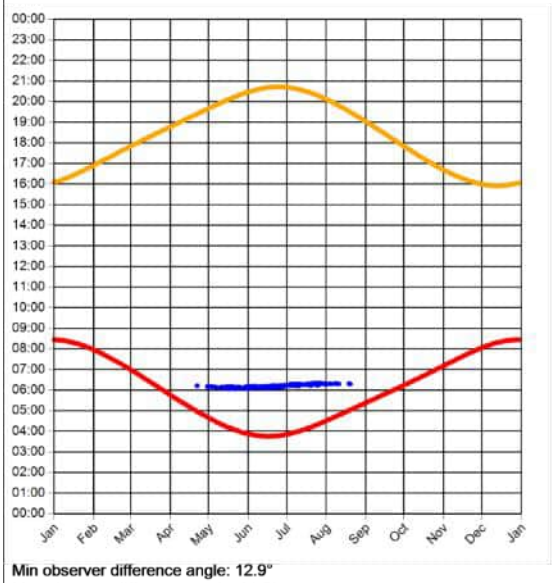
Min observer difference angle: 7.4°
Max observer difference angle: 25.2°

Observer Location — Sun azimuth range is 75.7° - 92.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 46 Results

Reflection Date/Time (GMT) Graph



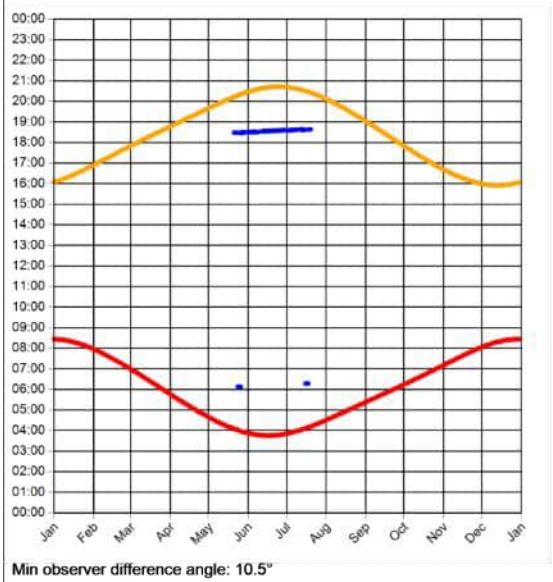
Min observer difference angle: 12.9°
Max observer difference angle: 21.5°

Observer Location — Sun azimuth range is 74.2° - 83° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 47 Results

Reflection Date/Time (GMT) Graph



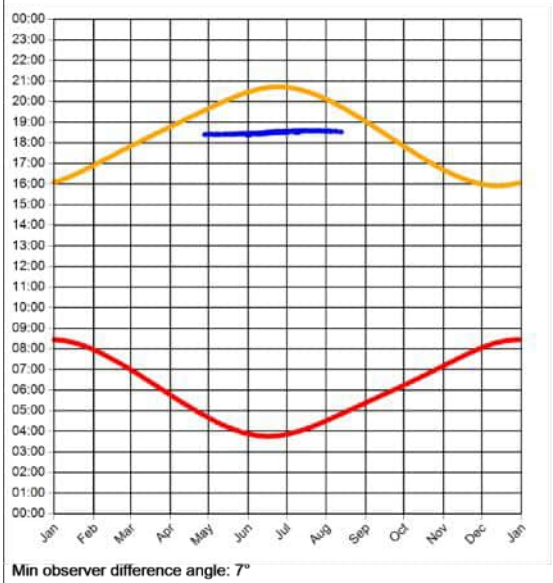
Min observer difference angle: 10.5°
Max observer difference angle: 19.4°

Observer Location — Sun azimuth ranges (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

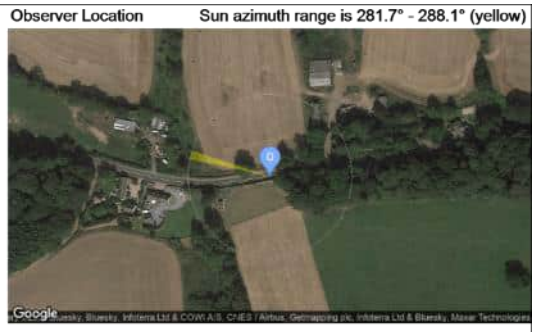
Observer 48 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 7°
Max observer difference angle: 15.3°

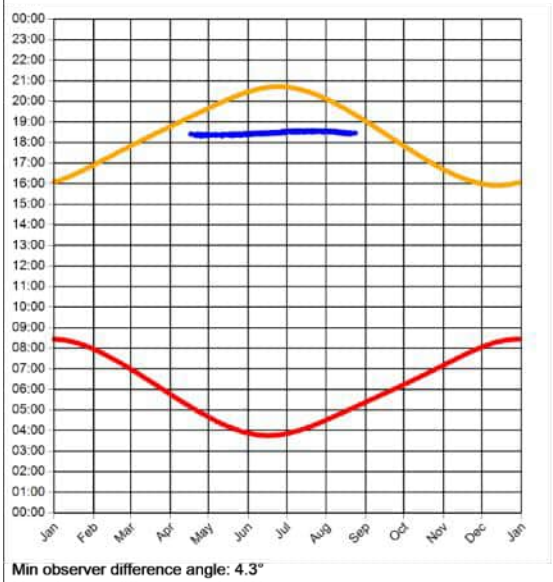
Observer Location — Sun azimuth range is 281.7° - 288.1° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 49 Results

Reflection Date/Time (GMT) Graph



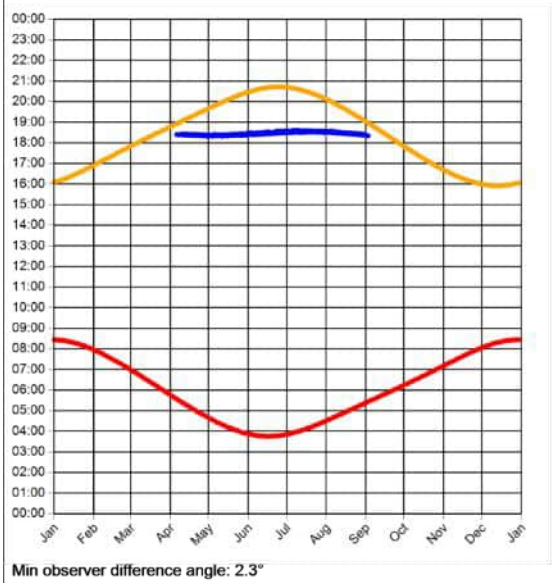
Min observer difference angle: 4.3°
Max observer difference angle: 16°

Observer Location — Sun azimuth range is 279.2° - 287.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 50 Results

Reflection Date/Time (GMT) Graph



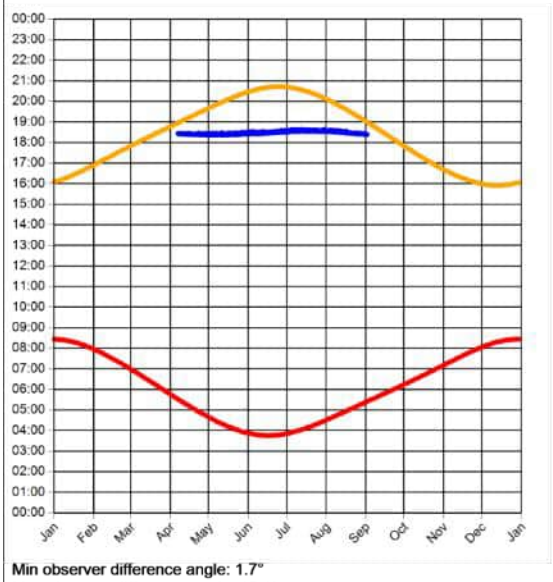
Min observer difference angle: 2.3°
Max observer difference angle: 15.8°

Observer Location — Sun azimuth range is 276.1° - 288.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 51 Results

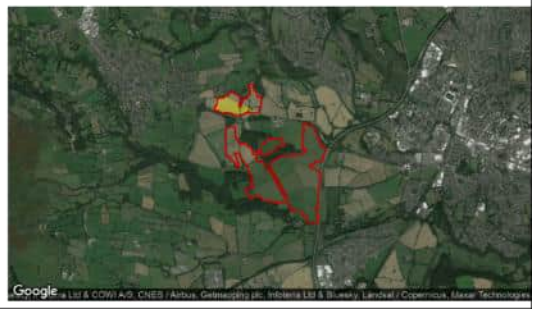
Reflection Date/Time (GMT) Graph



Min observer difference angle: 1.7°
Max observer difference angle: 15.4°

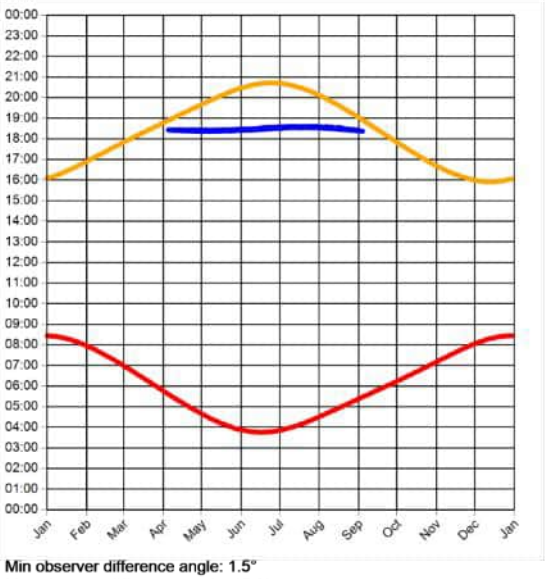
Observer Location — Sun azimuth range is 276.8° - 288.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 52 Results

Reflection Date/Time (GMT) Graph



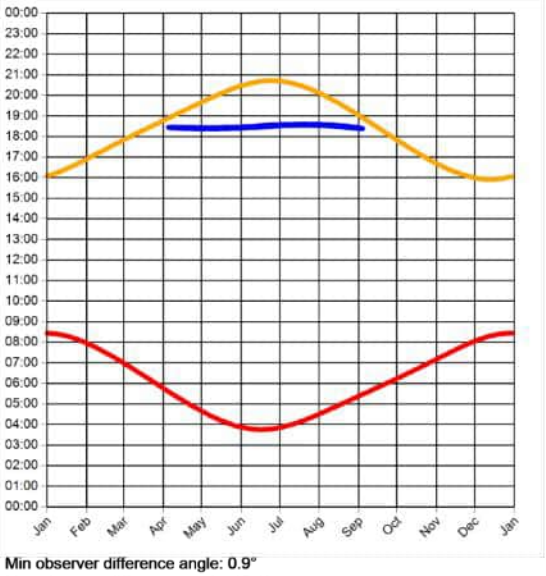
Min observer difference angle: 1.5°
Max observer difference angle: 15.6°

Observer Location — Sun azimuth range is 276.2° - 288.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 53 Results

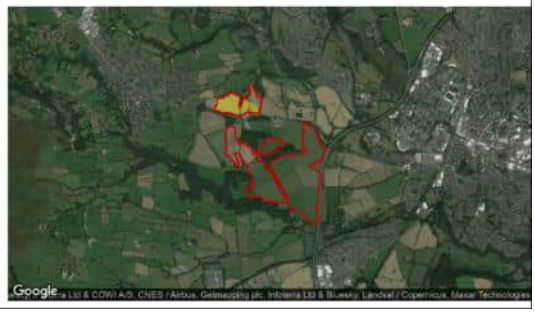
Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.9°
Max observer difference angle: 15.4°

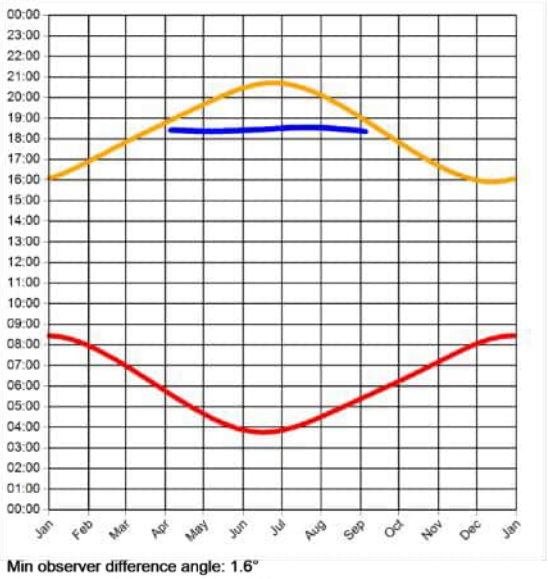
Observer Location — Sun azimuth range is 276.4° - 288.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 54 Results

Reflection Date/Time (GMT) Graph



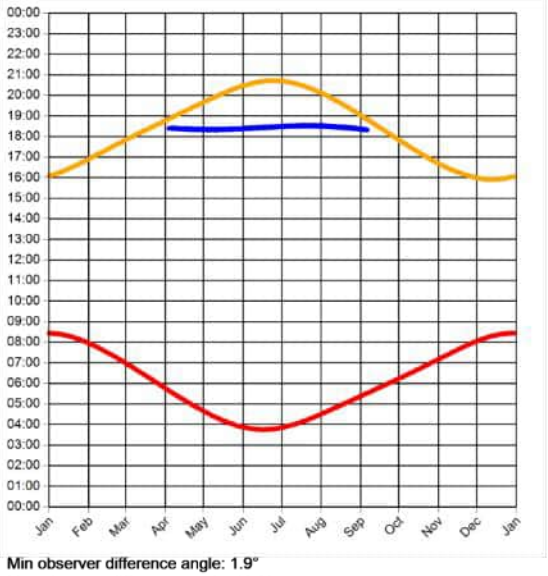
Min observer difference angle: 1.6°
Max observer difference angle: 15.8°

Observer Location — Sun azimuth range is 276° - 287.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 55 Results

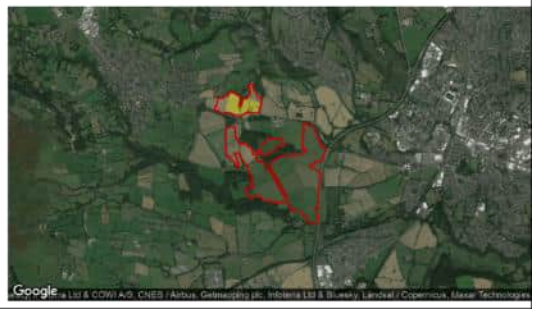
Reflection Date/Time (GMT) Graph



Min observer difference angle: 1.9°
Max observer difference angle: 16.2°

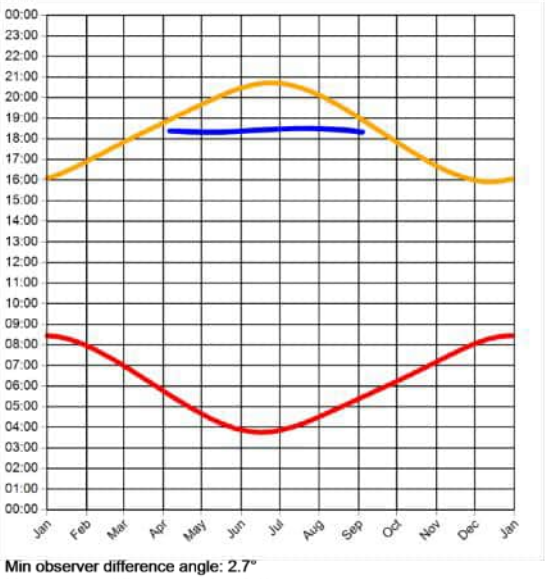
Observer Location — Sun azimuth range is 275.5° - 287.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



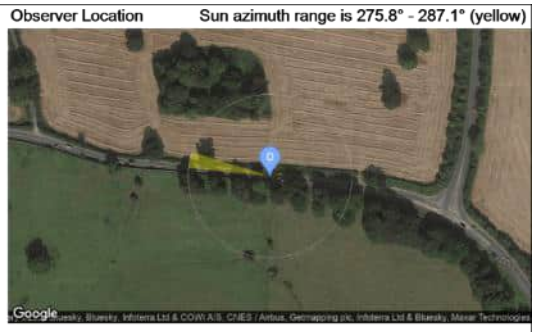
Observer 56 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 2.7°
Max observer difference angle: 16.4°

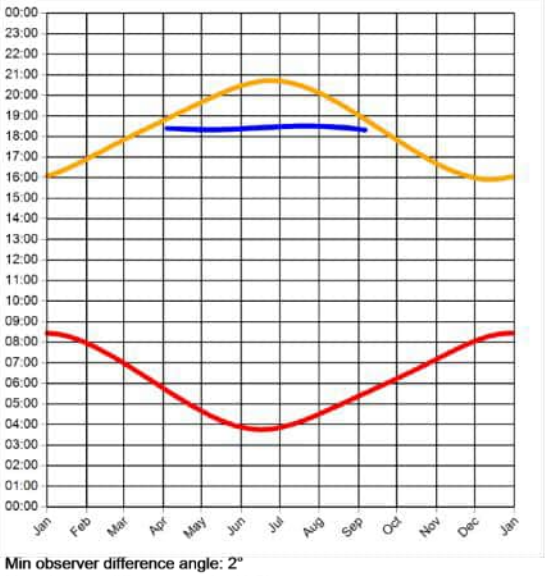
Observer Location — Sun azimuth range is 275.8° - 287.1° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 57 Results

Reflection Date/Time (GMT) Graph



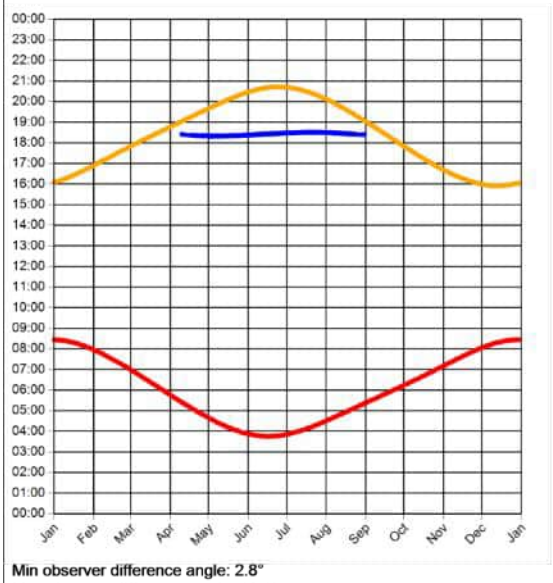
Min observer difference angle: 2°
Max observer difference angle: 16.5°

Observer Location — Sun azimuth range is 275.5° - 287.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 58 Results

Reflection Date/Time (GMT) Graph



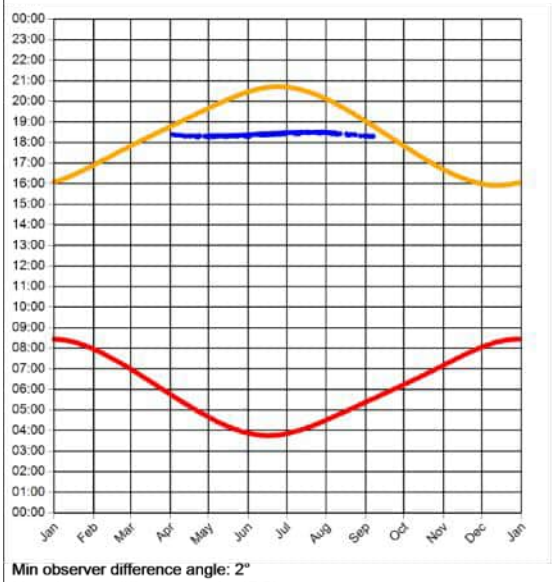
Min observer difference angle: 2.8°
Max observer difference angle: 16.4°

Observer Location — Sun azimuth range is 277.4° - 287.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 59 Results

Reflection Date/Time (GMT) Graph



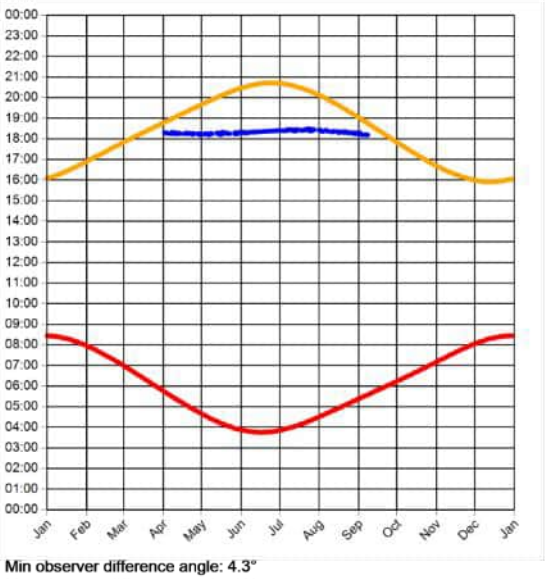
Min observer difference angle: 2°
Max observer difference angle: 17.5°

Observer Location — Sun azimuth range is 275.1° - 287° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 60 Results

Reflection Date/Time (GMT) Graph



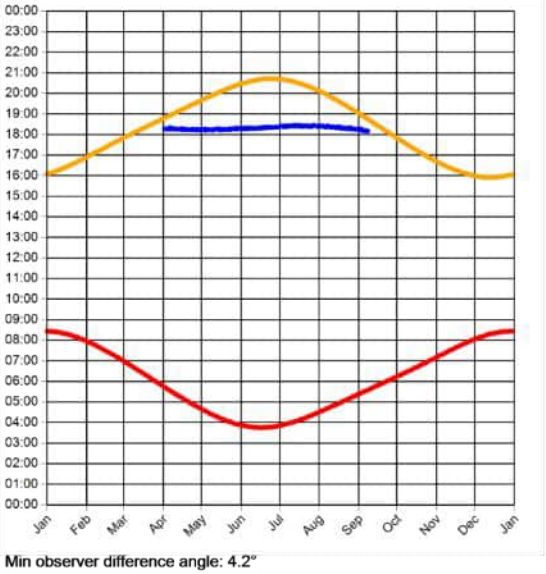
Min observer difference angle: 4.3°
Max observer difference angle: 18°

Observer Location — Sun azimuth range is 273.6° - 286.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 61 Results

Reflection Date/Time (GMT) Graph



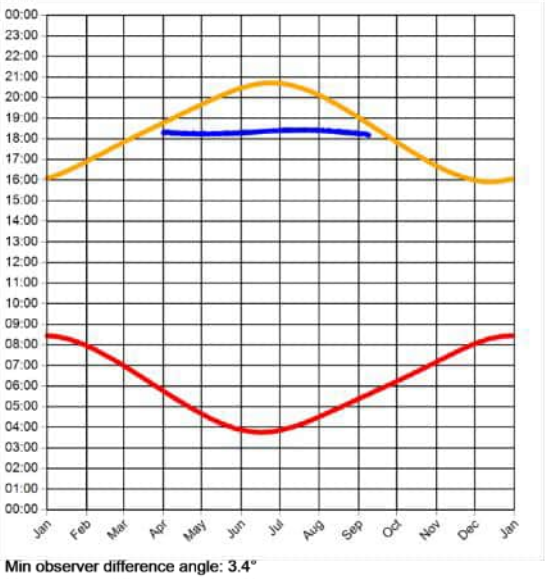
Min observer difference angle: 4.2°
Max observer difference angle: 18.8°

Observer Location — Sun azimuth range is 273.4° - 286.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 62 Results

Reflection Date/Time (GMT) Graph



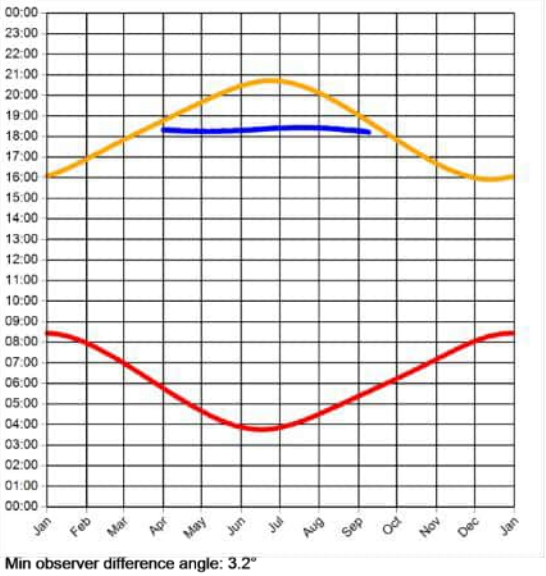
Min observer difference angle: 3.4°
Max observer difference angle: 18°

Observer Location — Sun azimuth range is 273.4° - 286.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 63 Results

Reflection Date/Time (GMT) Graph



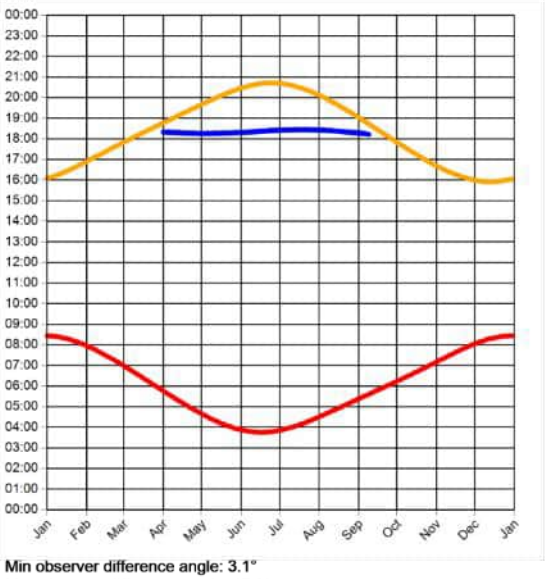
Min observer difference angle: 3.2°
Max observer difference angle: 18.3°

Observer Location — Sun azimuth range is 273.6° - 286.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 64 Results

Reflection Date/Time (GMT) Graph



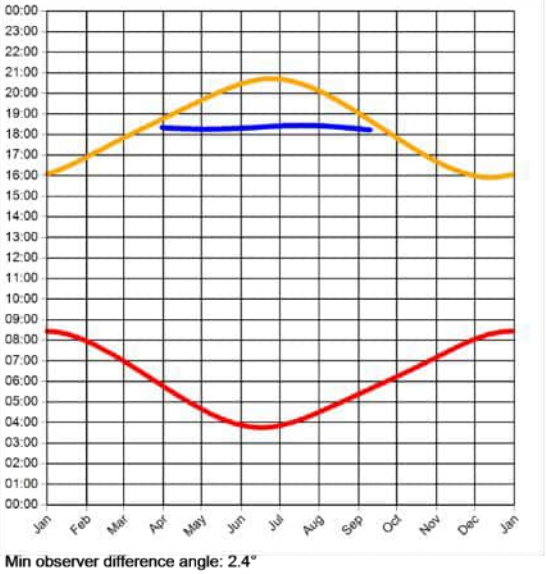
Min observer difference angle: 3.1°
Max observer difference angle: 17.9°

Observer Location — Sun azimuth range is 273.7° - 286.6° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 65 Results

Reflection Date/Time (GMT) Graph



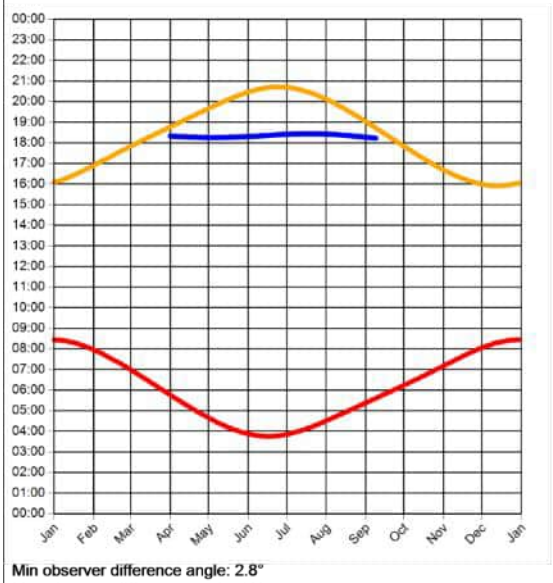
Min observer difference angle: 2.4°
Max observer difference angle: 17.9°

Observer Location — Sun azimuth range is 273.7° - 286.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 66 Results

Reflection Date/Time (GMT) Graph



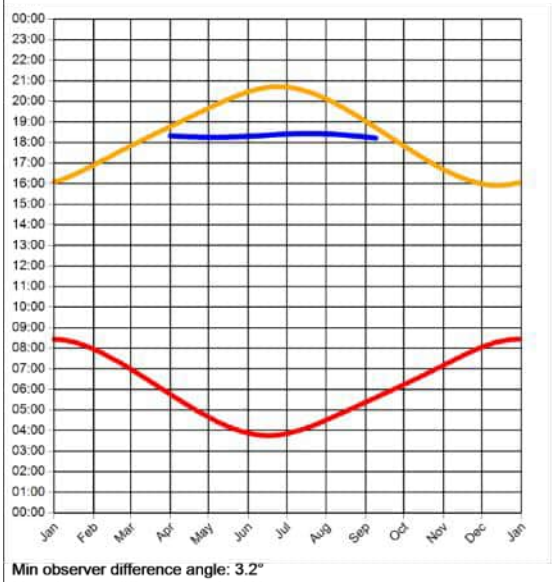
Min observer difference angle: 2.8°
Max observer difference angle: 18°

Observer Location — Sun azimuth range is 273.8° - 286.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 67 Results

Reflection Date/Time (GMT) Graph



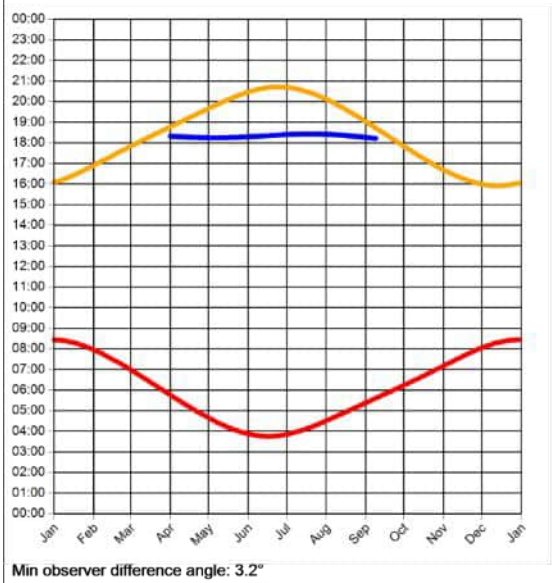
Min observer difference angle: 3.2°
Max observer difference angle: 18°

Observer Location — Sun azimuth range is 273.7° - 286.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 68 Results

Reflection Date/Time (GMT) Graph



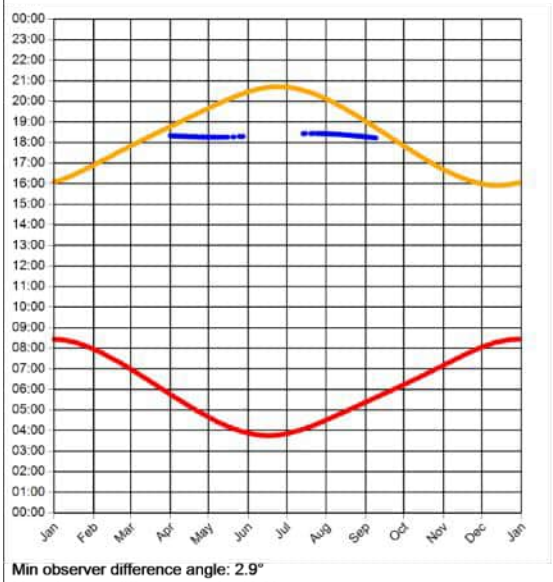
Min observer difference angle: 3.2°
Max observer difference angle: 18.2°

Observer Location — Sun azimuth range is 273.7° - 286.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 69 Results

Reflection Date/Time (GMT) Graph



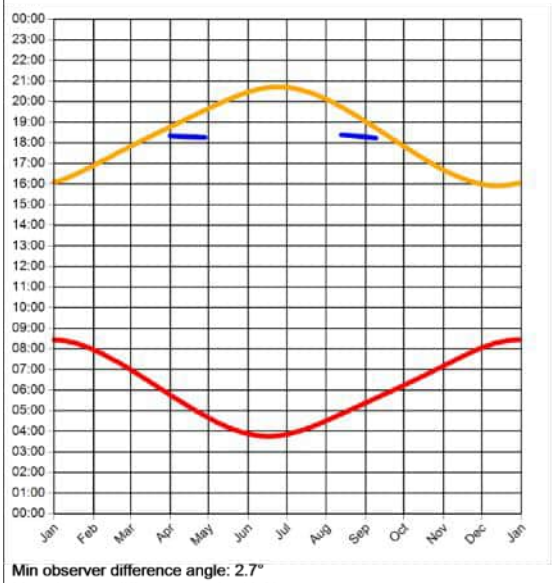
Min observer difference angle: 2.9°
Max observer difference angle: 16.3°

Observer Location — Sun azimuth range is 273.8° - 285° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 70 Results

Reflection Date/Time (GMT) Graph



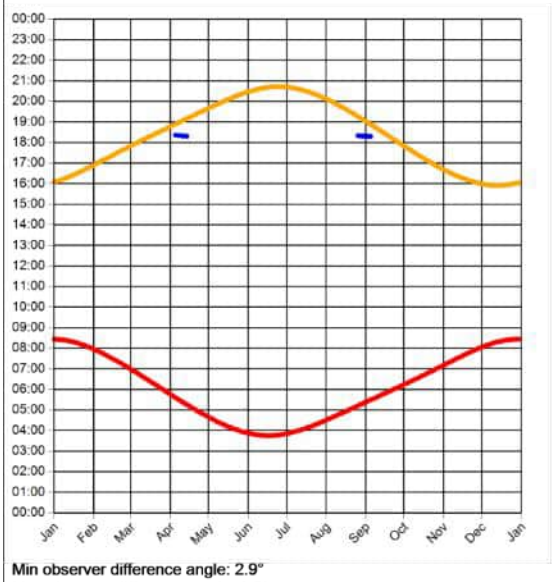
Min observer difference angle: 2.7°
Max observer difference angle: 10.6°

Observer Location — Sun azimuth range is 273.9° - 280.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 74 Results

Reflection Date/Time (GMT) Graph



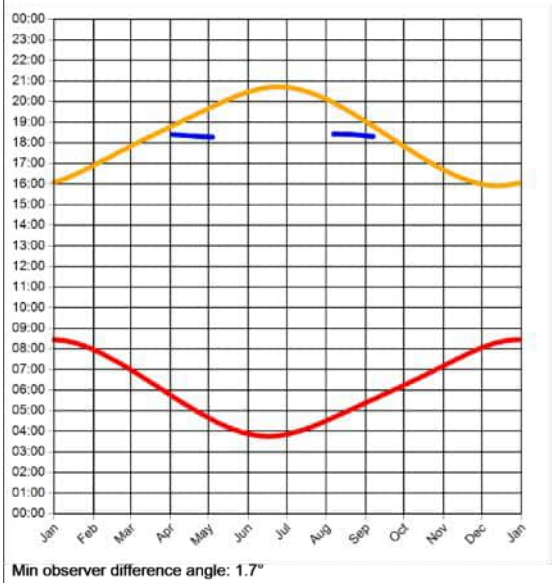
Min observer difference angle: 2.9°
Max observer difference angle: 6.5°

Observer Location — Sun azimuth range is 275.3° - 277.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 75 Results

Reflection Date/Time (GMT) Graph



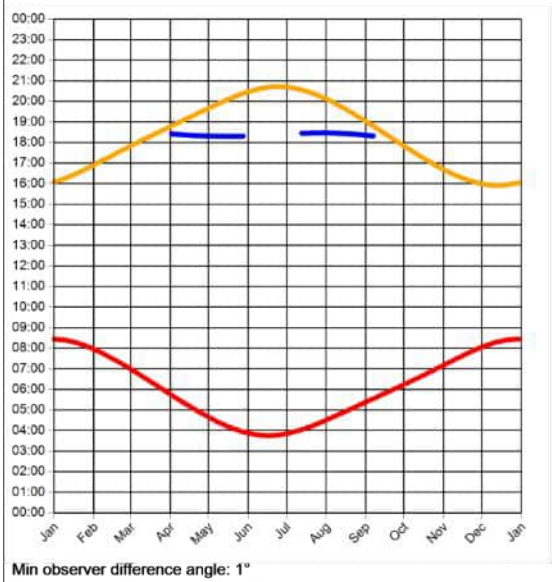
Min observer difference angle: 1.7°
Max observer difference angle: 11.5°

Observer Location — Sun azimuth range is 275.2° - 281.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 76 Results

Reflection Date/Time (GMT) Graph



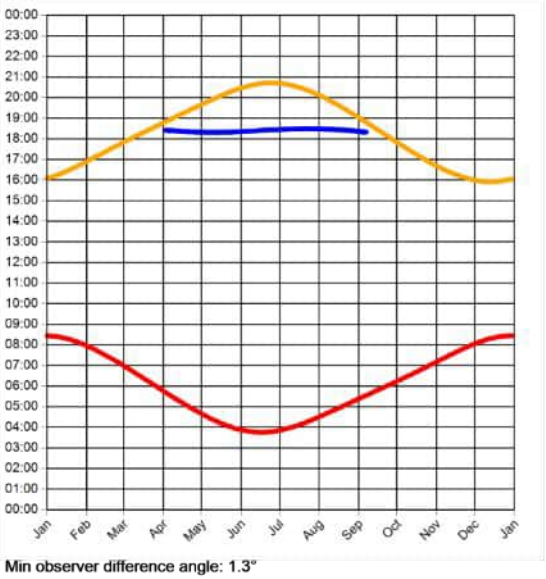
Min observer difference angle: 1°
Max observer difference angle: 16°

Observer Location — Sun azimuth range is 275.3° - 285.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

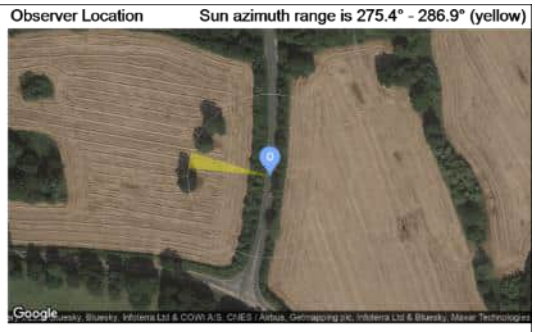
Observer 77 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 1.3°
Max observer difference angle: 16.8°

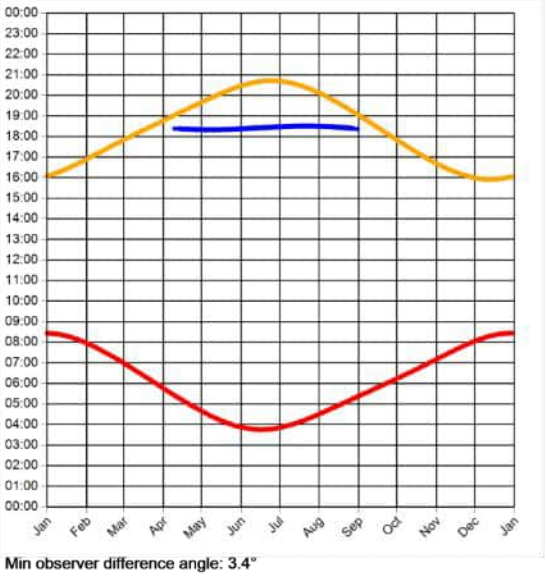
Observer Location — Sun azimuth range is 275.4° - 286.9° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 78 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 3.4°
Max observer difference angle: 16.5°

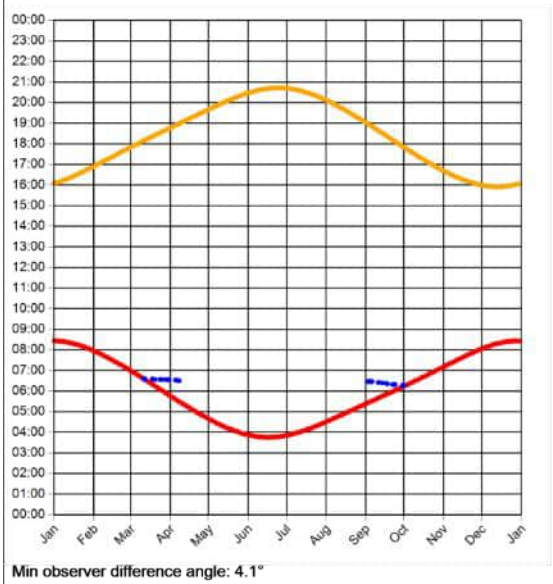
Observer Location — Sun azimuth range is 277° - 287.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Dwellings

Observer 1 Results

Reflection Date/Time (GMT) Graph



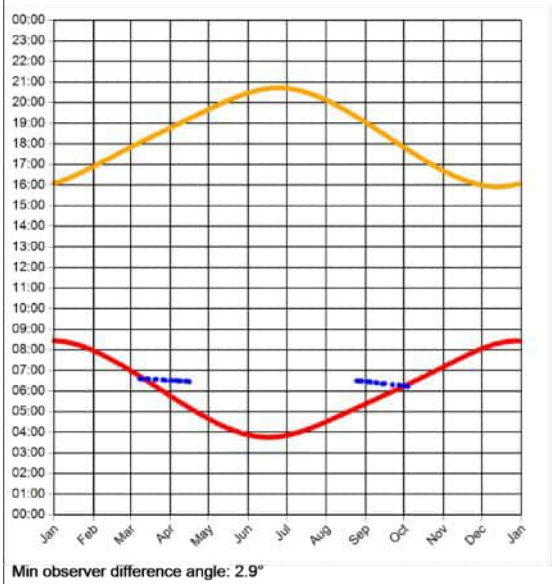
Min observer difference angle: 4.1°
Max observer difference angle: 14.6°

Observer Location — Sun azimuth range is 88.8° - 95° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 2 Results

Reflection Date/Time (GMT) Graph



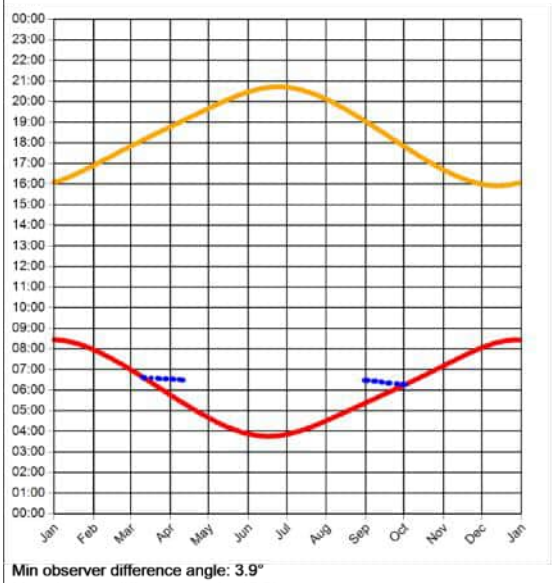
Min observer difference angle: 2.9°
Max observer difference angle: 17.1°

Observer Location — Sun azimuth range is 86.7° - 95.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 3 Results

Reflection Date/Time (GMT) Graph



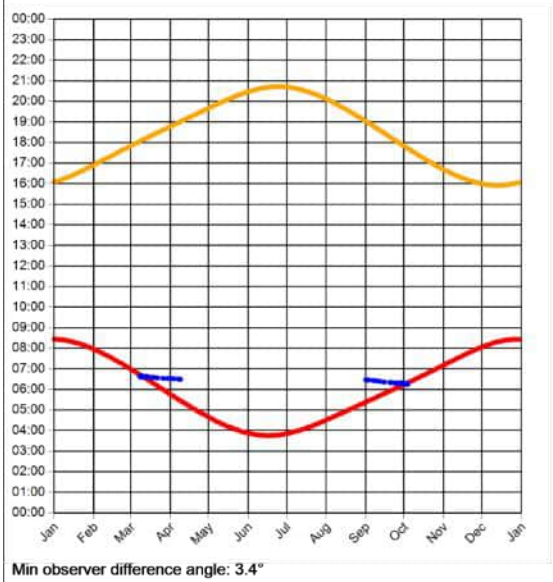
Min observer difference angle: 3.9°
Max observer difference angle: 15.5°

Observer Location — Sun azimuth range is 88.1° - 95.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 4 Results

Reflection Date/Time (GMT) Graph



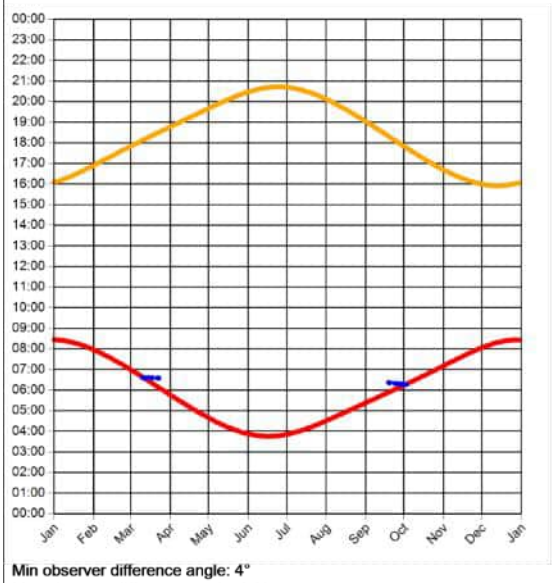
Min observer difference angle: 3.4°
Max observer difference angle: 14.9°

Observer Location — Sun azimuth range is 88.4° - 96.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 5 Results

Reflection Date/Time (GMT) Graph



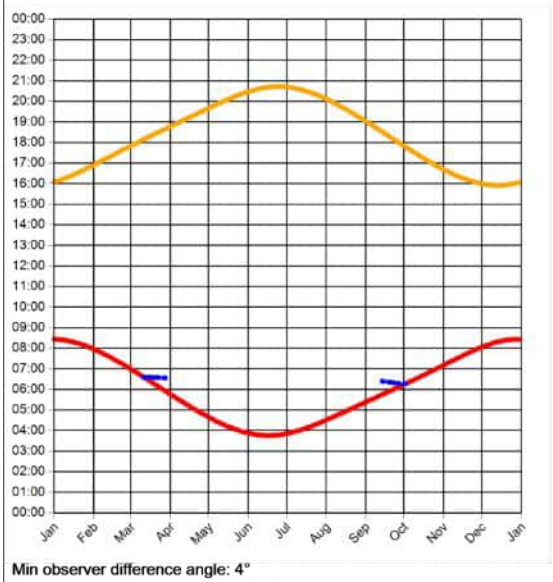
Min observer difference angle: 4°
Max observer difference angle: 8.9°

Observer Location — Sun azimuth range is 92.5° - 95.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 6 Results

Reflection Date/Time (GMT) Graph



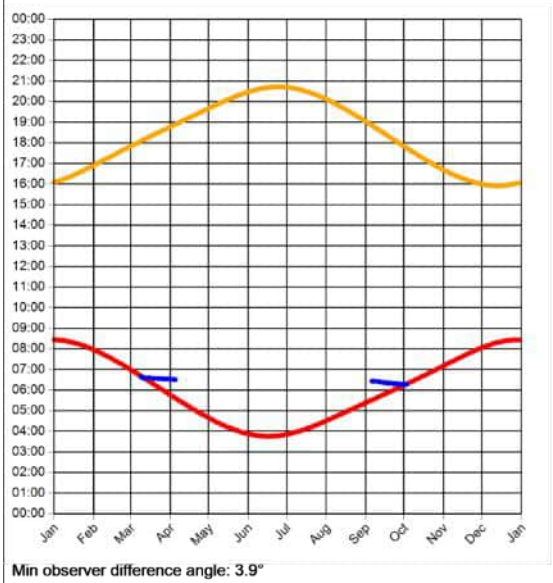
Min observer difference angle: 4°
Max observer difference angle: 10.6°

Observer Location — Sun azimuth range is 91.2° - 95.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 7 Results

Reflection Date/Time (GMT) Graph



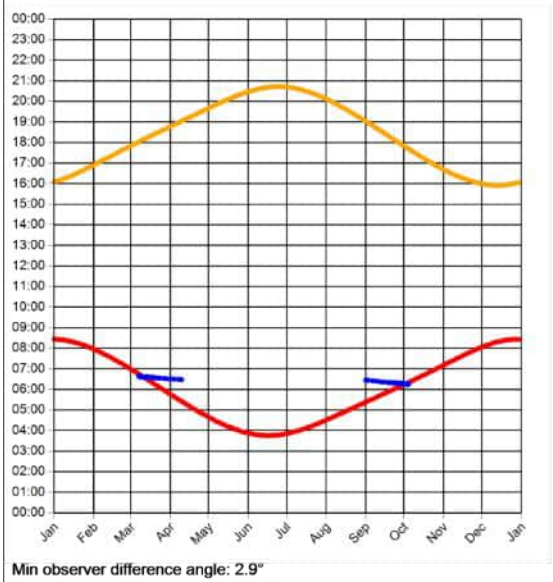
Min observer difference angle: 3.9°
Max observer difference angle: 13.1°

Observer Location — Sun azimuth range is 89.3° - 95.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 8 Results

Reflection Date/Time (GMT) Graph



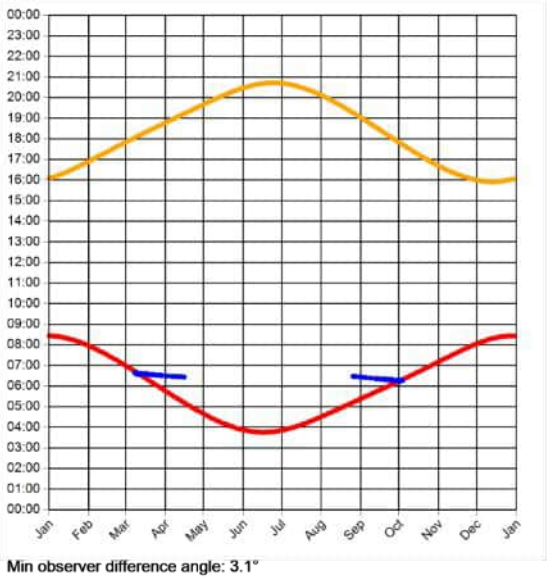
Min observer difference angle: 2.9°
Max observer difference angle: 14.6°

Observer Location — Sun azimuth range is 88.1° - 96.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 9 Results

Reflection Date/Time (GMT) Graph



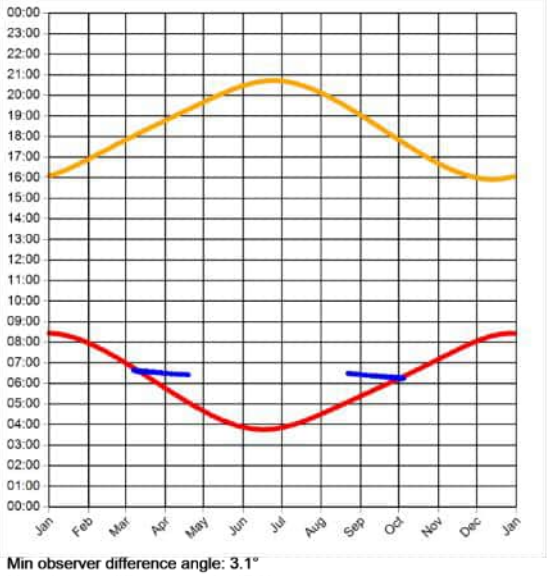
Min observer difference angle: 3.1°
Max observer difference angle: 16.3°

Observer Location — Sun azimuth range is 86.6° - 96° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 10 Results

Reflection Date/Time (GMT) Graph



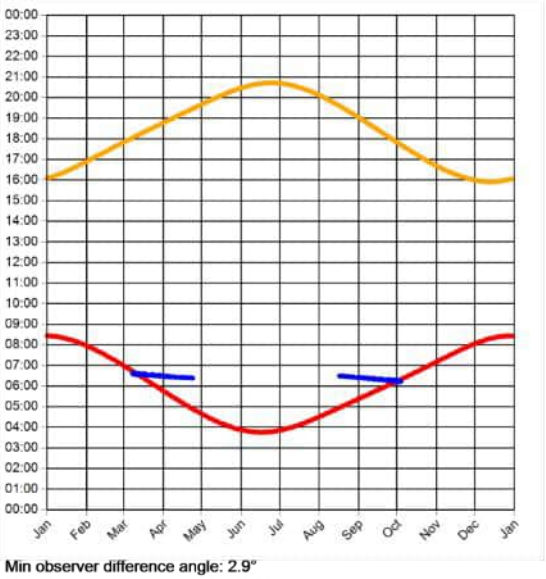
Min observer difference angle: 3.1°
Max observer difference angle: 17.3°

Observer Location — Sun azimuth range is 85.8° - 96.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 11 Results

Reflection Date/Time (GMT) Graph



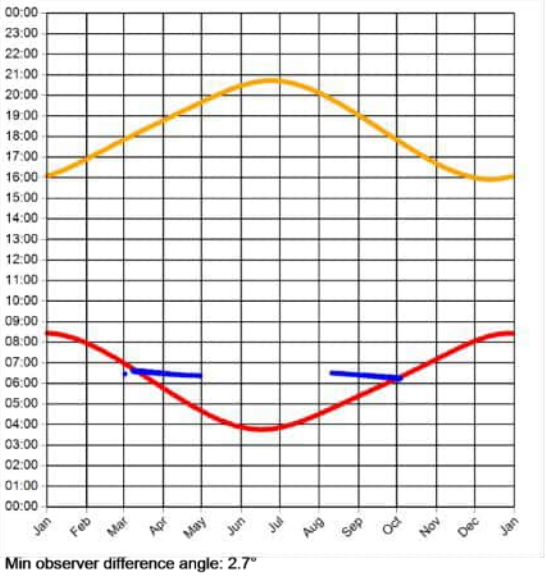
Min observer difference angle: 2.9°
Max observer difference angle: 18.3°

Observer Location — Sun azimuth range is 84.6° - 95.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 12 Results

Reflection Date/Time (GMT) Graph



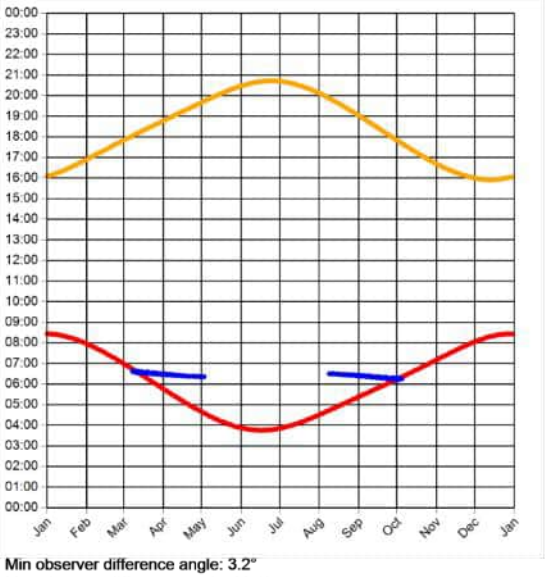
Min observer difference angle: 2.7°
Max observer difference angle: 19.9°

Observer Location — Sun azimuth range is 83.4° - 95.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 13 Results

Reflection Date/Time (GMT) Graph



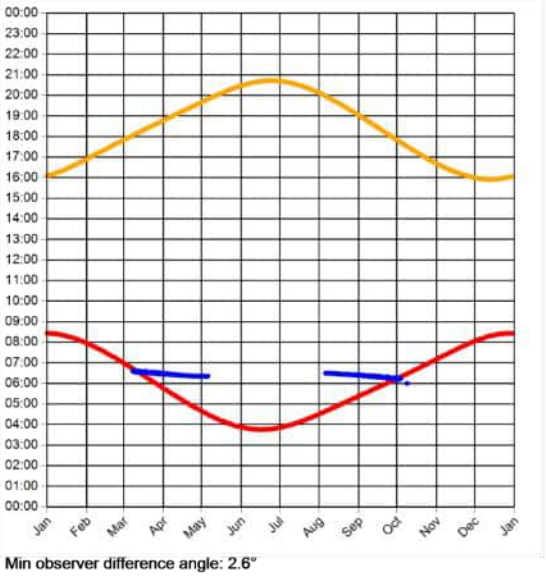
Min observer difference angle: 3.2°
Max observer difference angle: 20.4°

Observer Location — Sun azimuth range is 82.8° - 96° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 14 Results

Reflection Date/Time (GMT) Graph



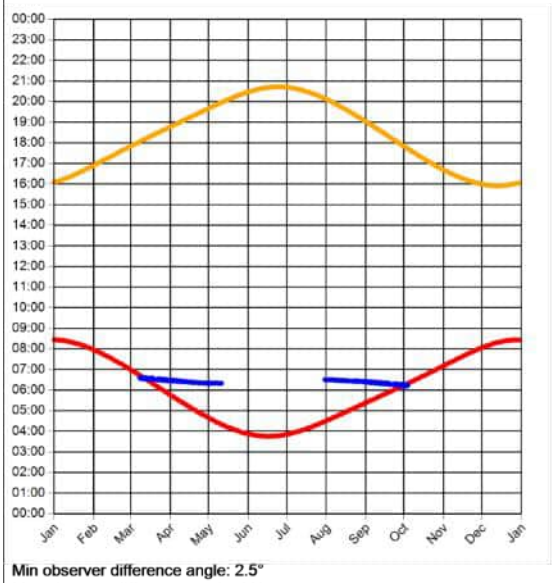
Min observer difference angle: 2.6°
Max observer difference angle: 20.9°

Observer Location — Sun azimuth range is 82.2° - 95.6° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 15 Results

Reflection Date/Time (GMT) Graph



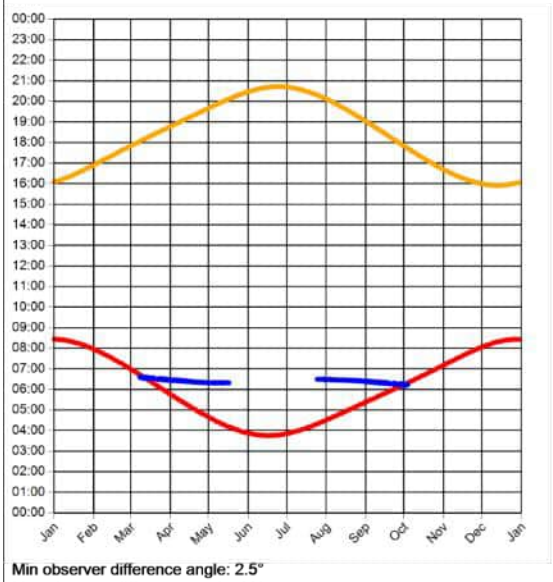
Min observer difference angle: 2.5°
Max observer difference angle: 22°

Observer Location — Sun azimuth range is 81.2° - 95.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 16 Results

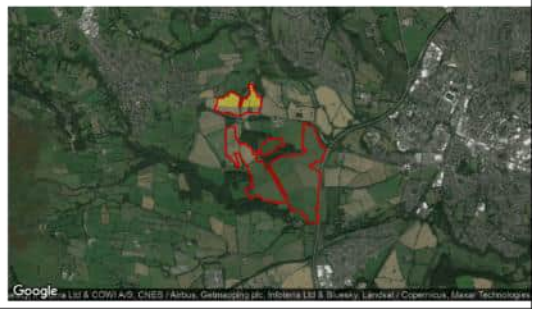
Reflection Date/Time (GMT) Graph



Min observer difference angle: 2.5°
Max observer difference angle: 23°

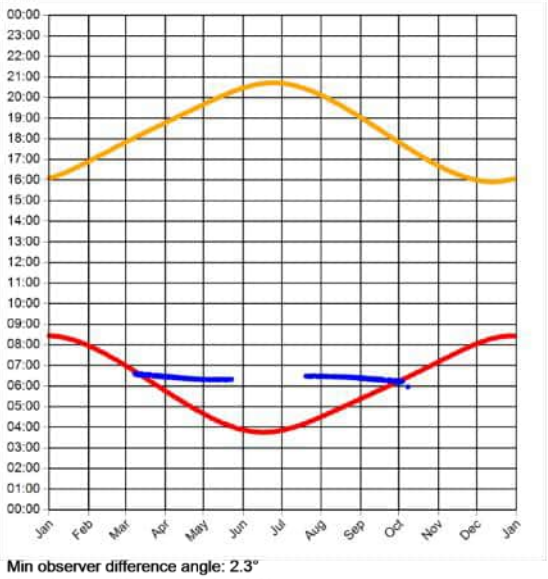
Observer Location — Sun azimuth range is 80.1° - 95.6° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 17 Results

Reflection Date/Time (GMT) Graph



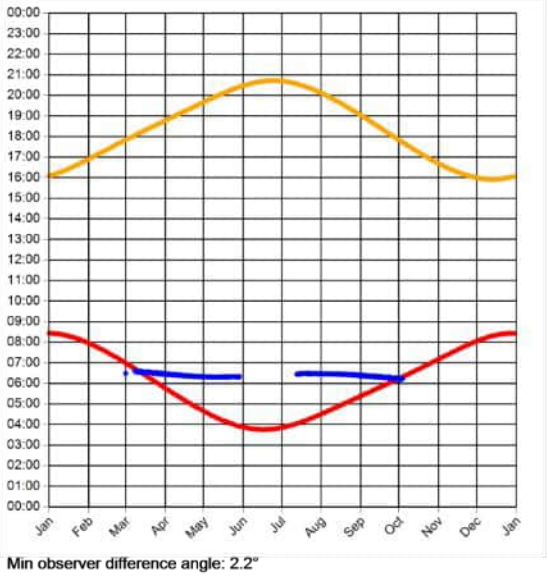
Min observer difference angle: 2.3°
Max observer difference angle: 23.9°

Observer Location — Sun azimuth range is 79.3° - 95.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 18 Results

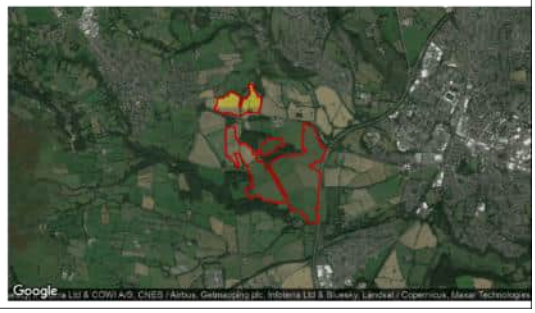
Reflection Date/Time (GMT) Graph



Min observer difference angle: 2.2°
Max observer difference angle: 24.6°

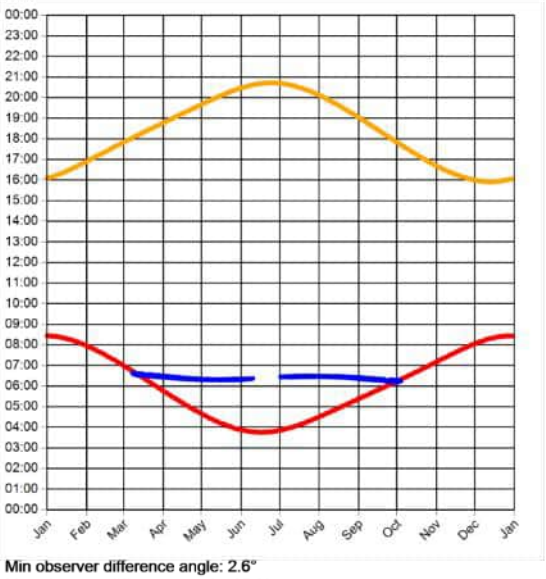
Observer Location — Sun azimuth range is 78.2° - 95.6° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 19 Results

Reflection Date/Time (GMT) Graph



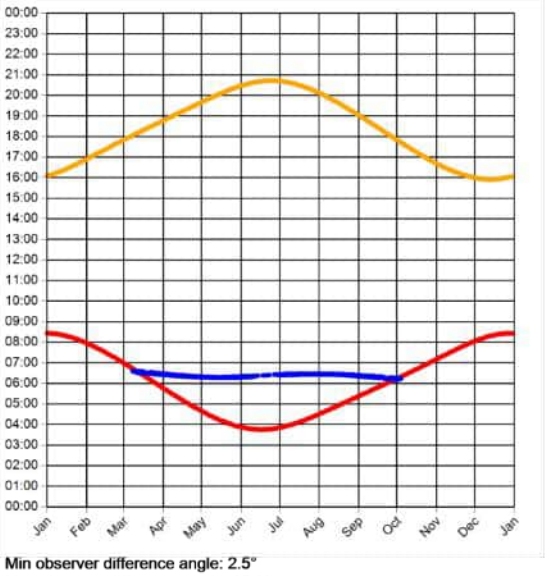
Min observer difference angle: 2.6°
Max observer difference angle: 25.8°

Observer Location — Sun azimuth range is 77.7° - 95.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 20 Results

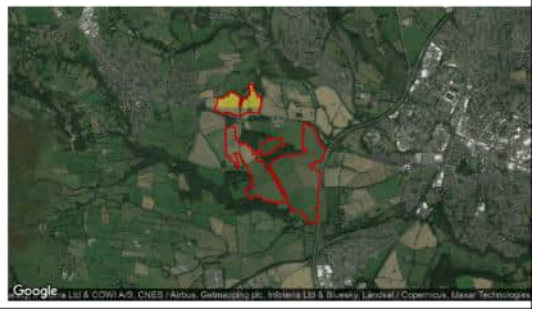
Reflection Date/Time (GMT) Graph



Min observer difference angle: 2.5°
Max observer difference angle: 25.9°

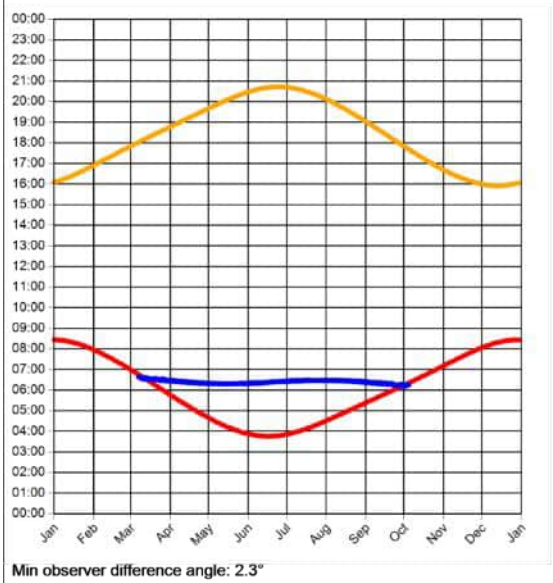
Observer Location — Sun azimuth range is 77.2° - 95.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 21 Results

Reflection Date/Time (GMT) Graph



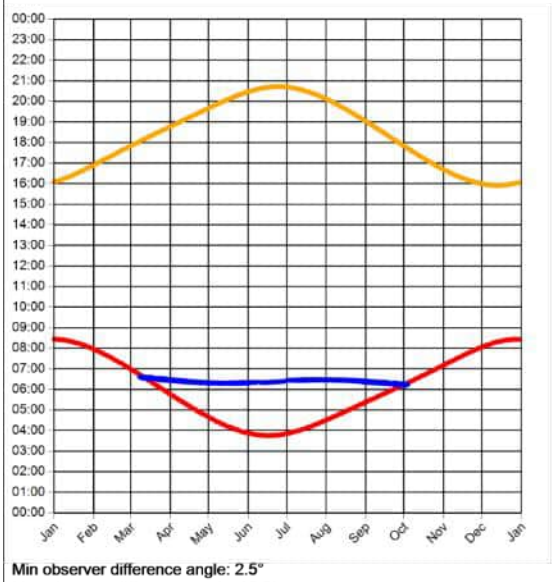
Min observer difference angle: 2.3°
Max observer difference angle: 26.2°

Observer Location — Sun azimuth range is 77.1° - 96.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 22 Results

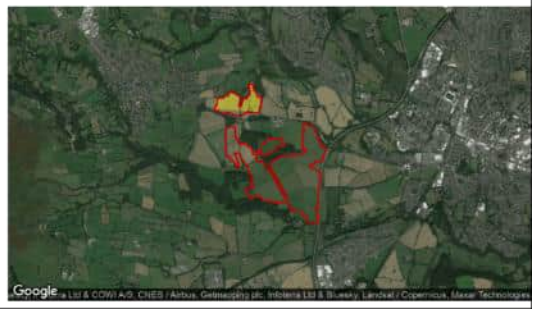
Reflection Date/Time (GMT) Graph



Min observer difference angle: 2.5°
Max observer difference angle: 25.5°

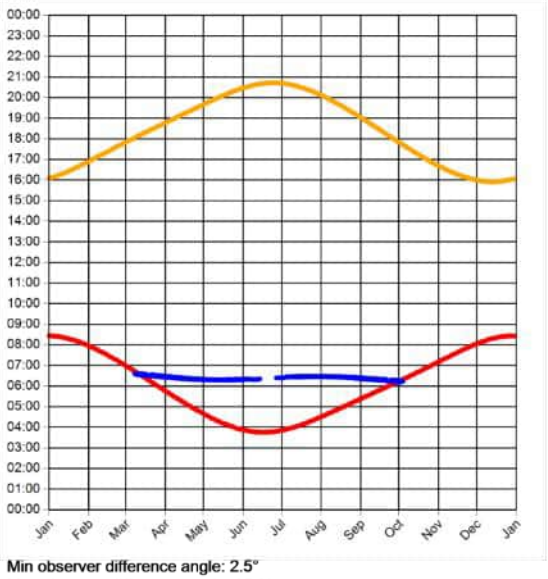
Observer Location — Sun azimuth range is 76.8° - 95.6° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 23 Results

Reflection Date/Time (GMT) Graph



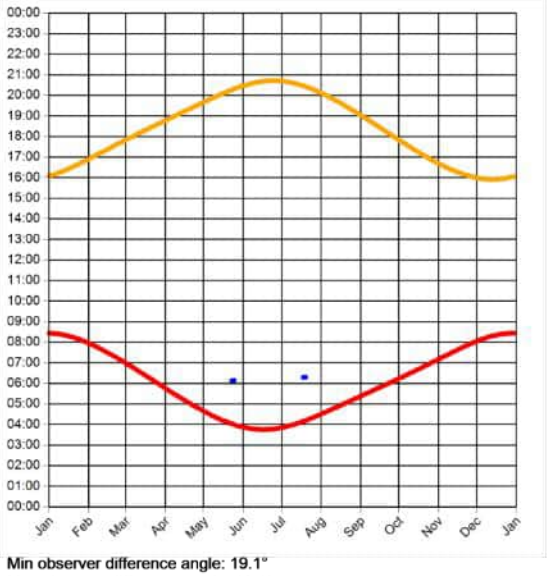
Min observer difference angle: 2.5°
Max observer difference angle: 25.3°

Observer Location — Sun azimuth range is 77.1° - 95.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 24 Results

Reflection Date/Time (GMT) Graph



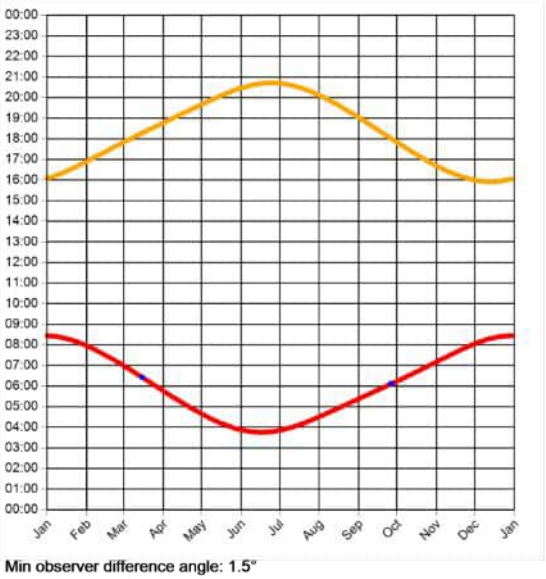
Min observer difference angle: 19.1°
Max observer difference angle: 19.4°

Observer Location — Sun azimuth range is 76.9° - 77.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 25 Results

Reflection Date/Time (GMT) Graph



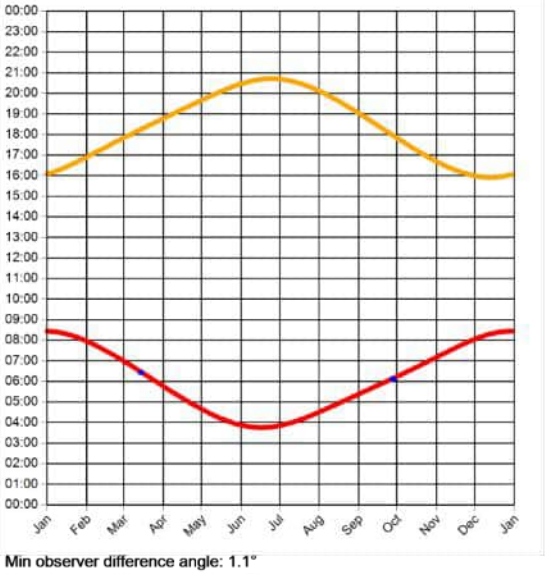
Min observer difference angle: 1.5°
Max observer difference angle: 1.9°

Observer Location — Sun azimuth range is 91.7° - 92° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 26 Results

Reflection Date/Time (GMT) Graph



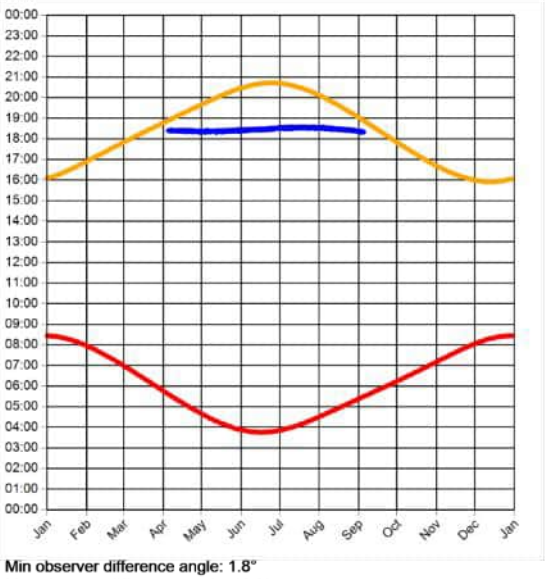
Min observer difference angle: 1.1°
Max observer difference angle: 1.7°

Observer Location — Sun azimuth range is 92.1° - 92.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 27 Results

Reflection Date/Time (GMT) Graph



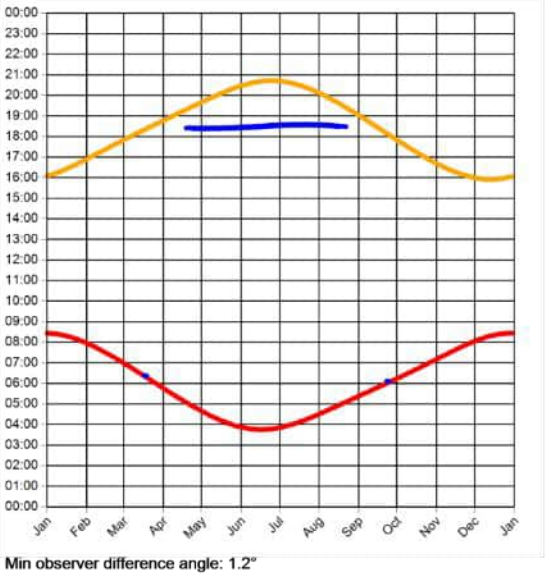
Min observer difference angle: 1.8°
Max observer difference angle: 16.3°

Observer Location — Sun azimuth range is 275.7° - 287.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 28 Results

Reflection Date/Time (GMT) Graph



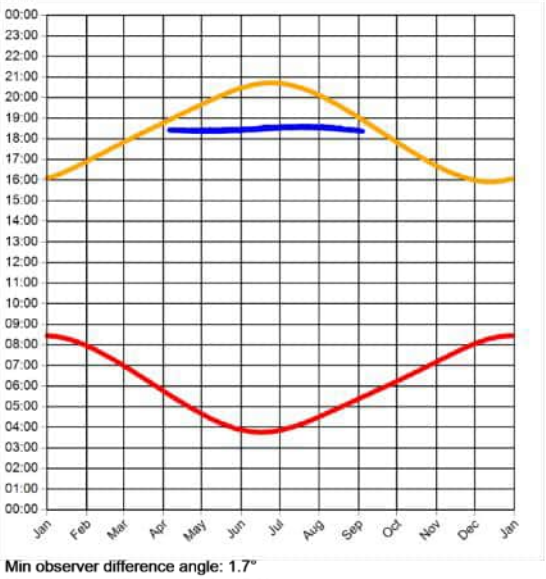
Min observer difference angle: 1.2°
Max observer difference angle: 15.2°

Observer Location — Sun azimuth ranges (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 29 Results

Reflection Date/Time (GMT) Graph



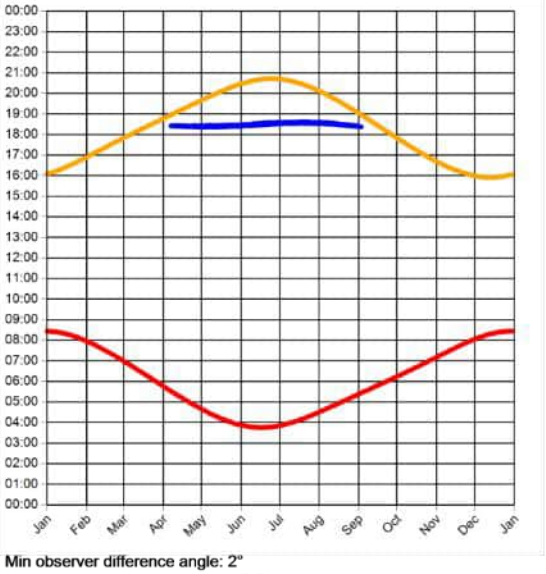
Min observer difference angle: 1.7°
Max observer difference angle: 15.3°

Observer Location — Sun azimuth range is 276.3° - 288.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 30 Results

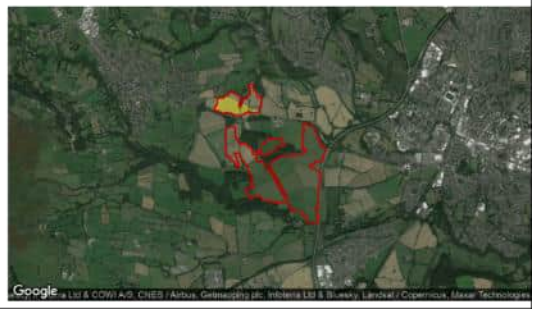
Reflection Date/Time (GMT) Graph



Min observer difference angle: 2°
Max observer difference angle: 15.5°

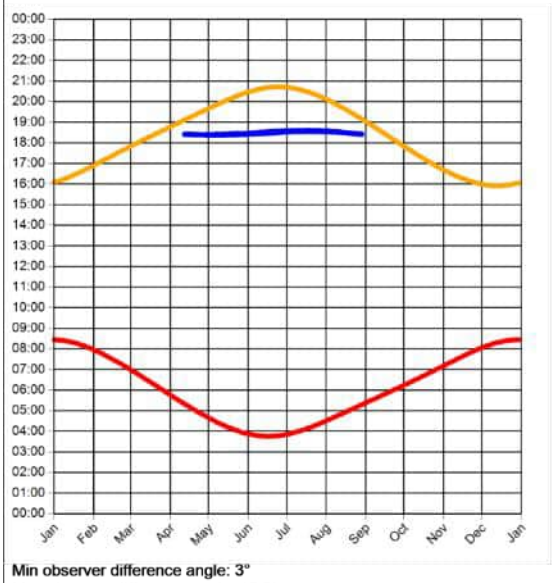
Observer Location — Sun azimuth range is 276.6° - 288.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 31 Results

Reflection Date/Time (GMT) Graph



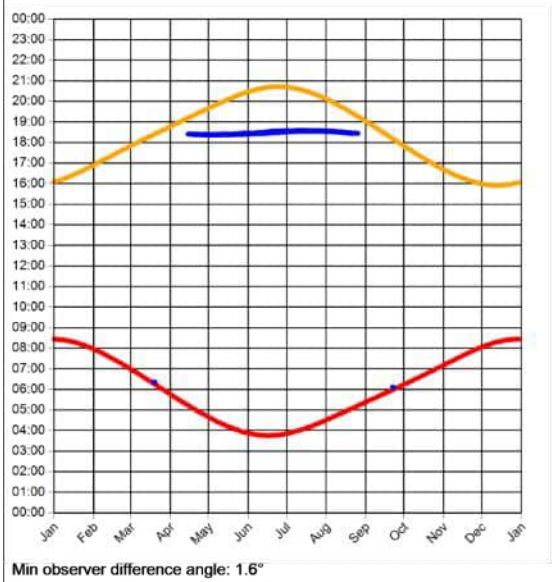
Min observer difference angle: 3°
Max observer difference angle: 15.5°

Observer Location — Sun azimuth range is 277.7° - 288.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 32 Results

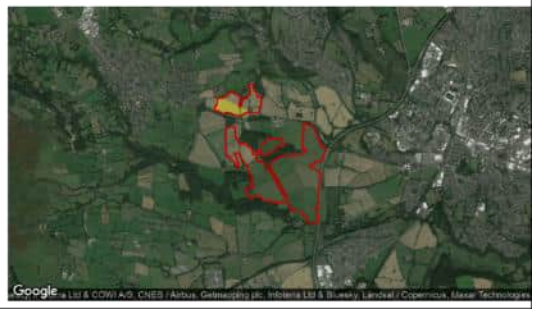
Reflection Date/Time (GMT) Graph



Min observer difference angle: 1.6°
Max observer difference angle: 15.5°

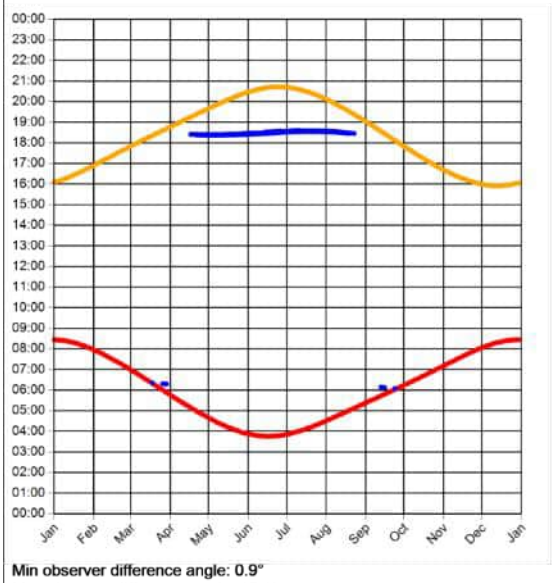
Observer Location — Sun azimuth ranges (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 33 Results

Reflection Date/Time (GMT) Graph



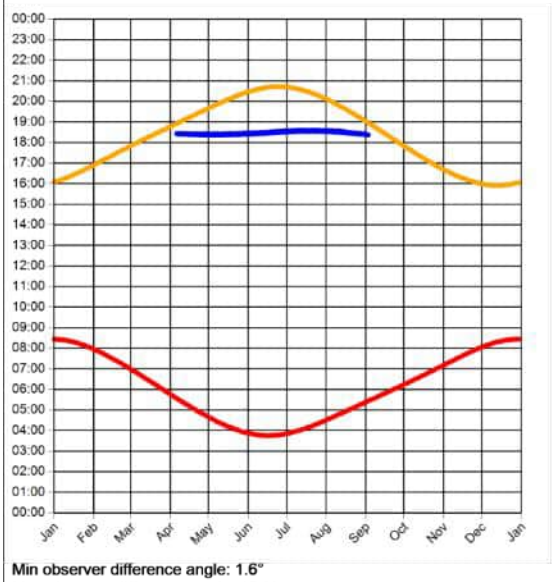
Min observer difference angle: 0.9°
Max observer difference angle: 15.4°

Observer Location — Sun azimuth ranges (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 34 Results

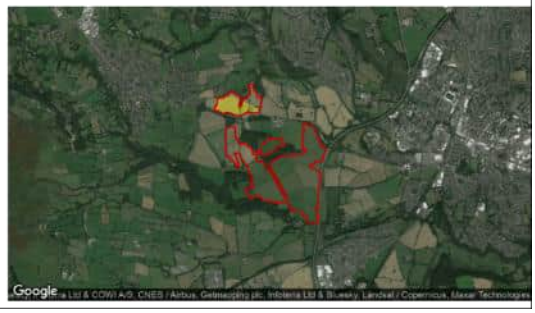
Reflection Date/Time (GMT) Graph



Min observer difference angle: 1.6°
Max observer difference angle: 15.3°

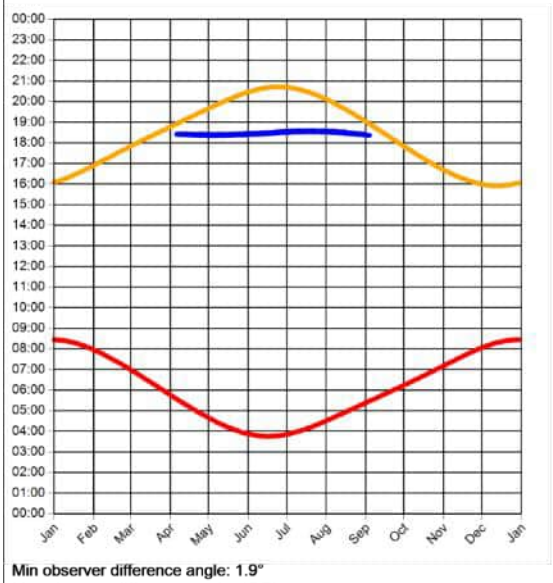
Observer Location — Sun azimuth range is 276.5° - 287.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)



Observer 35 Results

Reflection Date/Time (GMT) Graph



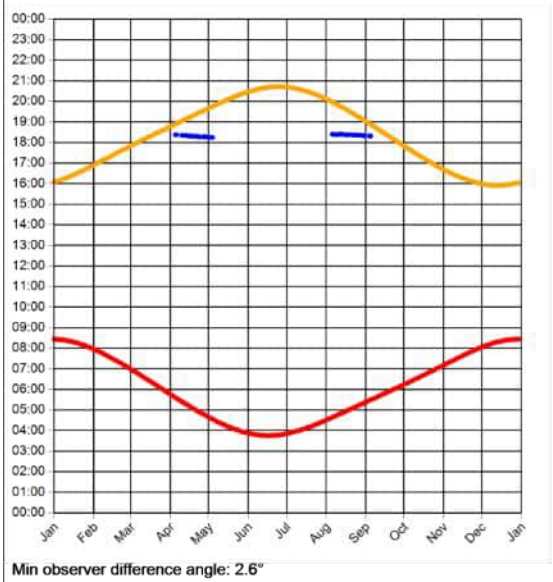
Min observer difference angle: 1.9°
Max observer difference angle: 15.7°

Observer Location — Sun azimuth range is 276.3° - 287.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 36 Results

Reflection Date/Time (GMT) Graph



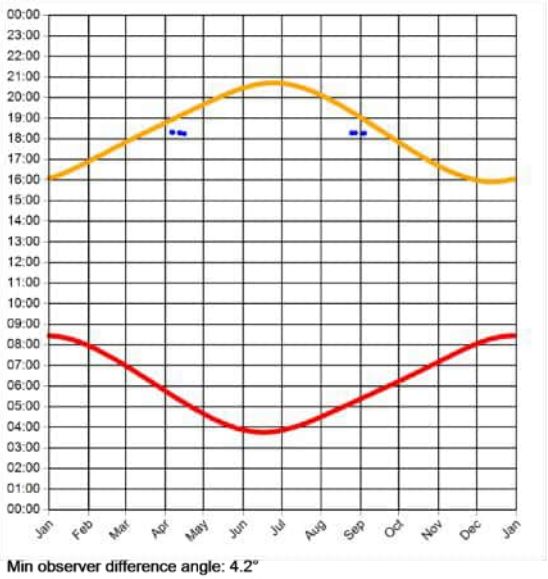
Min observer difference angle: 2.6°
Max observer difference angle: 12.4°

Observer Location — Sun azimuth range is 275.5° - 281.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 37 Results

Reflection Date/Time (GMT) Graph



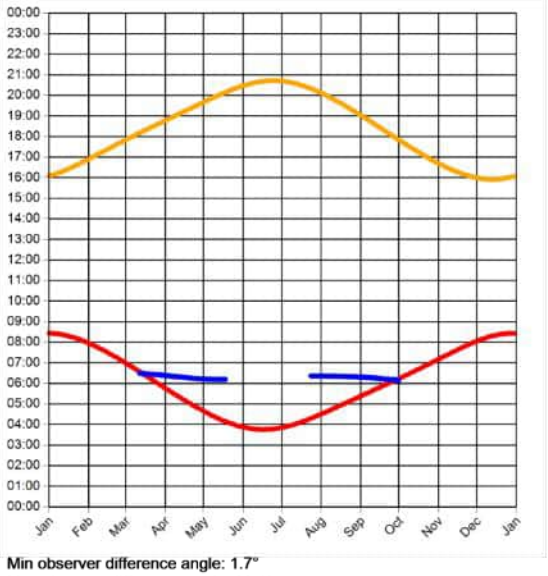
Min observer difference angle: 4.2°
Max observer difference angle: 8.3°

Observer Location — Sun azimuth range is 275.2° - 277° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 97 Results

Reflection Date/Time (GMT) Graph



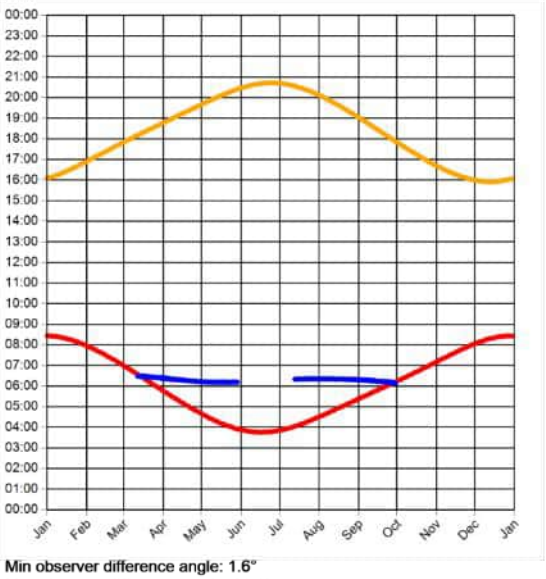
Min observer difference angle: 1.7°
Max observer difference angle: 20.1°

Observer Location — Sun azimuth range is 78.4° - 93.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 98 Results

Reflection Date/Time (GMT) Graph



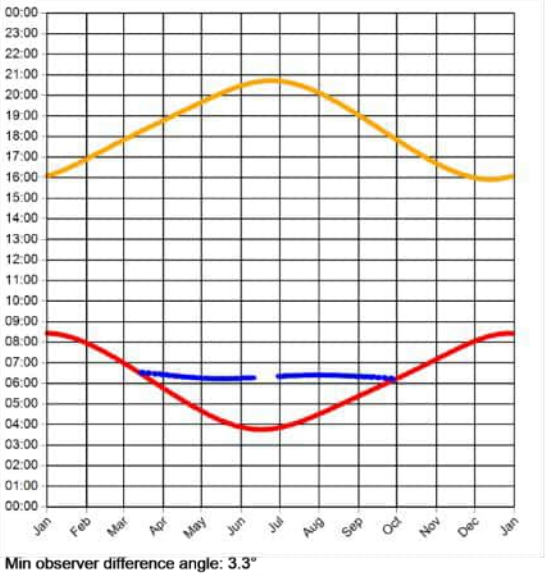
Min observer difference angle: 1.6°
Max observer difference angle: 21.4°

Observer Location — Sun azimuth range is 76.9° - 93.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 99 Results

Reflection Date/Time (GMT) Graph



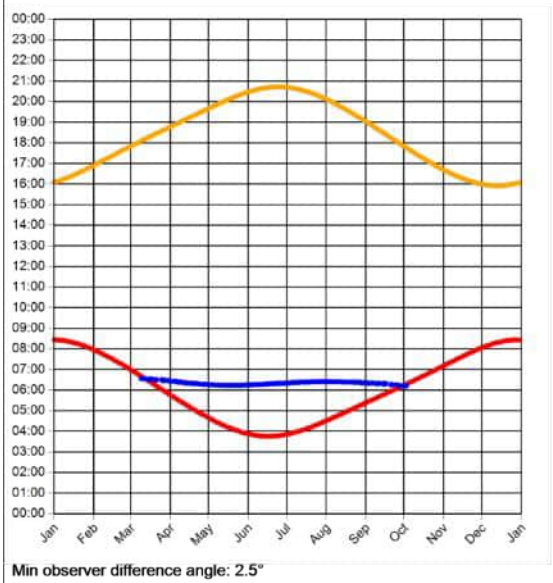
Min observer difference angle: 3.3°
Max observer difference angle: 23.5°

Observer Location — Sun azimuth range is 76.5° - 93.6° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 100 Results

Reflection Date/Time (GMT) Graph



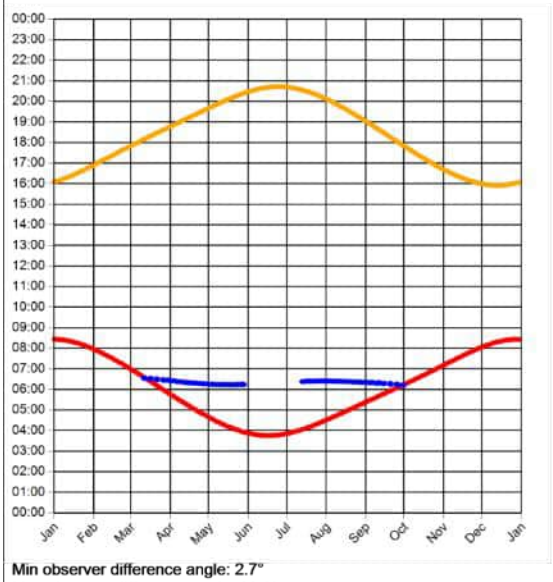
Min observer difference angle: 2.5°
Max observer difference angle: 24.1°

Observer Location — Sun azimuth range is 76.2° - 94.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 101 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 2.7°
Max observer difference angle: 22.6°

Observer Location — Sun azimuth range is 77.4° - 94.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)