Lime Down
Solar Park

EIA Scoping Report

Appendices (Part 3 of 3)

July 2024

Planning Inspectorate Reference: EN010168

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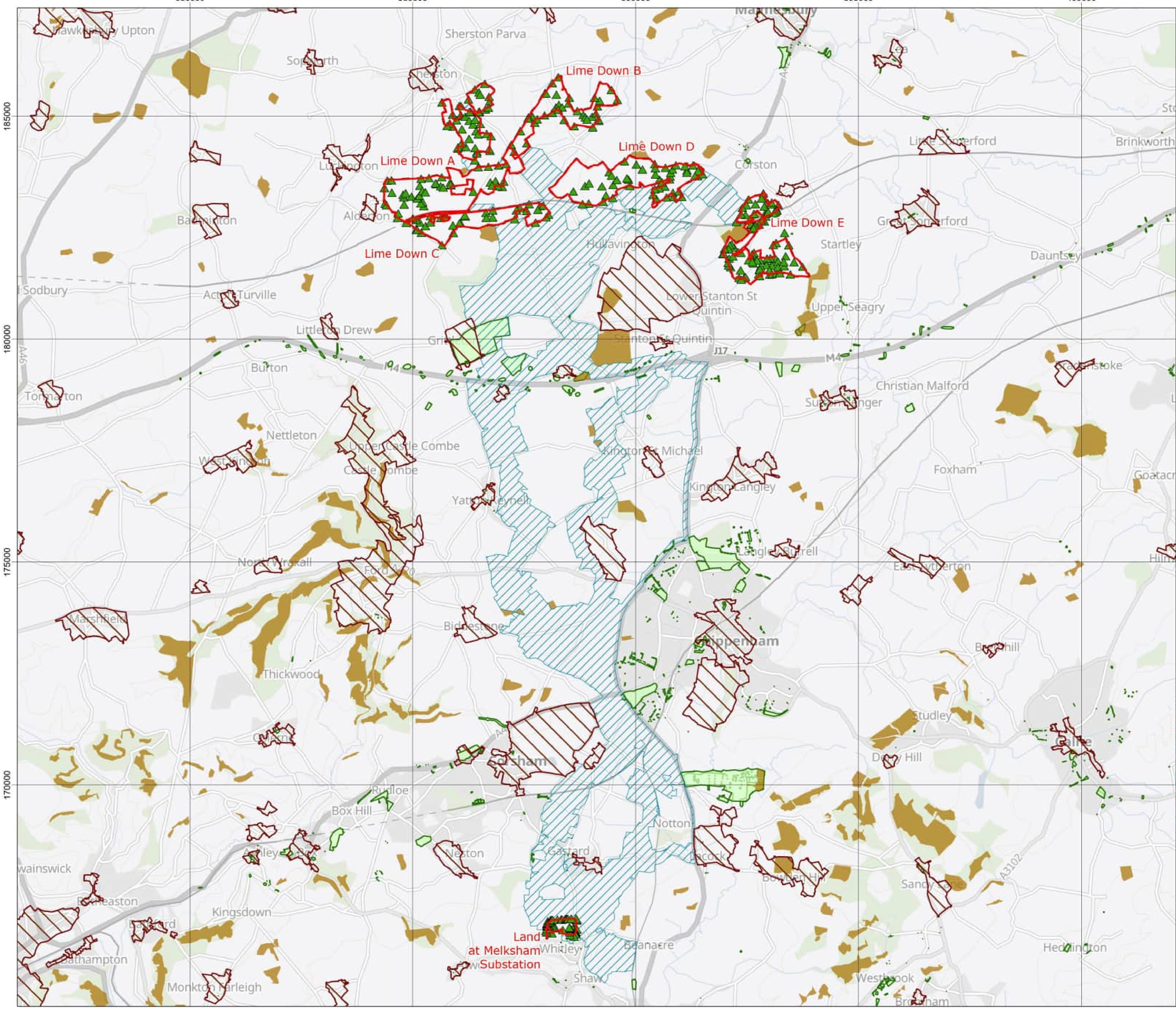
Lime Down
Solar Park

EIA Scoping Report

Appendix 9.1:
Arboriculture Figures

July 2024

EN010168



Lime Down
Solar Park

Title:

Figure 9.1 Study Area

Document:

Arboriculture
Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- 15m Study Area
- Cable Route Search Corridor
- Tree Survey Result
- Tree Preservation Order (TPO)
- Ancient Woodland
- Conservation Area

Data: IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673Contains OS data © Crown Copyright and database right 2023 Contains data from OS Zoomstack

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_ARB_0184

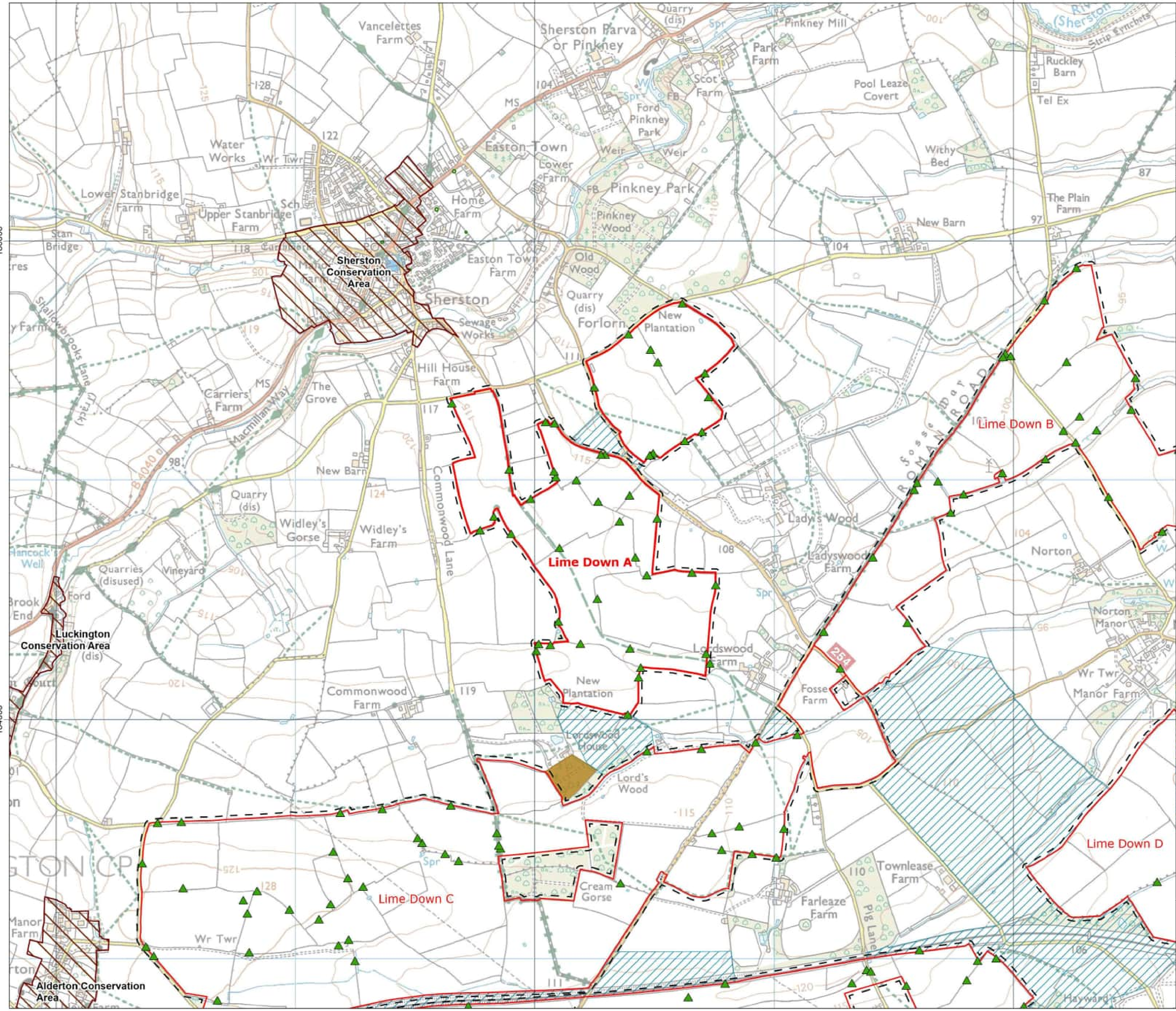
Coordinate system: British National Grid

Scale: 1:80,000 @ A3

0 2 4 km

Island GREEN POWER

Lanpro



Lime Down Solar Park

Title:

Figure 9.1.1 Study Area
Lime Down A

Document:

Arboriculture
Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- Cable Route Search Corridor
- 15m Study Area
- Tree Survey Result
- Tree Preservation Order (TPO)
- Ancient Woodland
- Conservation Area

Data: IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_ARB_0185

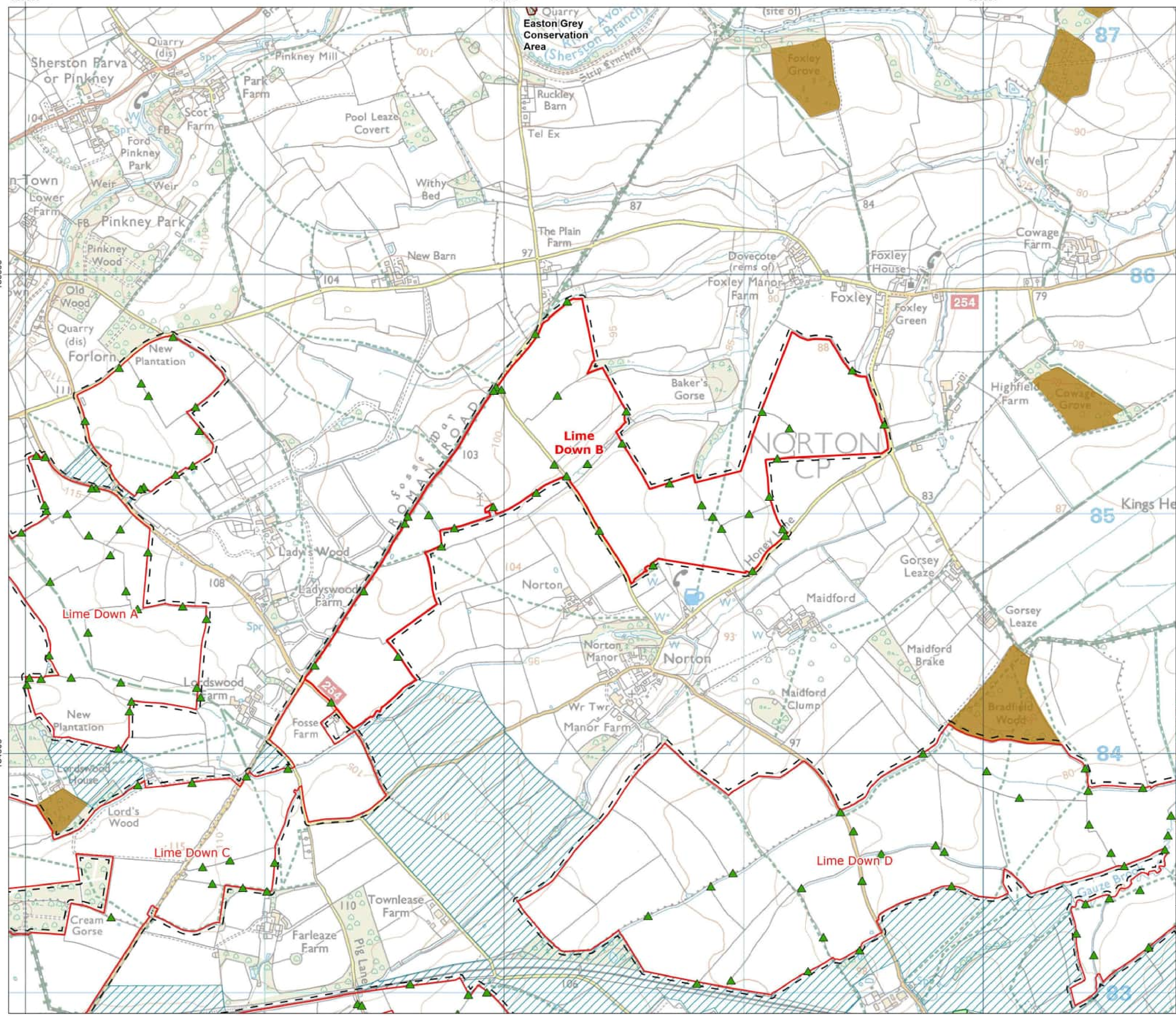
Coordinate system: British National Grid

Scale: 1:15,000 @ A3

0 400 800 Metres

Island GREEN POWER

Lanpro



Lime Down
Solar Park

Title:
Figure 9.1.2 Study Area
Lime Down B

Document:
Arboriculture
Environmental Impact Assessment Scoping Report

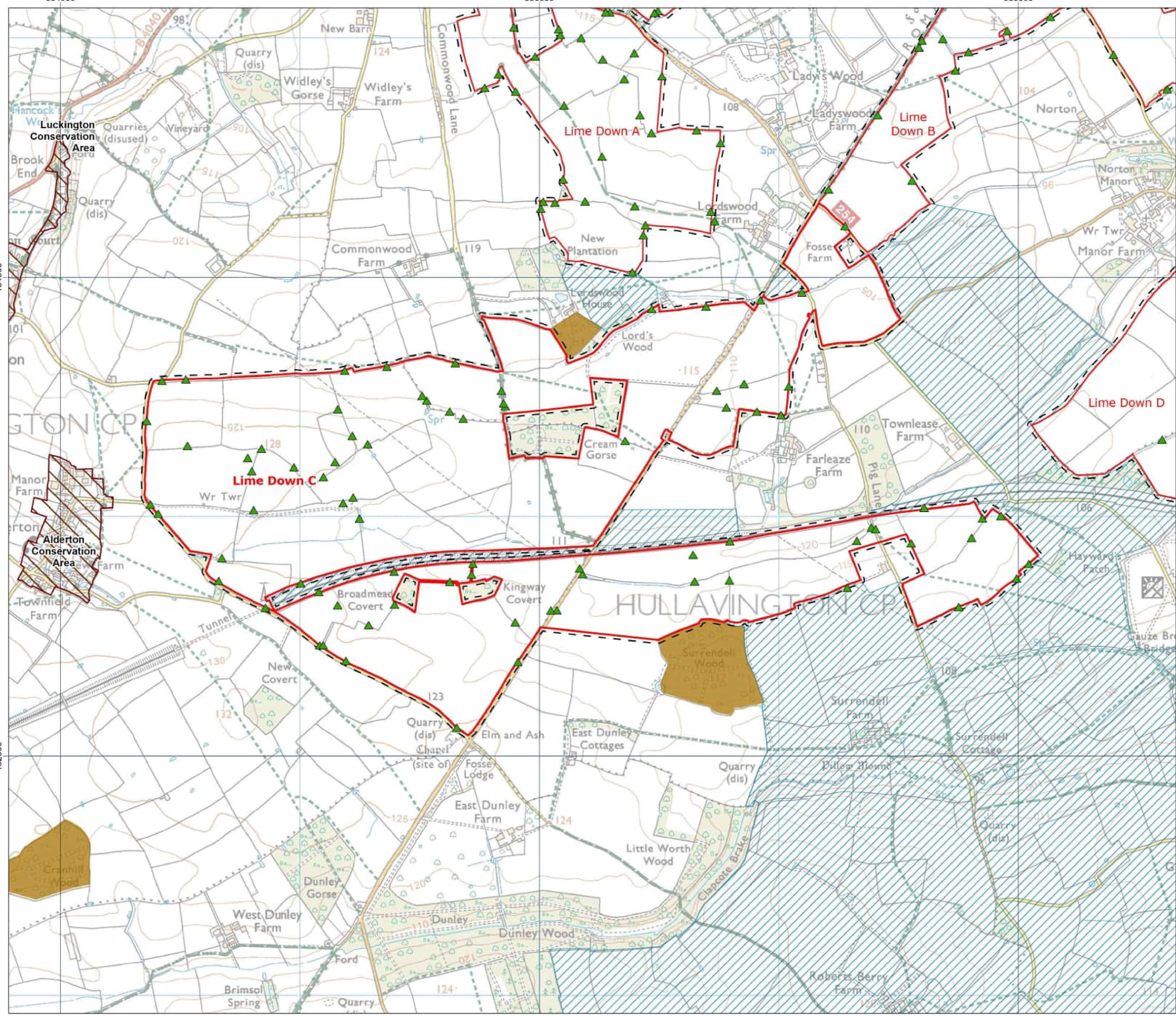
Legend:
- Area for Solar Panels and Associated Development
- Cable Route Search Corridor
- 15m Study Area
- Tree Survey Result
- Tree Preservation Order (TPO)
- Ancient Woodland
- Conservation Area

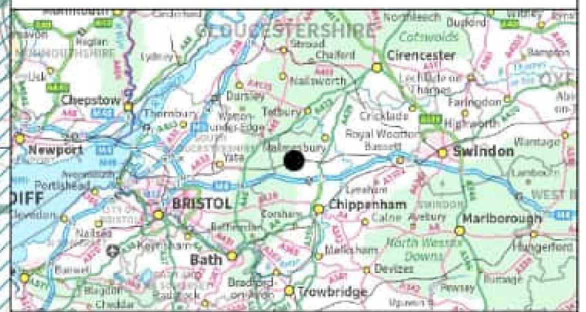
Data: IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_ARB_0185
Coordinate system: British National Grid
Scale: 1:15,000 @ A3

0 400 800 Metres

Island GREEN POWER
Lanpro





Lime Down
Solar Park

Title:
Figure 9.1.3 Study Area
Lime Down C

Document:
Arboriculture
Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- Cable Route Search Corridor
- 15m Study Area
- Tree Survey Result
- Tree Preservation Order (TPO)
- Ancient Woodland
- Conservation Area

Data: IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_ARB_0185
Coordinate system: British National Grid
Scale: 1:15,000 @ A3

0 400 800 Metres

Island GREEN POWER
Lanpro

388000 390000 392000

184000 182000

Lime Down

Solar Park

Title:

Figure 9.1.4 Study Area
Lime Down D

Document:

Arboriculture
Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- Cable Route Search Corridor
- 15m Study Area
- Tree Survey Result
- Tree Preservation Order (TPO)
- Ancient Woodland
- Conservation Area

Lime Down B

Lime Down C

Lime Down D

Lime Down E

Hullavington Airbase Conservation Area

NORTON CP

Baker's Gorse

Highfield Farm

Cowage Grove

Burnt Heath Farm

Kings Heath

85

84

83

82

Honey Lane

Gorsey Leaze

Maidford

Maidford Brake

Maidford Clump

Norton

Norton Manor

Wr Twr

Manor Farm

Bradfield Wood

Lower West Park Farm

West Park Farm

West Park Wood

Resr

Manor Farm

Gauze Brook

Bradfield Manor Farm

Sewage Works

Court Farm

Windmill Hill Brake

Gauze Brook Bridge

Lawn Farm

Hill Hayes

Kingway Nursery

New Barn

Kingway Barn

Bincombe Wood

Hangar Farm

Rowden Wood

KARTING

Hullavington

Surrendell Cottage

Prior's Corner

Quarry (dis)

Gardners Farm

Wellington Place

Hayward's Patch

A 429

Data: IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_ARB_0185

Coordinate system: British National Grid

Scale: 1:15,000 @ A3

0 400 800 Metres

Island GREEN POWER

Lanpro

392000

394000

184000

182000

Lime Down Solar Park

Title:

Figure 9.1.5 Study Area
Lime Down E

Document:

Arboriculture
Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- Cable Route Search Corridor
- 15m Study Area
- Tree Survey Result
- Tree Preservation Order (TPO)
- Ancient Woodland
- Conservation Area

Lime Down D

Lime Down E

Rodbourne Conservation Area

Hullavington Airbase Conservation Area

West Park Farm

West Park Wood

Corston

Newlands Farm

Resr

Manor Farm

Rodbourne Rail Farm

Ppg Sta

Angrove Farm

Angrove Cottages

Rodbourne House

Parsloe's Farm

Water Tower

Rodbourne

Manor Farm

Gabriel's Well

Bottom Farm

Goosegreen Farm

Heath Farm

Rodbourne Bottom

Grove Farm

Cleeve House (Childrens Home)

Startley

Marsh Farm

Clove Farm

Seagry Heat

Seagry Wood

Upper Farm

SEAGRY CP

Seagry House

Five Thorn Farm

Upper Seagry

Manor Farm

Tel Ex

Sch

Moat

Kingway Nursery

New Barn

Kingway Barn

Bincombe Wood

KARTING

Hangar Farm

Rowden Wood

Sewage Works (disused)

Avil's Farm

Lower Stanton Farm

Glebe Farmhouse

Lower Stanton St Quintin

Churchill Farm

Moat

Nables Farm

Woodman Croft Covert

Oak Hill

Ell Wood

STANTON ST QUINTIN CP

GREAT SOMERFORD

A429

MS

Data: IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_ARB_0185

Coordinate system: British National Grid

Scale: 1:15,000 @ A3

0 400 800 Metres

Island GREEN POWER

Lanpro

386000

388000

390000

168000

166000

Neston Conservation Area

Gastard Conservation Area

Land at Melksham Substation

Atworth Conservation Area

Broughton Gifford Conservation Area

Lime Down Solar Park

Title:

Figure 9.1.6 Study Area
Land at Melksham Substation

Document:

Arboriculture
Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- Cable Route Search Corridor
- 15m Study Area
- Tree Survey Result
- Tree Preservation Order (TPO)
- Ancient Woodland
- Conservation Area

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_ARB_0185

Coordinate system: British National Grid

Scale: 1:15,000 @ A3

0 400 800 Metres

Island GREEN POWER

Lanpro

386000 388000 390000 392000

180000

178000

176000

Grittleton Conservation Area

Hullavington Airbase Conservation Area

Stanton St Quintin Conservation Area

Leigh Delamere Conservation Area

Sevington Conservation Area

Castle Combe Conservation Area

Yatton Keynell Conservation Area

Long Dean, Ford and Slaughterford Conservation Area

Allington Conservation Area

Kington St Michael Conservation Area

Kington Langley Conservation Area

GRITTLETON CP

STANTON ST QUINTIN CP

CASTLE COMBE CP

KINGTON ST MICHAEL CP

KINGTON LANGLEY

YATTON KEYNELL CP

Lime Down Solar Park

Title:

Figure 9.1.7 Study Area
Cable Route Search Corridor

Document:

Arboriculture
Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- Cable Route Search Corridor
- 15m Study Area
- Tree Survey Result
- Tree Preservation Order (TPO)
- Ancient Woodland
- Conservation Area

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_ARB_0185

Coordinate system: British National Grid

Scale: 1:25,000 @ A3

0 400 800 Metres

N W E S

Island GREEN POWER

Lanpro

386000 388000 390000 392000

176000 174000 172000 170000

Long Dean, Ford and Slaughterford Conservation Area

Castle Combe Conservation Area

Allington Conservation Area

Biddestone Conservation Area

Chippenham Conservation Area

Rowden Conservation Area

Pickwick Conservation Area

Corsham Conservation Area

Easton Conservation Area

Lacock Conservation Area

Lime Down Solar Park

Title:

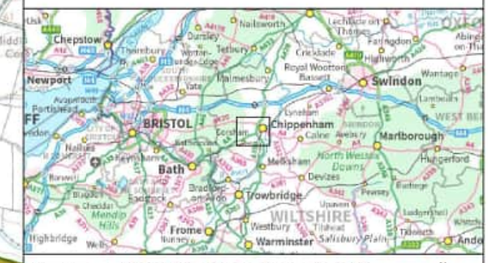
Figure 9.1.8 Study Area
Cable Route Search Corridor

Document:

Arboriculture
Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- Cable Route Search Corridor
- 15m Study Area
- Tree Survey Result
- Tree Preservation Order (TPO)
- Ancient Woodland
- Conservation Area



Drawing no.: P4443_LPR_ZZ_XX_DR_Z_ARB_0185

Coordinate system: British National Grid

Scale: 1:25,000 @ A3

0 400 800 Metres

N W E S

Island GREEN POWER

Lanpro

Lime Down
Solar Park

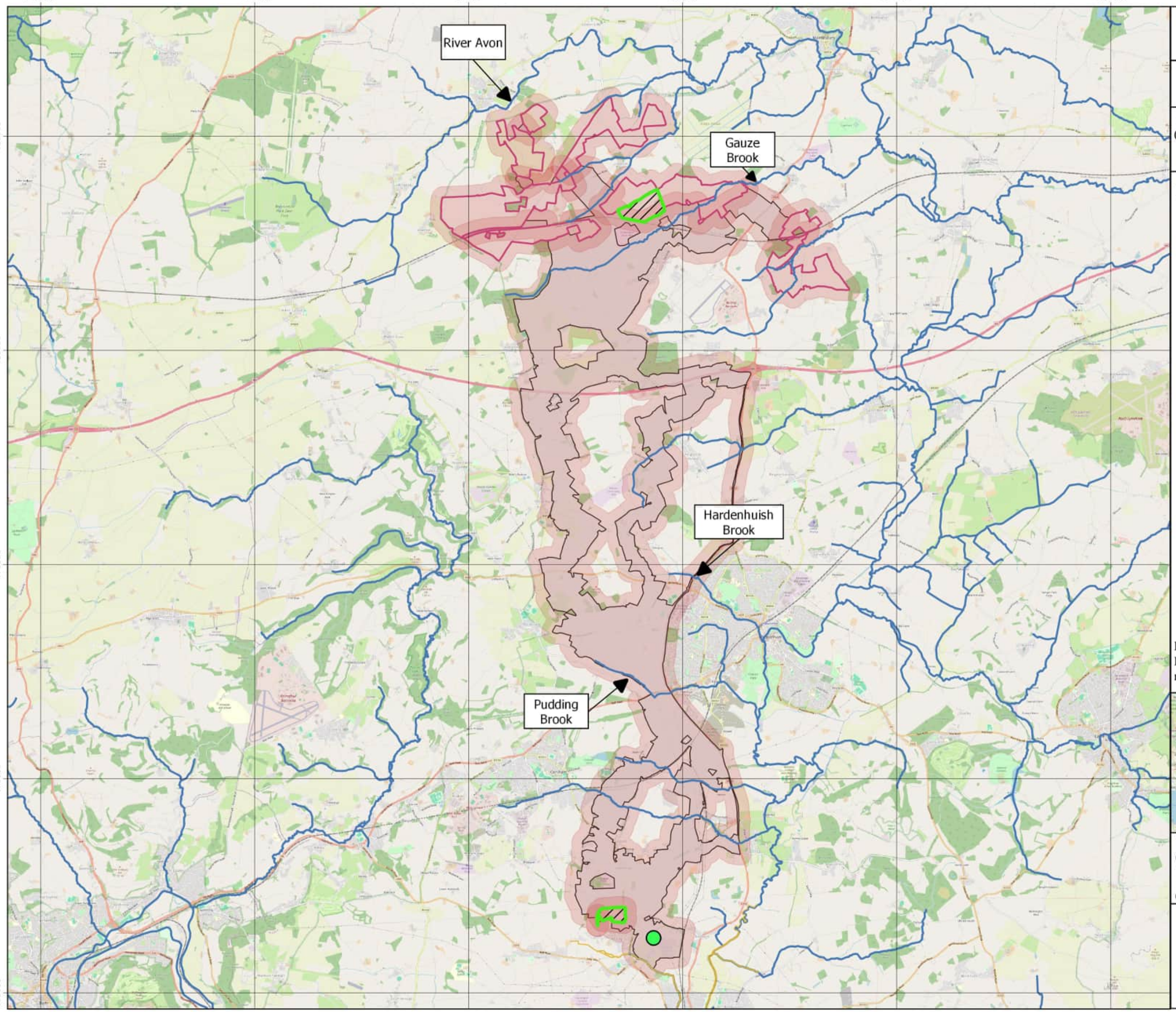
EIA Scoping Report

Appendix 10.1:

Hydrology, Flood Risk and Drainage Figures

July 2024

EN010168



Lime Down Solar Park

Title:
Figure 10.1: The Study Area

Document:
Chapter 10 Hydrology, Flood Risk and Drainage Environmental Impact Assessment Scoping Report

Legend:
- Study Area
- Area for Solar Panels and Associated Development
- Associated Development Site Area- Battery Energy Storage System
- Cable Route Search Area
- Watercourse
- Melksham Substation

Data:
Base Maps: © Crown copyright and database rights 2023 Ordnance Survey 0100031673

Drawing no.1
Co-ordinate system: OSGB36 / British National Grid
0 500 1,000 1,500 m Scale: 1:83579 @ A3

N W E S

Island GREEN POWER

Lanpro

375000 380000 385000 390000 395000 400000

185000 180000 175000 170000 165000

River Avon

Gauze Brook

Hardenhuish Brook

Pudding Brook

Lime Down Solar Park

Title:
Figure 10.2: Flood Map for Planning Rivers and Sea

Document:
Chapter 10 Hydrology, Flood Risk and Drainage Environmental Impact Assessment Scoping Report

Legend:
- Area for Solar Panels and Associated Development
- Associated Development Site Area- Energy Storage Ststem
- Cable Route Search Area
- Watercourse
- Flood Zone 2
- Flood Zone 3
- Melksham Substation

Data:
Base Maps: © Crown copyright and database rights 2023 Ordnance Survey 0100031673

Drawing no.1
Co-ordinate system: OSGB36 / British National Grid
0 500 1,000 1,500 m Scale: 1:83579 @ A3

N W E S

Island GREEN POWER

Lanpro

375000 380000 385000 390000 395000 400000

185000 180000 175000 170000 165000

River Avon

Gauze Brook

Hardenhuish Brook

Pudding Brook

Lime Down Solar Park

Title:
Figure 10.3: Risk of surface water flooding

Document:
Chapter 10 Hydrology, Flood Risk and Drainage Environmental Impact Assessment Scoping Report

Legend:
- Area for Solar Panels and Associated Development
- Associated Development Site Area- Battery Energy Storage System
- Cable Route Search Area
- Watercourse
- Risk of surface water 3.3% (1 in 30)
- Risk of surface water 1% (1 in 100)
- Risk of surface water 0.1% (1 in 1000)
- Melksham Substation

Data:
Base Maps: © Crown copyright and database rights 2023 Ordnance Survey 0100031673

Drawing no.1
Co-ordinate system: OSGB36 / British National Grid
0 500 1,000 1,500 m Scale: 1:83579 @ A3

N W E S

Island GREEN POWER

Lanpro

Lime Down
Solar Park

EIA Scoping Report

Appendix 11.1:
Preliminary Geo-Environmental Risk Assessment (Land at Melksham Substation)

July 2024

EN010168

Preliminary Geo-Environmental Risk Assessment

Land at Melksham Substation, Whitley, Wiltshire

Presented to: Lime Down Solar Park Limited

Issued: July 2024

Delta-Simons Project No: 93799.580479

Protecting people and planet

Executive Summary

Brief	Delta-Simons was instructed by Lime Down Solar Park Limited to produce a Preliminary Geo-Environmental Risk Assessment for land to the north of Whitley, Melksham, Wiltshire for a proposed solar Battery Energy Storage System (BESS).
Site Use & Surrounding Area	The Site currently comprises multiple undeveloped agricultural fields with associated field boundaries lined with occasional trees and shrubbery. The Site is located within a wider rural area comprising predominantly of agricultural land. The village of Whitley is approximately 220 m south of the Site. The B3353 road is immediately east of the Site.
Environmental Setting	No superficial deposits are mapped on Site. The south of the Site is mapped as being underlain by bedrock of the Kellaways Formation (Unproductive Strata), Cornbrash Formation (Secondary A Aquifer), and the Forest Marble Formation (Secondary A Aquifer). Due to a fault running through the Site from east to west. The north of the Site is directly underlain by the Forest Marble Formation. It is likely the Site is underlain with a limited thickness of weathered bedrock material. The north of the Site is within a Source Protection Zone I – Inner Protection Zone associated with two potable groundwater abstractions approximately 145 m north of the Site. The nearest surface water feature is a surface drain along the north western boundary of the Site which is considered to be for field drainage.
Contamination Potential Sources	No potential significant contamination sources have been identified based upon the historic and current Site use.
Development Considerations	Widespread or significant contamination is considered unlikely and the preliminary risk assessment has identified a **very low** risk of soil and groundwater contamination as well as hazardous ground gas at the Site. Potential geohazards have been identified associated with the geological fault present on-Site and the sloping nature of the Site potential leading to the requirement of earthworks.
Uncertainty and Data Gaps	This assessment is based on desk study information only. No Site-specific ground investigation data has been made available for review.
Recommendations	• A geotechnical specific Site investigation may be required to determine suitability of shallow soils on-Site for proposed foundation design and/or and to determine the groundwater level of the Site. • A Discovery Strategy should be put in place during development for ground workers to act upon should potential contamination be identified; and • Subject to the proposed development scheme a Materials Management Plan (MMP) may be required in accordance with regulatory protocols during redevelopment.
This is intended as a summary only. Further detail and the limitations of the assessment are provided within the main body of the Report.	

Table of Contents

1.0 Introduction

1.1 Appointment

Delta-Simons Limited ("Delta-Simons") was instructed by Lime Down Solar Park Limited (the "Client") to prepare a Preliminary (Geo-Environmental) Risk Assessment for a proposed solar Battery Energy Storage System (BESS) at land to the north of Whitley, Melksham, Wiltshire (the "Site").

This Report was undertaken in accordance with Delta-Simons fee proposal dated 9th June 2023. The standard limitations associated with this Assessment are presented in Appendix A.

1.2 Context & Purpose

The aim of this Report is to support the submission of a support the application for a development consent order for the proposed development.

The proposed development for the Site may comprise a Battery Energy Storage System (BESS) in association with Melksham Solar Scheme, however, no proposed development plans have been provided at the time of writing the report.

To that end this study assesses the likely environmental and geotechnical issues associated with soil and groundwater conditions that may affect the proposed development of the Site. This Report is designed in general accordance with guidance on Land Contamination: Risk Management pages of the GOV.UK web pages, the relevant requirements of the National Planning Policy Framework (NPPF) (as revised 2021) (paragraphs 174 & 183-184)[1] and the Planning Practice Guidance (Land Affected by Contamination)[2].

1.3 Scope of Works

The following scope of works is included within the report;

- Review of the environmental setting of the Site, including the current use / status of the Site and surrounding area, and review of the geology, hydrogeology and hydrology;
- Review of the historical activities of the Site and surrounding area;
- Review of regulatory information relating to the Site;
- Review of the online planning records for the Site;
- Consult and review information from the Local Authority / Petroleum Officer / Environment Agency in relation to Part 2A of the 1990 Environmental Protection Act;
- Review online records of potential unexploded ordnance risks;
- Complete a Site reconnaissance by undertaking a visual inspection of readily accessible areas of the Site;
- Review of readily available third party reports relating to the Site or surrounding area;
- Develop an outline Conceptual Site Model and undertake a Preliminary Risk Assessment with respect to potential contamination focussed on the proposed land use;
- Provide commentary on potential land contamination and geotechnical constraints in the context of the proposed development.

Data sources used in this assessment are listed in Appendix B.

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1004408/NPPF_JULY_2021.pdf

2 https://www.gov.uk/guidance/land-affected-by-contamination

1.4 Limitations

The standard limitations associated with this Assessment are presented in Appendix A. In addition, there are the following specific limitations that apply to this Assessment:

- No specific development plans have been made available;
- The Consultant undertaking the Site inspection maintained a general awareness for evidence of invasive plant species, particularly Japanese Knotweed. While none were observed during the walkover, it should be noted that the Consultant is not a trained ecologist and a separate survey undertaken by an experienced Ecologist would be necessary if a more robust assessment is needed;
- The Report includes an initial assessment of unexploded ordnance (UXO) risks for the Site using online data sources; and
- While a detailed radon assessment falls outside of the scope of this Report, a commentary based on UK Health Security Agency guidance (as at ukradon.org.uk) and data presented in the Envirocheck report, is provided.

2.0 Site Context & Data Review

The following sections provide a summary of the key site features based on the data sources listed in Appendix B. All distances, measurements and dates are approximate and the accuracy limitations of the data sources should be noted.

2.1 Site Information

<table>
<tr><th colspan="4">Site Overview</th></tr>
<tr><td colspan="4"> 
Imagery © Airbus, CNES/Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, Map data ©2023</td></tr>
<tr><td>Co-ordinates</td><td colspan="2">Centred at National Grid Reference 388330, 166860.</td><td>Elevation
61 - 78 m AOD
Area
18.15 Ha</td></tr>
<tr><td>Site Address and Location</td><td colspan="3">Land north of Whitley, Melksham, Wiltshire, SN12 8QU.
The Site is located in a rural area approximately 220 m north of Whitley village and immediately to the west of the B3353 road. A Site Location Map is provided as Figure 1.
Google Maps Link</td></tr>
<tr><td>Site Description</td><td colspan="3">Delta-Simons conducted a Site visit on 21st September 2023. A series of Site photographs are presented as Appendix D, and pertinent information that was observed or reported on-Site is summarised below.
The Site comprises multiple undeveloped agricultural fields with associated field boundaries lined with occasional trees. At the time of the walkover the fields comprised a series of cover crops and drilled wheat/ barley.
An overhead powerline with associated pylons was noted to intersect the site north west to south east through the centre of the Site.</td></tr>
</table>

Description of Adjacent and Surrounding Land Uses	The Site is located within a rural area to the north of Whitley, Melksham with farmland surrounding the Site to the north, east and west. The village of Whitley is approximately 220 m south of the Site. The B3353 (Goodes Hill) is immediately east of the Site. Small stockpiles comprising garden waste and wood was observed immediately to the north of the boundary to the north east.
Where identified, the potential on-Site or off-Site sources of contamination are considered further in Section 3.0.	

2.2 Physical Setting

The physical setting of the subject property can influence the susceptibility to, and relative magnitude of, environmental impacts and liabilities associated with on- and off-Site sources of contamination. The following table provides physical setting information for the subject property and surrounding area.

Published Geology	British Geological Survey (BGS) online viewer (mapapps2.bgs.ac.uk/geoindex) and mapping (bgs.ac.uk/maps) (1:50,000 Sheet Number 265, Bath) indicates that ground conditions at the Site comprise: • Superficial deposits: No superficial deposits are mapped at the Site. • Bedrock: The south of the Site is underlain by Kellaways Formation (21 – 31 m thick) comprising sandstone, siltstone and mudstone underlaid by the Cornbrash Formation (4 – 6 m thick), and further underlaid by the Forest Marble Formation (24 – 31 m thick) comprising mudstone with limestone. The north of the Site is directly underlain by the Forest Marble Formation. This is due to a normal fault which runs from the east to the west of the Site dipping south, which is a part of the wider horst and graben Atworth-Lacock Fault Belt
Site-Specific Geology	There are no BGS recorded boreholes (mapapps2.bgs.ac.uk/geoindex) on the Site or in the immediate vicinity of the Site.
Aquifers and Groundwater Receptors	The Environment Agency (EA) data magic.defra.gov.uk provides the following aquifer classification and designations: • Superficial deposits: No superficial deposits are mapped at the Site. • Bedrock: The Kellaways Formation is designated as an Unproductive Strata. The Cornbrash Formation and Forest Marble Formation are designated as Secondary A Aquifers. • Source Protection Zones: A Zone I - Inner Protection Zone is present in the north of the Site in the area of the Forest Marble Formation. The neighbouring Zone II Outer Protection Zone is located approximately 40m north from the northwest corner of the Site. The majority of the Site is not located in a designated groundwater Source Protection Zone. • Groundwater Abstractions: Two licenced public potable groundwater abstraction are recorded approximately 145 m north-east of the Site. Both abstractions are operated by Wessex Water Services Ltd. These abstractions are most likely associated with the presence of the SPZ I – Inner Protection Zone present on-Site.
Groundwater Levels and Flow Direction	Groundwater flow is most likely in a south easterly direction following local topography down gradient towards the River Avon which is located approximately 2.16 km south east of the Site. The regional Source Protection Zone maps also indicate a south easterly groundwater flow. Locally groundwater direction in the north of the Site could potentially be affected by the potable groundwater abstractions.

Hydrology	The nearest surface water feature is a drainage channel adjacent to the north-western boundary of the Site. The River Avon is located approximately 2.16 km south east of the Site. According to the Envirocheck Report, there are no licensed abstraction records from surface water located within 500 m of the Site.
Site Topography	The Site topography gently slopes downward from the north to the south, with a small undulating ridge present in the centre of the Site which may be related to the faulting present on-Site. Regional topography slopes downward in a similar direction.
Mining & Quarrying	Reference to the Coal Authority on-line viewer (bgs.ac.uk/coalauthority) indicates that the Site is not with a Coal Mining Reporting Area. Consequently, a Coal Mining Risk Assessment (CMRA) is unlikely to be required under the planning regime. The Envirocheck report records two ceased BGS Recorded Mineral Sites located approximately 200 m north east of the Site and approximately 225 m west of the Site, relating to limestone extraction from the Great Oolite Group.
Ground Stability Hazards	The Envirocheck Report indicates the following hazards on-Site: • Dissolution – *Very Low Hazard;* • Landslide – *Very Low Hazard;* • Shrinking and swelling clay - *Very Low to Low Hazard;* • Collapsible ground - *Very Low Hazard;* • Running sands - *Very Low Hazard; and* • Stability Hazards – *Low Hazard.* There are five manmade cavities listed within 1 km of the Site, the closest of which is approximately 495 northeast of the Site. The Cavity type is listed as a slope shaft entry for Bath Stone Mine for the extraction of limestone. The Mining and Ground Stability Datasheet obtained for the Site indicates 'Conclusive Rock Mining' at the Site. In addition, the Site is located within a Underground Mining Plan relating to the mining of limestone across the Bat area. Further desk-based assessment is recommended to assess the presence and extent of underground limestone mining.
Radon Gas	The UK health Security Agency (ukradon.org) data indicates that the Site lies within a lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level).

2.3 Sensitive Land Use

Ecological Receptors	It is understood from information provided within the Envirocheck Report, there are no statutory ecological receptors within 500 m of the Site.
Heritage Interest	Historic England Records (historicengland.org.uk) indicate that no areas of designated heritage interest are located on or adjacent to the Site.

2.4 Historical Use of the Site & Surrounding Area

2.4.1 Approach

The historical development of the Site and surrounding area has been assessed through a review of historical maps, aerial photographs and Google Earth historical satellite imagery. A summary of the key historical Site uses and developments in the surrounding area is presented below. Copies of selected historical maps are included as Appendix F.

2.4.2 Historical Use Summary

Since the earliest available mapping in 1886 the site has been undeveloped and presumably under agricultural use in line with the surrounding area. There has been no significant development on-Site to date with the Site remaining undeveloped.

Small quarry pits were mapped approximately 220 m west of the Site in both 1886 and 1900 but are no longer mapped by 1921. In 1886 and 1900 mapping a spring was mapped approximately 20 m west for the Site. In 1921 a tank was mapped in the vicinity of this spring presumably associated with the spring for water collection use. From 1886 there has been a road mapped to the east of the Site. In 1960 the road was mapped in its current layout and labelled as Goodes Hill and the B3353. In 1976 an overhead power cable was mapped transecting the northeastern corner of the Site with the pylons mapped just outside the northern and eastern boundaries of the Site.

2.4.3 Unexploded Ordnance (UXO)

The Zetica Regional Unexploded Bomb Risk Map for the area of the Site (zeticauxo.com) indicates that there is a low risk of UXO in the area of the Site.

2.5 Environmental Database Review

The Landmark Envirocheck® Report provides a database of environmental information held by various statutory bodies including the EA, Local Authority (LA), Health & Safety Executive (HSE) and Public Health England amongst others. A copy of the Envirocheck Report is provided in Appendix E and the most relevant information is summarised below.

Features On-Site	The Landmark Envirocheck® Report states that there no potentially contaminative features located on-Site.
Potentially Contaminative Features Off-Site	The Landmark Envirocheck® Report lists the following within 500 m of the Site: • Two inactive Contemporary Trade Directory Entries relating blind and awning sales and clay products located 275 m and 350 m south and south east; • Two BGS Recorded Mineral Sites for limestone, 200 m north-east and 225 m west; and • Two revoked Discharge Consents relating to treated effluent and agricultural trade discharge, approximately 225 m south and 430 m south. The treated effluent is listed as discharging to the land/soakaway. There are no BGS, LA or Historical Landfills within 500 m of the Site.

2.6 Planning Review/Regulatory Enquiries

On-line Planning Review	Wiltshire Council Website link	**Date Accessed**	12/09/2023
On-Site Applications	There are no planning application records relating to the Site.		
Off-Site Applications	No additional potentially contaminative activities or other information pertinent to this assessment was identified from the historical planning records.		
Part 2A of the Environmental Protection Act (EPA) 1990	Wiltshire Council's Environmental Health Team have confirmed that the Site is not registered under Part 2A of the Environmental Protection Act (EPA) 1990. Additionally, there are no records of any significant pollutant incidents or records indicating significant land contamination issues in the vicinity of the Site.		

2.7 Previous Reports

No third party reports have been made available to review from the Client or sourced through a review of planning application records.

3.0 Conceptual Site Model

3.1 Introduction

A Conceptual Site Model (CSM) represents the relationships between contaminant sources, pathways and receptors, to support the identification and assessment of contaminant linkages.

3.2 Overall Site Sensitivity

The majority of the Site is considered to be of a low environmental sensitivity given the presence of Kellaways Formation (Unproductive Strata) at the surface, underlaid by the Cornbrash and Forest Marble Formation (Secondary A Aquifers). The north of the Site would be considered to have a moderate environmental sensitivity given the Forest Marble Formation mapped at the surface and the presence of a Source Protection Zone I - Inner Protection Zone to the north of the Site associated with two potable water abstractions approximately 150 m north.

The nearest surface water receptor is a drainage channel along the north western boundary of the Site, but this is considered for surface drainage only and not a permanent surface water feature.

3.3 Potential Contamination Sources

A source is a contaminant or pollutant that is in, on or under the land that has the potential to cause harm or pollution.

The following identified potential contamination sources are considered in the CSM:

- No significant potential historic or current sources of contamination have been identified at the Site;
- Potential small-scale spills and leaks of agricultural machinery;
- No significant sources of volatile organic vapours have been identified; and
- No significant potential sources of hazardous ground gas have been identified on-, or immediately off-Site.

3.4 Potential Pathways

A pathway is a route by which a receptor is or could be affected by contaminant.

The potential pathways are considered to be as follows:

- Direct contact, ingestion or inhalation of soil bound contaminants / dust during or following redevelopment;
- Inhalation of organic vapours associated with contamination;
- Migration of ground gas / vapours into on-Site buildings causing asphyxiation or risk of explosion;
- Leaching of contamination into groundwater followed by migration of groundwater to the wider groundwater environment or discharge to surface waters; and
- Direct contact between aggressive ground conditions and new infrastructure

3.5 Potential Receptors

A receptor is something that could be adversely affected by a contaminant, for example a person, controlled waters, an organism, an ecosystem, or Part 2A receptors such as buildings crops or animals.

Relevant potential receptors are considered to include:

- Construction workers;
- Third parties during construction (adjacent Site users and adjacent residents);
- Future Site users and maintenance workers;

- The nearby surface water receptor of a drainage channel immediately adjacent west of the Site; and
- The underlying bedrock aquifer (Secondary A) particularly in the north of the Site and associated groundwater Source Protection Zone.

3.6 Contaminant Linkage Assessment

The table below considered the potential pollutant linkages present on-Site.

Source(s)	Pathway(s)	Receptor(s)	Risk	Comments	Requires Investigation
Potentially contaminated soils and/or groundwater located beneath the Site.	Direct contact/ ingestion and inhalation of dust and vapours.	Site users.	Very Low Risk	Significant potential sources of contamination have not been identified associated with the current or historical uses of the Site. No potential sources of volatile contamination have been identified. The potential for low-level contamination from on-Site agricultural practices remains, however within the context of the current Site use and proposed development as a battery storage facility, the risk to future Site users is considered to be very low.	No
	Direct contact, ingestion and inhalation of dust and vapours.	Maintenance workers during any future sub-surface works at the Site.	Low Risk	Although considered low risk, Site workers may become exposed to localised contaminated soils and shallow groundwater during intrusive groundworks undertaken at the Site. Safe working practices should be undertaken, and appropriate Personal Protective Equipment (PPE) should be used that will reduce the risk to low. A Discovery Strategy should also be introduced in the event localised contamination is found during ground works on Site.	No

Source(s)	Pathway(s)	Receptor(s)	Risk	Comments	Requires Investigation
	Leaching of contaminants and vertical migration. Lateral migration through any groundwater beneath the Site.	Groundwater beneath the Site (Cornbrash and Forest Marble Formations - Secondary A Aquifers). Off-Site receptors including the SPZ I and off-site groundwater abstractions	Very Low Risk	Significant potential sources of contamination have not been identified associated with the current or historical uses of the Site. The potential for low-level contamination from on-Site agricultural practices remains. The Forest Marble Formation (Secondary A Aquifer) underlies the Site but is present at surface in the north of the Site due to faulting activity This area is designated as an area of groundwater sensitivity (Zone I - Inner Protection Zone). The leaching and vertical migration of contaminants is possible, though the risk that mobile contaminants are present is likely to be low. The south of the Site is directly underlain by the Kellaways Formation (Unproductive Strata) which would restrict any potential contaminants from leaching into the underlying Secondary A Aquifers.	No
	Direct Contact.	Buried infrastructure.	Low Risk	Sulphates within the ground have the potential to attack buried infrastructure. Based on the anticipated natural clay/mudstone soils at the Site, the risk is considered low, however it would be prudent to assess the sulphate class of the soils at the time of any geotechnical investigation.	No
Ground gas.	Vertical and lateral migration of ground gases.	Site users & the buildings on-Site.	Very Low Risk	No potential on or off-Site sources of ground gas have been identified.	No
Potentially contaminated soil and groundwater from off-Site sources.	Lateral migration and subsequent inhalation.	Groundwater beneath the Site and future Site users.	Very Low Risk	No significant potential off-Site sources have been identified associated to the current or historic use of the surrounding area. The Site is located within an area of undeveloped agricultural land.	No

4.0 Conclusions & Recommendations

4.1 Land Contamination Risks and Liabilities

Uncertainty and Data Gaps	This assessment is based on desk study information only. No Site-specific ground investigation data has made available for review.
Soils and Groundwater	Significant on-Site sources have not been identified and given the low sensitivity end use the risk to future Site users is considered very low and no further assessment is required. Site workers may become exposed to localised contaminated soils and shallow groundwater during intrusive groundworks undertaken at the Site. Safe working practices should be undertaken, and appropriate Personal Protective Equipment (PPE) should be used that will reduce the risk to low. A Discovery Strategy should also be introduced in the event localised contamination is found during ground works on Site.
Groundwater	Significant widespread groundwater contamination is not anticipated.
Ground Gas	No significant potential sources of hazardous ground gases have been identified and no further assessment is required.
Potential Contaminated Land Development Risks	Widespread contamination is considered unlikely and the preliminary risk assessment has identified a **very low to low risk** of soil and groundwater contamination as well as hazardous ground gas at the Site.

4.2 Geotechnical Considerations

Uncertainty and Data Gaps	This assessment is based on desk study information only. No Site-specific ground investigation data has made available for review.
Preliminary Ground Model	Based on the available information, it is anticipated that the south of the Site is likely to be underlain by bedrock of the Kellaways Formation underlaid by the Cornbrash Formation and the Forest Marble Formation. The north of the Site is anticipated to be directly underlain by Forest Marble Formation comprising mudstone and limestone. Superficial deposits are not mapped however a limited thickness of weathered bedrock is most likely present. Given the Site's historic and current agricultural use, Made Ground is unlikely to be present. Groundwater is expected be present with the Secondary A Aquifers (Cornbrash and Forest Marble Formations) however, no data is available for the Site to determine the depth of the groundwater head.
Plausible Geo-Hazards	The geohazards listed below have been identified to follow guidance presented in the HE document CD622 'Managing Geotechnical Risk' (2019) which aims to identify and manage the geotechnical risks associated with a scheme throughout its lifespan, from planning to construction to maintenance. The following geohazards are considered to be substantial ground related risks associated with the proposed development. A substantial risk is defined by Delta-Simons in Appendix C. • Based on the information collected to date, there is the potential for underground limestone rock mining to be present at the Site and in the immediate area. The risk for ground instability associated with workings cannot be discounted and further assessment is recommended. • A geological fault line associated with the Atworth-Lacock Fault Belt is present in the north of the Site running east to west. The fault is a normal fault dipping southward.

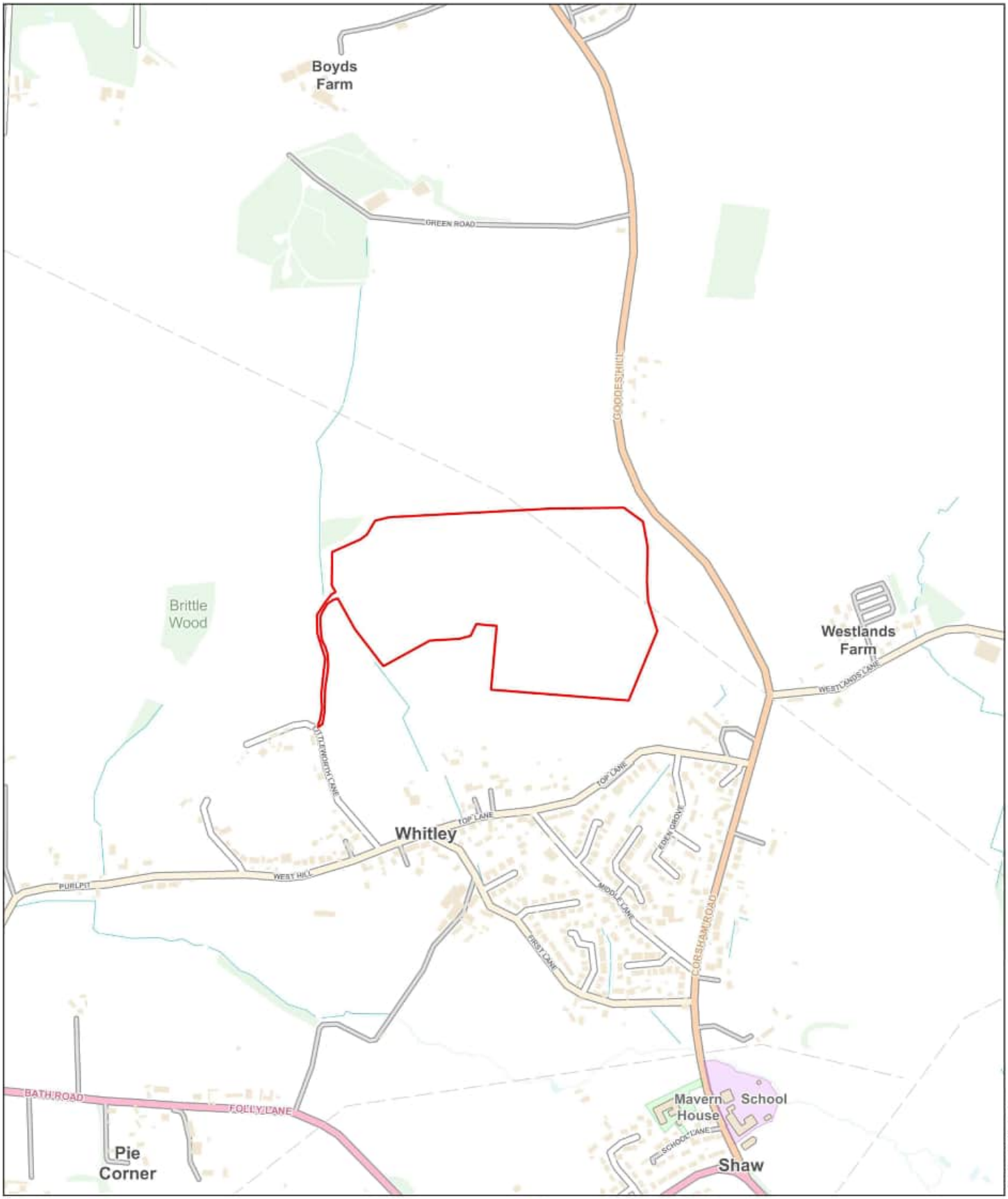
	• The Site gradually slopes downward towards the south and south-east. It is anticipated that a scheme of earthworks will be required to provide a development platform. • There is the potential for shrink/swelling clays associated with the bedrock and due to trees bordering the Site. • Sulphate testing may be required to determine a suitable concrete grade for any buried infrastructure.
Geotechnical Development Implications	Based upon the proposed development and the ground conditions of the Site normal shallow foundations would be potential satisfactory for the potential loads of a battery storage facility. Should the foundations be laid across the fault that is present on-Site or cross between strata of the Kellaways Formation and Forest Marble Formation located at surface then differential settlement may present a risk to the proposed development.

4.3 Recommendations and Other Development Considerations

Recommendations	The following recommendations and development abnormals area considered appropriate; • Further desk based assessment is recommended to assess he potential presence and extent of underground limestone mining at the Site; • A geotechnical Site investigation to assess in-situ geotechnical soil strength testing / laboratory testing and CBRs, in order to inform proposed foundation/roadway design; • A Discovery Strategy should be put in place for groundworks to act upon should potential contamination be identified; and • Subject to the proposed development scheme a Materials Management Plan (MMP) may be required in accordance with regulatory protocols during redevelopment

Figures

Figure 1 – Site Location Plan



Legend

Site Boundary

0 100 200 300 400 500 600 700 m

N

Figure: Site Location Plan		
Job: Land at Melksham Substation, Whitley		
Client: Lime Down Solar Park Limited		
Figure No.: 1	Revision: 1	Date: 08 July 2024
Drawn by: LB	Checked by: JG	Scale: 1:7,000
Job No.: 93799.580479		

DO NOT SCALE. NOT FOR CONSTRUCTION

Site Plan Provided by Client 2024

DeltaSimons

Lime Down
Solar Park

EIA Scoping Report

Appendix 11.2:
Limestone Mining Report

July 2024

EN010168

DeltaSimons

Limestone Mining Report

Lime Down Solar Scheme, Wiltshire

Presented to: Lime Down Solar Park Limited

Issued: July 2024

Delta-Simons Project No: 93799.580479

Protecting people and planet

Table of Contents

1.0 Introduction

1.1 Appointment

Delta-Simons Limited ("Delta-Simons") was instructed by Lanpro Services on behalf of Lime Down Solar Park Limited (the 'Client') to produce a Limestone Mining Report for land to the north of Whitley, Melksham, Wiltshire (the 'Site').

1.2 Context & Purpose

The proposed development for the Site may comprise a Battery Energy Storage System (BESS) in association with Melksham Solar Scheme, however, no proposed development plans have been provided at the time of writing the report.

Following completion of a Preliminary (Geo-Environmental) Risk Assessment for the Site, the Mining and Ground Stability Datasheet obtained for the Site indicated 'Conclusive Rock Mining' at the Site, as such, further desk-based assessment was recommended to assess the presence and extent of underground limestone mining.

The aim of the desk top assessment is to;

- Investigate the potential for above-ground and/or underground limestone mining and geology which may be in the zone of influence with respect to the proposed development and therefore represent an abnormal development risk/cost;
- Identify potential development constraints;
- Allow an appropriate intrusive investigation to be scoped up (if required) to quantify the risks;
- Set out appropriate mitigation measures (if required) to address the mining legacy issues affecting the Site, including necessary remedial works; and
- Demonstrate that the application Site is, or can be made, safe and stable to meet the requirements of national planning policy with regard to development on unstable land.

1.3 Limitations

The assessment is limited to the issues agreed within the proposal for the works. General notes on limitations associated with this assessment are provided in Appendix A.

In addition, there are the following specific limitations that apply to this assessment:

- No specific development plans have been made available.

2.0 Site Information

<table>
<tr><th colspan="4">Site Information</th></tr>
<tr><td colspan="4"> 

Imagery © Airbus, CNES/Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, Map data ©2023</td></tr>
<tr><td rowspan="2">Coordinates</td><td rowspan="2">Centred at National Grid Reference 388330, 166860.</td><td>Elevation</td><td>61 - 78 m AOD</td></tr>
<tr><td>Area</td><td>18.15 Ha</td></tr>
<tr><td>Site Location and Description</td><td colspan="3">Land north of Whitley, Melksham, Wiltshire, SN12 8QU.
The Site is located in a rural area approximately 220 m north of Whitley village and immediately to the west of the B3353 road.
Google Maps Link</td></tr>
<tr><td>Description and of Proposed Development</td><td colspan="3">The proposed development for the Site may comprise a Battery Energy Storage System (BESS) in association with the wider Melksham Solar Scheme, however, no proposed development plans have been provided at the time of writing the report.</td></tr>
<tr><td>Sources of Information</td><td colspan="3">The following sources of information have been used to inform this report:
• British Geological Survey (BGS) Map Sheet 265 ‘Bath’ 1:50,000 scale;
• Review of historical mapping included within the Envirocheck Report (Ref. 316694838_1_1), dated 8th September 2023;
• Mining and Ground Stability Datasheet (Ref. 324515764_1_1, dated 13th November 2023;</td></tr>
</table>

	• Regulated Stone Mining Search, Top Lane, Whitley, Groundsure Ref. GS-84V-IW6-74A-DUP, dated 13th December 2023; • BGS on-line database (interactive map viewer); • Review of BGS Mine Plans (No. 13671, 13672, 13688 and 13689).

3.0 Limestone Mining Risk Assessment

3.1 Geology & Ground Model

The published BGS information suggests that the Site is directly underlain by bedrock of the Kellaways Formation (21 – 31 m thick) comprising sandstone, siltstone and mudstone underlaid by the Cornbrash Formation (4 – 6 m thick), and further underlaid by the Forest Marble Formation (24 – 31 m thick) comprising mudstone with limestone. The north of the Site is directly underlain by the Forest Marble Formation. This is due to a normal fault which runs from the east to the west of the Site dipping south, which is a part of the wider horst and graben Atworth-Lacock Fault Belt.

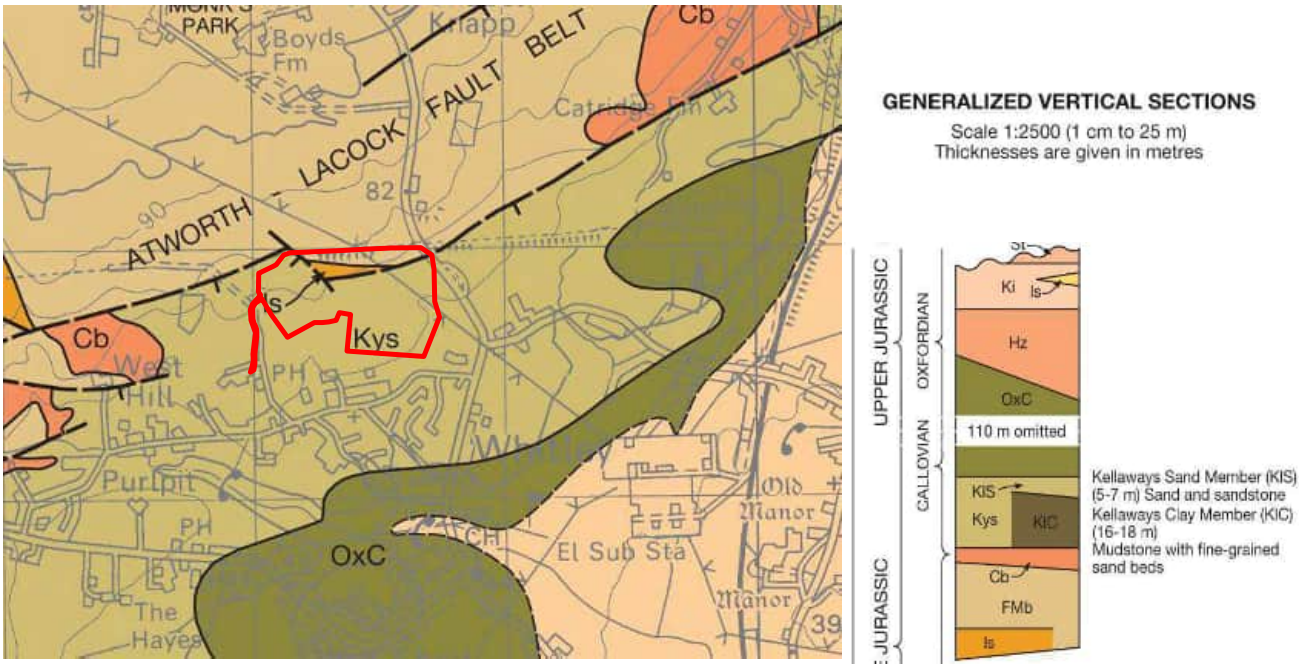


Plate 1: 1:50,000 Solid Geology Mapping (Reproduced from the British Geological Survey Maps Portal - contains British Geological Survey materials © NERC 2011).

3.1.1 BGS Borehole Records

There are no BGS borehole records located on-Site or within the surrounding area.

3.1.2 Sketch Cross Section

The sketch north-south cross section below shows the anticipated geology beneath the Site. The main faulting on-Site is also shown, which is anticipated to be at or near vertical based on the nature of the faulting with a downthrow in the south. The secondary minor faulting orientated approximately north-south is also anticipated to be at or near vertical with a westerly downthrow.

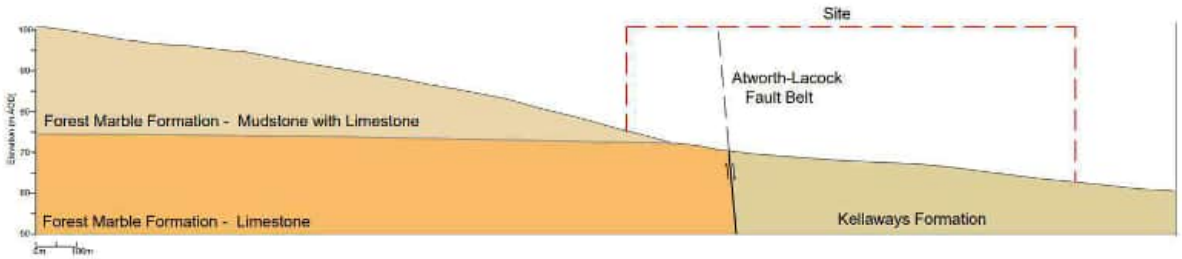


Plate 2: Sketch geological cross section of the Site.

3.2 Historical Map Review

Historical maps dating back to 1886 were obtained as part of an Envirocheck Report. A selection of useful and relevant maps is contained in Appendix B.

Since the earliest available mapping in 1886 the site has been undeveloped and presumably under agricultural use in line with the surrounding area. There has been no significant development on-Site to date with the Site remaining undeveloped.

Evidence of mining is noted throughout mapping in the wider surrounding area. Opencast quarries were mapped between approximately 220 m west and 850 m west of the Site from 1886. Underground mining is also inferred at quarries located 850 m west (Park Lane Quarry) and 750 m north (Monk's Quarry) given the presence of slope shafts, trial shafts and air shafts. The closest shaft is located approximately 250 m north east, mapped in 2000. By this time the surrounding quarries and shafts are largely mapped as disused. No evidence of limestone mining is noted on-Site, which is consistent with the geological mapping which indicates the Site to be largely underlain by the Kellaways Formation (sandstone, siltstone and mudstone).

3.3 Mine Plans

Delta-Simons has obtained copies of Mine Plans held for the area by the BGS. Information provided does not indicate the presence of mining beneath the Site or in close proximity. It should be noted that the quality of the received plans is poor and the exact location of some of the workings in relation to the Site are difficult to establish. An overlay of the plans has been undertaken using historical mapping and buildings shown at Boyds Farm (Plate 3) and grid reference lines (Plate 4).

Plate 3: Extract from Mine Plan No. KP13672 showing workings at Eastlays and Park Lane Quarries.

Plate 4: Extract from Mine Plan No. KP13689 showing workings at Eastlays, Park Lane and Monk's Park Quarries.

Two further plans (Ref. 13671 and 13688) were also obtained from the BGS, however, from geolocating the plans, neither extend onto the Site. No evidence of limestone mining has been identified on the Site.

3.4 Mining Search

Reference to the Mining and Ground Stability Datasheet identified that the Site is within an area of 'Conclusive Rock Mining', a copy of this report is included as Appendix C. The report also lists a BGS Recorded Mineral Site located approximately 365 m north east relating to the underground extraction of limestone (Goodes Hill Mine) and an air shaft located approximately 420 m north east.

As such a Regulated Stone Mining Search has been purchased for the Site (Ref. GS-84V-IW6-74A-DUP, dated 13th December 2023). The full report is provided within Appendix D.

According to the Regulated Stone Mining Search the property lies within an area of historic mining activity for the extraction of limestone. However, no evidence of stone mining has been identified that could affect the Site and no records of stone extraction are listed within 20 m of the Site. No further action is recommended.

4.0 Conclusions

Based on the findings of the research and the results of this assessment, there is no evidence to indicate that historical extraction of limestone (either opencast or underground) on the Site. As such no further assessment or mitigation is required for the proposed battery energy storage system development.

Lime Down
Solar Park

EIA Scoping Report

Appendix 11.3:
Preliminary Geo-Environmental Risk Assessment (Lime Down A to E)

July 2024

EN010168

DeltaSimons

Preliminary Geo-Environmental Risk Assessment

Lime Down Solar Scheme, Wiltshire

Presented to: Lime Down Solar Park Limited

Issued: July 2024

Delta-Simons Project No: 93799.580479

Protecting people and planet

Table of Contents

1.0 Introduction

1.1 Appointment

Delta-Simons Limited ("Delta-Simons") was instructed by Lanpro Services on behalf of Lime Down Solar Park Limited (the "Client") to prepare a Preliminary Geo-Environmental Risk Assessment for land located to the north-west of Chippenham, Wiltshire (the "Site").

This Report was undertaken in accordance with Delta-Simons fee proposals dated 6th December 2023, 8th April 2024 and 1st July 2024. The standard limitations associated with this Assessment are presented in Appendix A.

1.2 Context & Purpose

It is understood that the Site is proposed to be developed as a Solar Farm (Lime Down Solar Scheme), however, no detailed plans have been provided. It is anticipated that the majority of the Site will comprise ground mounted solar arrays with associated maintenance access routes and limited infrastructure such as sub-stations and battery storage.

The aim of this Report is to support the application for a development consent order.

To that end this study assesses the likely environmental and geotechnical issues associated with soil and groundwater conditions that may affect the proposed development of the Site. This Report is designed in general accordance with guidance on Land Contamination: Risk Management pages of the GOV.UK web pages, the relevant requirements of the National Planning Policy Framework (NPPF) (as revised 2023) (paragraphs 174 & 183-184)[1] and the Planning Practice Guidance (Land Affected by Contamination)[2].

1.3 Scope of Works

The scope of works includes the following;

- Review of the environmental setting of the Site, including the current use / status of the Site and surrounding area, and review of the geology, hydrogeology and hydrology;
- Review of the historical activities of the Site and surrounding area;
- Review of regulatory information relating to the Site;
- Review of the online planning records for the Site;
- Review information from the Local Authority in relation to Part 2A of the 1990 Environmental Protection Act;
- Review online records of potential unexploded ordnance risks;
- Complete a Site reconnaissance by undertaking a visual inspection of readily accessible areas of the Site;
- Develop an outline Conceptual Site Model and undertake a Preliminary Risk Assessment with respect to potential contamination focussed on the proposed land use; and
- Provide commentary on potential land contamination and geotechnical constraints in the context of the proposed development.

Data sources used in this assessment are listed in Appendix B.

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1182995/NPPF_Sept_23.pdf
[2] https://www.gov.uk/guidance/land-affected-by-contamination

1.4 Limitations

The standard limitations associated with this Assessment are presented in Appendix A. In addition, there are the following specific limitations that apply to this Assessment:

- No detailed development plans have been provided, however, it is anticipated that the majority of the Site will comprise ground mounted solar panels with associated maintenance access routes and limited infrastructure such as sub-stations and battery storage;
- A Site walkover has been undertaken as part of this assessment, however, given the scale of the Site it is not feasible to inspect all of the Site, although key areas have been inspected;
- The Consultant undertaking the Site inspection maintained a general awareness for evidence of invasive plant species, particularly Japanese Knotweed. While none were observed during the walkover, it should be noted that the Consultant is not a trained ecologist and a separate survey undertaken by an experienced Ecologist would be necessary;
- The Report includes an initial assessment of unexploded ordnance (UXO) risks for the Site using online data sources. A detailed UXO assessment falls outside of the scope of this Report; and
- While a detailed radon assessment falls outside of the scope of this Report, a commentary based on UK Health Security Agency guidance (as at ukradon.org.uk) and data presented in the Envirocheck report is provided.

2.0 Site Context & Data Review

The following sections provide a summary of the key site features based on the data sources listed in Appendix B. All distances, measurements and dates are approximate and the accuracy limitations of the data sources should be noted.

2.1 Site Information

<table>
<tr><th colspan="4">Site Overview</th></tr>
<tr><td colspan="4"> 

Contains OS data © , Crown Copyright and Database Right (2023)</td></tr>
<tr><td>Co-ordinates</td><td>Centred at National Grid;
Lime Down A: 386000, 184730
Lime Down B: 385670, 183600
Lime Down C: 388130, 185250
Lime Down D: 389100, 183540
Lime Down E: 392680, 182520</td><td>Total Area</td><td>901.0 Ha</td></tr>
<tr><td>Site Address and Location</td><td colspan="3">The Solar Scheme comprises five land parcels proposed to house solar arrays. Lime Down A to E are shown on the plan above. In addition, the scheme will include a cable corridor which connects the land parcels to Melksham Solar Battery Energy Storage System (BESS), north of Whitley, Melksham. The exact location of the cable corridor is unknown at this stage, however, an anticipated route has been assessed (where provided).

Lime Down A: Land to the south-east of Sherston, Wiltshire Google Maps Link.

Lime Down B: Land to the east of Alderton, Wiltshire and adjacent to the Fosse Way Google Maps Link.

Lime Down C: Land to the east of Ladyswood and west of Norton, Wiltshire. Adjacent to the east of the Fosse Way Google Maps Link.

Lime Down D: Land to the west and south of Norton and west of Corston, Wiltshire Google Maps Link.</td></tr>
</table>

	Lime Down E: Land to the south of Corston and Rodbourne, and to the east of the A429 road Google Maps Link.
Site Description	The Site has been assessed through readily available online aerial and street view imagery. In addition, a Delta-Simons representative undertook a Site walkover on 31st January 2024 of readily accessible areas. Pertinent entries noted or observed on-Site are described below, with supporting photographs in Appendix D. To note, due to the scale of the walkover and lack of access, the majority of the Site areas were observed from either the roadside of public footpaths. Given the size and complexity of the study area, the Site has been separated into a series of Sites referenced as Lime Down A to E, as shown on Drawing 1. The majority of the Site comprises agricultural fields, small residential dwellings, farmsteads and farm infrastructure (including barns) with associated tracks and ditches. The Bristol to London train line runs east to west through the centre of the land portions. No significant evidence of contamination (visual and olfactory) was observed during the walkover.
Description of Adjacent and Surrounding Land Uses	The majority of the Sites are surrounded by undeveloped agricultural land and associated buildings for agricultural use in addition to roads. A review of adjacent and surrounding land uses aside from agriculture is provided below: • A vehicle repair shop is located immediately south of **Lime Down A;** • Two residential properties are present approximately 90 m north of **Lime Down A**; • A sports/recreational field and associated clubhouse is present immediately north of **Lime Down B**; • A railway line is present between the land parcels of **Lime Down B** and **Lime Down E**, and immediately south of **Lime Down D**; and • A garden machinery supplier is present approximately 200 m south of **Lime Down D**.

2.2 Physical Setting

The physical setting of the subject property can influence the susceptibility to, and relative magnitude of, environmental impacts and liabilities associated with on- and off-Site sources of contamination. The following table provides physical setting information for the subject property and surrounding area.

Published Geology	British Geological Survey (BGS) online viewer (mapapps2.bgs.ac.uk/geoindex) indicates that ground conditions at the Sites comprise:

Strata	**Location**
Superficial Deposits	
Alluvium comprising clay, silt, sand and gravel	Discrete pockets in Lime Down C, D, and E, associated with Gauze Brook in C and D and Gabriel's Well in Lime Down E.
Head Deposits comprising clay, silt, sand and gravel	Discrete pockets in the south of Lime Down B and east of Lime Down C.

	Bedrock Geology
	Forest Marble Formation (mudstone) — Mapped across Lime Down A and B. A discrete pocket in the east of Lime Down E associated with the lower elevation of Gabriel's Well and in the western areas of Lime Down D.
	Cornbrash Formation (limestone) — Across large parts of Lime Down C, D, and E.
	Kellaways Clay Member (mudstone) — Across the majority of Lime Down D, areas of Lime Down E and a discrete pocket in Lime Down C.
	Kellaways Sand Member (sandstone and limestone) — A discrete pocket in the east of Lime Down D.
Site-Specific Geology	There are two BGS recorded boreholes (mapapps2.bgs.ac.uk/geoindex) on-Site in the south western corner of Lime Down B, adjacent to the existing railway line. The boreholes recorded a general sequence of clayey topsoil underlain by loose silty sandy gravel becoming dense to very dense with depth. Groundwater was identified at 1.50 m bgl.
Aquifers and Groundwater Receptors	The Environment Agency (EA) data magic.defra.gov.uk provides the following aquifer classification and designations.

Strata	**Location**	**Aquifer Designation**
Superficial Deposits		
Alluvium comprising clay, silt, sand and gravel	Discrete pockets in Lime Down C, D, and E, associated with Gauze Brook in C and D and Gabriel's Well in Lime Down E.	Secondary A
Head Deposits comprising clay, silt, sand and gravel	Discrete pockets in the south of Lime Down B and east of Lime Down C.	
Bedrock Geology		
Forest Marble Formation comprising mudstone	Mapped across Lime Down A and B. A discrete pocket in the east of Lime Down E associated with the lower elevation of Gabriel's Well and in the western areas of Lime Down D.	Secondary A
Cornbrash Formation comprising limestone	Across large parts of Lime Down C, D, and E.	Secondary A
Kellaways Clay Member comprising mudstone	Across the majority of Lime Down D, areas of Lime Down E and a discrete pocket in Lime Down C.	Unproductive Strata
Kellaways Sand Member comprising sandstone and limestone	A discrete pocket in the east of Lime Down D.	Secondary A

The Environment Agency (EA) data provides the following designations for groundwater Source Protection Zones:

	• Zone I - Subsurface Activity – Lime Down E and the eastern portion of Lime Down C and D. • Zone II - Subsurface Activity - Lime Down A, B, and the western portion of Lime Down C and D. According to the Envirocheck Report there is a licensed groundwater abstraction located on-Site along the north western area of Lime Down C. The license is noted to have expired in 1995 and was in use for general agriculture. There are a further four licensed abstractions from groundwater within 500 m of the Site for general and agricultural uses. The closest of which is located approximately 150 m from Lime Down B in the central eastern area. There are no licensed groundwater abstraction records for potable water within 500 m of the Site.
Groundwater Levels	The available BGS borehole information indicated groundwater to be present at 1.50 m bgl, which based on the description of the soils is considered to have been identified within superficial deposits. Given the extent of the Site and the presence of drains, variable superficial deposits and bedrock strata the depth to groundwater is anticipated to vary across the Site, however, may be perched and/or shallow.
Hydrology	The nearest surface water features for each of the Sites are summarised below: • **Lime Down A** - A small pond is present approximately 160 m south, and the River Avon is present approximately 260 m north of the Lime Down A; • **Lime Down B** - A small pond is present in the central portion, and a drainage channel is present in the west of the Lime Down B; • **Lime Down C** - A small pond immediately north-east of Lime Down C; • **Lime Down D** - A drainage channel is located in the central portion, eventually conjoining with Gauze Brook in the extreme north-east. An unlabelled water network is located across the western portion of Lime Down D; and, • **Lime Down E** – Gabriel's Well runs through the centre from north-east to south of Lime Down E. The Site and surrounding area are characterised by a series of drainage ditches given the agricultural use of the wider area. According to the Envirocheck Report, there is a single licensed abstraction record from surface water located within 500 m of the Site. The abstraction is located approximately 300 m northeast of Lime Down C and is recorded to have expired in October 1992.
Site Topography	The regional topography of the area gradually fluctuates whilst generally sloping downwards in a south-easterly direction. The highest point of elevation is in the western areas (Lime Down A and B [~ 120m AOD]). The lowest point of elevation is within Lime Down E (~ 75 m AOD). **Lime Down A:** Gently slopes to the south and east, varying from ~ 120m in the north west to in the west to ~ 115m in the east and south; **Lime Down B:** Remains from ~ 120 m in the west to ~ 120 m in the east; **Lime Down C:** Slopes from ~ 100 m in the south to ~ 85 m in the north east; **Lime Down D:** Slopes from ~ 105 m in the west to ~ 75 m in the east; and **Lime Down E:** Slopes from ~ 90 m in the north west to ~ 75 m in the south east.
Mining & Quarrying	Reference to the Coal Authority on-line viewer (bgs.ac.uk/coalauthority) indicates that the Site is not with a Coal Mining Reporting Area. Consequently, a Coal Mining Risk Assessment (CMRA) is unlikely to be required under the planning regime.

	The Envirocheck report records a BGS Recorded Mineral Site in the north western area of Lime Down E and along the southern boundary of Lime Down C. The entries relate to the opencast extraction of limestone and clay/shale, both of which are noted to be ceased. It is considered that the entry on Lime Down E is located off-Site adjacent to the Site boundary as no evidence on on-Site extraction is noted in historical mapping. There are a further seven BGS Recorded Mineral Sites within 250 m of the Site, all of which relate the opencast extraction of clay and shale and are noted to be ceased.
Ground Stability Hazards	The Envirocheck Report indicates the following hazards on the Site; • Dissolution – *No Hazard to Low;* • Landslide – *Generally very low to low hazard. A single moderate risk area is identified in the western area of Lime Down B associated with the existing rail cutting. Given this is an engineered feature monitored by the Network Rail the risk is considered low, however, development near/adjacent to the cutting will need to be developed in conjunction with input from the rail company;* • Shrinking and swelling clay – *No Hazard to Moderate Hazard associated with mapped cohesive materials;* • Collapsible ground – *No Hazard to Very Low;* • Running sands - *Ho Hazard to Low;* • Compressible Hazards – *Generally No Hazard or Low Hazard across the Site, however, moderate risk associated with discrete areas of superficial Alluvium.*
Radon Gas	The Envirocheck data indicates that the Site lies within an area of low to intermediate radon probability with a maximum radon potential of 1-3% of homes being above the action level for radon. No radon protective measures are necessary in the construction of new buildings on-Site.

2.3 Sensitive Land Use

Ecological Receptors	It is understood from information provided within the Envirocheck Report, the following statutory ecological receptors are located within 500 m of the Site:
	• Ancient woodlands;
	  ○ Plantation on Ancient Woodland located adjacent to the central northern boundary of Lime Down B;
	  ○ Surrendell Wood in the central area of Lime Down B. The woods are off-Site, however, are surrounded by Lime Down B;
	  ○ An ancient and Semi-natural woodland located adjacent to the north western boundary of Lime Down D;
	  ○ Bincombe Wood and Noth Bincombe Wood located adjacent to the south eastern boundary of Lime Down D;
	  ○ West Park Wood located approximately 210 m north east of Lime Down D;
	  ○ Seagry Wood located approximately 20 m south east of Lime Down E;
	• A Site of Special Scientific Interest (Harries Ground, Rodbourne) is located adjacent to the central northern boundary of Lime Down E; and

	• The Cotswolds Area of Outstanding Beauty is located off-Site to the north and west of Lime Down A, B and C.
Heritage Interest	Historic England Records (historicengland.org.uk) indicate that no areas of designated heritage interest are located on the Site.

2.4 Historical Use of the Site & Surrounding Area

2.4.1 Approach

The historical development of the Site and surrounding area has been assessed through a review of historical maps, aerial photographs and Google Earth historical satellite imagery. A summary of the key historical Site uses and developments in the surrounding area is presented below. Copies of selected historical maps are included as Appendix E. It is to be noted that the Red Line Boundaries relating to the Site are indicative and reflect boundaries at time of report submission.

2.4.2 Historical Use Summary

Based on a review of the compilation of historical sources dating back to 1888, it appears that the Site has been largely in agricultural use to present day. Discrete areas of development are noted including roadways, farm tracks and agricultural buildings. There are three areas of agricultural buildings noted in the historical mapping:

- Barns in the western area of Lime Down B from the earliest map edition until no longer visible in aerial imagery dated 1999;
- Two barns/storage buildings in the south of Lime Down E from the earliest map edition. The western barn is no longer visible in 2014 aerial imagery, with the central buildings remaining present; and
- Fosse Farm Cottage and Well in the western portion of Lime Down D, present from the earliest historical mapping, remaining present within 2024 aerial imagery.

In addition, a quarry is noted on-Site along the southern boundary of Lime Down C from 1888 until 1955. This area is noted to comprise a localised depression and is heavily vegetated in aerial imagery, as such, it is unlikely that the quarry underwent significant backfilling following disuse.

The following are noted in the immediate vicinity of the Site:

- A quarry adjacent to the south west boundary of Lime Down B from 1888 until noted to be disused in 1923. The area comprises a localised depression, as such, is unlikely to have undergone significant backfill;
- A railway line adjacent to the central area of Lime Down B and central Lime Down C noted to be in construction in 1900 and mapped fully from 1923 until present;
- A quarry located approximately 30 m north of Lime Down B between 1900 and 1983; and
- Rodbourne Brick Works adjacent to north of Lime Down E from 1888 until noted to be disused in 1983.

No significant potentially contaminated historical land uses have been identified on or off-Site.

2.4.3 Unexploded Ordnance (UXO)

The Zetica Regional Unexploded Bomb Risk Map for the area of the Site (zeticauxo.com) indicates that there is a low risk of UXO in the area of the Site.

2.5 Environmental Database Review

The Landmark Envirocheck® Report provides a database of environmental information held by various statutory bodies including the EA, Local Authority (LA), Health & Safety Executive (HSE) and Public Health England amongst others. A copy of the Envirocheck Report is provided in Appendix F and the most relevant information is summarised below. It is to be noted that the Red Line Boundaries relating to the Site are indicative and reflect boundaries at time of report submission.

Features On-Site	The Landmark Envirocheck® Report does not list any pertinent entries for the Site. The report does indicate the presence of a gas pipeline (Wormington to Pucklechurch) in the north west of Lime Down B, in the north of Lime Down D and south east of Lime Down A.
Potentially Contaminative Features Off-Site	The Landmark Envirocheck® Report lists the following pertinent entries within 250 m of the Site: • Three contemporary Trade Directory entries located approximately between 190 m south west of Lime Down C and 230 m west of Lime Down D. The entry relates to an active brewery, active garage and inactive rubber & plastic manufacturer; • A Substantiated Pollution Incident Register located approximately 170 m north east relating to vehicle waste. The incident was listed as minor impact (category 3) to land and no impact (category 4) to water; There are no BGS, LA or historical landfills within 500 m of the Site.

2.6 Planning Review/Regulatory Enquiries

On-line Planning Review	Wiltshire Council Council Planning Website	**Date Accessed**	17th June 2024
On-Site Applications	The following planning applications are listed within the Site boundary; • 15/07427/OGL for Electric Lines to be above ground. The application is located in the southern area of Lime Down B. • 13/03567/HRN for the removal of hedgerow for access to a bridge during renovations of Pig Lane. The application is located in the southern area of Lime Down B. • PL/2022/02686 for the retrospective erection of a single-storey building for associated adjoining outdoor activities area. The application is listed in the southwestern area of Lime Down C and is noted to have been refused. • PL/2022/06054 for the change of use of land to outdoor recreational use included motorised driving archery and clay pigeon shooting together with erection of ancillary single-storey building (part retrospective). The application is also listed in the southwestern area of Lime Down C and is noted to have been approved subject to conditions. • 15/00425/FUL to demolish existing cottage and erect new replacement dwelling. The application is located in the western portion of Lime Down D and is noted to have been approved subject to conditions. 15/03101/VAR Variation of Condition of 15/00425/FUL (Demolition of Existing Cottage. New Replacement Dwelling. The application is located in the western portion of Lime Down D and is noted to have been approved subject to conditions. • N/13/00527/FUL for the extension of Swallow Cottage to Form 2 Bedroom Dwelling. The application is located in the western portion of Lime Down D and is noted to have been approved subject to conditions. No relevant information in relation to land contamination is included within the supporting documentation.		
Off-Site Applications	No additional potentially contaminative activities or other information pertinent to this assessment was identified from the historical planning records.		

2.7 Previous Reports

No third party reports have been made available to review from the Client or sourced through a review of planning application records.

3.0 Conceptual Site Model

3.1 Introduction

A Conceptual Site Model (CSM) represents the relationships between contaminant sources, pathways and receptors, to support the identification and assessment of contaminant linkages.

3.2 Overall Site Sensitivity

The Site is considered to be of a low environmental sensitivity given the historical and current agricultural use.

3.3 Potential Contamination Sources

A source is a contaminant or pollutant that is in, on or under the land that has the potential to cause harm or pollution.

Potential sources of contamination are limited to any small scale spills/leaks associated with the agricultural use of the Site.

Locally residual contaminants may be present associated with the historical quarrying in the southern area of Lime Down C.

No potential sources of ground gases or vapours have been identified on or off-Site.

3.4 Potential Pathways

A pathway is a route by which a receptor is or could be affected by contaminant.

The potential pathways are considered to be as follows:

- Direct contact, ingestion or inhalation of soil bound contaminants / dust during or following redevelopment.
- Inhalation of organic vapours associated with contamination.
- Migration of ground gas / vapours into on-Site buildings causing asphyxiation or risk of explosion.
- Leaching of contamination into groundwater followed by migration of groundwater to the wider groundwater environment or discharge to surface waters.
- Direct contact between aggressive ground conditions and new infrastructure.

3.5 Potential Receptors

A receptor is something that could be adversely affected by a contaminant, for example a person, controlled waters, an organism, an ecosystem, or Part 2A receptors such as buildings crops or animals.

Relevant potential receptors are considered to include:

- Construction workers;
- Third parties during construction (adjacent Site users and adjacent residents);
- Future Site users and maintenance workers;
- Surface waters (ponds and drainage ditches) on Site and in the surrounding area;
- The underlying aquifers (Secondary A);
- The Built Environment (new buildings and infrastructure / utilities).

Contaminant Linkage Assessment				
Source(s)	**Pathway(s)**	**Receptor(s)**	**Risk**	**Comments**
Potentially contaminated soils and/or groundwater located beneath the Site.	Direct contact/ ingestion and inhalation of dust and vapours.	Site users.	**Very Low Risk**	No significant potential sources of contamination have been identified associated with the historical agricultural use of the Site. Given the very low sensitivity end use comprising a solar farm the risk to future Site users is considered very low. No further works are considered to be required.
	Direct contact, ingestion and inhalation of dust and vapours.	Maintenance workers during any future sub-surface works at the Site.	**Very Low Risk**	Site workers may become exposed to localised contaminated soils and shallow groundwater during intrusive groundworks undertaken at the Site. Safe working practices should be undertaken and appropriate Personal Protective Equipment (PPE) should be used that will reduce the risk to low. Intrusive investigation will inform potential risks in new development areas.
	Leaching of contaminants and vertical migration.	Groundwater beneath the Site.	**Very Low Risk**	No significant potential sources have been identified and there are no licensed groundwater abstraction records for potable water within 500 m of the Site, as such, the risk to controlled waters is considered very low.
	Direct contact.	Buried infrastructure.	**Low Risk**	Sulphates within the ground have the potential to attack buried infrastructure. Based on the anticipated natural soils at the Site, the risk is considered low, however it would be prudent to assess the sulphate class of the soils at the time of any geotechnical investigation. It is considered unlikely that new potable supply pipes are required.
Ground gas.	Vertical and lateral migration of ground gases.	Site users & the buildings on-Site.	**Very Low Risk**	No potential sources of ground gas have been identified. In addition, given the very low sensitivity end use comprising a solar farm with limited infrastructure comprising battery storage and sub-stations, the potential for hazardous ground gas to accumulate is consider very low as such no further assessment is required.

4.0 Conclusions & Recommendations

4.1 Land Contamination Risks and Liabilities

Uncertainty and Data Gaps	This assessment is based on desk study information only. No Site specific ground investigation data has made available for review.
Soils	Given the very low sensitivity end use comprising a solar farm the risk to future Site users is considered very low and no further assessment is required.
Groundwater	No significant potential sources have been identified and there are no licensed groundwater abstraction records for potable water within 500 m of the Site, as such, the risk to controlled waters is considered very low.
Ground Gas	No significant potential sources have been identified. In addition, given the very low sensitivity end use comprising a solar farm with limited infrastructure comprising battery storage and sub-stations, the potential for hazardous ground gas to accumulate is consider very low as such no further assessment is required.
Potential Contaminated Land Development Risks	Widespread contamination is considered unlikely and the preliminary risk assessment has identified a **very low to low** risk of soil/groundwater contamination and hazardous ground gas at the Site.

4.2 Geotechnical Considerations

Uncertainty and Data Gaps	This assessment is based on desk study information only. No Site specific ground investigation data has made available for review.
Preliminary Ground Model	Based on the available information, it is anticipated that the Site is likely underlain by a sequence of Topsoil and varying superficial deposits of Alluvium (near water courses) or Head deposits. The bedrock is mapped as the Forest Marble Formation (mudstone), Cornbrash Formation (limestone) and Kellaways Clay Member (mudstone). Given the presence of drains, variable superficial deposits and bedrock strata the depth to groundwater is anticipated to vary across the Site, however, may be perched and/or shallow.
Plausible Geo-Hazards	The geohazards listed below have been identified to follow guidance presented in the HE document CD622 'Managing Geotechnical Risk' (2019) which aims to identify and manage the geotechnical risks associated with a scheme throughout its lifespan, from planning to construction to maintenance. The following geohazards are considered to be substantial ground related risks associated with the proposed development. A substantial risk is defined by Delta-Simons in Appendix C. • Potential for Made Ground associated with historical development (Lime Down B and E, the former quarry in Lime Down C and western portion of Lime Down D. Made Ground is typically variable in nature and strength with a potentially low bearing capacity and unacceptable levels of total/differential settlement may occur; • Potential soft, variable and compressible superficial Alluvial deposits which have potentially low bearing capacity and unacceptable levels of total/differential settlement may occur; • The Sites vary from ~120m AOD across Lime Down A and B, to ~75 m AOD in Lime Down E. The sloping ground across the Sites may require earthworks to support the development;

	• There is the potential for shrink/swelling clays associated with the bedrock and due to trees bordering the Site; • Sulphate testing may be required to determine a suitable concrete grade for any buried infrastructure; • High groundwater table/perched groundwater can lead to unstable excavations which will required suitable shoring and dewatering; and • Variable strata could lead to further requirements for suitable shoring of excavations.

4.3 Recommendations and Other Development Considerations

Recommendations	The following recommendations are considered appropriate; • Confirmation on the routes of below ground services crossing the route, including gas pipelines present in the Site area; • A geotechnical Site investigation to assess in-situ geotechnical soil strength testing / laboratory testing and CBRs, in order to inform proposed foundation/roadway design; • A discovery strategy should be put in place for groundworks to act upon should potential contamination be identified; and • Subject to the proposed development scheme a Materials Management Plan (MMP) may be required in accordance with regulatory protocols during redevelopment.

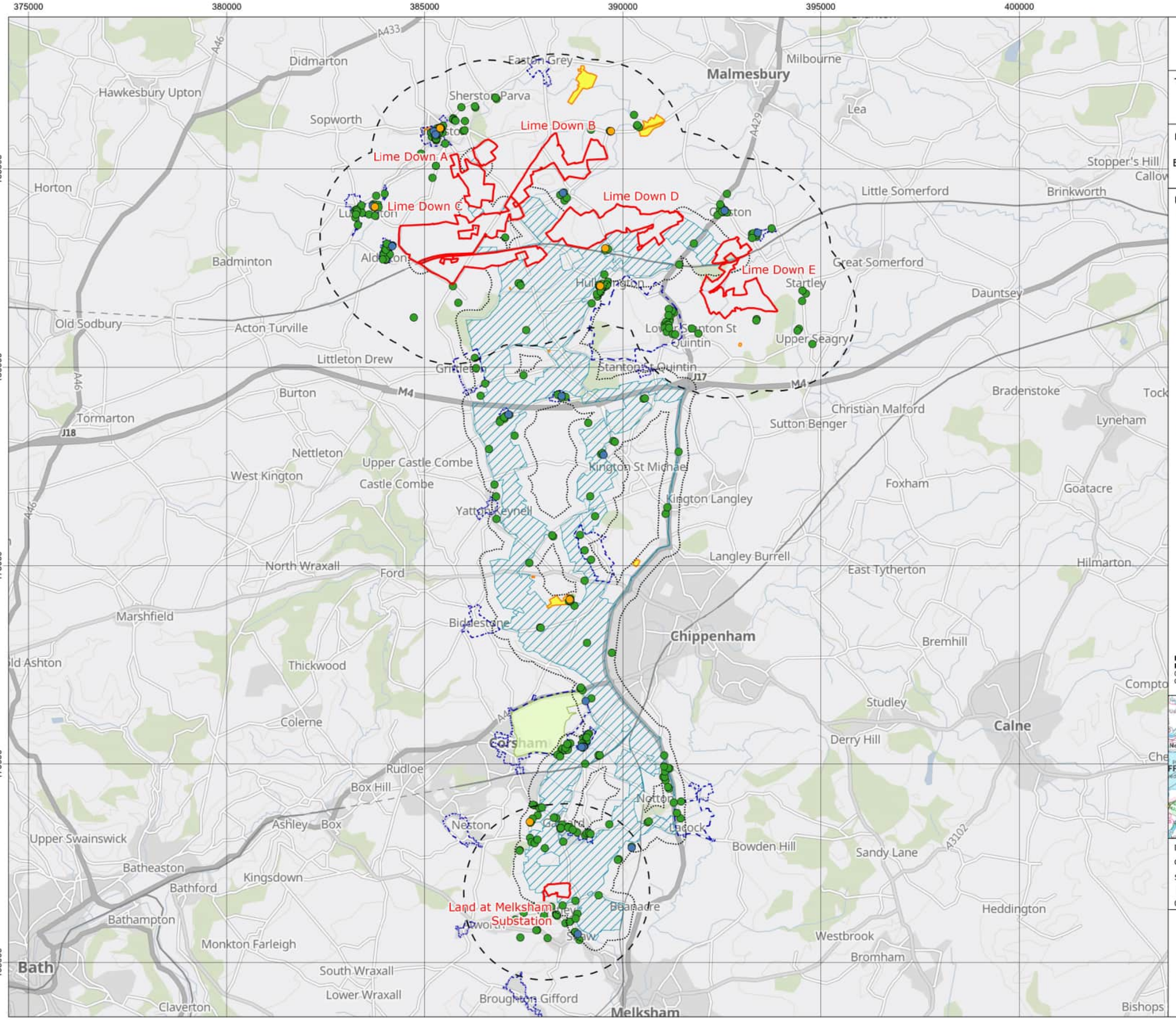
Lime Down
Solar Park

EIA Scoping Report

Appendix 12.1:
Cultural Heritage Figures

July 2024

EN010168



Lime Down Solar Park

Title:
Figure 12.1 Designated Heritage Assets 2km Buffer

Document:
Historic Environment
Environmental Impact Assessment Scoping Report

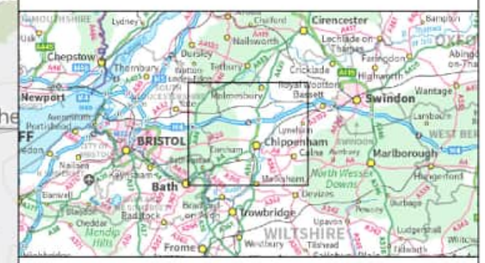
Legend:

- Site Boundary
- 2km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area

Listed Building

- Grade I
- Grade II*
- Grade II
- Conservation Area
- Scheduled Monument
- Registered Park and Garden

Data: Historic England, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673Contains OS data © Crown Copyright and database right 2023 Contains data from OS Zoomstack



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Island GREEN POWER

Lanpro

384000 386000 388000 390000

188000 186000 184000 182000

Lime Down Solar Park

Title:
Figure 12.1.1 Designated Heritage Assets
Lime Down A

Document:
Historic Environment
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 2km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary

Listed Building
- Grade I
- Grade II*
- Grade II
- Conservation Area
- Scheduled Monument
- Registered Park and Garden

Data: Historic England, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0117
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

386000 388000 390000 392000

188000 186000 184000 182000

Lime Down Solar Park

Title:
Figure 12.1.2 Designated Heritage Assets
Lime Down B

Document:
Historic Environment
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 2km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary

Listed Building
- Grade I
- Grade II*
- Grade II
- Conservation Area
- Scheduled Monument
- Registered Park and Garden

Lime Down B

Easton Grey Conservation Area

Sherston Conservation Area

Hullavington Airbase Conservation Area

1013354
1018389
1023219
1004703
1023223
1198808
1356040
1018610

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0117
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

384000 386000 388000 390000

186000 184000 182000 180000

Lime Down Solar Park

Title:
Figure 12.1.3 Designated Heritage Assets
Lime Down C

Document:
Historic Environment
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 2km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary

Listed Building
- Grade I
- Grade II*
- Grade II
- Conservation Area
- Scheduled Monument
- Registered Park and Garden

Data: Historic England, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0117
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

386000 388000 390000 392000 394000

186000 184000 182000

1013354 1018389 1023219 1198808 1356040 1018610 1018418 1013076

Lime Down D

Rodbourne Conservation Area

Hullavington Airbase Conservation Area

Lime Down Solar Park

Title:
Figure 12.1.4 Designated Heritage Assets
Lime Down D

Document:
Historic Environment
Environmental Impact Assessment Scoping Report

Legend:

- Site Boundary
- 2km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary

Listed Building

- Grade I
- Grade II*
- Grade II
- Conservation Area
- Scheduled Monument
- Registered Park and Garden

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0117
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

390000 392000 394000 396000

184000 182000 180000

Rodbourne Conservation Area

Lime Down E

1198808

1356040

Hullavington Airbase Conservation Area

1013076

Stanton St Quintin Conservation Area

Lime Down Solar Park

Title:
Figure 12.1.5 Designated Heritage Assets
Lime Down E

Document:
Historic Environment
Environmental Impact Assessment Scoping Report

Legend:

- Site Boundary
- 2km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary

Listed Building

- Grade I
- Grade II*
- Grade II
- Conservation Area
- Scheduled Monument
- Registered Park and Garden

Data: Historic England, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0117
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

386000 388000 390000 392000

170000 168000 166000 164000

Corsham Court RPG

1363968

Neston Conservation Area

Gastard Conservation Area

Lacock Conservation Area

Land at Melksham Substation

Atworth Conservation Area

Broughton Gifford Conservation Area

Lime Down Solar Park

Title:
Figure 12.1.6 Designated Heritage Assets Land at Melksham Substation

Document:
Historic Environment
Environmental Impact Assessment Scoping Report

Legend:

- Site Boundary
- 2km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary

Listed Building

- Grade I
- Grade II*
- Grade II
- Conservation Area
- Scheduled Monument
- Registered Park and Garden

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0117
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

386000 388000 390000 392000

180000 178000 176000

1018418
Grittleton Conservation Area
1425267
Allington Conservation Area
1010908
1018428
Sheldon Manor RPG

GRITTLETON CP
STANTON ST QUINTIN CP
CASTLE COMBE CP
KINGTON ST MICHAEL CP
KINGTON LANGLEY
YATTON KEYNELL CP

Lime Down Solar Park

Title:
Figure 12.1.7 Designated Heritage Assets
Cable Route Search Corridor

Document:
Historic Environment
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 2km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary

Listed Building
- Grade I
- Grade II*
- Grade II
- Conservation Area
- Scheduled Monument
- Registered Park and Garden

Data: Historic England, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0117
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER
Lanpro

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176000 174000 172000 170000

Allington Conservation Area

1425267

1010908

1022907

1018428

Sheldon Manor RPG

Biddestone Conservation Area

Corsham Court RPG

Corsham Conservation Area

Easton Conservation Area

Lime Down Solar Park

Title:
Figure 12.1.8 Designated Heritage Assets
Cable Route Search Corridor

Document:
Historic Environment
Environmental Impact Assessment Scoping Report

Legend:

- Site Boundary
- 2km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary

Listed Building

- Grade I
- Grade II*
- Grade II
- Conservation Area
- Scheduled Monument
- Registered Park and Garden

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0117
Coordinate system: British National Grid
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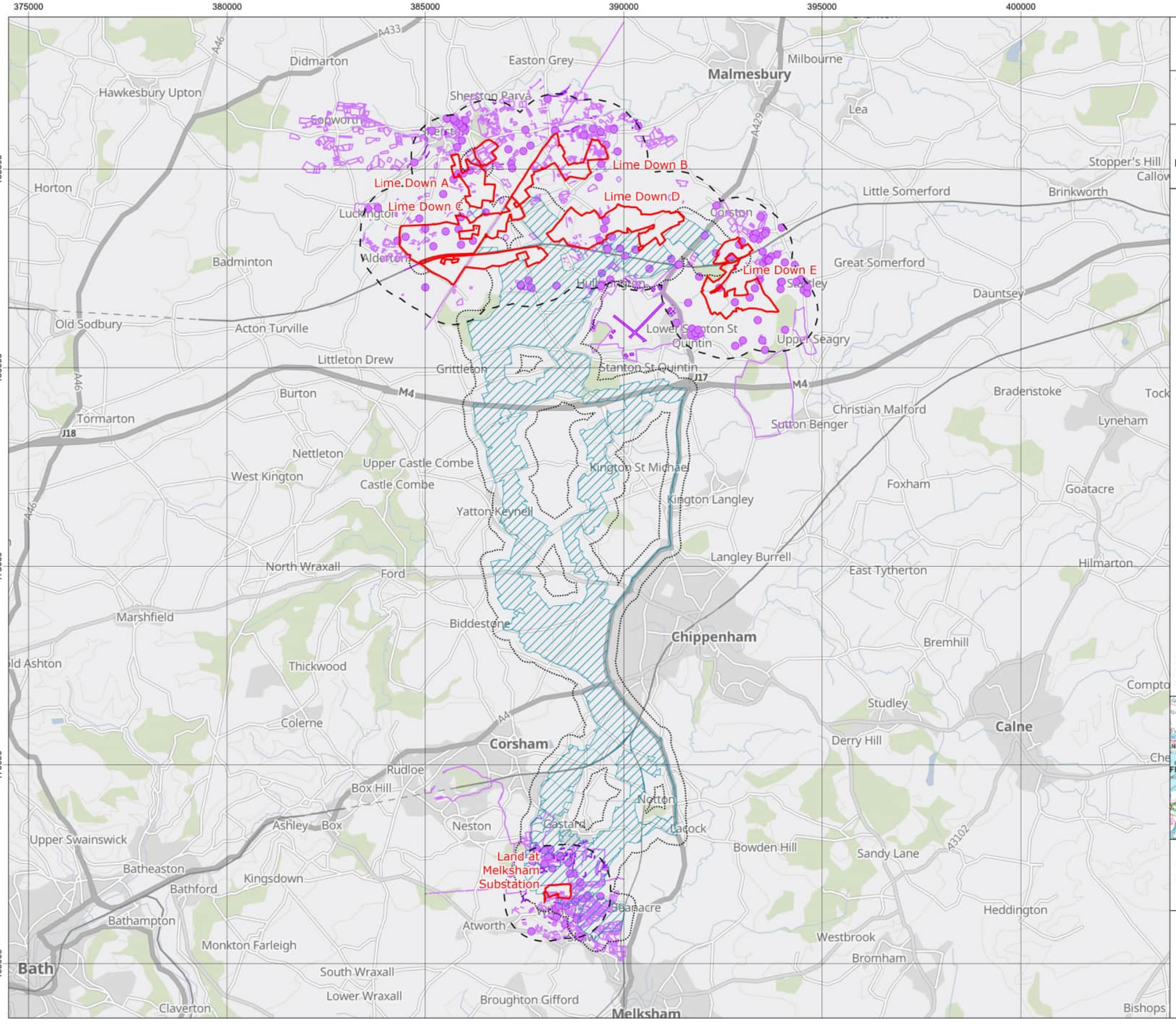
Island GREEN POWER

Lanpro



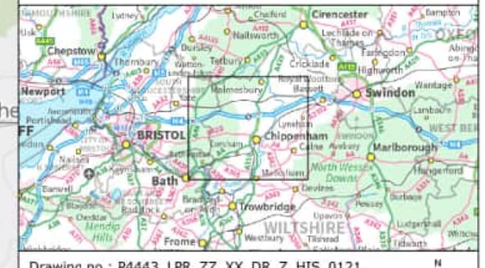
Lime Down Solar Park

Title:
Figure 12.2 Non-Designated Heritage Assets 1km Buffer

Document:
Cultural Heritage
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 1km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- HER 'monument' point
- HER 'monument' line
- HER 'monument' polygon

Data: Wiltshire County Council, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673Contains OS data © Crown Copyright and database right 2023 Contains data from OS Zoomstack



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Island GREEN POWER
Lanpro

384000 386000 388000 390000

188000 186000 184000 182000

Lime Down Solar Park

Title:
Figure 12.2.1 Non-Designated Heritage Assets
Lime Down A

Document:
Cultural Heritage
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 1km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary
- HER 'monument' point
- HER 'monument' line
- HER 'monument' polygon

Lime Down A
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12

SHERSTON CP
EASTON GREY CP
LUCKINGTON CP
HULLAVINGTON CP
NORTON CP

Data: Wiltshire County Council, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0122
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

386000 388000 390000 392000

188000 186000 184000 182000

Lime Down Solar Park

Title:
Figure 12.2.2 Non-Designated Heritage Assets
Lime Down B

Document:
Cultural Heritage
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 1km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary
- HER 'monument' point
- HER 'monument' line
- HER 'monument' polygon

Lime Down B
B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12
SHERSTON CP
EASTON GREY CP
NORTON CP
HULLAVINGTON CP
ROMAN SETTLEMENT (site of)
KARTING

Data: Wiltshire County Council, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0122
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

Lime Down Solar Park

Title:
Figure 12.2.3 Non-Designated Heritage Assets
Lime Down C

Document:
Cultural Heritage
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 1km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary
- HER 'monument' point
- HER 'monument' line
- HER 'monument' polygon

Lime Down C

Data: Wiltshire County Council, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0122
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

386000 388000 390000 392000 394000

186000 184000 182000

Lime Down Solar Park

Title:
Figure 12.2.4 Non-Designated Heritage Assets
Lime Down D

Document:
Cultural Heritage
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 1km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary
- HER 'monument' point
- HER 'monument' line
- HER 'monument' polygon

Lime Down D
D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D17 D18 D19 D20 D21 D22 D23 D24
81 83 84 85 86 87 88 89 90 91 92 93 94

HULLAVINGTON CP
NORTON CP
ST PAUL MALMESBURY WITHOUT CP
STANTON ST QUINTIN CP

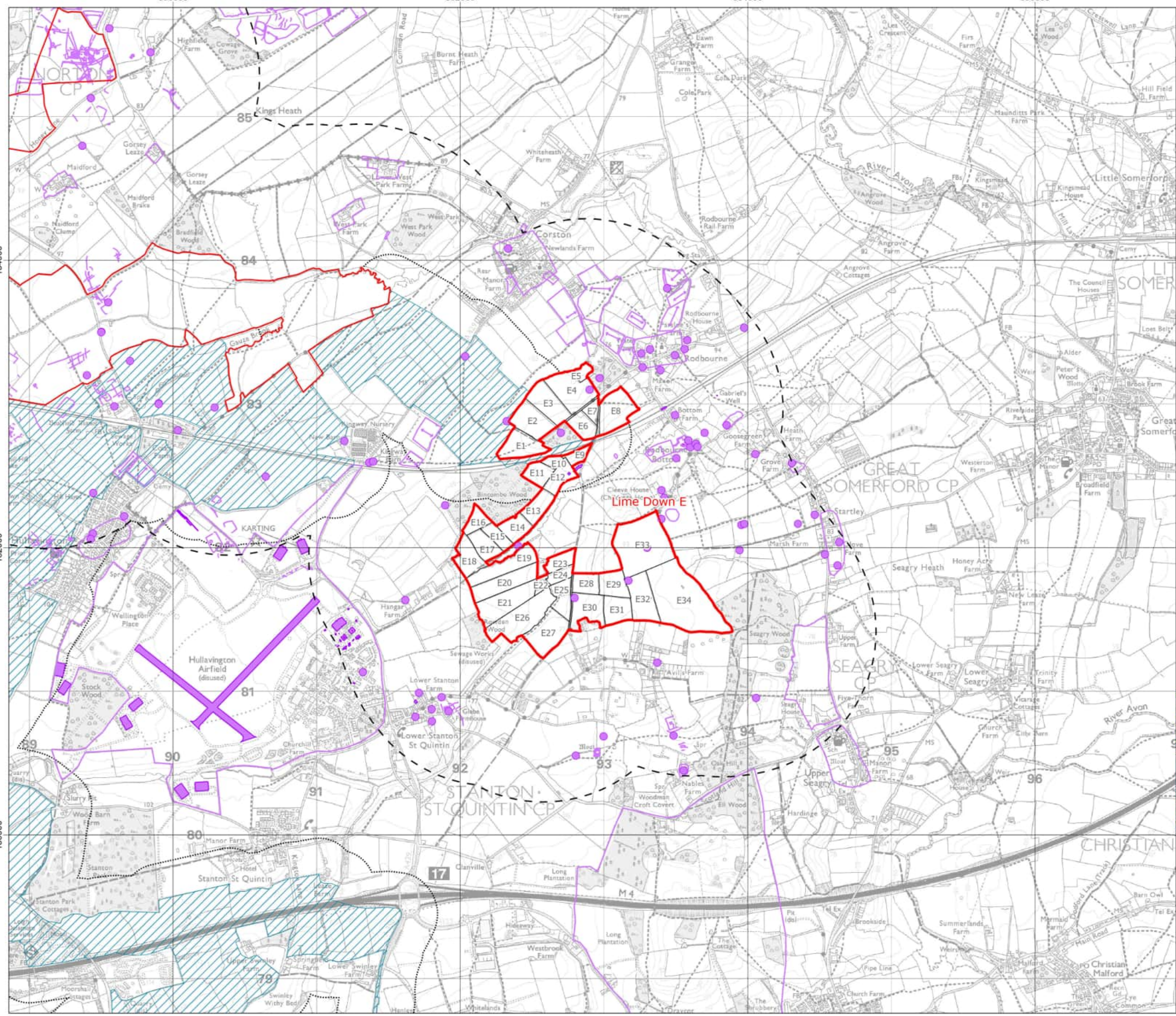
Hullavington Airfield (disused)
KARTING

Data: Wiltshire County Council, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0122
Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER
Lanpro



Lime Down Solar Park

Title:
Figure 12.2.5 Non-Designated Heritage Assets
Lime Down E

Document:
Cultural Heritage
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 1km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary
- HER 'monument' point
- HER 'monument' line
- HER 'monument' polygon

Data: Wiltshire County Council, IGP, Lanpro 2024
Base map: © Crown copyright and database rights 2024 Ordnance Survey 0100031673

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_HIS_0122
Coordinate system: British National Grid
Scale: 1:25,000 @ A3
0 500 1,000 1,500 Metres

Island GREEN POWER
Lanpro

386000 388000 390000 392000

170000 168000 166000 164000

Land at Melksham Substation

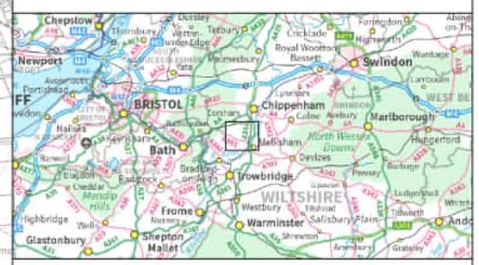
CORSHAM CP
LACOCK CP
ATWORTH CP
MELKSHAM CP
BROUGHTON GIFFORD CP

Lime Down Solar Park

Title:
Figure 12.2.6 Non-Designated Heritage Assets
Land at Melksham Substation

Document:
Cultural Heritage
Environmental Impact Assessment Scoping Report

Legend:
- Site Boundary
- 1km Study Area
- Cable Route Search Corridor
- 250m Cable Route Search Corridor Study Area
- Field Parcel Boundary
- HER 'monument' point
- HER 'monument' line
- HER 'monument' polygon



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Coordinate system: British National Grid
Scale: 1:25,000 @ A3

0 500 1,000 1,500 Metres

Island GREEN POWER

Lanpro

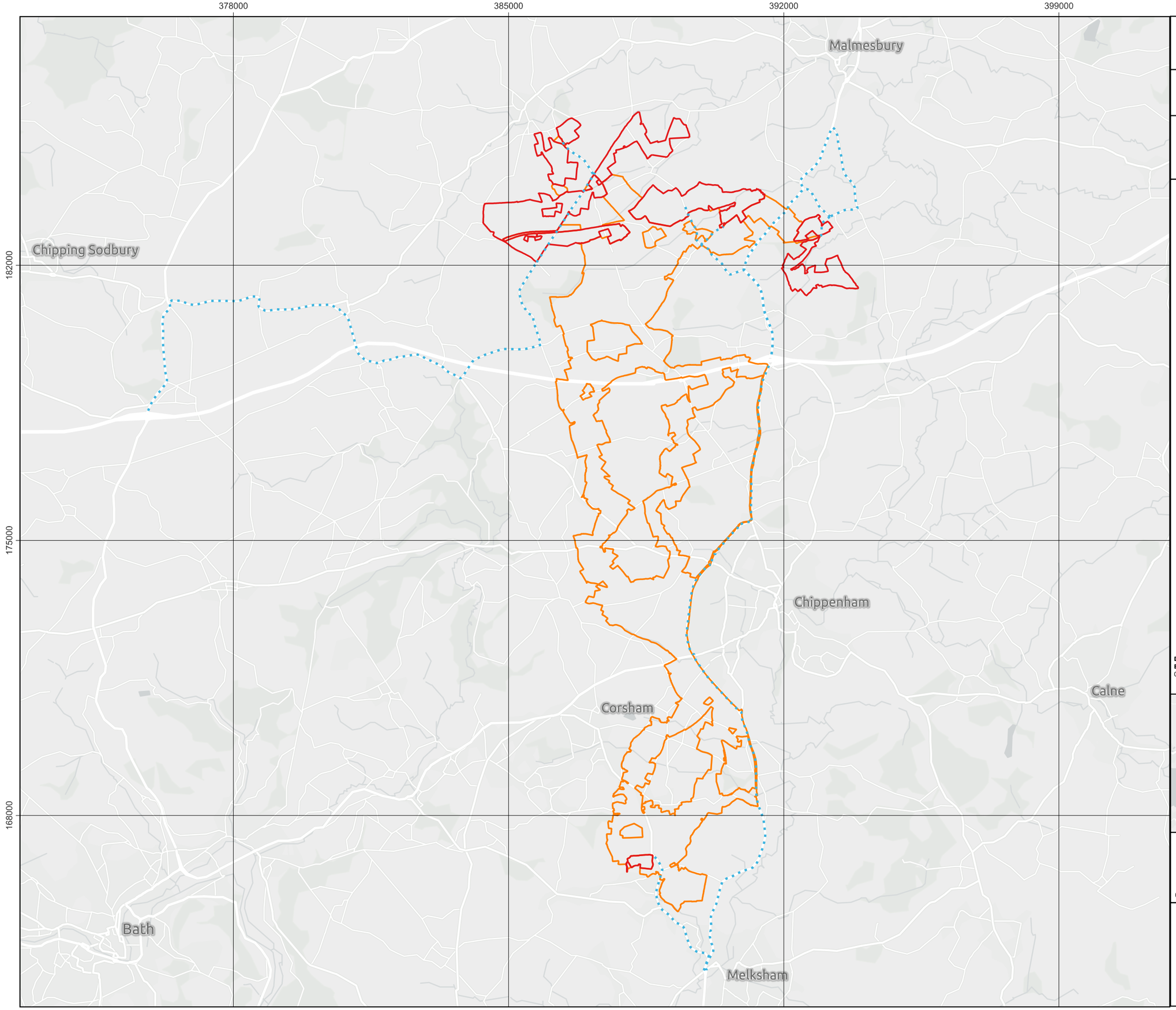
Lime Down
Solar Park

EIA Scoping Report

Appendix 13.1:
Transport and Access Figures

July 2024

EN010168



Lime Down Solar Park

Title:

Figure 13.1 Indicative Study Area

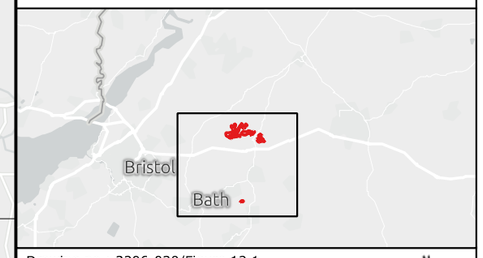
Document:

Transport and Access Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- Construction Vehicle Route
- Cable Corridor Search Area

Data:
Base Maps: © Crown copyright and database rights 2023 Ordnance Survey 0100031673



Drawing no.: 2306-020/Figure 13.1

Co-ordinate system: OSGB36 / British National Grid

Scale: 1:90000 @ A3

0 500 1,000 1,500 m

N W E S

Island GREEN POWER

tpa Transport Planning Associates

376000
384000
392000
400000
184000
176000
168000
Malmesbury
Chippenham
Corsham
Calne
Bath
Melksham

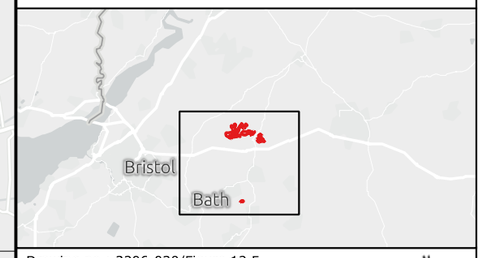
Lime Down Solar Park

Title:
Figure 13.2 Public Rights of Way Location Plan

Document:
Transport and Access
Environmental Impact Assessment Scoping Report

Legend:
- Area for Solar Panels and Associated Development
- Public Rights of Way
- Cable Corridor Search Area

Data:
Base Maps: © Crown copyright and database rights 2023 Ordnance Survey 0100031673



Drawing no.: 2306-020/Figure 13.5
Co-ordinate system: OSGB36 / British National Grid
Scale: 1:90000 @ A3
0 500 1,000 1,500 m

N
W
E
S

Island GREEN POWER
tpa Transport Planning Associates

386000
388000
390000
392000
186000
184000
182000
180000
Sherston Parva
Easton Town
Sherston
Corston
Hullavington
Hullavington Airfield
Lower Stanton St Quintin
Stanton St Quintin
Whitley
Land at Melksham Substation
0 100 200 m
1
2
3a
3b
4
5
6
7
8
9
10a
10b
11
12
13
14
15
16
17
18
19
20

Lime Down Solar Park

Title:
Figure 13.3 Indicative Construction Vehicle Access Locations

Document:
Transport and Access
Environmental Impact Assessment Scoping Report

Legend:
- Area for Solar Panels and Associated Development
- Access Points
- Cable Corridor Search Area

Bristol
Bath

Drawing no.: 2306-020/Figure 13.6
Co-ordinate system: OSGB36 / British National Grid
Scale: 1:30000 @ A3
0 500 1,000 1,500 m

N
W E
S

Island GREEN POWER
tpa Transport Planning Associates

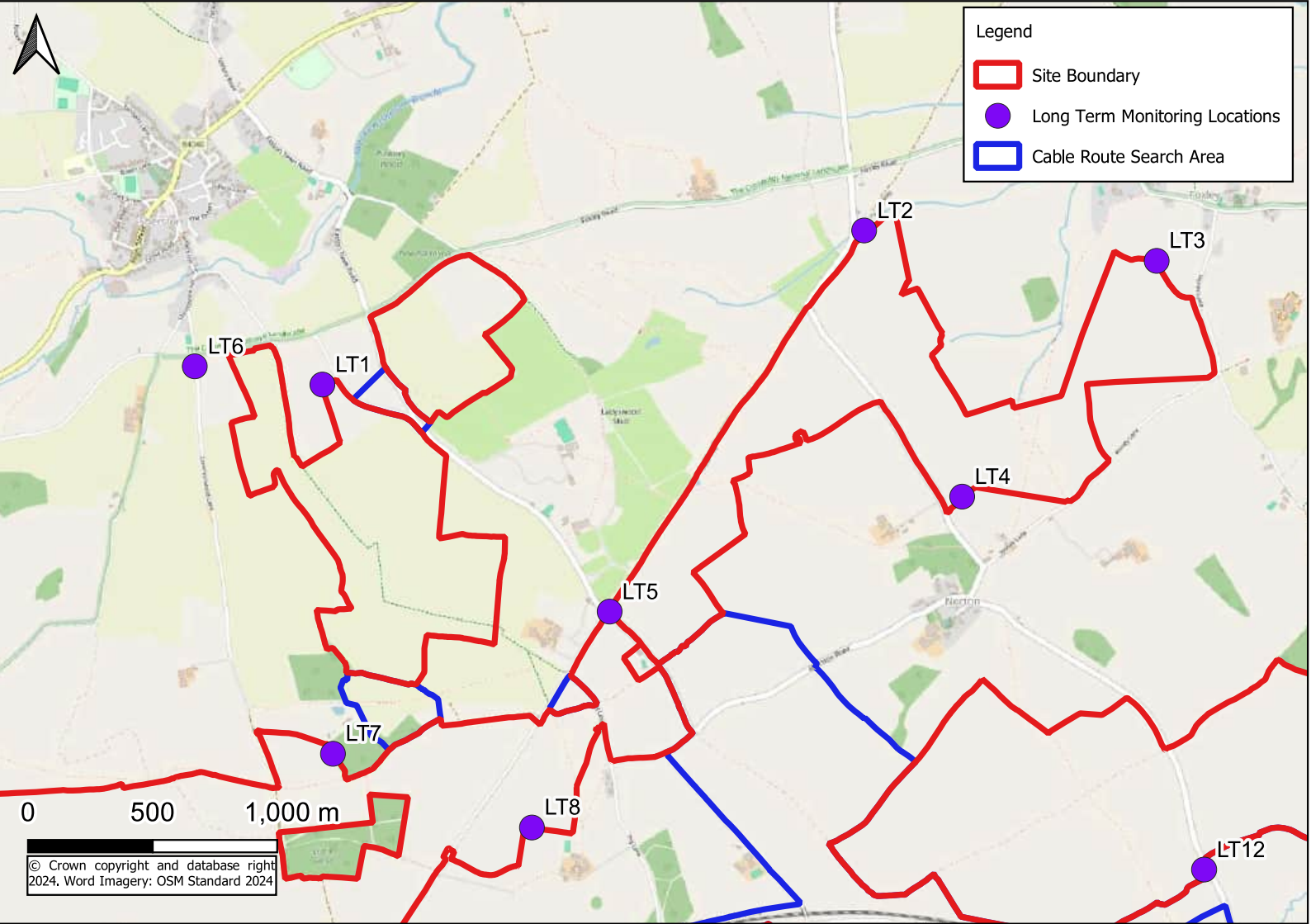
Lime Down
Solar Park

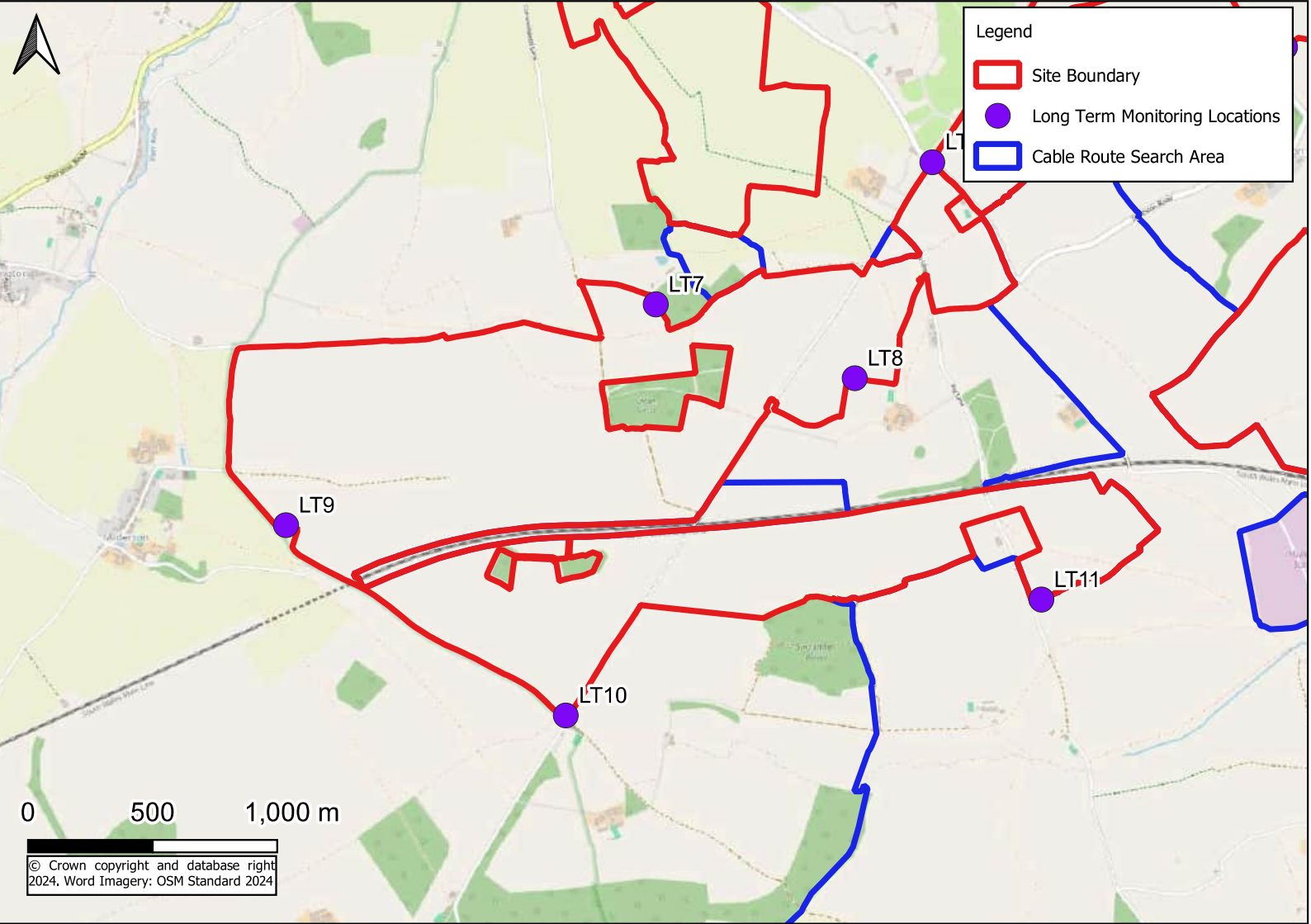
EIA Scoping Report

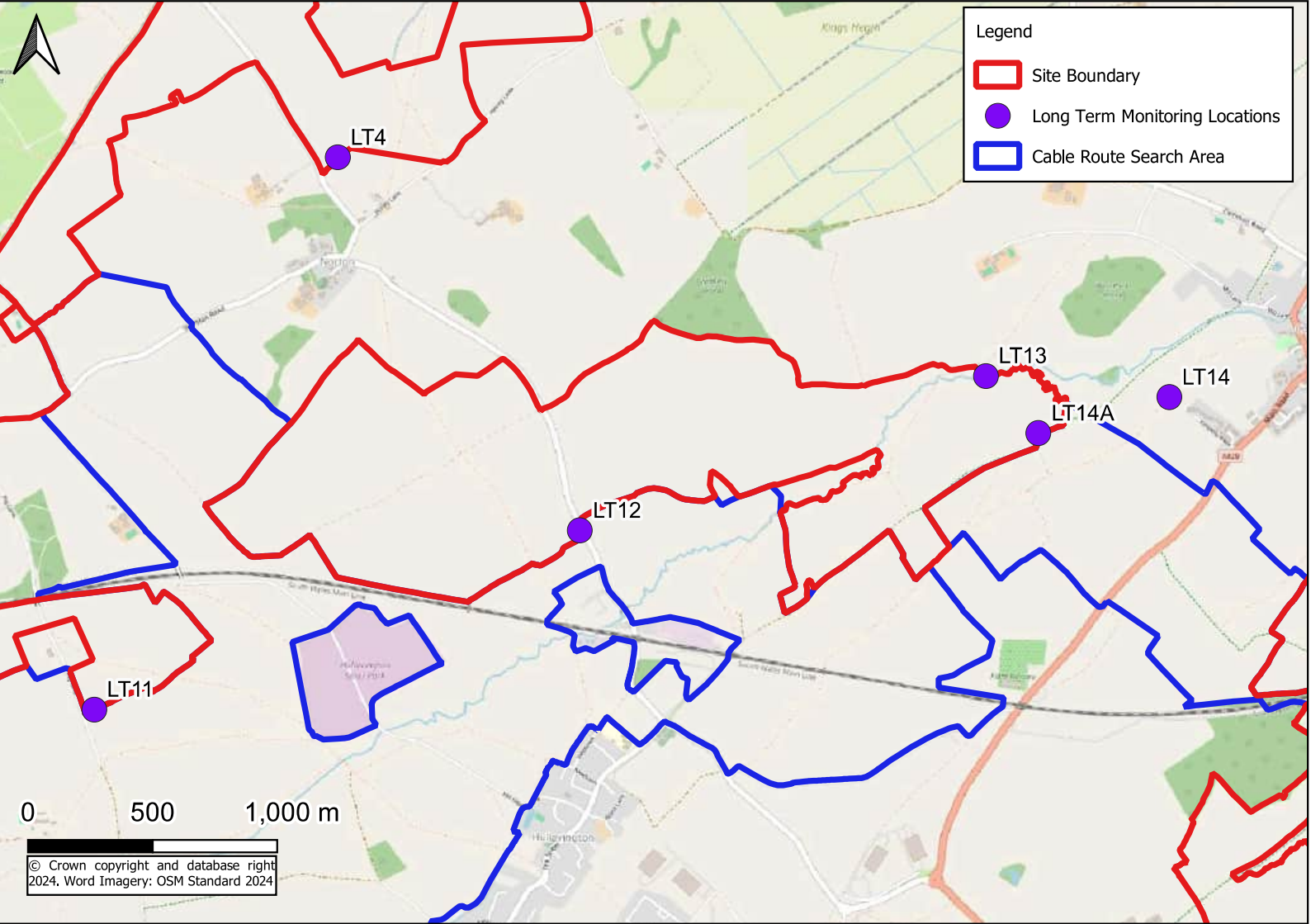
Appendix 14.1:
Noise and Vibration Figures

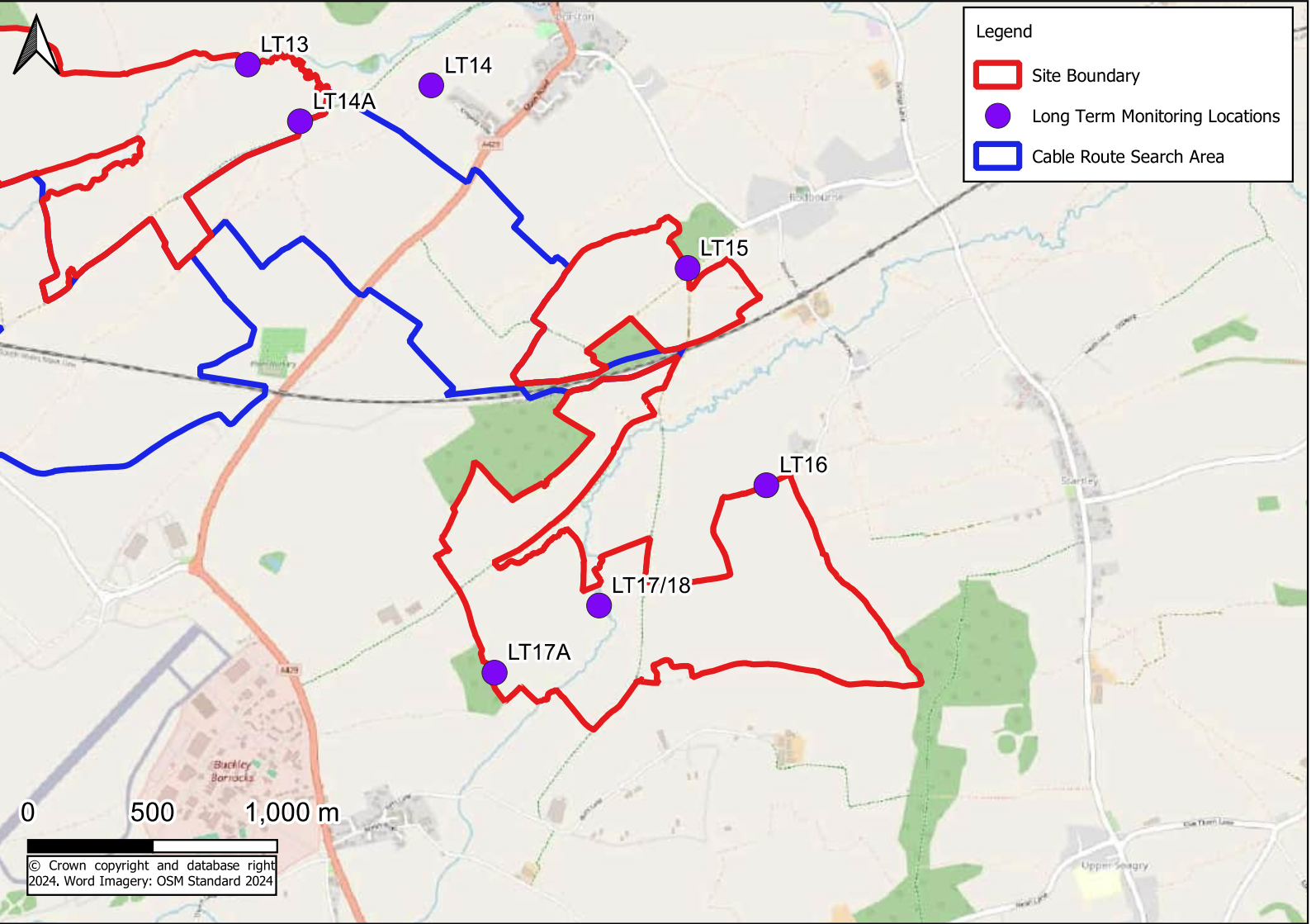
July 2024

EN010168


Legend
Site Boundary
Long Term Monitoring Locations
Cable Route Search Area
LT1
LT2
LT3
LT4
LT5
LT6
LT7
LT8
LT12
0
500
1,000 m
© Crown copyright and database right 2024. Word Imagery: OSM Standard 2024


Legend
Site Boundary
Long Term Monitoring Locations
Cable Route Search Area
LT7
LT8
LT9
LT10
LT11
0
500
1,000 m
© Crown copyright and database right 2024. Word Imagery: OSM Standard 2024


Legend
Site Boundary
Long Term Monitoring Locations
Cable Route Search Area
LT4
LT11
LT12
LT13
LT14
LT14A
0
500
1,000 m
© Crown copyright and database right 2024. Word Imagery: OSM Standard 2024


Legend
Site Boundary
Long Term Monitoring Locations
Cable Route Search Area
LT13
LT14
LT14A
LT15
LT16
LT17/18
LT17A
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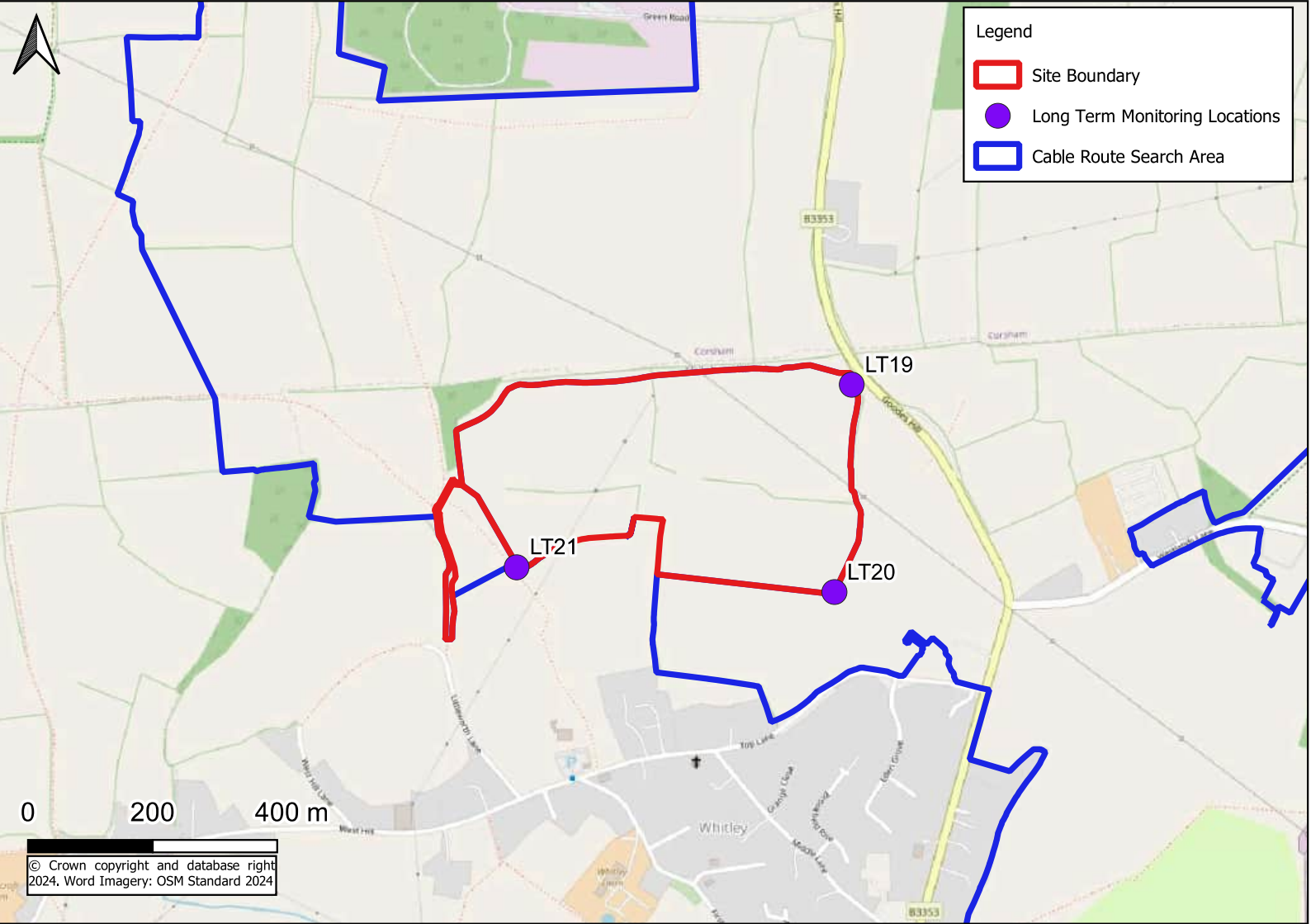
1,000 m
© Crown copyright and database right 2024. Word Imagery: OSM Standard 2024


Legend
Site Boundary
Long Term Monitoring Locations
Cable Route Search Area
LT19
LT20
LT21
Corsham
Whitley
B3353
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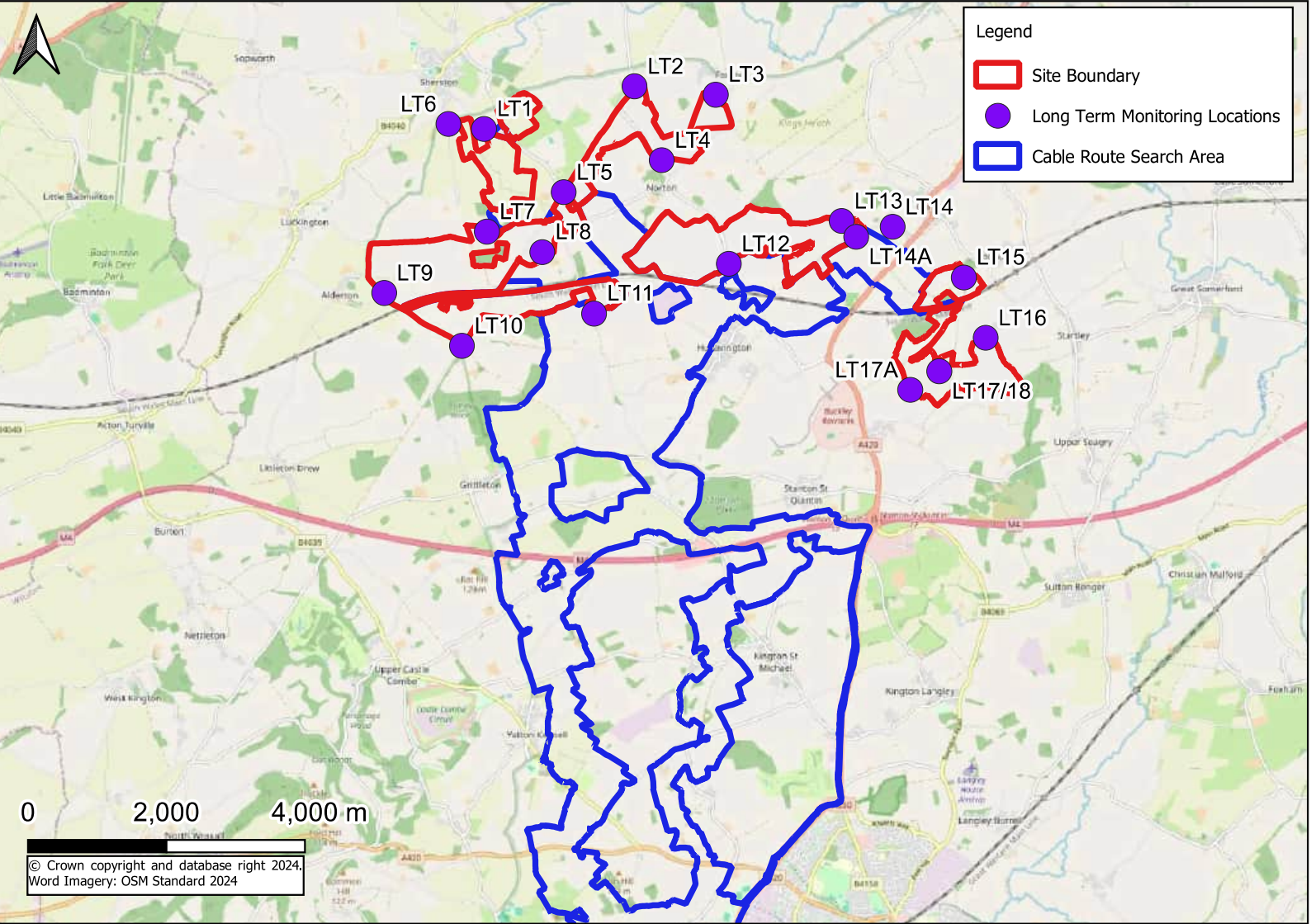
200
400 m
© Crown copyright and database right 2024. Word Imagery: OSM Standard 2024


Legend
Site Boundary
Long Term Monitoring Locations
Cable Route Search Area
LT1
LT2
LT3
LT4
LT5
LT6
LT7
LT8
LT9
LT10
LT11
LT12
LT13
LT14
LT14A
LT15
LT16
LT17A
LT17/18
0
2,000
4,000 m
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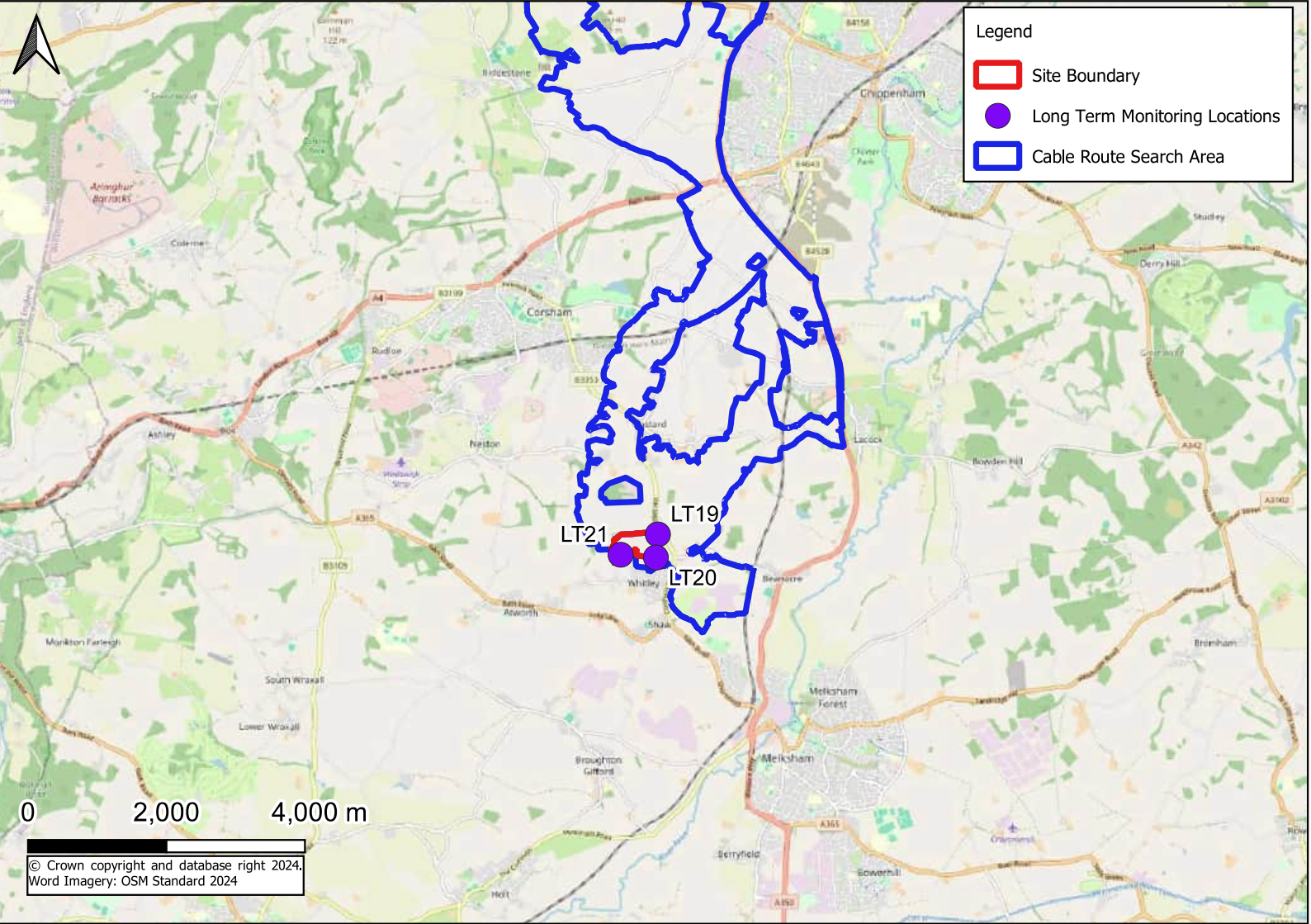
Legend
Site Boundary
Long Term Monitoring Locations
Cable Route Search Area
LT19
LT21
LT20
Chippenham
Corsham
Melksham
Melksham Forest
Broughton Gifford
Berryfield
Bowerhill
Whitley
Shaw
Atworth
Beanacre
Lacock
Neston
Ashley
Rudloe
Monkton Farleigh
South Wraxall
Lower Wraxall
Holt
Studley
Derry Hill
Bowden Hill
Brimham
0
2,000
4,000 m
© Crown copyright and database right 2024.
Word Imagery: OSM Standard 2024

Lime Down
Solar Park

EIA Scoping Report

Appendix 15.1:

Glint and Glare Receptor Scoping and Methodology

July 2024

EN010168

PAGERPOWER
Urban & Renewables

Glint and Glare Receptor Scoping and Methodology

Island Green Power UK Limited

Lime Down Solar

July 2024

EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the possible effects of glint and glare from a fixed ground-mounted solar photovoltaic development, located in Wiltshire, UK. This receptor scoping and methodology document shows the proposed receptors and the methodology that will be used to assess them in the glint and glare assessment, as the basis for the ES chapter. The included receptors relate to road safety, residential amenity, railway safety, and aviation activity associated with Hullavington Airfield, Badminton Airfield, Langley House Airfield, Charlton Park Airfield, and Bowldown Farm Airfield.

Guidance and Studies

Guidelines exist in the UK (produced by the Civil Aviation Authority) and in the USA (produced by the Federal Aviation Administration) with respect to solar developments and aviation activity. The UK CAA guidance is relatively high-level and does not prescribe a formal methodology.

A national policy for determining the impact of glint and glare on road safety, residential amenity and railway safety has not been produced to date. Therefore, in the absence of this, Pager Power reviewed more general existing planning guidelines and the available studies (discussed below) in the process of defining its own glint and glare assessment guidance and methodology[1]. This methodology defines the process for determining the impact upon road safety, residential amenity and railway safety.

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]. Reflections from solar panels are less intense than those from glass or steel because solar panels are designed in order to absorb light, rather than reflect it, as panels are more efficient when they reflect less light.

[1] Pager Power Glint and Glare Guidance, Fourth Edition (4.0), September 2022.

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

PAGERPOWER
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 59 countries within Europe, Africa, America, Asia and Australasia.

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 fixed ground-mounted solar photovoltaic development, located in Wiltshire, UK. This assessment pertains to the potential impact upon road safety, residential amenity, railway safety, and aviation activity associated with Hullavington Airfield, Badminton Airfield, Langley House Airfield, Charlton Park Airfield, and Bowldown Farm Airfield.

This report contains the following:

- Solar development details;
- Explanation of glint and glare;
- Overview of relevant guidance and relevant studies;
- Overview of Sun movement;
- Assessment methodology;
- Identification of receptors.

1.2 Pager Power's Experience

Pager Power has undertaken over 1,300 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[3] of glint and glare is as follows:

- 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 i.e. glint and glare.

[3] These definitions are aligned with those of the Draft National Policy Statement for Renewable Energy Infrastructure (EN-3) – published by the Department for Business, Energy & Industrial Strategy in September 2021, and the Federal Aviation Administration (FAA) in the United States of America.

2 SCHEME LOCATION AND DETAILS

2.1 Scheme Site Layout

Figure 1 below shows the Scheme Sites overlaid onto aerial imagery as the blue areas.

Figure 1 *Scheme Sites overlaid onto aerial imagery*

3 RAILWAYS AND GLINT AND GLARE

3.1 Overview

A railway stakeholder (such as Network Rail) may request further information regarding the potential effects of glint and glare from reflective surfaces when a development is located adjacent to a railway line (typically 50-100m from its infrastructure). The request may depend on the scale, percentage of reflective surfaces and the complexity of the nearby railway, for example. The following section presents details regarding the most common concerns relating to glint and glare.

3.2 Glint and Glare Definition

As well as the glint and glare definition presented in Section 1.3, glare can also be categorised as causing visual discomfort whereby an observer would instinctively look away, or cause disability whereby objects become difficult to see. The guidance produced by the Commission Internationale de L'Eclairage (CIE)[4] describes disability glare as:

'Disability glare is glare that impairs vision. It is caused by scattering of light inside the eye…The veiling luminance of scattered light will have a significant effect on visibility when intense light sources are present in the peripheral visual field and contrast of objects is seen to be low.'

'Disability glare is most often of importance at night when contrast sensitivity is low and there may well be one or more bright light sources near to the line of sight, such as car headlights, streetlights or floodlights. But even in daylight conditions disability glare may be of practical significance: think of traffic lights when the sun is close to them, or the difficulty viewing paintings hanging next to windows.'

These types of glare are of particular importance in the context of railway operations as they may cause a distraction to a train driver (discomfort) or may cause railway signals to be difficult to see (disability).

3.3 Common Concerns and Signal Overview

Typical reasons stated by a railway stakeholder for requesting a glint and glare assessment often relate to the following:

1. The development producing solar reflections towards train drivers.
2. The development producing solar reflections, which causes a train driver to take action.
3. The development producing solar reflections that affect railway signals.

With respect to point 1, a reflective panel could produce solar reflections towards a train driver. If this reflection occurs where a railway signal, crossing etc., is present, or where the driver's workload is particularly high, the solar reflection may affect operations. This is deemed to be the most concern with respect to solar reflections.

[4] CIE 146:2002 & CIE 147:2002 Collection on glare (2002).

Following from point 1, point 2 identifies whether a modelled solar reflection could be significant by determining its intensity. Only where a solar reflection occurs under certain conditions and is of a particular intensity may it cause a reaction from a train driver and thus potentially affect safe operations. Therefore intensity calculations are undertaken where a solar reflection is identified and where its presence could potentially affect the safety of operations. Points 1 and 2 are completed in a 2-step approach.

With respect to all points, railway lines use light signals to manage trains on approach towards particular sections of track. If a signal is passed when not permitted, a SPAD (Signal Passed At Danger) is issued. The concerns will relate specifically to the possibility of the reflections appearing to illuminate signals that are not switched on (known as a phantom aspect illusion) or a distraction caused by the glare itself, both of which could lead to a SPAD. The definition is presented below:

'Light emitted from a Signal lens assembly that has originated from an external source (usually the sun) and has been internally reflected within the Signal Head in such a way that the lens assembly gives the appearance of being lit.[5]*'*

[5] Source: Glossary of Signalling Terms, Railway Group Guidance Note GK/GN0802. Issue One. Date April 2004.

4 GLINT AND GLARE ASSESSMENT METHODOLOGY

4.1 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.

4.2 Background

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

4.3 Methodology

4.3.1 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 this glint and glare assessment 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;
- 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;
- 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 - including intensity calculations where appropriate;
- Determine whether a significant detrimental impact is expected in line with the process presented in Appendix D.

4.3.2 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.

4.4 Assessment Methodology and Limitations

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

5 IDENTIFICATION OF RECEPTORS

5.1 Aviation Receptors

The following subsections present the relevant data and receptors associated with the assessed airfields. The locations of the airfields relative to the Scheme are shown in Figure 3 on page 18, and summarised below:

- Hullavington Airfield: approximately 1.0km west of the Scheme;
- Badminton Airfield: approximately 4.6km west of the Scheme.

Three further airfields have been identified to be assessed at a high-level. It is considered due to their distance from the Scheme, and their runway configurations, that no more than a low impact is possible. The locations of the airfields relative to the Scheme are shown in Figures 4 and 5 on pages 19 and 20, and summarised below:

- Langley House Airfield: approximately 5.2km south of the Scheme;
- Charlton Park Airfield: approximately 5.7km north-east of the Scheme;
- Bowldown Farm Airfield: approximately 7.0km north of the Scheme.

5.1.1 Hullavington Airfield Information

Hullavington Airfield was an RAF aerodrome which closed in 1993. The site continued to be used for flying until 2016, when the site was permanently closed. It had one operational runway, the details[6] of which are presented below:

- 05/23 measuring 1,220m by 45m (asphalt).

5.1.2 Badminton Airfield Information

Badminton Airfield is an unlicensed aerodrome and is understood not to have an ATC Tower. It has one operational runway, the details[7] of which are presented below:

- 07/25 measuring 1,300m by 27m (grass).

5.1.3 Langley House Airfield Information

Langley House Airfield is an unlicensed aerodrome and is understood not to have an ATC Tower. It has one operational runway, the details[6] of which are presented below:

- 04/22 measuring 250m by 4m (grass);
- 03/21 measuring 215m by 4m (grass).

5.1.4 Charlton Park Airfield Information

Charlton Park Airfield is an unlicensed aerodrome and is understood not to have an ATC Tower. It has one operational runway, the details[7] of which are presented below:

- 07/25 measuring 900m by 20m (grass).

[6] As determined by available aerial imagery
[7] Pooleys Flight Guide, 61st Edition

5.1.5 Bowldown Airfield Information

Bowldown Airfield is an unlicensed aerodrome and is understood not to have an ATC Tower. It has two operational runways, the details[7] of which are presented below:

- 09/27 measuring 750m by 15m (grass);
- 04/22 measuring 550m by 15m (grass).

5.1.6 Runway Approach Paths and Visual Circuits

All of the assessed airfields are general aviation (GA) airfields where aviation activity is dynamic and does not necessarily follow the typical approaches / flight paths of a larger licensed aerodrome or airport. It is not possible to assess every single location of airspace that an aircraft travels in flight around an aerodrome; however, it is possible to assess the most frequently flown flight paths and the most critical stages of flight, which would cover most, or all, of the relevant locations.

As such, Pager Power's methodology is to assess whether a solar reflection can be experienced on a 5-degree splayed approach path based on the extended runway centreline, and the final sections of the visual circuits and joins on approach to the corresponding runway thresholds.

The assessed receptors are based on the following characteristics:

- 1-mile approach paths with a splay angle of 5 degrees, considering 2.5 degrees either side of the extended runway centreline;
- A descent angle of 5 degrees;
- Circuit width of 1 nautical mile from runway centreline;
- Maximum altitude of 500 feet above the aerodrome threshold altitude.

Figure 2 on the following page illustrates the splayed approach and final sections of the visual circuits.

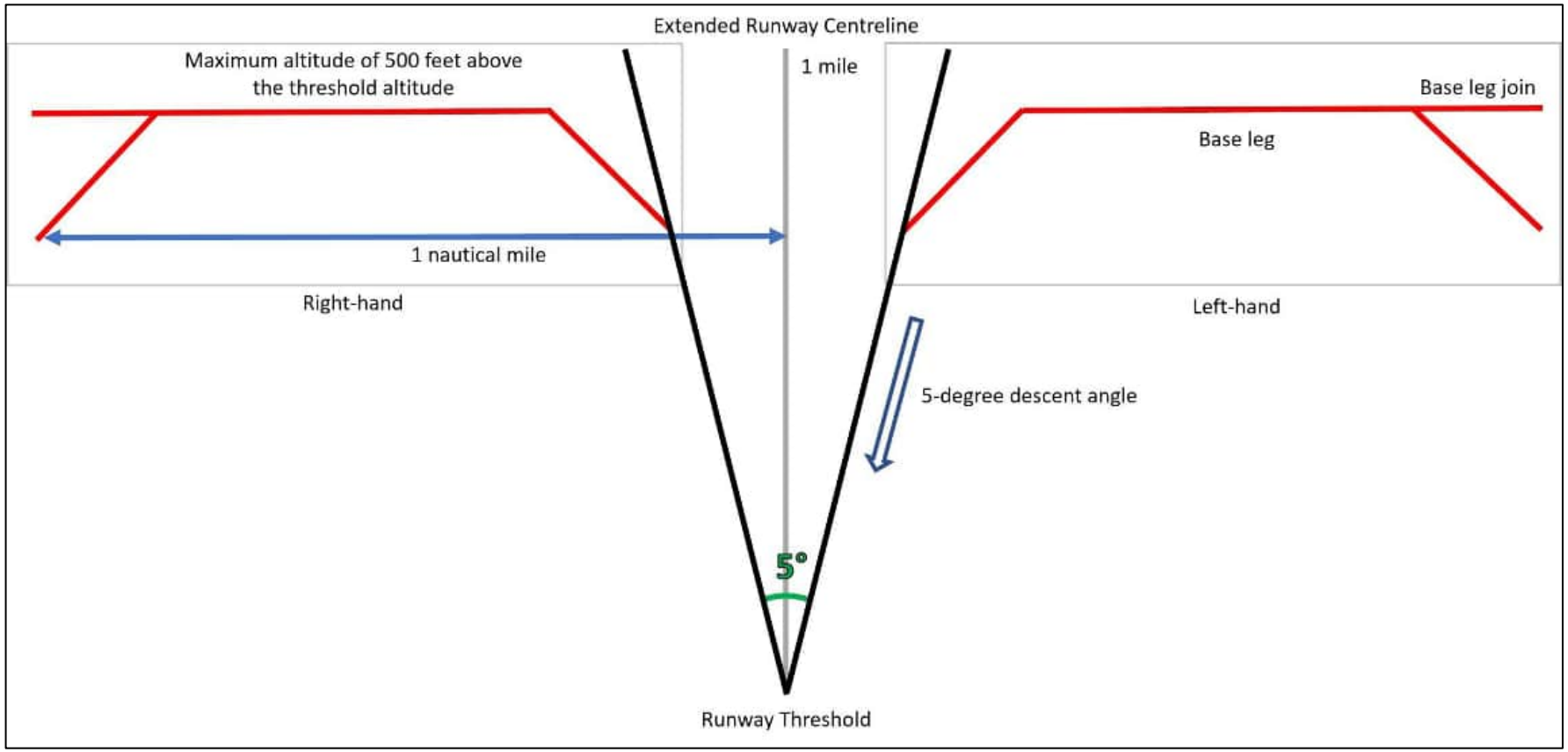

Figure 2 *Splayed approach and final sections of visual circuits*

Figure 3 on the following page shows the assessed aircraft receptor points of the splayed approach and final sections of the visual circuits at the assessed airfields. The receptor points pertaining to runway 25 at Badminton Airfield are labelled.

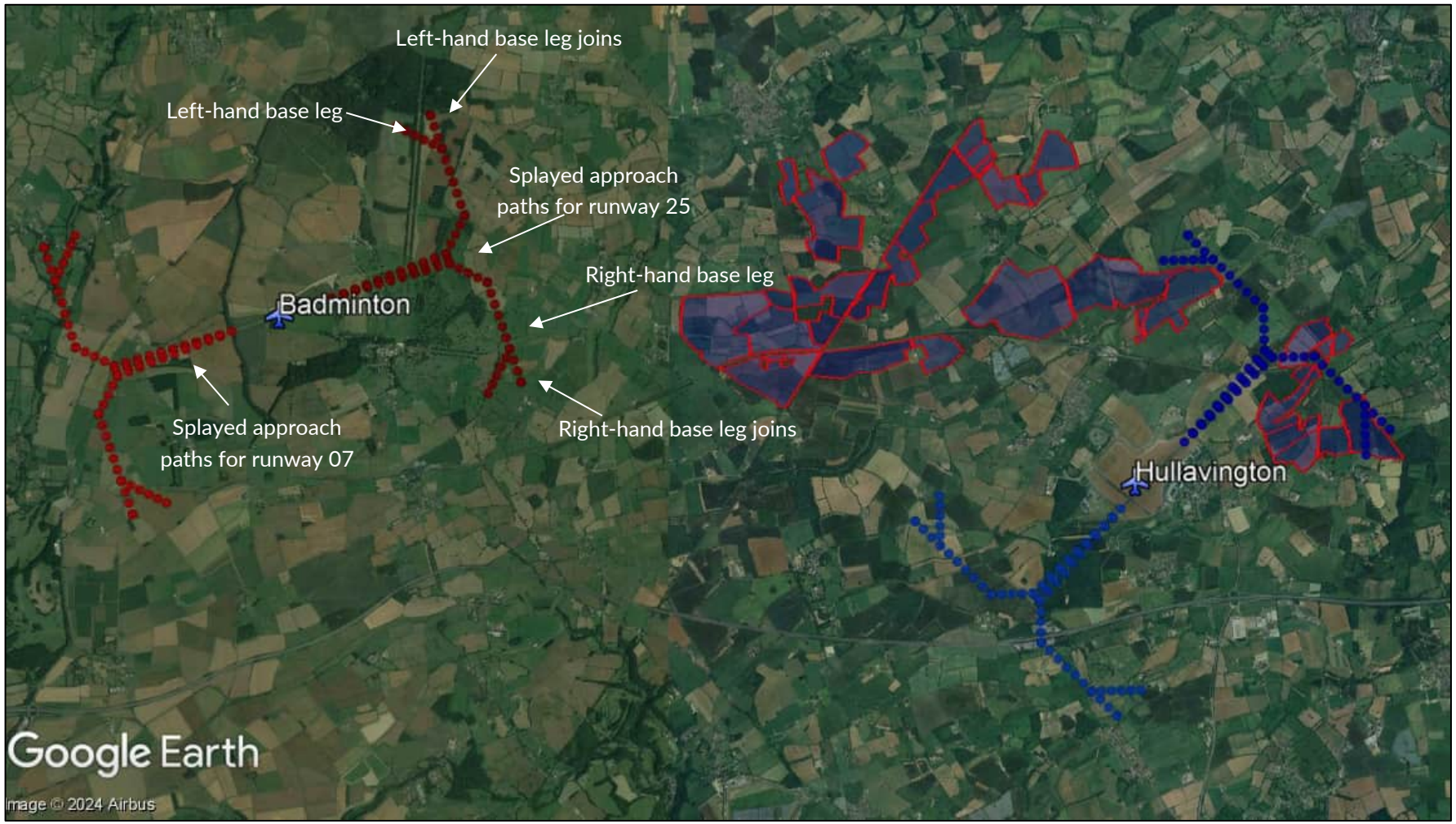

Figure 3 *General aviation splayed approach and visual circuit receptors*

Figures 4 and 5 below and on the following page show the locations of the airfields to be assessed at a high-level, relative to the Scheme. They also show the splayed runway approach paths at each airfield.

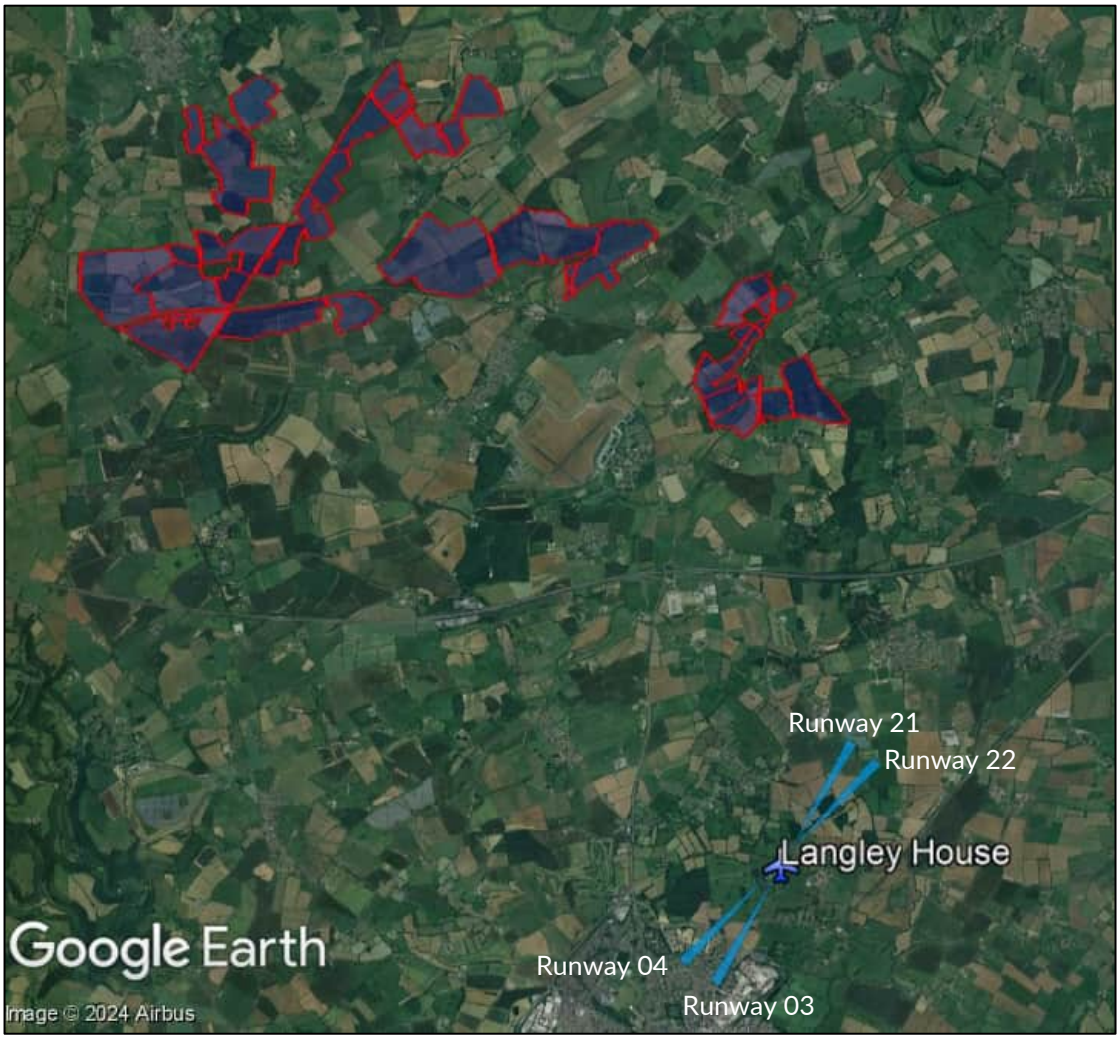

Figure 4 *Location of Langley House Airfield relative to the Scheme*

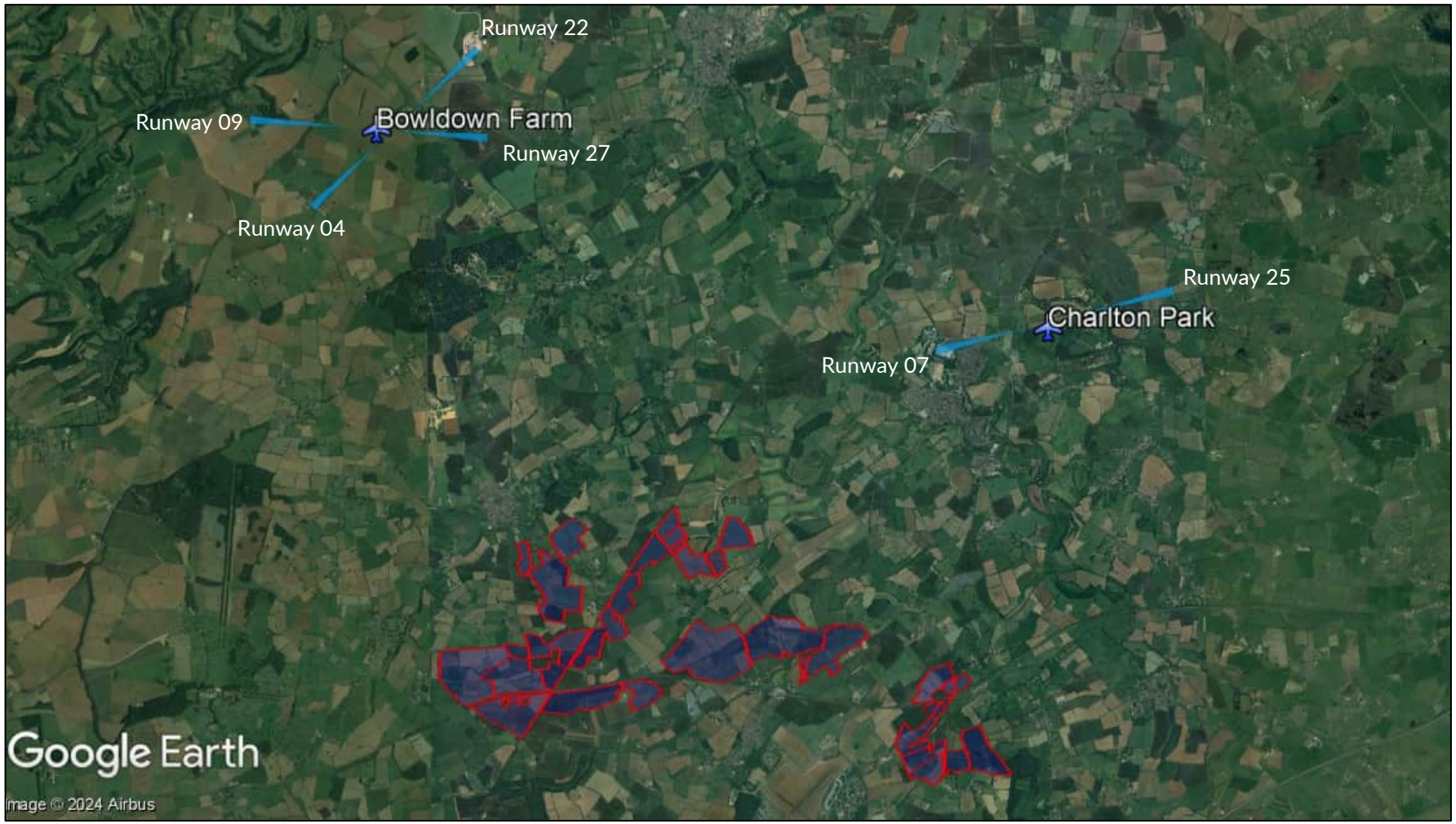

Figure 5 *Locations of Charlton Park Airfield and Bowldown Airfield relative to the Scheme*

5.2 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.

A 1km assessment area is considered appropriate for glint and glare effects on ground-based receptors. Receptors within this distance are identified based on mapping and aerial photography of the region. The assessment area is bounded by the orange outline in Figure 6 below.

The receptor details are presented in Appendix G and the terrain elevations have been interpolated based on OS Terrain 50 DTM[8] data.

Figure 6 *Assessment area*

[8] Digital Terrain Model

5.3 Road Receptors

5.3.1 Road Receptors Overview

Road types can generally be categorised as:

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

Technical modelling is not recommended for local roads, where traffic densities are likely to be relatively low. Any solar reflections from the Scheme 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 has therefore considered major national, national, and regional roads that:

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

5.3.2 Identified Road Receptors

Table 2 below shows a summary of the roads identified within the 1km assessment area. Receptors 1 to 66 are placed circa 100m apart. A height of 1.5 metres above ground level has been taken as the typical eye level of a road user[9]. Figures 7 to 9, on the following pages show the assessed road receptors.

Road	Receptors
A429	1 – 45
Bradfield Cottages	46 – 66

Table 1 *Summary of identified road receptors*

[9] This fixed height for the road receptors is for modelling purposes. Changes to the modelling height by a few metres is not expected to significantly change the modelling results. Views for elevated drivers are also considered in the results discussion, where appropriate.

Figure 7 *Road receptors 1 to 29*

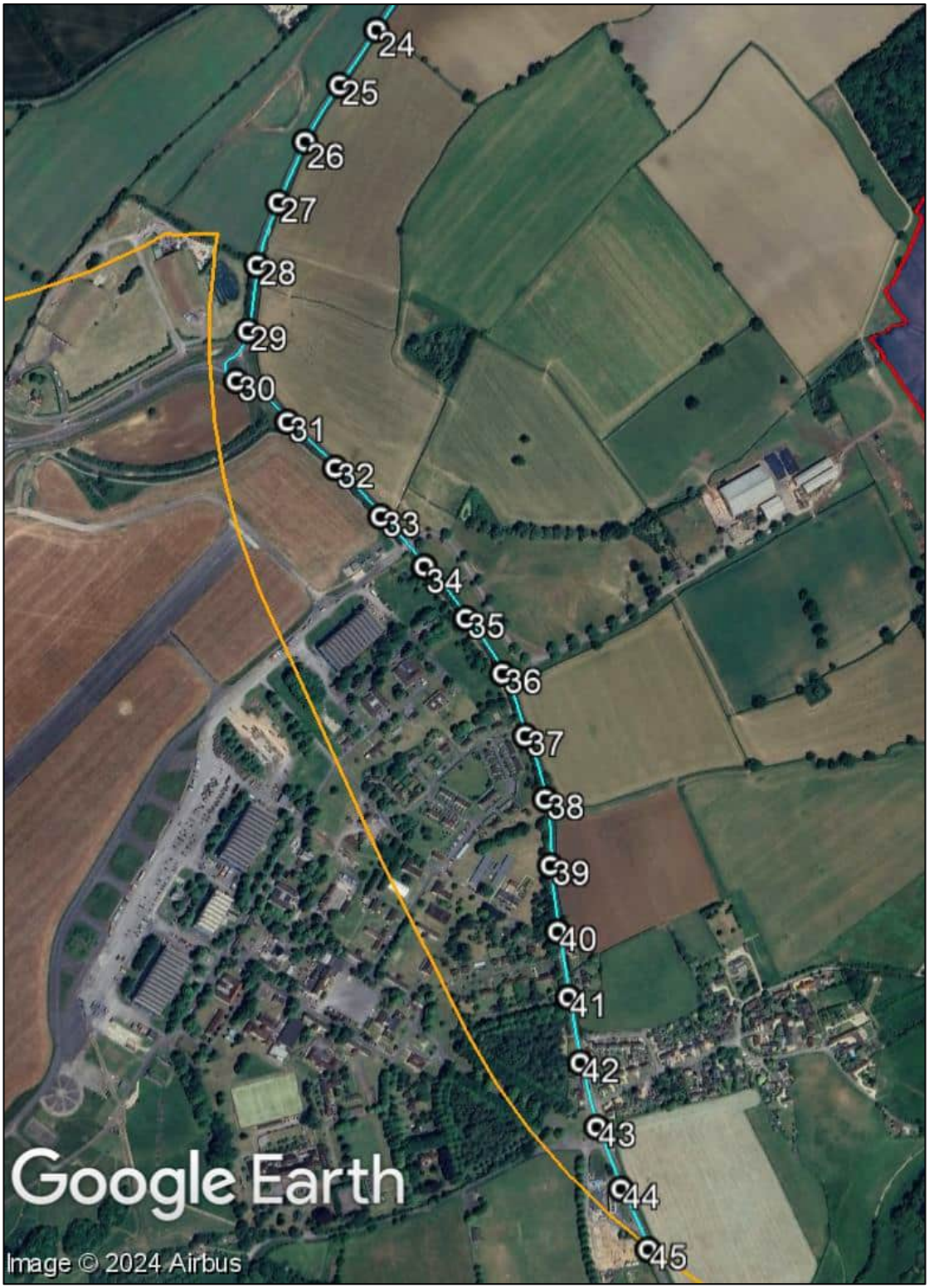

Figure 8 *Road receptors 30 to 45*

Figure 9 *Road receptors 46 to 66*

5.4 Dwelling Receptors

5.4.1 Dwelling Receptors Overview

The analysis has considered dwellings that:

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

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 Scheme because line of sight will be removed, or they will experience comparable effects to the closest assessed dwelling.

Additionally, in some cases, a single receptor point may be used to represent a small number of separate addresses. In such cases, the results for the receptor will be representative of the adjacent observer locations, such that the overall level of effect in each area is captured reliably.

5.4.2 Identified Dwelling Receptors

The assessed dwelling receptors are shown in Figures 10 to 30, below and on the following pages. In total, 248 dwelling receptors will be assessed. An additional 1.8m height above ground is used in the modelling to simulate the typical viewing height of an observer on the ground floor[10].

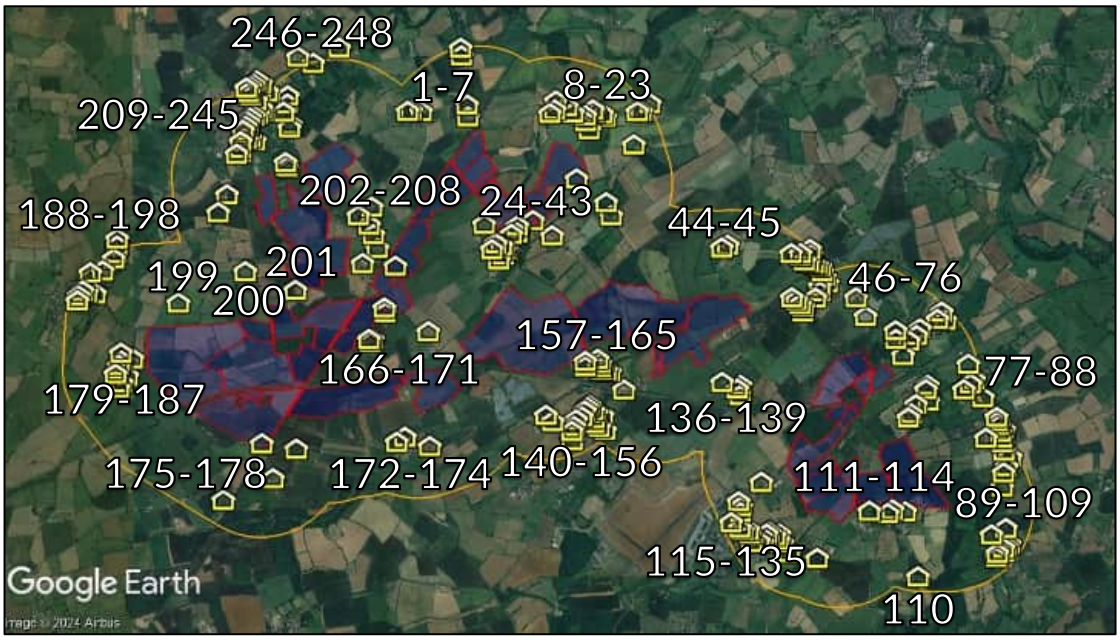

Figure 10 *Overview of all dwellings*

[10] This fixed height for the dwelling receptors is for modelling purposes. 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 11 *Dwellings 1 to 7*

Figure 12 *Dwellings 8 to 24*

Figure 13 *Dwellings 25 to 41*

Figure 14 *Dwellings 42 to 45*

Figure 15 *Dwellings 46 to 68*

Figure 16 *Dwellings 69 to 86*

Figure 17 *Dwellings 87 to 101*

Figure 18 *Dwellings 102 to 114*

Figure 19 *Dwellings 115 to 135*

Figure 20 *Dwellings 136 to 139*

Figure 21 *Dwellings 140 to 156*

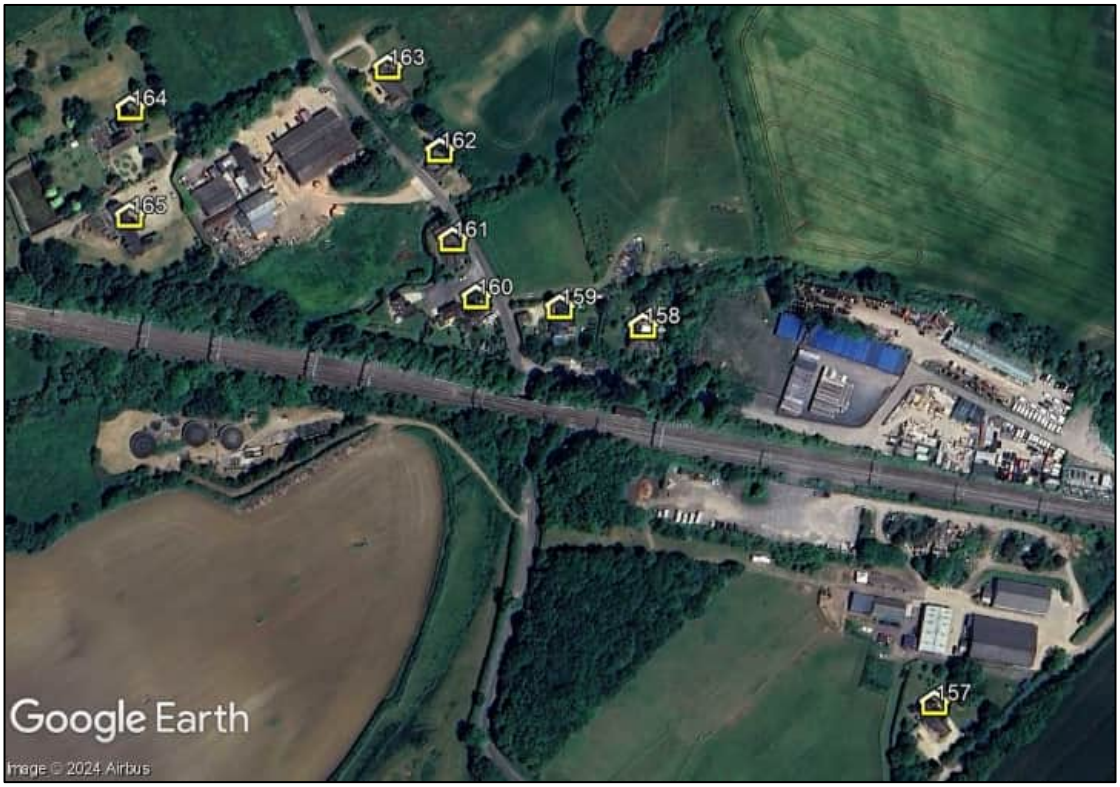

Figure 22 *Dwellings 157 to 165*

Figure 23 *Dwellings 166 to 171*

Figure 24 *Dwellings 172 to 178*

Figure 25 *Dwellings 179 to 187*

Figure 26 *Dwellings 188 to 199*

Figure 27 *Dwellings 200 to 208*

Figure 28 *Dwellings 209 to 220*

Figure 29 *Dwellings 221 to 245*

Figure 30 *Dwellings 246 to 248*

5.5 Railway Receptors

5.5.1 Railway Receptors Overview

The analysis has considered railway receptors, in the context of train drivers, that:

- Are within 500 metres of the Scheme; and
- Have a potential view of the panels.

5.5.2 Identified Railway Receptors

An approximate 9.7km section of railway operates within the assessment area and has therefore been assessed, as part of the HS1 Line between Bristol Parkway and Swindon. In total, 94 receptors have been placed circa 100m along the railway line, as shown in Figures 31 to 33 below and on the following page.

No signals have been identified after a review of the available imagery. This report can be updated if any railway signals are identified.

Based on previous consultation[11], an additional 2.75m height above ground is used in the modelling as the typical viewing height of a train operator[12].

Figure 31 *Railway receptors 1 to 29*

[11] Consultation undertaken with Network Rail in the UK.

[12] This height may vary based on driver height however this figure is used as the industry standard.

Figure 32 *Railway receptors 30 to 61*

Figure 33 *Railway receptors 62 to 94*

6 GEOMETRIC ASSESSMENT METHODOLOGY

6.1 Overview

The following sub-section presents the methodology used to assess each receptor type, with the relevant criteria set out in each sub-section. 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 used, whereby it is assumed views of the panels are possible if it cannot be reliably determined that existing screening will remove effects.

6.2 Aviation Receptors

6.2.1 Overview

The process for quantifying impact significance is defined in the report appendices. For the runway approach paths, the key considerations are:

- Whether a reflection is predicted to be experienced in practice.
- The location of glare relative to a pilot's primary field-of-view (50 degrees either side of the approach bearing).
- The intensity of glare for the solar reflections:
    - Glare with 'low potential for temporary after-image' (green glare);
    - Glare with 'potential for temporary after-image' (yellow glare);
    - Glare with 'potential for permanent eye damage' (red glare).
- Whether a reflection is predicted to be operationally significant in practice or not.

Where no solar reflections are geometrically possible or where solar reflections are predicted to be significantly screened, no impact is predicted, and mitigation is not required.

Where solar reflections are of an intensity no greater than 'low potential for temporary after-image' (green glare) or occur outside of a pilot's primary field of view (50 degrees either side of the approach bearing), the impact significance is low, and mitigation is not recommended.

Glare with 'potential for a temporary after-image' (yellow glare) was formerly not permissible under the interim guidance provided by the Federal Aviation Administration in the USA[13] for on-airfield solar. Whilst this guidance was never formally applicable outside of the USA, it has been a common point of reference internationally. Pager Power recommends a pragmatic approach whereby instances of 'yellow' glare are evaluated in a technical and operational context. As per Pager Power's glint and glare guidance document[14], where solar reflections are of an intensity

[13] This FAA guidance from 2013 has since been superseded by the FAA guidance in 2021 whereby airports are tasked with determining safety requirements themselves.
[14] Pager Power Glint and Glare Guidance, Fourth Edition, September 2022.

no greater than 'low potential for temporary after-image' expert assessment of the following relevant factors is required to determine the impact significance[15]:

- The likely traffic volumes and level of safeguarding at the aerodrome – licensed aerodromes typically have higher traffic volumes and are formally safeguarded;
- The time of day at which glare is predicted and whether the aerodrome will be operational such that pilots can be on the approach at these times;
- The duration of any predicted glare – glare that occurs for low durations throughout the year is less likely to be experienced than glare that occurs for longer durations throughout the year;
- The location and size of the reflecting panel area relative to a pilot's primary field-of-view;
- The location of the source of glare relative to the position of the Sun at the times and dates in which solar reflections are geometrically possible – effects that coincide with direct Sunlight appear less prominent than those that do not;
- The level of predicted effect relative to existing sources of glare – a solar reflection is less noticeable by pilots when there are existing reflective surfaces in the surrounding environment.

Following consideration of these mitigating factors, where the solar reflection does not remain significant, a low impact is predicted, and mitigation is not recommended; however, consultation with the aerodrome is recommended to understand their position along with any feedback or comments regarding the Scheme. Where the solar reflection remains significant, the impact significance is moderate, and mitigation is recommended.

Where solar reflections are of an intensity greater than 'potential for temporary after-image', the impact significance is high, and mitigation is required.

[15] This approach taken is reflective of the changes made in the 2021 FAA guidance; however, it should be noted that this guidance states that it is up to the airport to determine the safety requirements themselves. Therefore, an airport may not accept any yellow glare towards approach paths.

6.3 Road Receptors

6.3.1 Overview

The process for quantifying the impact significance concerning road safety is outlined in Appendix D. 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 reflections are geometrically possible but expected to be screened, no impact is predicted, and mitigation is not required.

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

- Whether visibility is likely for elevated drivers (relevant to dual carriageways and motorways[16]);
- Whether the solar reflection originates from directly in front of a road user. Solar reflections that are directly in front of a road user are more hazardous;
- The separation distance to the reflecting 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. The Sun is a far more significant source of light.

Following consideration of these mitigating factors, where the solar reflection does not remain significant, a low impact is predicted, and mitigation is not recommended. Where the solar reflection remains significant, the impact significance is moderate, and mitigation is recommended.

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

[16] There is typically a higher density of elevated drivers (such as HGVs) along dual carriageways and motorways compared to other types of roads.

6.4 Dwelling Receptors

6.4.1 Overview

The process for quantifying the impact significance concerning residential amenity is outlined in Appendix D. 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 reflections are geometrically possible but expected to be screened, no impact is predicted, and mitigation is not required.

Where effects occur for less than 3 months per year and less than 60 minutes on any given day, or the closest reflecting panel is over 1km from the road user, the impact significance is low, and mitigation is not recommended.

Where reflections are predicted to be experienced for more than 3 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:

- The separation distance to the reflecting panel area[17]. 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. The Sun is a far more significant source of light;
- Whether solar reflections will be experienced from all storeys. The ground floor is typically considered the main living space and therefore has a greater significance with respect to residential amenity;
- Whether the dwelling appears to have windows facing the reflecting areas. An observer may need to look at an acute angle to observe the reflecting areas.

Following consideration of these mitigating factors, where the solar reflection does not remain significant, a low impact is predicted, and mitigation is not recommended. Where the solar reflection remains significant, the impact significance is moderate, and mitigation is recommended.

If there are no mitigating factors and the effects last for more than 3 months per year **and** for more than 60 minutes on any given day, the impact significance is high, and mitigation is required.

[17] Which is often greater than the nearest panel boundary, because not all areas of the site cause specular reflections towards particular receptor locations.

6.5 Railway Receptors

6.5.1 Overview

The process for quantifying the impact significance concerning railway safety is outlined in Appendix D. The key considerations for quantifying impact significance for train driver receptors are:

- Whether a reflection is predicted to be experienced in practice;
- The location of the reflecting panel relative to a train driver's direction of travel;
- The workload of a train driver experiencing a solar reflection.

Where reflections are geometrically possible but expected to be screened, no impact is predicted, and mitigation is not required.

Where reflections originate from outside of a train driver's primary horizontal field of view (30 degrees either side of the direction of travel), or the closest reflecting panel is over 500m from the railway user, the impact significance is low, and mitigation is not recommended.

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

- Whether the solar reflection originates from directly in front of a train driver. Solar reflections that are directly in front of a train driver are more hazardous;
- The separation distance to the reflecting 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. The Sun is a far more significant source of light;
- Whether a signal, station, level crossing, or switching point is located within the reflection zone.

Following consideration of these mitigating factors, where the solar reflection does not remain significant, a low impact is predicted, and mitigation is not recommended. Where the solar reflection remains significant, the impact significance is moderate, and mitigation is recommended. Where reflections originate from directly in front of a train driver and there are no further mitigating factors, the impact significance is high, and mitigation is required.

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[18] (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.'

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

National Policy Statement for Renewable Energy Infrastructure

The National Policy Statement for Renewable Energy Infrastructure (EN-3)[19] sets out the primary policy for decisions by the Secretary of State for nationally significant renewable energy infrastructure. Sections 2.10.102-106 state:

'2.10.102 Solar panels are specifically designed to absorb, not reflect, irradiation.[20] However, solar panels may reflect the sun's rays at certain angles, causing glint and glare. Glint is defined as a momentary flash of light that may be produced as a direct reflection of the sun in the solar panel. Glare is a continuous source of excessive brightness experienced by a stationary observer located in the path of reflected sunlight from the face of the panel. The effect occurs when the solar panel is stationed between or at an angle of the sun and the receptor.

2.10.103 Applicants should map receptors to qualitatively identify potential glint and glare issues and determine if a glint and glare assessment is necessary as part of the application.

2.10.104 When a quantitative glint and glare assessment is necessary, applicants are expected to consider the geometric possibility of glint and glare affecting nearby receptors and provide an assessment of potential impact and impairment based on the angle and duration of incidence and the intensity of the reflection.

2.10.105 The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and design. This may need to account for 'tracking' panels if they are proposed as these may cause differential diurnal and/or seasonal impacts.

2.10.106 When a glint and glare assessment is undertaken, the potential for solar PV panels, frames and supports to have a combined reflective quality may need to be assessed, although the glint and glare of the frames and supports is likely to be significantly less than the panels.'

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

Sections 2.10.134-136 state:

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

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

2.10.136 Applicants may consider adjusting the azimuth alignment of or changing the elevation tilt angle of a solar panel, within the economically viable range, to alter the angle of incidence.

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[19] National Policy Statement for Renewable Energy Infrastructure (EN-3), Department for Energy Security & Net Zero, date: November 2023, accessed on: 21/12/2023.

[20] '*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 2.10.158-159 state:

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

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

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

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

Assessment Process – Ground-Based Receptors

No process for determining and contextualising the effects of glint and glare has been determined when assessing the impact of solar reflections upon surrounding roads and dwellings. Therefore, the Pager Power approach is to determine whether a reflection from the Scheme 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[21] which was produced due to the absence of existing guidance and a specific standardised assessment methodology.

[21] Solar Photovoltaic Development Glint and Glare Guidance, Third Edition V3.1, May 2021. Pager Power.

Aviation Assessment Guidance

The UK Civil Aviation Authority (CAA) issued interim guidance relating to Solar Photovoltaic Systems (SPV) on 17 December 2010 and was subject to a CAA information alert 2010/53. The formal policy was cancelled on September 7th, 2012[22] however the advice is still applicable[23] until a formal policy is developed. The relevant aviation guidance from the CAA is presented in the section below.

CAA Interim Guidance

This interim guidance makes the following recommendations (p.2-3):

'8. It is recommended that, as part of a planning application, the SPV developer provide safety assurance documentation (including risk assessment) regarding the full potential impact of the SPV installation on aviation interests.

9. Guidance on safeguarding procedures at CAA licensed aerodromes is published within CAP 738 Safeguarding of Aerodromes and advice for unlicensed aerodromes is contained within CAP 793 Safe Operating Practices at Unlicensed Aerodromes.

10. Where Schemes in the vicinity of aerodromes require an application for planning permission the relevant LPA normally consults aerodrome operators or NATS when aeronautical interests might be affected. This consultation procedure is a statutory obligation in the case of certain major airports, and may include military establishments and certain air traffic surveillance technical sites. These arrangements are explained in Department for Transport Circular 1/2003 and for Scotland, Scottish Government Circular 2/2003.

11. In the event of SPV developments proposed under the Electricity Act, the relevant government department should routinely consult with the CAA. There is therefore no requirement for the CAA to be separately consulted for such proposed SPV installations or developments.

12. If an installation of SPV systems is planned on-aerodrome (i.e. within its licensed boundary) then it is recommended that data on the reflectivity of the solar panel material should be included in any assessment before installation approval can be granted. Although approval for installation is the responsibility of the ALH[24], as part of a condition of a CAA Aerodrome Licence, the ALH is required to obtain prior consent from CAA Aerodrome Standards Department before any work is begun or approval to the developer or LPA is granted, in accordance with the procedures set out in CAP 791 Procedures for Changes to Aerodrome Infrastructure.

13. During the installation and associated construction of SPV systems there may also be a need to liaise with nearby aerodromes if cranes are to be used; CAA notification and permission is not required.

14. The CAA aims to replace this informal guidance with formal policy in due course and reserves the right to cancel, amend or alter the guidance provided in this document at its discretion upon receipt of new information.

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[22] Archived at Pager Power
[23] Reference email from the CAA dated 19/05/2014.
[24] Aerodrome Licence Holder.

15. Further guidance may be obtained from CAA's Aerodrome Standards Department via aerodromes@caa.co.uk.'

FAA Guidance

The most comprehensive guidelines available for the assessment of solar developments near aerodromes has been produced by the United States Federal Aviation Administration (FAA). The first guidelines were produced initially in November 2010 and updated in 2013. A final policy was released in 2021, which superseded the interim guidance.

The 2010 document is entitled '*Technical Guidance for Evaluating Selected Solar Technologies on Airports'*[25], the 2013 update is entitled '*Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports'*[26], and the 2021 final policy is entitled '*Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports'*[27].

Key excerpts from the final policy are presented below:

Initially, FAA believed that solar energy systems could introduce a novel glint and glare effect to pilots on final approach. FAA has subsequently concluded that in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. However, FAA has continued to receive reports of potential glint and glare from on-airport solar energy systems on personnel working in ATCT cabs. Therefore, FAA has determined the scope of agency policy should be focused on the impact of on-airport solar energy systems to federally-obligated towered airports, specifically the airport's ATCT cab.

The policy in this document updates and replaces the previous policy by encouraging airport sponsors to conduct an ocular analysis of potential impacts to ATCT cabs prior to submittal of a Notice of Proposed Construction or Alteration Form 7460-1 (hereinafter Form 7460-1). Airport sponsors are no longer required to submit the results of an ocular analysis to FAA. Instead, to demonstrate compliance with 14 CFR 77.5(c), FAA will rely on the submittal of Form 7460-1 in which the sponsor confirms that it has analyzed the potential for glint and glare and determined there is no potential for ocular impact to the airport's ATCT cab. This process will enable FAA to evaluate the solar energy system project, with assurance that the system will not impact the ATCT cab.

FAA encourages airport sponsors of federally-obligated towered airports to conduct a sufficient analysis to support their assertion that a proposed solar energy system will not result in ocular impacts. There are several tools available on the open market to airport sponsors that can analyze potential glint and glare to an ATCT cab. For proposed systems that will clearly not impact ATCT cabs (e.g., on-airport solar energy systems that are blocked from the ATCT cab's view by another structure), the use

[25] Archived at Pager Power

[26] Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports, Department of Transportation, Federal Aviation Administration (FAA), date: 10/2013, accessed on: 08/12/2021.

[27] Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports, Federal Aviation Administration, date: May 2021, accessed on: 08/12/2021.

of such tools may not be necessary to support the assertion that a proposed solar energy system will not result in ocular impacts.

The excerpt above states where a solar PV development is to be located on a federally obligated aerodrome with an ATC Tower, it will require a glint and glare assessment to accompany its application. It states that pilots on approach are no longer a specific assessment requirement due to effects from solar energy systems being similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. Ultimately it comes down to the specific aerodrome to ensure it is adequately safeguarded, and it is on this basis that glint and glare assessments are routinely still requested.

The policy also states that several different tools and methodologies can be used to assess the impacts of glint and glare, which was previously required to be undertaken by the Solar Glare Hazard Analysis Tool (SGHAT) using the Sandia National Laboratories methodology.

In 2018, the FAA released the latest version (Version 1.1) of the '*Technical Guidance for Evaluating Selected Solar Technologies on Airports'*[28]. Whilst the 2021 final policy also supersedes this guidance, many of the points are still relevant because aerodromes are still safeguarding against glint and glare irrespective of the FAA guidance. The key points are presented below for reference:

- *Reflectivity refers to light that is reflected off surfaces. The potential effects of reflectivity are glint (a momentary flash of bright light) and glare (a continuous source of bright light). These two effects are referred to hereinafter as "glare," which can cause a brief loss of vision, also known as flash blindness*[29].
- *The amount of light reflected off a solar panel surface depends on the amount of sunlight hitting the surface, its surface reflectivity, geographic location, time of year, cloud cover, and solar panel orientation.*
- *As illustrated on Figure 16*[30]*, flat, smooth surfaces reflect a more concentrated amount of sunlight back to the receiver, which is referred to as specular reflection. The more a surface is polished, the more it shines. Rough or uneven surfaces reflect light in a diffused or scattered manner and, therefore, the light will not be received as bright.*
- *Because the FAA has no specific standards for airport solar facilities and potential glare, the type of glare analysis may vary. Depending on site specifics (e.g., existing land uses, location and size of the project) an acceptable evaluation could involve one or more of the following levels of assessment:*
    - *A qualitative analysis of potential impact in consultation with the Control Tower, pilots and airport officials;*

[28] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 08/12/2021.
[29] Flash Blindness, as described in the FAA guidelines, can be described as a temporary visual interference effect that persists after the source of illumination has ceased. This occurs from many reflective materials in the ambient environment.
[30] First figure in Appendix B.

- *A demonstration field test with solar panels at the proposed site in coordination with FAA Tower personnel;*
- *A geometric analysis to determine days and times when an impact is predicted.*

- *The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and system design.*
- ***1. Assessing Baseline Reflectivity Conditions** – Reflection in the form of glare is present in current aviation operations. The existing sources of glare come from glass windows, auto surface parking, rooftops, and water bodies. At airports, existing reflecting surfaces may include hangar roofs, surface parking, and glassy office buildings. To minimize unexpected glare, windows of air traffic control towers and airplane cockpits are coated with anti-reflective glazing. Operators also wear polarized eye wear. Potential glare from solar panels should be viewed in this context. Any airport considering a solar PV project should first review existing sources of glare at the airport and the effectiveness of measures used to mitigate that glare.*
- ***2. Tests in the Field** – Potential glare from solar panels can easily be viewed at the airport through a field test. A few airports have coordinated these tests with FAA Air Traffic Controllers to assess the significance of glare impacts. To conduct such a test, a sponsor can take a solar panel out to proposed location of the solar project, and tilt the panel in different directions to evaluate the potential for glare onto the air traffic control tower. For the two known cases where a field test was conducted, tower personnel determined the glare was not significant. If there is a significant glare impact, the project can be modified by ensuring panels are not directed in that direction.*
- ***3. Geometric Analysis** – Geometric studies are the most technical approach for reflectivity issues. They are conducted when glare is difficult to assess through other methods. Studies of glare can employ geometry and the known path of the sun to predict when sunlight will reflect off of a fixed surface (like a solar panel) and contact a fixed receptor (e.g., control tower). At any given site, the sun moves across the sky every day and its path in the sky changes throughout year. This in turn alters the destination of the resultant reflections since the angle of reflection for the solar panels will be the same as the angle at which the sun hits the panels. The larger the reflective surface, the greater the likelihood of glare impacts.*
- *Facilities placed in remote locations, like the desert, will be far from receptors and therefore potential impacts are limited to passing aircraft. Because the intensity of the light reflected from the solar panel decreases with increasing distance, an appropriate question is how far you need to be from a solar reflected surface to avoid flash blindness. It is known that this distance is directly proportional to the size of the array in question[31] but still requires further research to definitively answer.*
- ***Experiences of Existing Airport Solar Projects** – Solar installations are presently operating at a number of airports, including megawatt-sized solar facilities covering multiple acres. Air traffic control towers have expressed concern about glint and glare from a small number of*

[31] Ho, Clifford, Cheryl Ghanbari, and Richard Diver. 2009. Hazard Analysis of Glint and Glare From Concentrating Solar Power Plants. SolarPACES 2009, Berlin Germany. Sandia National Laboratories.

solar installations. These were often instances when solar installations were sited between the tower and airfield, or for installations with inadequate or no reflectivity analysis. Adequate reflectivity analysis and alternative siting addressed initial issues at those installations.

Air Navigation Order (ANO) 2016

In some instances, an aviation stakeholder can refer to the ANO 2016[32] with regard to safeguarding. Key points from the document are presented below.

Lights liable to endanger

224. (1) A person must not exhibit in the United Kingdom any light which—

(a) by reason of its glare is liable to endanger aircraft taking off from or landing at an aerodrome; or

(b) by reason of its liability to be mistaken for an aeronautical ground light is liable to endanger aircraft.

(2) If any light which appears to the CAA to be a light described in paragraph (1) is exhibited, the CAA may direct the person who is the occupier of the place where the light is exhibited or who has charge of the light, to take such steps within a reasonable time as are specified in the direction—

(a) to extinguish or screen the light; and

(b) to prevent in the future the exhibition of any other light which may similarly endanger aircraft.

(3) The direction may be served either personally or by post, or by affixing it in some conspicuous place near to the light to which it relates.

(4) In the case of a light which is or may be visible from any waters within the area of a general lighthouse authority, the power of the CAA under this article must not be exercised except with the consent of that authority.

Lights which dazzle or distract

225. A person must not in the United Kingdom direct or shine any light at any aircraft in flight so as to dazzle or distract the pilot of the aircraft.'

The document states that no 'light', 'dazzle' or 'glare' should be produced which will create a detrimental impact upon aircraft safety.

Endangering safety of an aircraft

240. A person must not recklessly or negligently act in a manner likely to endanger an aircraft, or any person in an aircraft.

[32] The Air Navigation Order 2016. [online] Available at: <https://www.legislation.gov.uk/uksi/2016/765/contents/made> [Accessed 4 February 2022].

Endangering safety of any person or property

241. A person must not recklessly or negligently cause or permit an aircraft to endanger any person or property.

Civil Aviation Authority consolidation of UK Regulation 139/2014

The Civil Aviation Authority (CAA) published a consolidating document[33] of UK regulations, (Implementing Rules, Acceptable Means of Compliance and Guidance Material), in 2023. A summary of material relevant to aerodrome safeguarding is presented below:

(a) The aerodrome operator should have procedures to monitor the changes in the obstacle environment, marking and lighting, and in human activities or land use on the aerodrome and the areas around the aerodrome, as defined in coordination with the CAA. The scope, limits, tasks and responsibilities for the monitoring should be defined in coordination with the relevant air traffic services providers, and with the CAA and other relevant authorities.

(b) The limits of the aerodrome surroundings that should be monitored by the aerodrome operator are defined in coordination with the CAA and should include the areas that can be visually monitored during the inspections of the manoeuvring area.

(c) The aerodrome operator should have procedures to mitigate the risks associated with changes on the aerodrome and its surroundings identified with the monitoring procedures. The scope, limits, tasks, and responsibilities for the mitigation of risks associated to obstacles or hazards outside the perimeter fence of the aerodrome should be defined in coordination with the relevant air traffic services providers, and with the CAA and other relevant authorities.

(d) The risks caused by human activities and land use which should be assessed and mitigated should include:

1. obstacles and the possibility of induced turbulence;
2. the use of hazardous, confusing, and misleading lights;
3. the dazzling caused by large and highly reflective surfaces;
4. sources of non-visible radiation, or the presence of moving, or fixed objects which may interfere with, or adversely affect, the performance of aeronautical communications, navigation and surveillance systems; and

non-aeronautical ground light near an aerodrome which may endanger the safety of aircraft and which should be extinguished, screened, or otherwise modified so as to eliminate the source of danger.

Railway Assessment Guidelines

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

[33] https://regulatorylibrary.caa.co.uk/139-2014-pdf/PDF.pdf

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

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

Railway guidelines are presented below. These relate specifically to the sighting distance for railway signals.

Reflections and Glare

The extract below is taken from Section A5 – Reflections and glare (pages 64-65) of the 'Signal Sighting Assessment Requirements'34 which details the requirement for assessing glare towards railway signals.

Reflections and glare

Rationale

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

Guidance

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

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

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

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

Examples of the adverse effect of disability glare include:

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

Options for militating against A5 include:

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

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

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

Determining the Field of Focus

The extract below is taken from Appendix F - Guidance on Field of Vision (pages 98-101) of the 'Signal Sighting Assessment Requirements'35 which details the visibility of signals, train drivers' field of vision and the implications with regard to signal positioning.

Asset visibility

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

a) Position in the observer's visual field.
b) Contrast with its background.
c) Luminance properties.
d) The observer's adaptation to the illumination level of the environment.

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

Field of vision

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

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

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

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

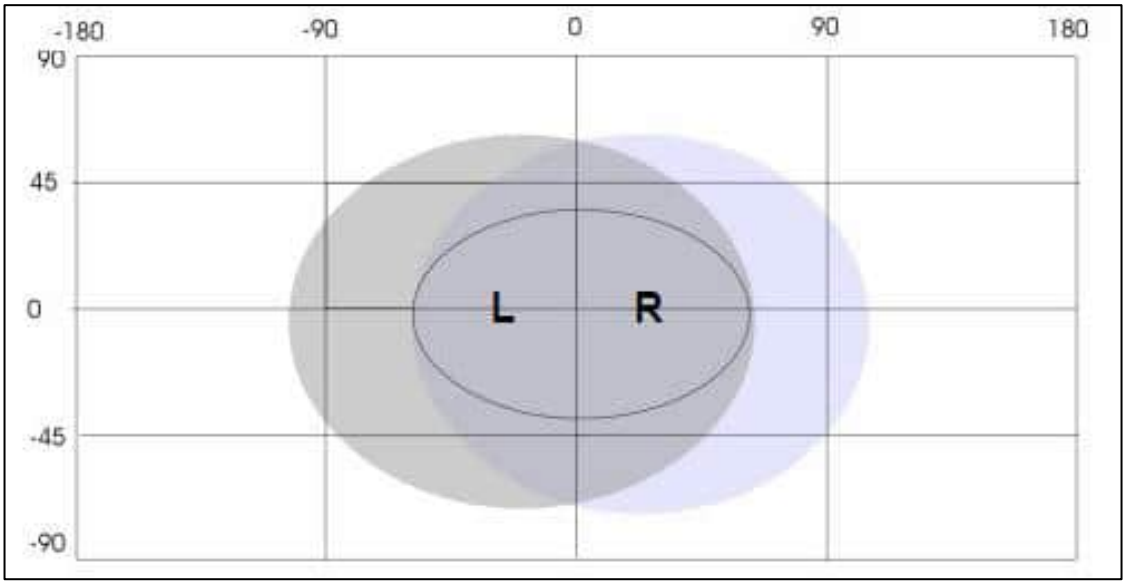


Figure G 21 - Field of view

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

Research has shown that drivers search for signs or signals towards the centre of the field of vision. Signals, indicators and signs should be positioned at a height and distance from the running line that permits them to be viewed towards the centre of the field of vision. This is because:

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

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

Figure G 22 and Table G 5 identify the radius of an 8o cone at a range of close-up viewing distances from the driver's eye. This shows that, depending on the lateral position of a stop signal, the optimal (normal) train stopping point could be as far as 25 m back from the signal to ensure that it is sufficiently prominent.

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

a) A co-acting signal.

b) A miniature banner repeater indicator.

c) A right away indicator.

d) A sign to remind the driver to check the signal aspect.

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

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

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

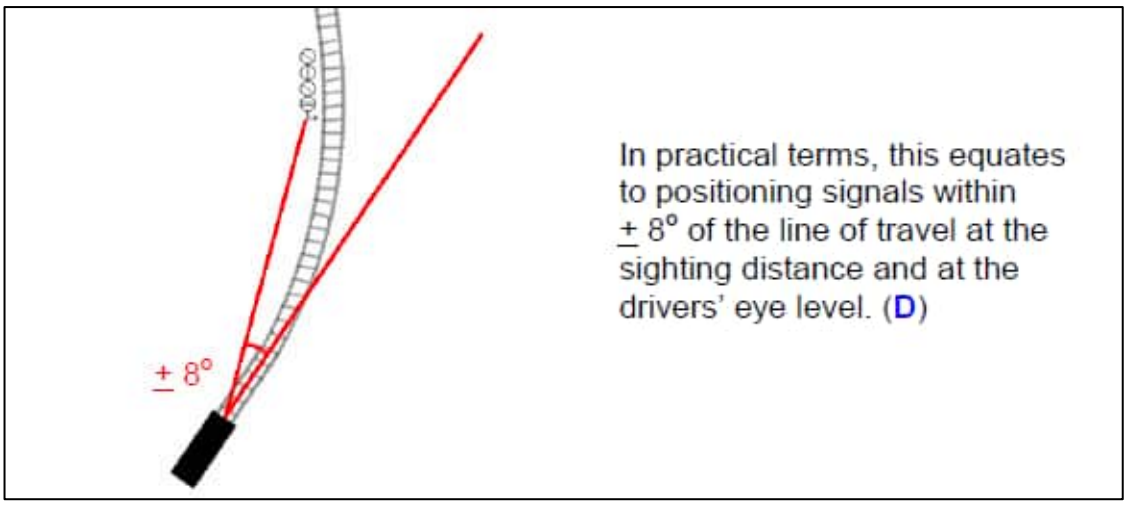


Figure G 22 - Signal positioning

'A' (m)	'B' (m)	Typical display positions
5	*0.70*	-
6	*0.84*	-
7	*0.98*	-
8	*1.12*	-
9	*1.26*	-
10	*1.41*	-
11	*1.55*	-
12	*1.69*	-
13	*1.83*	-
14	*1.97*	-

15	*2.11*	*A stop aspect positioned 3.3 m above rail level and 2.1 m from the left hand rail is within the 8° cone at 15.44 m in front of the driver*
16	*2.25*	-
17	*2.39*	-
18	*2.53*	*A stop aspect positioned 5.1 m above rail level and 0.9 m from the left hand rail is within the 8° cone at 17.93 m in front of the driver*
19	*2.67*	-
20	*2.81*	-
21	*2.95*	-
22	*3.09*	-
23	*3.23*	-
24	*3.37*	-
25	*3.51*	*A stop aspect positioned 3.3 m above rail level and 2.1 m from the right hand rail is within the 8° cone at 25.46 m in front of the driver*

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

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

Determining the Assessed Minimum Reading Time

The extracts below are taken from the RIS-0737-CCS-1 of the 'Signal Sighting Assessment Requirements' which details the required minimum reading time for a train driver when approaching a signal.

The following abbreviations are defined within the 'Definitions and Abbreviations':

'Baseline response time

The minimum time value that can be used by the SSC to specify the MRT for a particular signalling asset type.

Supplementary response time

The assessed amount of extra time that the SSC adds to the BRT to determine the MRT value for a specific lineside signalling asset.'

The following extract is taken from page 114 of the RIS-0737-CCS-1:

'Minimum response time (MRT)

The assessed minimum time needed by a driver (or other authorised user) to respond to the information presented by a specific lineside signalling asset, taking account of the following human tasks:

a) Read the display or display combination.

a) Interpret the display or display combination

b) Assimilate all of the available information

c) Decide what action to take (if any), and when it needs to be taken

d) Take the action, where necessary, before the train passes the asset.

MRT = BRT + SRT'

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

Signal Design and Lighting System

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

- An LED railway signal produces a more intense light making them more visible to approaching trains when compared to the traditional filament bulb technology[36];
- No reflective mirror is present within the LED signal itself unlike a filament bulb. The presence of the reflective surfaces greatly increases the likelihood of incoming light being reflecting out making the signal appear illuminated.

Many LED signal manufacturers[37,38,39] claim that LED signal lights significantly reduce or completely remove the likelihood of a phantom aspect illumination occurring.

[36] Source: Wayside LED Signals – Why it's Harder than it Looks, Bill Petit.
[37] Source: http://www.unipartdorman.co.uk/assets/unipart_dorman_rail_brochure.pdf. (Last accessed 21.02.18).
[38] Source: http://www.vmstech.co.uk/downloads/Rail.pdf. (Last accessed 21.02.18).
[39] Source: Siemens, Sigmaguard LED Tri-Colour L Signal – LED Signal Technology at Incandescent Prices. Datasheet 1A-23. (Last accessed 22.02.18).

APPENDIX B – OVERVIEW OF GLINT AND GLARE STUDIES

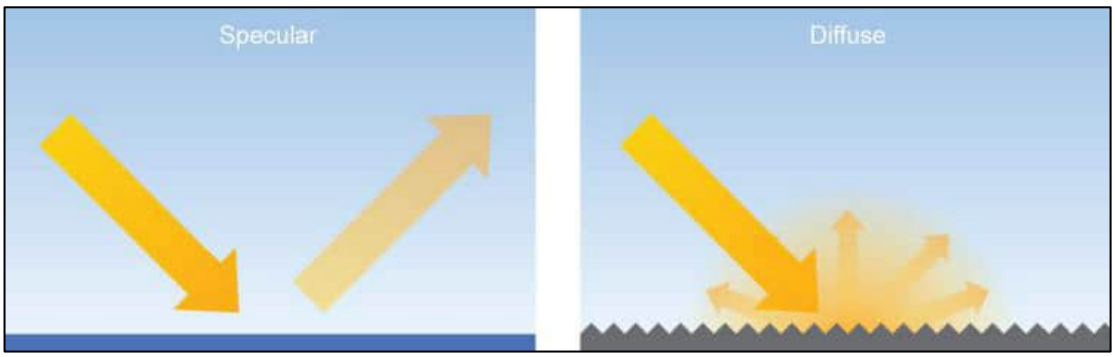
Overview

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

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

Reflection Type from Solar Panels

Based on the surface conditions reflections from light can be specular and diffuse. A specular reflection has a reflection characteristic similar to that of a mirror; a diffuse reflection will reflect the incoming light and scatter it in many directions. The figure below, taken from the FAA guidance[40], 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

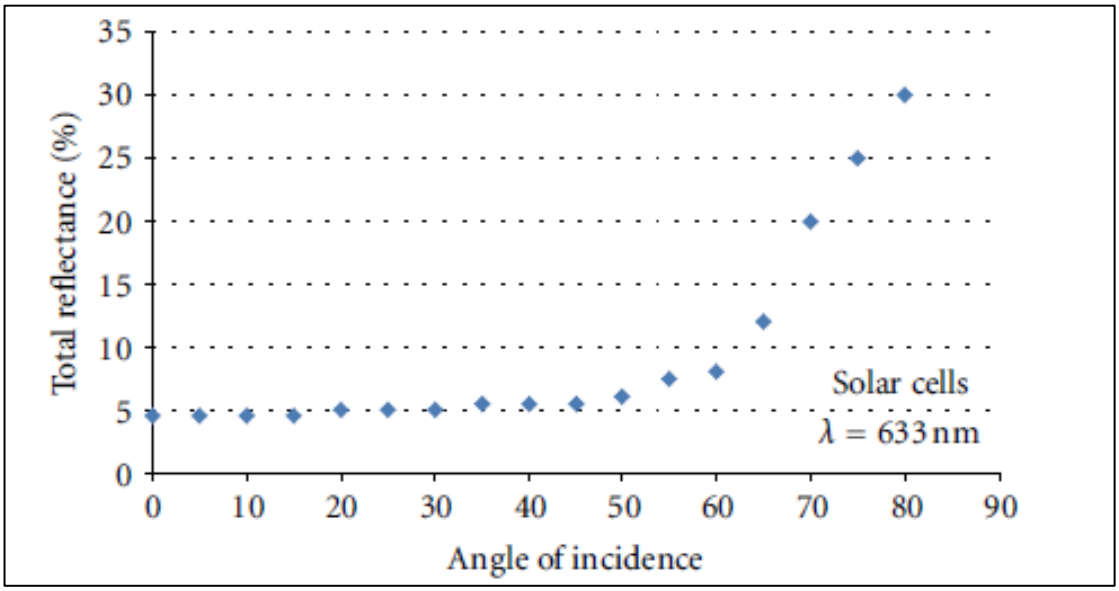
[40] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 08/12/2021.

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*[41]". 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.

[41] 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"[42]

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[43]
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.

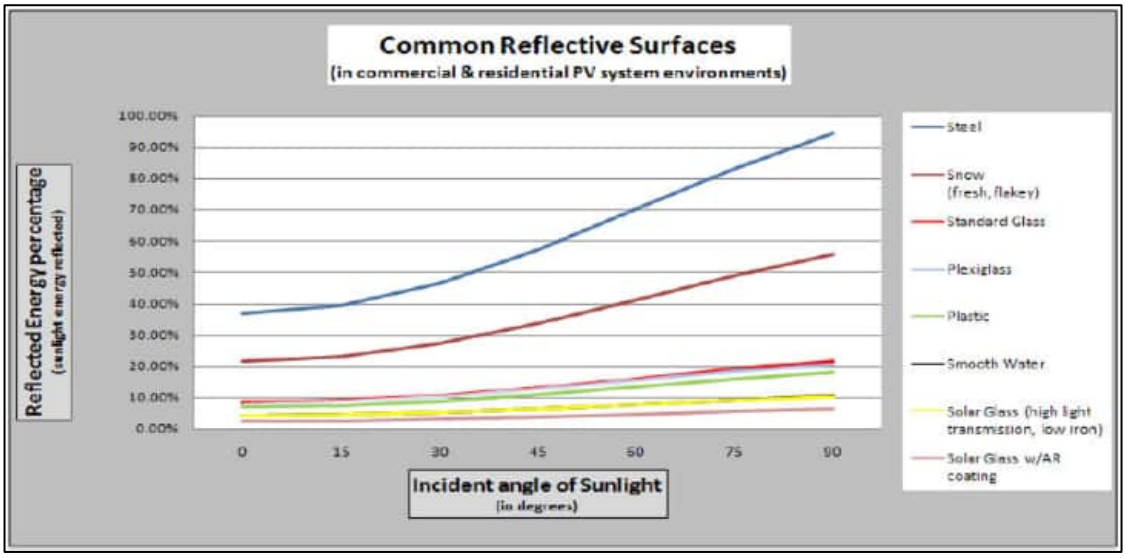
[42] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 08/12/2021.

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

SunPower Technical Notification (2009)

SunPower published a technical notification[44] 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.

[44] 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.

APPENDIX D – GLINT AND GLARE IMPACT SIGNIFICANCE

Overview

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

Impact Significance Definition

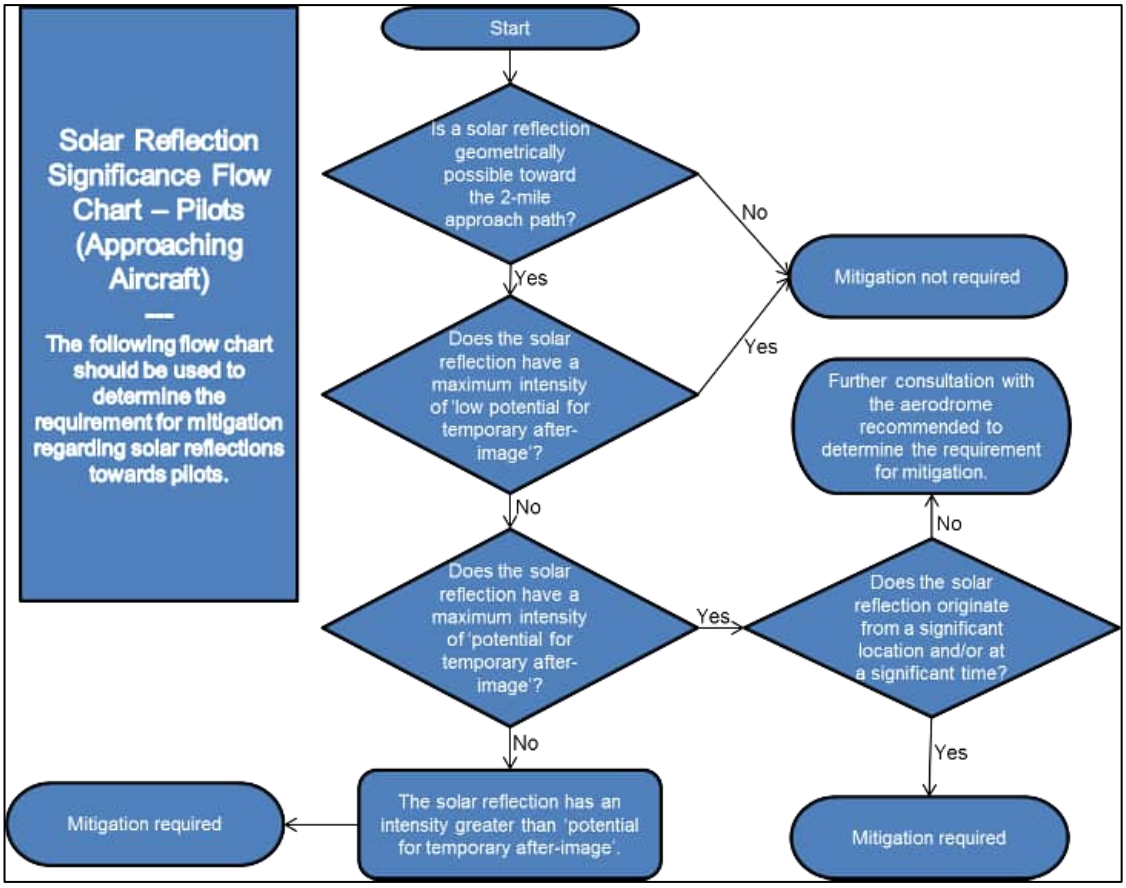
The table below presents the recommended definition of 'impact significance' in glint and glare terms and the requirement for mitigation under each.

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

Impact significance definition

Impact Significance Determination for Approaching Aircraft

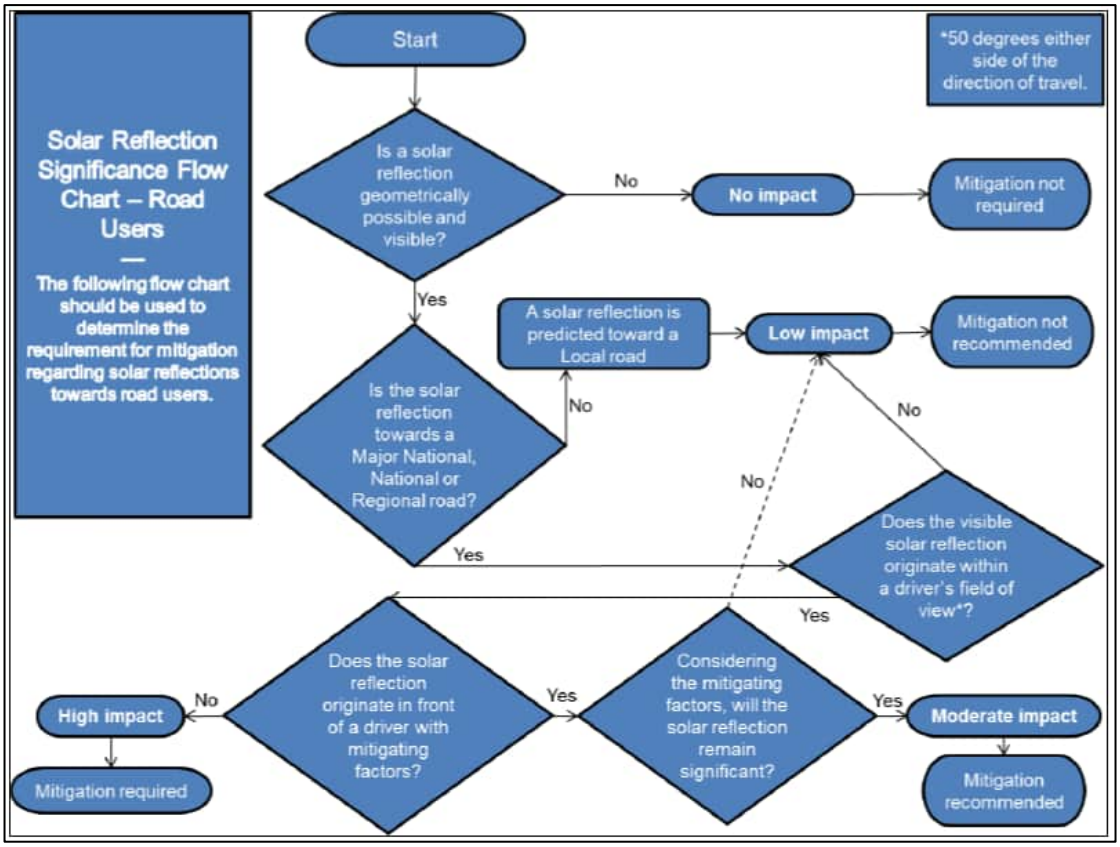
The flow chart presented below has been followed when determining the mitigation requirement for approaching aircraft.



Approaching aircraft receptor mitigation requirement flow chart

Impact Significance Determination for Road Receptors

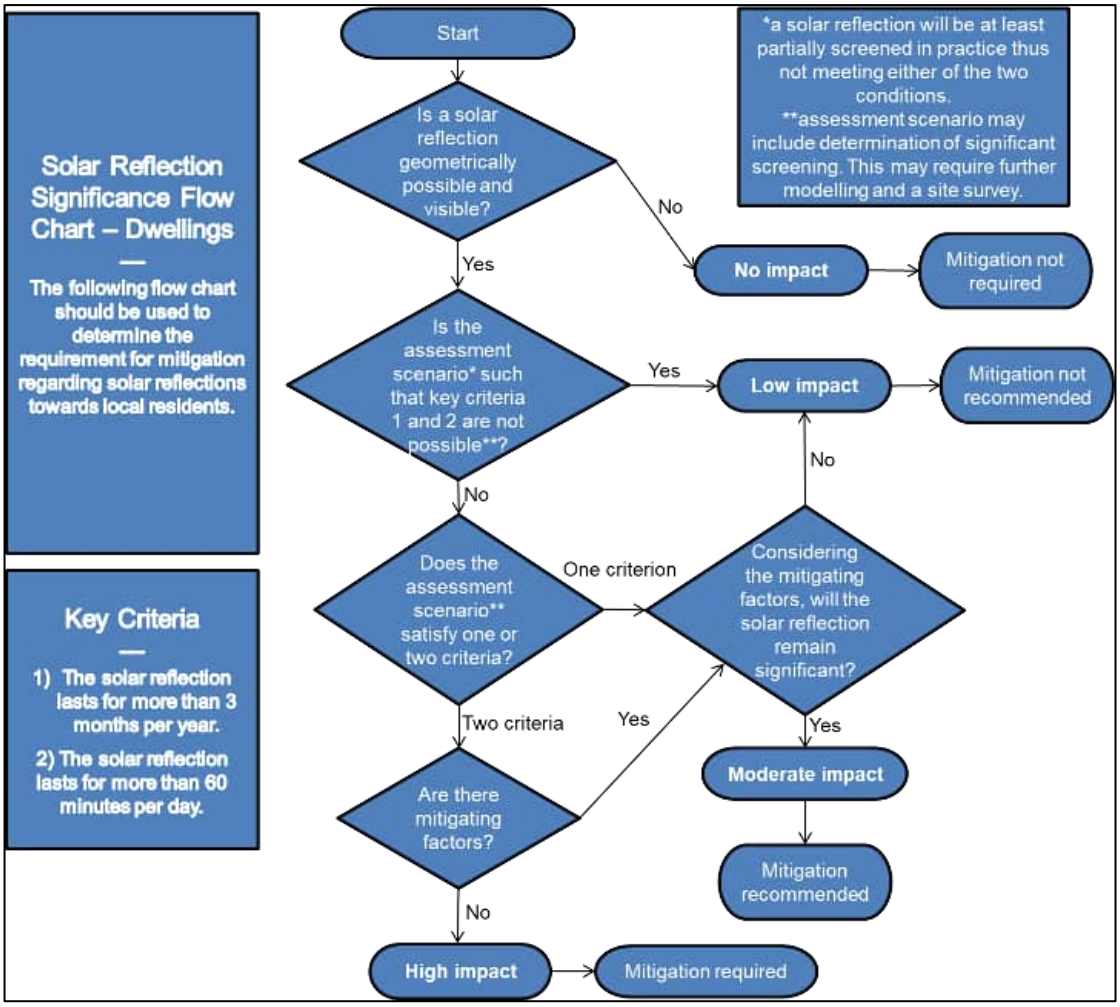
The flow chart presented below has been followed when determining the mitigation requirement for road receptors.



Road receptor mitigation requirement flow chart

Impact Significance Determination for Dwelling Receptors

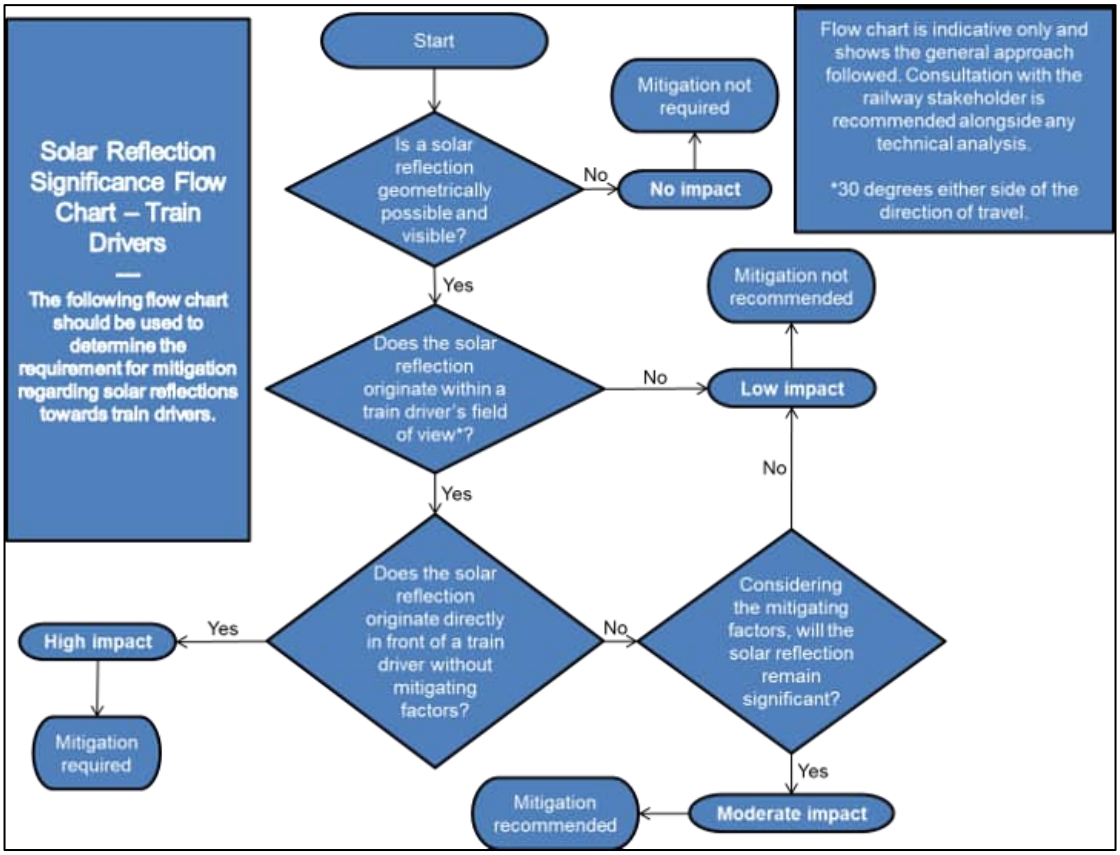
The flow chart presented below has been followed when determining the mitigation requirement for dwelling receptors.



Dwelling receptor mitigation requirement flow chart

Impact Significance Determination for Railway Receptors

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



Train driver impact significance flow chart

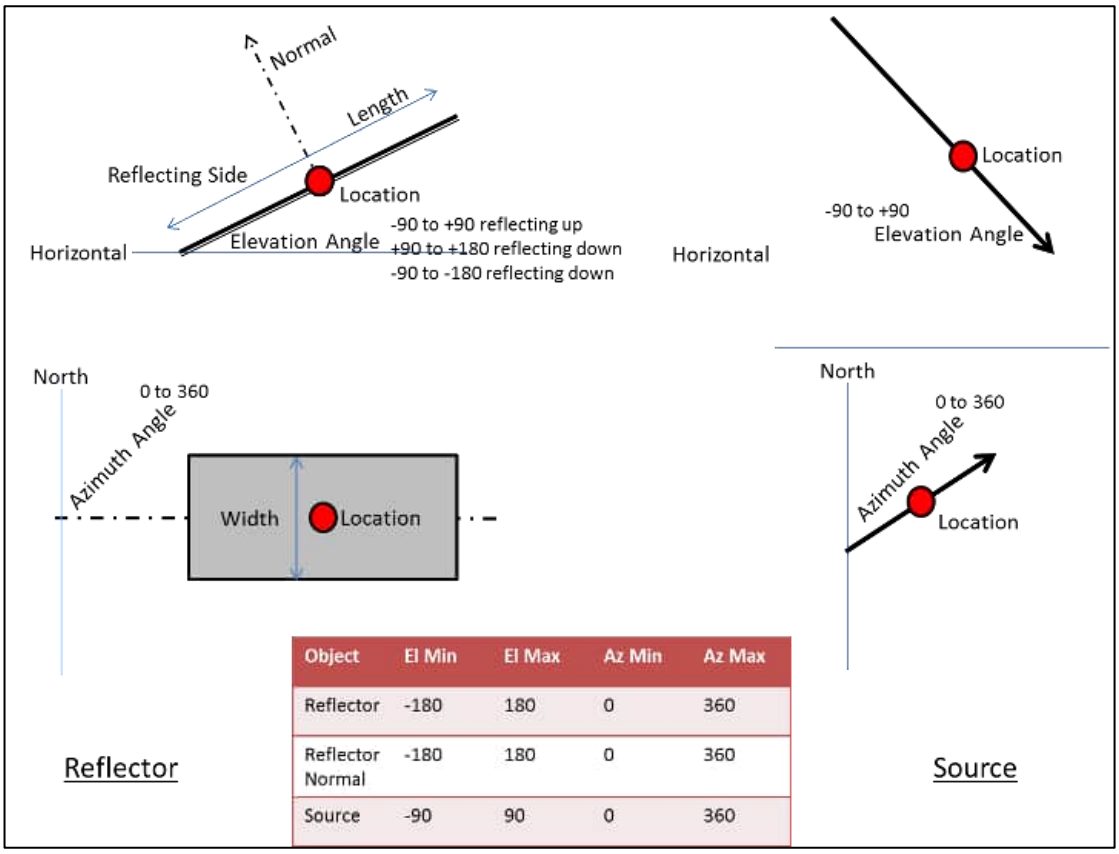
APPENDIX E – REFLECTION CALCULATIONS METHODOLOGY

Pager Power 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

Reflection calculation process

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)[45].

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

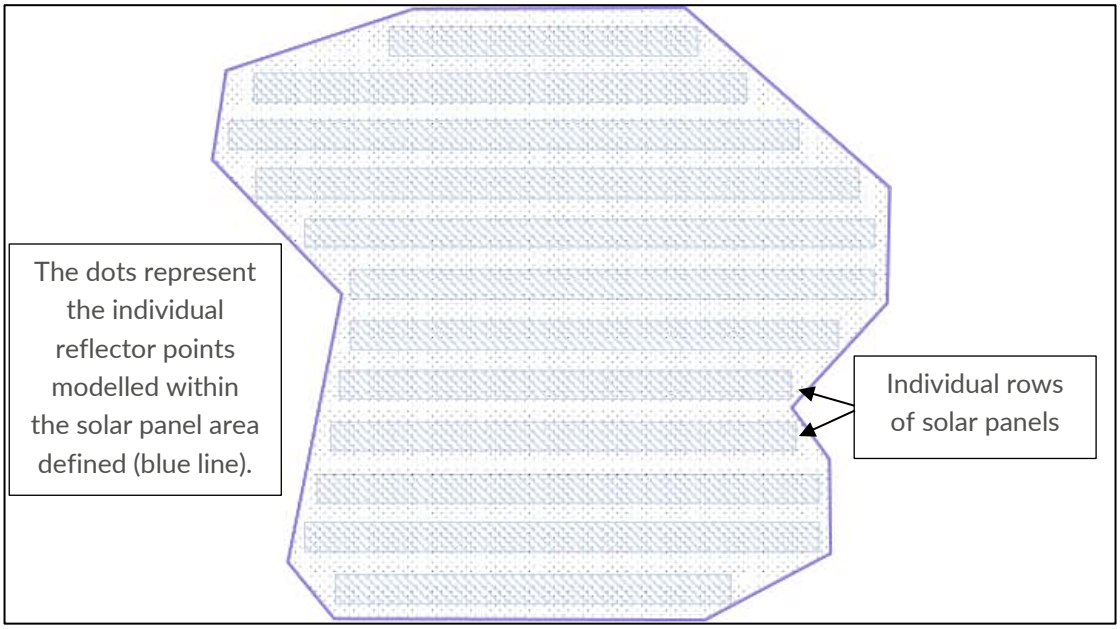
It is assumed that the panel azimuth angle assessed represents the azimuth angle for all of the panels within each solar panel area defined.

Only a reflection from the face of the panel has been considered. The frame or the reverse or 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 below which illustrates this process.

[45] 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.

PAGERPOWER

Urban & Renewables

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

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

Lime Down
Solar Park

EIA Scoping Report

Appendix 16.1:

High-Level Electromagnetic Field Assessment

July 2024

EN010168

PAGERPOWER
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High-Level Electromagnetic Field Assessment

Island Green Power UK Ltd

Lime Down Solar

July 2024

EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the potential electromagnetic fields generated by electrical equipment within a fixed ground-mounted solar photovoltaic development with respect to safe levels for human exposure. The Scheme is located within Wiltshire, England, and will consist of underground power cables, transformers, photovoltaic (PV) inverters, distribution substation and Battery Energy Storage System (BESS)[1].

Emissions

All electrical equipment emits electric and magnetic radiation. Power cables produce both electric and magnetic fields which can potentially affect human health. Radiation from underground cables is generally less than radiation from overhead powerlines because emissions from adjacent conductors within a cable tend to cancel each other out. When assessing the impacts of overhead power lines, it is important to consider the impact of both electric and magnetic fields. Underground cables generally cause a negligible electric field above ground but can cause a significant magnetic field which is dependent on the current in the conductors.

Standards in the UK

The UK Policy on public exposure limits to EMF radiation is designed to comply with the 1998 ICNIRP (International Commission on the Non-Ionizing Radiation Protection) guidelines in terms of the 1999 EU Recommendation. In 2010 ICNIRP produced new guidelines but these have not yet been incorporated into UK Policy. The public exposure limits in UK policy define reference levels for electric and magnetic fields. Where field levels exceed these reference levels in significantly occupied spaces, further investigation is warranted. Further information can be found in section **Error! Reference source not found.** of the report.

Overall Conclusion

Maximum levels of electromagnetic radiation from the proposed underground cables are predicted to be below ICNIRP reference levels for magnetic fields.

Radiation from the transformers and PV inverters will be even less significant because the equipment is typically housed in protective enclosures and the transformers and PV inverters will be CE marked, meaning they should not generate or be affected by electromagnetic disturbance.

Additionally, radiation from the substation and BESS will not be significant as the proposed BESS location is at a safe distance from surrounding dwellings.

[1] The maximum voltages and potential locations for all underground cables, transformers/PV inverters and BESS have been considered to account for a worst-case scenario in the absence of a finalised electrical design of the site.

Conclusions - 400kV Underground Cables

The maximum magnetic field produced by the proposed underground cables is predicted to be 96.17 micro-Tesla. The magnetic field levels are therefore below the reference level from the public exposure limits in UK policy (100 micro-Tesla for magnetic fields). External electric fields are not produced from underground cables so have not been considered.

Conclusions - Transformers, and PV Inverters

Notable sources of radiation other than the cables will be the transformers/PV inverters positioned across the Scheme.

The transformers and PV inverters should be 'CE' marked. CE marking indicates that a product has been assessed by the manufacturer and deemed to meet European Union safety, health and environmental protection requirements. CE marking requirements have been adopted and extended indefinitely in Great Britain.

The CE marking should ensure that electrical and electronic equipment does not generate, or is not unintentionally affected by, electromagnetic disturbance.

The transformers and PV inverters are also predicted to produce fields at a lower level than that of underground cables because the equipment is typically housed in protective enclosures.

Conclusions - Distribution Substation and BESS

The Scheme will connect to Melksham Substation (an existing National Grid distribution substation). According to UK regulation, the substation conforms with the applicable exposure limitations for the general public, and the field from the equipment inside a substation does not extend far, if at all, outside the perimeter fence.

The BESS contributes to the electromagnetic radiation produced by the Scheme. However, when evaluating the proposed BESS location, the closest dwelling is over 130m away. As electromagnetic radiation levels reduce with increased distance, all nearby dwellings are situated at a safe distance from the BESS installations.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 59 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 Purpose of the Study

Pager Power has been retained to assess the potential electromagnetic fields generated by electrical equipment within a fixed ground-mounted solar photovoltaic development with respect to safe levels for human exposure. The Scheme is located within Wiltshire, England, and will consist of underground power cables, transformers, photovoltaic (PV) inverters, distribution substation and Battery Energy Storage System (BESS)[2].

1.2 Scheme Site Layout

Figure 1 below shows the solar Sites for the Scheme, overlaid onto aerial imagery.

Figure 1 Scheme site layout

[2] The maximum voltages and potential locations for all underground cables, transformers/PV inverters and BESS have been considered to account for a worst-case scenario in the absence of a finalised electrical design of the site.

1.3 Assessed Infrastructure

The known locations of assessed infrastructure are shown in Figure 2 below:

- Proposed solar array footprint (blue polygons);
- The proposed underground cable search area (pink area);
- Proposed BESS location options (orange polygons).

More detailed sections are shown within the technical assessment sections of this report. Figure 2 is intended to provide an overview of the environment and infrastructure.

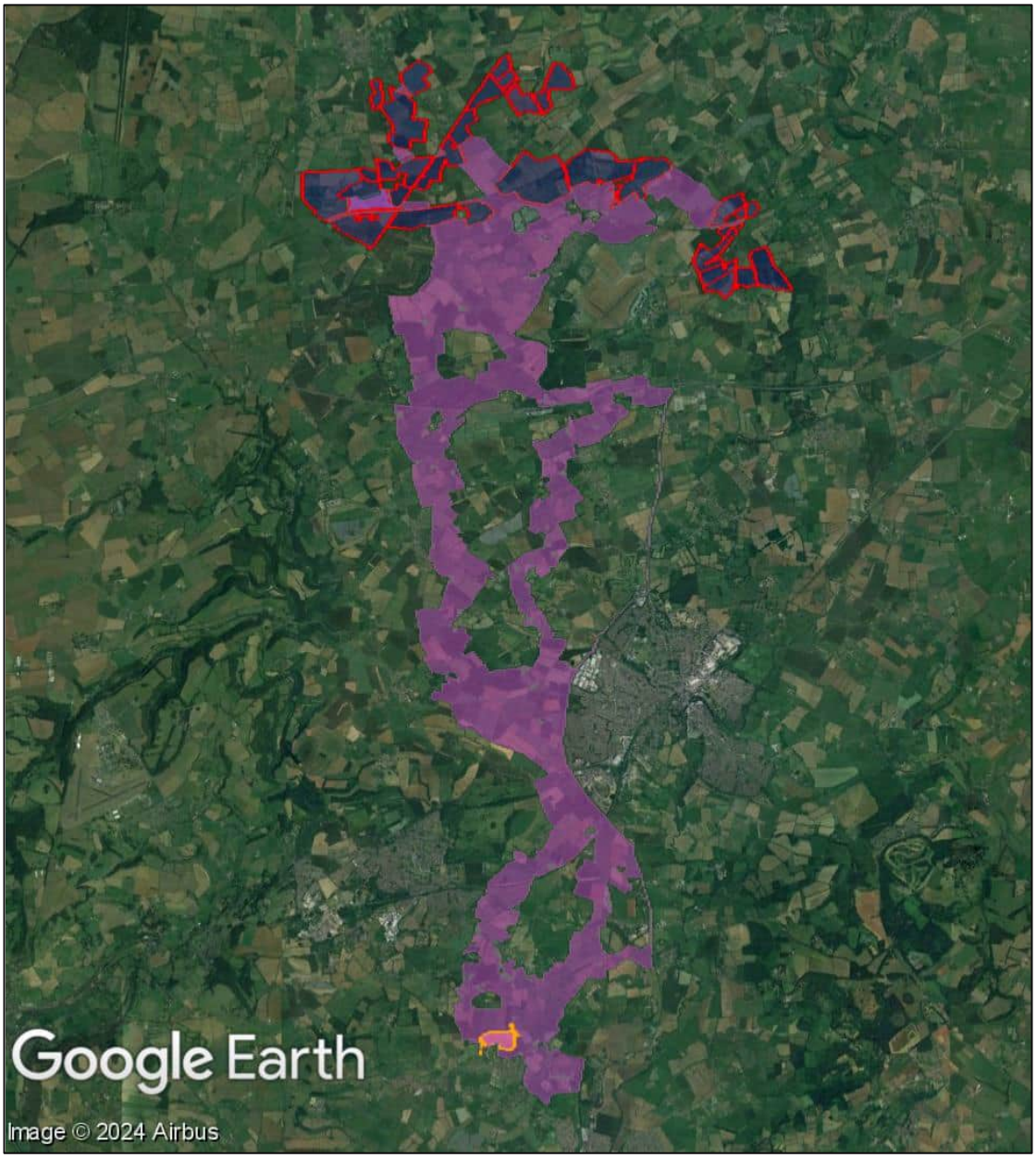

Figure 2 *Assessed infrastructure locations*

2 TECHNICAL BACKGROUND

2.1 Emissions

All electrical equipment emits electric and magnetic radiation. Power cables produce both electric and magnetic fields which can potentially affect human health. Radiation from underground cables is generally less than radiation from overhead lines because emissions from adjacent conductors within a cable tend to cancel each other out. When assessing the impacts of overhead powerlines, it is important to consider the impact of both electric and magnetic fields.

Underground cables generally cause a negligible electric field above ground but can cause a significant magnetic field which is dependent on the current in the conductors.

2.2 Electromagnetism

The movement of electric charge causes electric and magnetic fields to be produced in the space surrounding the charge. Human exposure to such fields can cause health problems if persistent and/or they are of high strength. The magnitude of the effects is dependent on both the field strength and the exposure time.

2.3 Health Concerns – Potential Effects

The potential effects on human health caused by time-varying magnetic fields, such as those generated by AC[3] cables, are due to induced current on functions of the central nervous system. There are various international bodies which provide maximum safe exposure levels to time varying electromagnetic fields.

Various sources of information relating to safe exposure levels have been reviewed as part of this study.

The UK Policy on public exposure limits to EMF radiation is designed to comply with the 1998 ICNIRP (International Commission on the Non-Ionizing Radiation Protection) guidelines in terms of the 1999 EU Recommendation. In 2010 ICNIRP produced new guidelines but these have not yet been incorporated into UK Policy. The public exposure limits in UK policy define reference levels for electric and magnetic fields. Where field levels exceed these reference levels in significantly occupied spaces, further investigation is warranted.

Another relevant resource consulted is the EMFs.info webpage, where the UK electricity industry have collected the relevant studies pertaining to safe limits on exposure in the UK and elsewhere in the world. The relevant sections are analysed in the next chapter.

2.4 Radiation from Home Electrical Equipment

The World Health Organization (WHO) publishes data regarding electromagnetic fields including the following typical levels for home electrical equipment, shown in Table 1 below.

[3] Alternating Current

Appliance	Electric field strength (Volts per metre)	Magnetic field strength (micro-Tesla) (at 1 metre)
Hair Dryer	80	0.01 – 7
Iron	120	0.12 – 0.3
Vacuum Cleaner	50	2 – 20
Refrigerator	120	0.01 – 0.25
Television	60	0.04 - 2

Table 1 *Typical emissions from home electrical equipment*

2.5 Radiation Reduction with Distance

Radiation levels reduce with distance which means, for example, the typical magnetic field from a vacuum cleaner reduces from 800 micro-Tesla to 2 micro-Tesla when the separation distance increases from 3 centimetres to 100 centimetres.

This means radiation levels from the cables, transformers, PV inverters, and BESS will tend to reduce with distance in any direction – including towards a receptor.

3 OVERVIEW OF ELECTROMAGNETIC FIELDS

3.1 Overview

The Electricity Networks Association[4] provides a comprehensive overview of electromagnetic fields (EMFs) and the issues associated with these on their webpage. Regarding health issues caused by EMFs they state the following:

However, there are suggestions that magnetic fields may cause other diseases, principally childhood leukaemia, at levels below these limits. The evidence for this comes from epidemiology studies, which have found a statistical association - an apparent two-fold increase in leukaemia incidence, from about 1 in 24,000 per year up to 1 in 12,000 per year, for the children with the top half percent of exposures. The evidence is strong enough for magnetic fields to be classified by the World Health Organization as "possibly carcinogenic". But because these studies only show statistical associations and do not demonstrate causation, and because the evidence from the laboratory is against, the risk is not established, it remains only a possibility.

3.2 Exposure limits in the UK

As set out in the previous section, the limits in the UK come from the 1998 ICNIRP guidelines. The original guidance in 1999 specified:

i) Basic Restrictions

These are the levels at which radiation is potentially harmful to humans. This is a current density[5] given in mA m^{-2} (milliamps per metre squared).

ii) Reference Level (Investigation Level)

Provided for practical exposure assessment purposes to determine whether the basic restrictions are likely to be exceeded. Compliance with the reference level will ensure compliance with the relevant basic restriction.

iii) Field Actually Required

This is the field strength at which the basic restriction is likely to be exceeded.

The values for the above stated in the ICNIRP 1998 paper are shown in Table 2 on the following page. These are the public exposure values, not the occupational exposure values – the former is more conservative than the latter by a factor of five.

[4] This is an industry body for the companies which run the UK and Ireland's energy networks. The group comprises 14 members including National Grid.

[5] Current density is the amount of electric current flowing through a unit area.

ICNIRP 1998 – Public Exposure Limits				
Basic Restriction (mA m^{-2})	Magnetic Fields Reference Level (µT)	Electric Fields Reference Level (kV m^{-1})	Magnetic Field Actually Required (µT)	Electric Field Actually Required (kV m^{-1})
2	100	5	360	9

Table 2 *ICNIRP Exposure Limits 1998*

The levels in Table 2 will be considered within this analysis.

3.3 Height Above Ground Used for Testing Compliance

EMFs.info specifically states the following with regard to the height to be used to test compliance:

The standard height for measuring fields, especially from power lines, is 1 m above ground level … This isn't just because it's a convenient round number, it's because roughly half way up the height of a standing person is actually the height that gives the best approximation to the induced current in the body.

3.4 Safe Levels – Summary

The values of interest are those shown in Table 2 above. Effectively, this means that in locations of significant exposure time, such as residences, levels should be below:

- 100µT (magnetic fields).
- 5kV m^{-1} (electric fields).

Values exceeding the limits above, at one metre above ground level, would suggest that further investigation is required.

4 TECHNICAL ASSESSMENT

4.1 Field Levels – Underground Cables

Field level data from various cable configurations have been sourced from EMFS.info. The data below and on the following page shows the magnetic fields for 400kV cables, which represent the maximum assumed voltage for underground cables in the Scheme, considering a worst-case scenario. Typical values for magnetic fields are approximately a third of these maximum values[6]. The assessment accounts for varying cable voltages in the Scheme, with the analysis based on the maximum and shallowest depths to adopt a conservative approach. Maximum field data has been used where possible to provide a more conservative assessment. It's important to note that there are no electric fields associated with underground cables. The relevant chart is shown in Figure 3 below. Table 3 on the following page provides the associated indicative numerical values at set distances.

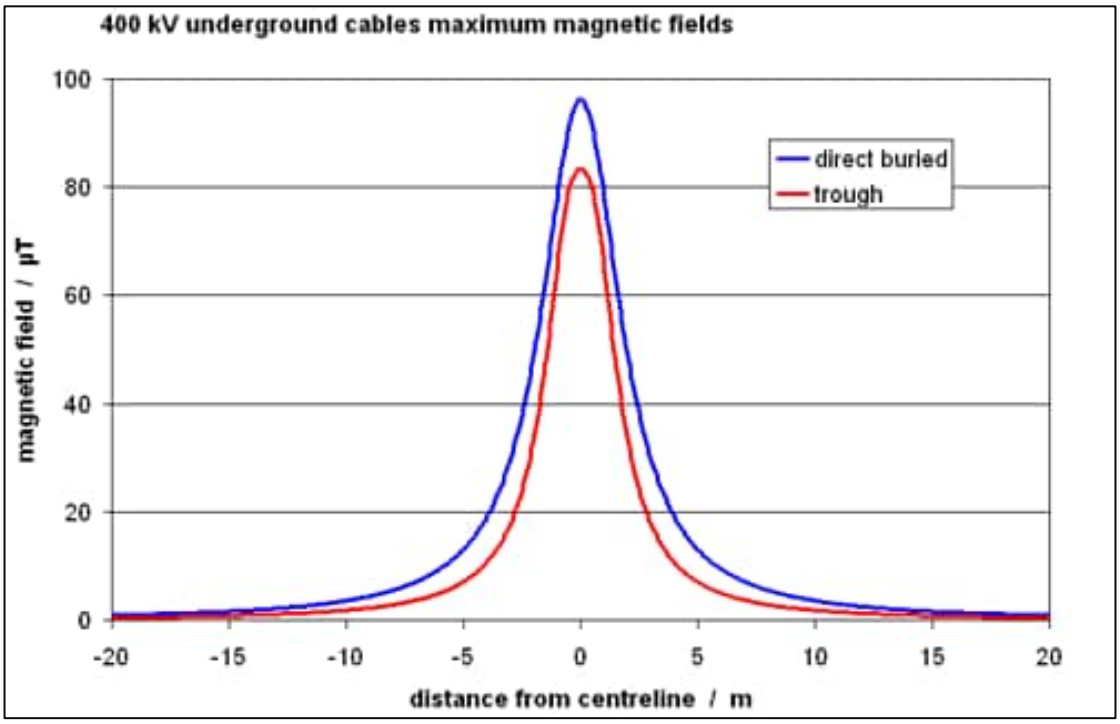

Figure 3 *Typical magnetic fields associated with 400kV underground cables*

[6] Source: https://www.emfs.info/sources/overhead/specific/400-kv/

Distance from Centreline (m)	Magnetic Field (trough double circuit cable with 0.13m spacing and 0.3m depth)	Magnetic Field (direct buried single cable with 0.5m spacing and 0.9m depth)[7]
0	83.30 micro Teslas	96.17 micro Teslas
5	7.01 micro Teslas	13.05 micro Teslas
10	1.82 micro Teslas	3.58 micro Teslas
20	0.46 micro Teslas	0.92 micro Teslas

Table 3 *Typical magnetic field levels for an underground 400kV cable (source: EMFS.info)*

4.2 Recommended Minimum Clearance Distances

The recommended minimum clearance distances for underground cables based on the public exposure limits previously referenced in this report for magnetic and electric fields are presented in Table 4 below.

The dataset provided maximum values and typical values for the configurations that have been evaluated – in all cases the 'maximum' option has been chosen where possible in order to remain conservative.

Type of Line	Recommended minimum Clearance Distance (m)	Estimated Maximum Magnetic Field (micro-Tesla)	Estimated Maximum Electric Field (kV/m)
400kV underground cable	None	96.17 (below 100 limit)	-

Table 4 *Recommended minimum clearance distances for the 400kV underground cables*

This shows that clearance distances are not required for any proposed underground cables. The table highlights that the maximum fields produced by the cables are below the acceptable exposure limit and significant effects upon human health are not predicted.

[7] This cable was used for the assessment in the following sections.

4.3 Radiation from Other Sources

4.3.1 Transformers and PV Inverters

Notable sources of radiation, other than the underground cables, will include the transformers and PV inverters positioned across the Scheme. As of the time of this report, the specific locations for these have not been finalised.

The transformers and PV inverters should be CE marked. CE marking indicates that a product has been assessed by the manufacturer and deemed to meet European Union safety, health and environmental protection requirements[8]. CE marking requirements have been adopted and extended indefinitely in Great Britain. This will be confirmed prior to installation.

In this case, the relevant EU Directive for CE marking is[9] Electromagnetic Compatibility Directive 2014/30/EU, which should ensure that electrical and electronic equipment should not generate, or be affected by, electromagnetic disturbance.

Additionally, the transformers and PV inverters are also predicted to produce fields at a lower level than that of underground cables as the equipment will be housed in a protective enclosures.

4.3.2 Substation and BESS

Other notable sources of radiation associated with the Scheme include the substation and BESS. There are two potential locations for the BESS, one located at Land at Melksham Substation, and the other at Lime Down D. The locations of these are shown in Figures 4 and 5 below and on the following page, with the green polygon (Figure 4 only) representing Melksham Substation (an existing National Grid substation) and the orange polygons representing the potential BESS location.

Figure 4 *Proposed BESS option at Land at Melksham Substation*

[8] Source: https://europa.eu/youreurope/business/product-requirements/labels-markings/ce-marking/index_en.htm
[9] Source: https://ec.europa.eu/growth/sectors/electrical-engineering/emc-directive_en

Figure 5 *Proposed BESS option at Lime Down D*

The minimum horizontal distance between the BESS option at Land at Melksham Substation and any dwelling is approximately 130m. This is illustrated in Figure 6 below. Within this figure, the square icon shows the position of an existing pylon.

Figure 6 *Minimum distance between the BESS at Land at Melksham Substation and the nearest dwelling*

The most significant source of radiation for this dwelling is the existing overhead line shown by the blue line in the above figure. This dwelling and other nearby dwellings are already in close proximity to the existing overhead power cables, which are a much more significant source of radiation. Additionally, the magnetic fields from the proposed underground cable routes have been assessed accordingly within this report for the nearest dwelling locations.

The minimum horizontal distance between the BESS option at Lime Down D and any dwelling is approximately 180m. This is illustrated in Figure 7 below.

Figure 7 *Minimum distance between the BESS at Lime Down D and the nearest dwelling*

Significant radiation is not predicted from the existing substation and BESS because:

- Melksham Substation is more than 300 metres from any dwelling and would be required to comply with the relevant exposure limits for the general public, and the electromagnetic fields from the equipment inside a substation do not extend far if at all outside the perimeter fence.
- The proposed BESS locations are at least 130 metres from any dwelling, meaning that all dwellings are at a safe distance as electromagnetic radiation levels reduce as the separation distance increases.

4.4 Comparative Assessment

The maximum magnetic field produced by household appliances like vacuum cleaners can reach up to 50 micro-Tesla[10]. It would follow that appliances with higher voltages would generate stronger magnetic fields. For instance, the proposed underground cables are projected to produce a maximum magnetic field of 96.17 micro-Tesla. While this value is notably higher than that of household appliances, it remains within acceptable exposure limits. Notably, the magnetic field strength is expected to drop to approximately 13 micro-Tesla just 5 meters from the source for 400kV cables less than 1 meter deep; a value even less than that of a vacuum cleaner. With the confirmed depth of the high voltage 400kV underground cables being around 1.2 meters for the Scheme, a likely reduction in the strength of the magnetic field is predicted.

Moreover, the transformers and PV inverters will produce magnetic fields at levels lower than the underground cables.

4.5 Cumulative Effects

When assessing the cumulative effects of electromagnetic fields, the worst case is based upon the addition of source a and source b; however, it is important to note that this is only true for magnetic fields that are exactly in line. When the electromagnetic fields are not in line, the sum of these is less than 'a+b'.

For the purpose of this assessment the worst case has been calculated i.e. based upon 'a+b'. As there are no proposed overhead powerlines to consider for the Scheme, there are no cumulative effects to assess. As discussed in Section 4.3, the transformers, PV inverters, and BESS produce smaller magnetic fields than that of the underground cables, thus, considering all sources of radiation and their relative locations, the cumulative magnetic and electric fields are predicted to be below the acceptable exposure limits.

The cumulative effects are not significantly impacted by the use of household items. Electrical household appliances will add to the overall exposure of electromagnetic fields; however, these levels will still remain below the recommended exposure limit, due to the lower voltages of the appliances, and are not used constantly, providing only a temporary addition to the resultant electromagnetic field levels.

[10] Source: https://www.nationalgrid.com/electricity-transmission/document/141896/download#:~:text=Normally%20these%20underground%20cables%20will,do%20not%20emit%20electric%20fields

5 CONCLUSIONS

5.1 400kV Underground Cables

The maximum magnetic field produced by the proposed underground cables is predicted to be 96.17 micro-Tesla. The magnetic field levels are therefore below the reference level from the public exposure limits in UK policy (100 micro-Tesla for magnetic fields). External electric fields are not produced from underground cables so have not been considered.

5.2 Transformers, and PV Inverters

Notable sources of radiation other than the cables will be the transformers/PV inverters positioned across the Scheme.

The transformers and PV inverters should be 'CE' marked. CE marking indicates that a product has been assessed by the manufacturer and deemed to meet European Union safety, health and environmental protection requirements. CE marking requirements have been adopted and extended indefinitely in Great Britain.

The CE marking should ensure that electrical and electronic equipment does not generate, or is not unintentionally affected by, electromagnetic disturbance.

The transformers and PV inverters are also predicted to produce fields at a lower level than that of underground cables because the equipment is typically housed in protective enclosures.

5.3 Distribution Substation and BESS

The Scheme will connect to Melksham Substation (an existing National Grid distribution substation). According to UK regulation, the substation conforms with the applicable exposure limitations for the general public, and the field from the equipment inside a substation does not extend far, if at all, outside the perimeter fence.

The BESS contributes to the electromagnetic radiation produced by the Scheme. However, when evaluating the proposed BESS locations, the closest dwellings are at least 130m away. As electromagnetic radiation levels reduce with increased distance, all nearby dwellings are situated at a safe distance from the BESS installations.

PAGERPOWER

Urban & Renewables

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

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

Lime Down
Solar Park

EIA Scoping Report

Appendix 18.1:

Socio-Economics, Tourism and Recreation Baseline Data

July 2024

EN010168

1.1 Introduction

1.1.1 For the purposes of assessing socio-economic, tourism and recreation effects, the Scheme is considered functionally and geographically in its entirety. The geographic extents of the Scheme, consisting of Lime Down A to E, the Land at Melksham Substation, and Cable Route Search Corridor, are set out on the Location Plan at **Figure 3.1** and in more detail in **Figures 3.1.1** to **Figure 3.1.6** and **Figures 3.2.1** to **Figure 3.2.3**.

1.1.2 The Local Impact Area (LIA) comprises a 20km offset from the Scheme, defined by offsetting from the outermost extents of the Sites and Cable Route Search Corridor. As the Cable Route Search Corridor is subject to refinement to a preferred route which will be presented in the Preliminary Environmental Information Report (PEIR) and Environmental Statement (ES).

1.2 Baseline Conditions

Socio-Economics

Resident Population

1.2.1 The LIA sits across seven local authority areas: Wiltshire (the host local authority to the Scheme), Bath & North East Somerset, Cotswold, Somerset, South Gloucestershire, Stroud, and Swindon. The Local Impact Area (LIA) had a combined population of 716,400 in 2021 (Ref 1). The proportion per authority area is as follows in **Table 18.1** below.

Table 18.1: Population of LIA by Local Authority Area

Authority Area	LIA Population	LIA Proportion per Authority Area	LIA Proportion of Authority Area
Wiltshire (Host)	311,800	43.5%	*61.1%*
Bath & North East Somerset	121,200	16.9%	*62.7%*
Cotswold	22,500	3.1%	*24.8%*
Somerset	9,700	1.3%	*1.7%*
South Gloucestershire	127,900	17.9%	*44.0%*
Stroud	77,500	10.8%	*64.0%*
Swindon	45,900	6.4%	*19.7%*

1.2.2 The South West International Territorial Level 1 statistical region forms the Regional Impact Area (RIA), which had a population of 5,701,200 in 2021 (**Ref 1**). Therefore, the LIA population is approximately 12.6% of the population of the RIA, and 1.1% of the population of the United Kingdom (**Ref 2**, **Ref 3**).

1.2.3 National population projections estimate that the population of the United Kingdom will grow by approximately 3.8% between 2021 and 2028 (**Ref 4**), the projected earliest construction commencement date. Within the RIA, and the authority areas that comprise the LIA, the estimated population growth in this period is 4.9%. Applying this, the estimated population of the LIA in 2028 is 751,800, while the population of the RIA is estimated to be 5,982,700. The Scheme is proposed to operate for up to 60 years, with the proposed date of decommissioning of 2089 (for the purpose of this assessment). From 2021-2089, the national population is estimated to grow by 17.9%.

1.2.4 The age and sex demographic profile of the Assessment Impact Area will be detailed further in the ES, as will the projected changes to the demographic profile at the assessment area level and at the national level up to the end of the construction phase of the Scheme (estimated as up to 2031).

1.2.5 A baseline profile of population health and wellbeing is included in **Chapter 19** of this Scoping Report.

Deprivation

1.2.6 The Indices of Multiple Deprivation 2019 provides the most up-to-date information regarding measures of population deprivation across England. The Assessment Impact Area falls across a total of nine former district areas that were used for assessment in 2019. Each area has the following rank of the 317 authority areas (where '1st' is the most deprived area in England) (**Ref 5**):

- Wiltshire – 231st;
- Bath & North East Somerset – 274th;
- Cotswold – 272nd;
- Mendip (Somerset) – 170th;
- South Gloucestershire – 267th;
- Stroud – 279th; and
- Swindon – 171st.

1.2.7 The local authorities that the LIA falls within all rank within the least deprived half of council areas in England. That notwithstanding, the council areas of Wiltshire and Cotswold are more likely than the national average to be deprived due to barriers to accessing suitable housing and services. Residents in Swindon specifically are also at risk of being more deprived than the national average in relation to access to suitable education and skills attainment, health, and crime.

1.2.8 Whilst there are significant deprivation inequalities present within the LIA, particularly within urban areas, the Sites fall within Lower Super Output Areas that are in the 30% least deprived neighbourhoods in England (**Ref 6**). Similarly, the Cable Route Search Corridor falls within Lower Super Output Areas that are in the 50% least deprived neighbourhoods in England.

Skills and Qualification Attainment

1.2.9 The qualification attainment rate within the LIA at the time of the December 2021 Annual Population Survey (**Ref 7**) indicated a significant variance in skills and qualification between the subject local authority areas. The proportion of the population of ages 16-64 years old achieving no qualifications is between 1.4% (in Stroud) and 6.9% (in

Cotswold) Overall, the LIA rate is 4.9%, while in the RIA rate is 5.1%. These both compares favourably to the UK national average of 6.7%. The LIA similarly contains significant variation in attainment of NVQ Level 4 and higher qualification rates This ranges from 33.5% in Cotswold, up to 58.8% in Stroud. The overall rate in the LIA of 44.1% is comparable to, albeit slightly higher than, the RIA (43.8%) but less than the UK national average rate of 47.1%. Generally, the LIA performs at or lower than the national average, whilst Bath and North East Somerset and Stroud both tend to perform somewhat better in attainment of higher qualifications.

Employment and Economic Activity

1.2.10 The economically active population is defined as the members of the working age (16-64 year-old) population being in employment, and those who are seeking employment and are able for work. Economically inactive members of a population are predominantly categorised by retirement, those in full-time education not seeking employment, full-time carers of family members, and long-term sick and disabled people.

1.2.11 The September 2023 Annual Population Survey (**Ref 8**) indicates that the LIA has an economic activity rate of 82.2%, which a range across the constituent authority areas from 78.2-88.8%. The overall area figure is comparable to the regional rate (81.0%), both of which compare favourably to national rates (78.7%). Related to this, the employment rate of 16-64 year olds ranges from 77.6-88.1% across the LIA, totalling a labour market of 941,100 workers (80.3% of 16-64 year old population). This also compares favourably with both the regional average of 78.9%, and to the national average of 75.7%.

1.2.12 Of the economically active population, the September 2023 Annual Population Survey estimates a total of 23,000 people are unemployed within the LIA. This equates to 2.4% of the economically active population. In the RIA, there are an estimated 70,400 unemployed people, representing 2.6% of the economically active population. Both the LIA and RIA therefore perform well against the UK national rate of 3.8%. However, unemployment is uneven across the four authority areas, with Cotswold and Stroud (indicatively <1.0%) performing significantly better than Bath and North East Somerset (4.4%). (**Ref 8**) A full review of trends in economic activity and unemployment at the local and national scale is likely to be required in the ES.

1.2.13 For residents within the LIA, the median annual gross salary for full-time workers (in 2023) was approximately £34,900. This is higher than the regional average (£34,000) and comparable with that of the UK (£35,000). There is however some considerable level of difference within the LIA, with the median annual gross salary for residents in Somerset being some £6,000 less than those in Bath and North East Somerset (**Ref 9**).

Working Population

1.2.14 The workplace population of the LIA authority areas was 940,300 in 2022 (**Ref 10**), some 0.8% greater than the population of residents in employment of 932,600 in December 2022 (**Ref 11**). This therefore indicates a small, albeit demonstrable net inflow of people to the LIA authorities travelling for work.

1.2.15 Commuting data has not been collected due to the absence of up-to-date reliable baseline data. This is predominantly due to the Census 2021 being undertaken during the COVID-19 pandemic, during which official government guidance was to work from home where possible. As such, this data is unlikely to be reflective of the current (2024) conditions, nor those anticipated during the Scheme's construction (estimated 2027-2029).

1.2.16 For the workplace population within the LIA, the median annual gross salary for full-time workers (in 2023) was approximately £34,700. This is somewhat higher than the £33,500 median average for the RIA, and marginally lower than that of the UK of £35,000. As for residents, there is significant difference within the LIA, with the median annual gross salary for workers in Cotswold being nearly £11,000 less than those in South Gloucestershire (**Ref 12**).

Business Sectors

1.2.17 The 2022 Business Register and Employment Survey (**Ref 10**) shows the largest business sector by percentage of employed workforce in the LIA is health (group Q) (11.8%), followed by manufacturing (9.4%), and education (9.3%). The local agriculture, forestry & fishing (group A) and manufacturing (group C) sectors are significantly larger by business proportion than the national level, whilst the information and communication (group J) sector is significantly smaller. Most other sectors are relatively consistent with national trends. This is not however consistent across the LIA Impact Area, with some significant outliers. Notable business sectors larger than national average include the manufacturing industry in Stroud and agriculture, forestry and fishing sector in Cotswold. In contrast (although notably in the same Districts), the public administration and defence sector in Cotswold, and business administration and support services sector in Stroud are very significantly smaller than the national average.

1.2.18 The size of business sectors by percentage of employed workforce RIA is largely consistent with national rates. The predominant outliers are the agriculture, forestry & fishing (group A) which is significantly larger in the RIA than the national average, and both the information and communication (group J) and business administration and support services (group N) sectors which are significantly smaller than national trends.

1.2.19 Due to its spread across multiple authority areas, the strategic industrial and business context which has helped to form the evidence base for economic policy within the LIA includes the Local Industrial Strategies (LIS) of Swindon and Wiltshire LEP (**Ref 13**) and West of England LEP (**Ref 14**). A draft LIS is also currently available from G First LEP, covering the county of Gloucestershire (**Ref 15**Ref 14). These documents identify key target business sector for ongoing development, whilst setting out key ambitions for promoting innovation, employment and economic performance.

1.2.20 The Swindon and Wiltshire LIS identifies four strategic priorities: development of life sciences, high-value manufacturing and advanced engineering innovation, delivery of sustainable technologies for a circular economy, and research and innovation opportunities in cultural and heritage storage, renewable energy generation, energy storage, automotive testing, data storage and technology R&D (**Ref 13**).

1.2.21 The West of England LIS identifies four main priorities: cross-sectoral innovation; inclusive growth; addressing the productivity challenge; and delivering innovation in infrastructure delivery. It's key innovation sectors include advanced engineering and aerospace; creative, cultural, and digital industries; financial, business and legal 'tech' services; and low carbon technology (**Ref 14**Ref 13).

1.2.22 Although still in draft, the GFirst LEP's Gloucestershire Local Industrial Strategy sets out the proposed strategic aims for the Gloucestershire area, including cyber-tech innovation, capitalisation of green and natural assets, and promoting productivity through supporting ideas and innovation, people and skills, improvements to the business environment, and deliver of infrastructure and places (**Ref 15**Ref 14).

Tourism and Recreation

1.2.23 The LIA falls across a number of authority areas, each with their own economic strategies for tourism and visitors. The LIA also includes two National Landscapes – The Cotswolds (immediately to the northwest of the Scheme), and North Wessex Downs (at closest 10km southeast from the Scheme).

1.2.24 The visitor economy in Wiltshire and Swindon is estimated to be worth £1.5 billion and supports approximately 28,000-30,000 jobs (**Ref 16**). This is built around Wiltshire's natural landscape and anthropological heritage – namely the North Wessex Downs National Landscape (at closest 10km from the Scheme), and Stonehenge and Avebury World Heritage Site (Stonehenge is 35km, whilst Avebury is 20km from the Scheme). Salisbury (45km from the Scheme), and the county's historic towns such as Malmesbury and Chippenham (both less than 5km from the Scheme), provide further key historic attractions, while leisure and cultural attractions can be found through the county. The neighbouring authority areas in the LIA also have significant heritage and landscape attractions which perform an important role in drawing visitors to the area. In Bath and North East Somerset, the city of Bath is a key heritage and historic architecture destination, also designated as a World Heritage Site. Much like Wiltshire, Gloucestershire's visitor and tourism economy is based around natural landscapes, with both the Cotswolds and Forest of Dean being located in the county. The Cotswolds is a nationally important tourism destination, and generates an estimated £800 million in tourism spending, supporting 31,000 across the entire Cotswolds Area of Outstanding Natural Beauty (AONB) (**Ref 17**).

1.2.25 A number of the Sites, as well as the Cable Route Search Corridor host Public Rights of Way (PRoW) (see **Figure 7.12.1** to **Figure 7.12.6** in **Appendix 7.6**). Furthermore, the Scheme is located within 5km of a small number of long-distance recreational walking and cycling routes. The Macmillan Way passes through Luckington and Sherston, no less than 500m NW of Lime Down A. The Macmillan Way also meets the Monarch's Way, 5.0km north of Lime Down A in Westonbirt with Lasborough. The Mid Wilts Way also passes approximately 5.0km to the SE of the Grid Connection Point near Melksham.

1.2.26 Although not shown on OS maps, the Long Distance Walking Association (**Ref 18**) registers the following other long distance walking routes, some of which are waymarked:

- The Palladian Way crosses through Lime Down D between Corston and Hullavington and crossing the Cable Route Search Corridor between Hullavington and Upper Castle Combe;
- The Palladian Way Tetbury Alternative also runs less than 300m from part of Lime Down B in Foxley;
- The Celtic Way, which crosses the Cable Route Search Corridor between Yatton Keynell and Kington St. Michael;
- The North Wiltshire Rivers Route crosses the Cable Route Search Corridor twice in short succession between Chippenham and Easton, and then between Easton and Lacock;
- The Long Path (from Land's End to Winterton-on-Sea, Norfolk) crosses the Cable Route Search Corridor between Chippenham, and Gastard and Neston (Corsham);
- Wilts and Berks Canal Towpath runs approximately 1km from the Cable Route Search Corridor between Derry Hill and Melksham;
- The Bradford on Avon Wheel – Outer comes less than 4.0km from the Grid Connection Point as it passes through Great Chalfield; and

- The Kennet and Avon Canal Walk is located to the south of Melksham, 4.8km south of the Grid Connection Point.

1.2.27 A number of long-distance cycle routes directly cross or border the Scheme and the Cable Route Search Corridor. Sustrans Wiltshire Cycleway passes through Lime Down C and adjacent to Lime Down B, and runs parallel to the Cable Route Search Corridor between Grittleton and Yatton Keynell. The Avon Wiltshire Cycle Link also joins the route between these villages. National Cycle Route 403 crosses the Cable Route Search Corridor on the same route as the North Wiltshire Rivers Route, while National Route 4 follows the Kennet and Avon Canal Walk 4.8km to the south of the Point of Connection (**Ref 19**).

1.2.28 The Fosse Way Roman Road crosses through Lime Down C and adjacent to Lime Down B, as part of the Wiltshire Cycleway. The route is likely used by additional recreational users for its historic significance and provides a low-traffic recreational route from near Bath to near Cirencester.

1.2.29 The Scheme is located in an area with few recreational and navigable waterways. There are no navigable waterways near the Scheme, although Corsham Lake, within Corsham Court is located approximately 0.5km from the Cable Route Search Corridor and appears to be in use for recreation by 1st Corsham Scouts. A small number of fishing lakes are present along or near to the Cable Route Search Corridor at Sevington, Lacock, and Pockeridge in Corsham.

1.2.30 A full survey of the accessibility and navigability of waterways for recreational uses is continuing through ongoing dialogue with statutory stakeholders and through public consultation. Updated information will be made available in the final ES.

1.2.31 The area, villages and urban areas within theoretical visibility of the Scheme and on likely Scheme construction routes are home to a number of recreational facilities, including formal leisure and recreation facilities, sports venues, and informal and youth facilities. A full assessment of the potential impacts on access to these facilities during construction, and on their desirability and use during the construction and operational life of the Scheme will be undertaken in the final ES.

1.2.32 The Scheme is predominantly set within agricultural land, which due to its existing use, is not in itself a key tourist attraction or destination. The land does however play a role in providing a landscape context to recreational use of pedestrian and cycling routes and trails, and to the enjoyment and appreciation of the neighbouring Cotswolds Area of Outstanding Natural Beauty, to which the Scheme directly borders. The potential impacts to the tourism and visitor economy are explored in this chapter, and will utilise assessment outcomes in relation to landscape-derived impacts from Chapter 7: Landscape and Visual, and heritage-derived impacts from Chapter 12: Built Heritage.

1.3 References

Ref 1 ONS (2022). Census 2021: TS001 – Number of usual residents in households and communal establishments (2021). Available at NomisWeb.

Ref 2 NISRA (2022). Census 2021 population and household estimates for Northern Ireland

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Ref 4 ONS (2018). National population projections by single year of age (2018 base). Available at NomisWeb.

Ref 5 MHCLG (2019). IoD2019 Interactive Dashboard – Local Authority Focus. Available at GOV.UK

Ref 6 MHCLG (2019). Indices of Deprivation: 2019 and 2015 Mapping Browser. Available at dclgapps.communities.gov.uk

Ref 7 ONS (2024). Annual Population Survey: 12 months to December 2023 – Qualification Rates. Available at NomisWeb.

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Ref 9 ONS (2024). Annual Survey of Hours and Earnings – Resident Analysis. Available at NomisWeb.

Ref 10 ONS (2023). 2022 Business Register and Employment Survey – Employment. Available at NomisWeb.

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Ref 12 ONS (2024). Annual Survey of Hours and Earnings – Workplace Analysis. Available at NomisWeb.

Ref 13 SWLEP (2020). Swindon and Wiltshire Local Industrial Strategy. Chippenham: Swindon & Wiltshire Local Enterprise Partnership.

Ref 14 West of England LEP (2019). West of England Local Industrial Strategy. Bristol: West of England Combined Authority.

Ref 15 GFirst LEP (2023). Draft Gloucestershire Local Industrial Strategy. Gloucester: G First Local Enterprise Partnership.

Ref 16 Blue Sail (2015). Wiltshire & Swindon Destination Management & Development Plan 2015-2020. Salisbury: Visit Wiltshire.

Ref 17 Cotswolds (2022). Cotswolds Tourism Destination Management Plan 2022-2025. Cirencester: Cotswolds

Ref 18 Long Distance Walkers Association (2024). Long Distance Paths: Search for a Path app. Available at ldwa.org.uk

Ref 19 Sustrans (2024). The National Cycle Network. Available at www.sustrans.org.uk/national-cycle-network/

EIA Scoping Report

Appendix 21.1:

Other Environmental Matters Figures

July 2024

EN010168

Lime Down Solar Park

Title:

Figure 21.3.1 Minerals

Document:

Other Environmental Matters
Environmental Impact Assessment Scoping Report

Legend:

- Area for Solar Panels and Associated Development
- Cable Route Search Corridor
- 1km Study Area
- 1km Cable Route Search Corridor Study Area
- Mineral Resource Zone
- Mineral Safeguarding Area
- Permitted area of Monks Park and Park Lane Mines

Lime Down A
Lime Down B
Lime Down C
Lime Down D
Lime Down E
Landrattley Melksham Substation

Malmesbury
Chippenham
Calne
Corsham
Bath
Melksham

Drawing no.: P4443_LPR_ZZ_XX_DR_Z_LVIA_0160
Coordinate system: British National Grid
Scale: 1:90,000 @ A3

0 1 2 3 4 5 km

Island GREEN POWER

Lanpro