Hilfield Solar Farm and Battery Storage

Agricultural Land Classification

on behalf of Elstree Green Limited

Prepared by Askew Land & Soil Limited | December 2020 |
Document Reference: R015

Agricultural Land Classification:

Hilfield Solar Farm, Elstree, Hertfordshire

Reference Number R015

Prepared for:
Aardvark EM Limited

On Behalf Of:
Elstree Green Limited

Prepared by:
R W Askew BSC(Hons) MSc F.I Soil Sci CSci
Askew Land and Soil Ltd

Date:
17th December 2020

Project Number:
C718

Contract/Proposal No:	C718
Issue:	3
Author:	Rob Askew
Date:	17th December 2020

Our interpretation of the site characteristics is based on available data made during our desktop study and soil survey. This desktop study and soil survey has assessed the characteristics of the site in relation to the assessment of its Agricultural Land Classification. It should not be relied on for alternative end-uses or for other schemes. This report has been prepared solely for the benefit of Elstree Green Limited.

Version Control Record			
Issue	**Description of Status**	**Date**	**Initials**
A	First draft	26/07/2020	RWA
1	First issue	29/07/2020	RWA
2	Second Issue incorporating LDA comments	31/07/2020	RWA
3	Third issue incorporating Aardvark comments	17/12/2020	RWA

CONTENTS

1 INTRODUCTION

1.1 Background

1.1.1 This report was commissioned by Aardvark EM Limited on behalf of Elstree Green Limited to determine the quality of agricultural land proposed for a 49.9 Megawatt (MW) solar photovoltaic (PV) array with battery storage and associated infrastructure (“the generating station”) at Hilfield Solar Farm, Elstree, Hertfordshire (‘the Site’). The location and extent of the Site is shown on **Figure 1**. The Site, which measures approximately 128.0 ha, is divided into twenty fields, identified as Field 1 to Field 20 on a plan given as **Appendix 1**. For descriptive purposes, the Site is divided into two areas, namely the west area (Fields 1 - 5), and the east area (Fields 6 – 20). An underground cable connection route between the west and east area is shown on Figure 1 and Appendix 1. This involves constructing a narrow trench along the field margins, laying the cable, and then backfilling and restoring the land to agricultural use. Accordingly, the underground cable route is not included in the ALC study area. This assessment is made in accordance with the Agricultural Land Classification (ALC) system for England and Wales (see ‘Methodology’ below).

1.2 Competency

1.2.1 The work has been carried out by a Chartered Scientist (CSci), who is a Fellow (F.I. Soil Sci) of the British Society of Soil Science (BSSS). The soil surveyor meets the requirements of the BSSS Professional Competency Scheme for ALC (see IPSS PCSS Document 2 ‘*Agricultural Land Classification of England and Wales*’[1]. The BSSS Professional Competency Scheme is endorsed, amongst others, by the Department for Environment, Food and Rural Affairs (Defra), Natural England, the Science Council, and the Institute of Environmental Assessment and Management (IEMA).

1.3 Methodology

1.3.1 This assessment is based upon the findings of a study of published information on climate, geology and soil in combination with a soil investigation carried out in accordance with the Ministry of Agriculture, Fisheries and Food (MAFF)[2] ‘*Agricultural Land Classification of England and Wales: Revised Guidelines and Criteria for Grading the Quality of Agricultural Land*’, October, 1988 (henceforth referred to as the ‘the ALC Guidelines’).

1.3.2 The ALC system provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use. The ALC system divides agricultural land into five grades (Grade 1 ‘*Excellent*’ to Grade 5 ‘*Very Poor*’), with Grade 3 subdivided into Subgrade 3a ‘*Good*’ and Subgrade 3b ‘*Moderate*’. Agricultural land classified as Grade 1, 2 and Subgrade 3a falls in the ‘*best and most versatile*’ category in Paragraph 170 and 171 of the National Planning Policy Framework (NPPF) revised in February 2019. Further

[1] British Society of Soil Science. Professional Competency Scheme Document 2 ‘Agricultural Land Classification of England and Wales’. Available online @ https://www.soils.org.uk/sites/default/files/events/flyers/ipss-competency-doc2.pdf Last accessed December 2020

[2] The Ministry of Agriculture, Fisheries and Food (MAFF) was incorporated within the Department for Environment, Food and Rural Affairs (Defra) in June 2001

details of the ALC system and national planning policy implications are set out by Natural England in Technical Information Note 049[3].

1.3.3 A semi-detailed ALC survey of the approximately the 128.0 ha Site was carried out over the 16th and 17th July 2020. The semi-detailed survey involved examination of the soil's physical properties at 31 locations located on a 200m by 200m grid, i.e. at a density of approximately 1 auger bore per 4 ha of land surveyed. The soil profile was examined at each sample location to a maximum depth of approximately 1.2 m by hand with the use of a 5 cm diameter Dutch (Edleman) soil auger. One soil pit was hand dug with a spade to examine certain soil physical properties, such as soil structure and stone content, more closely. The locations of the auger bores and soil pits are shown on **Figure 1**. A log of the auger bores examined on Site is given as **Appendix 2**. A description of the soil pit is given as **Appendix 3**.

1.3.4 The sample locations were located using a hand-held Garmin E-Trec Geographic Information System (GIS) to enable the sample locations to be relocated for verification, if necessary. Where the auger locations fell close to a hedgerow, tree or gateway, the auger location was moved to at least 3m away, i.e. to avoid areas affected by tree roots or which maybe compacted.

1.3.5 The soil profile was examined at each sample location to a maximum depth of approximately 1.2 m by hand with the use of a 5 cm diameter Dutch (Edleman) soil auger. A soil pit was excavated at auger location 1 with a spade in order to examine physical soil profile characteristics, including subsoil structure, of the main representative soil types determined at the Site.

1.3.6 The soil profile at each sample location was described using the 'Soil Survey Field Handbook: Describing and Sampling Soil Profiles' (Ed. J.M. Hodgson, Cranfield University, 1997). Each soil profile was ascribed an Agricultural Land Classification (ALC) grade following the MAFF ALC Guidelines.

1.3.7 A sample of topsoil was collected at auger bore locations 10, 12 and 25. The samples of topsoil were sent to an accredited laboratory for particle size analysis, i.e. the proportions of sand, silt and clay. This is to determine the definitive texture class of the topsoil, especially to distinguish between medium clay loams (i.e. <27% clay), heavy clay loams (27% to 35% clay) and clays (>35% clay). The results of the laboratory analysis are given as a Certificate of Analysis as **Appendix 4**.

1.4 Structure of the Remainder of this Report

1.4.1 The remainder of this report is structured as follows:

- Section 2 – Planning Policy Framework;
- Section 3 – Semi-detailed Agricultural Land Classification;
- Section 4 – ALC at the Site in a Wider Geographical Context; and
- Section 5 – Summary and Conclusions.

[3] Natural England (December, 2012). 'Agricultural Land Classification: protecting the best and most versatile agricultural land (TIN049)'. Available online @ http://publications.naturalengland.org.uk/publication/35012 Last accessed December 2020

2 PLANNING POLICY FRAMEWORK

2.1 Background

2.1.1 This section of the report sets out the national and local planning framework in which to assess the opportunities and constraints to development at the Site in agricultural land quality terms.

2.2 National Planning Policy Statement (NPPF) February 2019

2.2.1 National planning policy guidance on development involving agricultural land is set out in National Planning Policy Framework (NPPF), which was revised on the 19th February 2019. The NPPF aims to provide a simplified planning framework which sets out the Government's economic, environmental and social planning policies for England. The NPPF includes policy guidance on '*Conserving and Enhancing the Natural Environment*' (Section 15). Paragraph 170 (a and b) (page 49) are of relevance to this assessment of agricultural land quality and soil and state that:

'170…Planning policies and decisions should contribute to and enhance the natural and local environment by:

a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);

b) recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland;…' National planning *other benefits of the best and most versatile agricultural land, and of trees and woodland;…'*

2.2.2 Paragraph 171 of the NPPF (2019) goes on to describe that:

'171. Plan should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework[53] …'

2.2.3 Footnote number 53 states that:

'[53] Where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be preferred to those of a higher quality.'

2.3 Soil Health

2.3.1 Aims and objectives for safeguarding and, where possible, improving soil health are set out in the Government's 'Safeguarding our soils: A strategy for England'[4]. The Soil Strategy for England, which

[4] Department for Environment, Food and Rural Affairs (2009). Safeguarding our soils: A strategy for England'. Available online @ https://www.gov.uk/government/publications/safeguarding-our-soils-a-strategy-for-england Last accessed December 2020

builds on Defra's '*Soil Action Plan for England (2004-2006)*, sets out an ambitious vision to protect and improve soil to meet an increased global demand for food and to help combat the adverse effects of climate change.

2.3.2 The Soil strategy for England states that '*…soil is a fundamental and essentially non-renewable natural resource, providing the essential link between the components that make up our environment. Soils vary hugely from region to region and even from field to field. They all perform a number of valuable functions or ecosystem services for society including:*

- *nutrient cycling;*
- *water regulation;*
- *carbon storage;*
- *support for biodiversity and wildlife;*
- *providing a platform for food and fibre production and infrastructure'*

2.3.3 The vision of the Soil Strategy for England has been developed in the Government's 25 Year Plan for the Environment[5]. Soil is recognised as an important national resource, and the Plan states that:

'*We will ensure that resources from nature, such as food, fish and timber, are used more sustainably and efficiently. We will do this* (in part) by:

….improving our approach to soil management: by 2030 we want all of England's soils to be managed sustainably, and we will use natural capital thinking to develop appropriate soil metrics and management approaches…'

2.3.4 The maintenance, and improvement, of soil health is therefore a material consideration when deciding if a development is appropriate on agricultural land. Soil health can be defined as a soil's ability to function and sustain plants, animals and humans as part of the ecosystem.

2.3.5 Of relevance to the proposed development at the Site, the installation of a solar photovoltaic (PV) array is a reversible, i.e. the agricultural land can be returned to its former agricultural productivity once the generation of renewable electricity has ceased, and the solar panels and associated infrastructure is removed. The agricultural land at the Site is currently used mainly for producing arable crops. In many respects, the management of the land under solar PV panels as grassland can benefit soil health, as described in detail in **Appendix 5**.

2.3.6 A healthy soil has a well-developed soil structure, where soil particles are aggregated into soil peds (structural units) separated by pores or voids. This allows the free movement of water (precipitation) through the soil and facilitates gaseous exchange between the plant roots and the

[5] Department for Environment, Food and Rural Affairs (2009). A Green Future: Our 25 Year Plan to Improve the Environment. Available online @ https://www.gov.uk/government/publications/25-year-environment-plan Last accessed December 2020

air. These soils are well aerated (oxygenated), which encourages healthy plant (crop) growth and an abundance of soil fauna and aerobic microbes. These soils often have high amounts of soil organic matter (SOM), associated with an accumulation of plant and animal matter, and thus are a good store of soil organic carbon (SOC).

2.3.7 The greatest benefits in terms of increase in soil organic matter (SOM), and hence soil organic carbon (SOC), can be realised through land use change from intensive arable to grasslands. Likewise, SOM and SOC are increased when cultivation of the land for crops (tillage) is stopped and the land is uncultivated (zero tillage). Global evidence suggests that zero tillage results in more total soil carbon storage when applied for 12 years or more. Therefore, there is evidence that conversion of land from arable to grassland which is uncultivated over the long-term (>12 years), such as that under solar PV arrays, increases SOC and SOM.

2.3.8 Soils are habitats for millions of species, ranging from bacteria, fungi, protozoa, and microscopic invertebrates to mites, springtails, ants, worms and plants. Soil biota are strongly influenced by land management. Modern farming has led to the loss of soil biodiversity. Changes in land management practice and land use can have large effects on soil biodiversity over relatively short-time scales. Reducing the intensity of management, introducing no-tillage management, and converting arable land to pasture, such as grassland under solar PV arrays, has substantial beneficial effects.

2.3.9 In a well-structured soil, water and air can move freely through cracks and pores. However, a poor soil structure prevents water and air movement, and increases the risk of runoff. Soil structure is improved when the land is uncultivated over time (no tillage), and when soil organic matter content (SOM) is increased through the accumulation of plant material, such as roots, in the soil. The aerobic (oxygenated) decomposition of SOM helps to bind soil particles together into aggregates (peds). Therefore, the conversion of land which is tilled for arable to long-term grassland (no tillage), such as that under solar PV arrays, improves soil structure over time.

2.4 Best Practice Guidance

2.4.1 The Department for Environment, Food and Rural Affairs (Defra) has published '*Safeguarding our Soils – A Strategy for England'* (24th September 2009). The Soil Strategy was published in tandem with a '*Code of Practice for the Sustainable Use of Soils on Construction Sites*'[6].

[6] Department for Environment, Food and Rural Affairs (September, 2009) '*Code of Practice for the Sustainable Use of Soils on Construction Sites'*. Available online @ https://www.gov.uk/government/publications/code-of-practice-for-the-sustainable-use-of-soils-on-construction-sites. Last accessed December 2020

3 SEMI-DETAILED AGRICULTURAL LAND CLASSIFICATION

3.1 Background

3.1.1 This section of the report sets out the findings of a semi-detailed Agricultural Land Classification (ALC). It is based on a desktop study of relevant published information on climate, topography, geology, and soil in conjunction with a soil survey carried out on Site by a Chartered Soil Scientist over the 16th and 17th July 2020 (see 'Methodology' in Section 1.0).

3.1.2 As described in the ALC Guidelines, the main physical factors influencing agricultural land quality are:

- climate;
- site;
- soil; and
- interactive limitations.

3.1.2 These factors are considered in turn below.

3.2 Climate

3.2.1 Interpolated climate data relevant to the determination of the Agricultural Land Classification (ALC) grade of land at the Site is given in Table 3.1 below.

Table 3.1: Interpolated ALC Climate Data for Hilfield Solar Farm, Elstree, Hertfordshire

Climate Parameter	National Grid Reference TQ 166 976 (Auger Bore 9, Figure 1)
Average Altitude (m)	83
Average Annual Rainfall (mm)	688
Accumulated Temperature above 0˚C (January – June)	1407
Field Capacity Days (FCD)	106
Moisture Deficit (mm) Wheat	98
Moisture Deficit (mm) Potatoes	147
Best ALC Grade According to Climate Limitation	1

3.2.2 With reference to Figure 1 '*Grade according to climate*' on page 6 of the ALC Guidelines, the quality of agricultural land at the Site is not limited by overall climate, meaning that agricultural land at the Site could be graded as high as Grade 1, in the absence of any other limiting factor.

3.2.3 Agricultural land at the Site is predicted to be at field capacity (i.e. near saturation point) for 106 days per year, respectively, over the late autumn, winter and early spring. This is below the average for central, lowland England (i.e. 150 Field Capacity Days).

3.2.4 The climate can interact with physical properties of the soil, e.g. topsoil texture and subsoil drainage (Wetness Class). This is assessed further under 'interactive limitations' below.

3.3 Site

3.3.1 The Site measures approximately 128.0 ha in area and comprises land currently in agricultural production. The Site is formed by two parts what are located to the west and east of Elstree Aerodrome. The location and extent of the Site is shown on **Figure 1** and **Appendix 1**.

3.3.2 With regard to the ALC Guidelines, agricultural land quality can be limited by one or more of three main site factors as follows:

- gradient;
- micro-relief (i.e. complex change in slope angle over short distances); and
- risk of flooding.

I. Gradient and Micro-Relief

3.3.3 The study area is broadly level, at an elevation of between 101 metres (m) Above Ordnance Datum (AOD) in the east of the Site, and 80mAOD in the south west. Gradient is not a limiting factor to agricultural land quality at this Site (re Table 1 of the ALC Guidelines). Likewise, micro-relief, i.e. complex changes in slope angle and direction over short distances, is not limiting to agricultural land quality at the Site.

II. Risk of Flooding

3.3.4 From the Government Flood Map for Planning website[7], most of the Site is in Flood Zone 1, whilst the north-western corner of Field 1 (**Appendix 1**) is in Flood Zones 2 and 3. However, the risk of flooding is not limiting to agricultural land quality with regard to Table 2 '*Grade according to flood risk in summer*', and Table 3 '*Grade according to flood risk in winter*', of the ALC Guidelines.

3.4 Soil

I. Geology/Soil Parent Material

3.4.1 British Geological Survey (BGS) information available online has been utilised to show the Superficial Deposits (Drift) and Bedrock underlying the Site[8]. This provides information on the geological materials in which the soil has formed.

3.4.2 The BGS describes how the Site is underlain by the London Clay Formation (clay, silt and sand) and Lambeth Group (clay, silt and sand). There are no superficial deposits covering the Site. Therefore, the soil is developed from the London Clay.

[7] Government Flood Map for Planning. Available online @ https://flood-map-for-planning.service.gov.uk/ Last accessed December 2020
[8] British Geological Survey 'Geology of Britain Viewer'. Available online @ http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html Last accessed December 2020

II. Published Information on Soil

3.4.3 Provisional information for soils at the Site was gathered from the Soil Survey of England and Wales (SSEW) soil map of South East England (Sheet 6) at a scale of 1:250,000 and accompanying Bulletin No. 15 '*Soils and their Use in South East England* (M. G. Jarvis *et al,* Harpenden, 1984). This provisional soil map indicates that land at the Site is covered soils grouped in the Windsor Association.

3.4.4 As described by the SSEW, the soils of the Windsor Association have clay topsoils with grey and ochreous mottled clayey subsurface horizons that become increasingly brown with depth. These soils are usually stoneless and usually well structured. As well as this, they are commonly waterlogged for long periods in winter (Wetness Class IV) and need effective underdrainage to achieve good yields of grass and cereals.

III. Soil Survey

3.4.5 The ALC/soil survey in July 2020 confirmed the occurrence of clayey soils which are comparable to those described by the SSEW as belonging to the Windsor Association. A log of the soil profiles recorded on Site is give as Appendix 2. A description of a soil pit (i.e. Soil Pit 1, located near auger bore 20, **Figure 1**), is given as **Appendix 3**.

IV. Topsoil Texture

3.4.6 In order to determine the topsoil texture, three samples of topsoil were collected at auger bore location 10, 12 and 25, as shown on **Figure 1**. The topsoil samples were sent to an accredited laboratory for analysis of particle size distribution (PSD), based on the British Standard Institution particle size grades. The certificate of analysis is provided as **Appendix 4**. The findings of the PSD analysis are shown in Table 3.2 below:

Table 3.2: Topsoil Texture (re Table 10, ALC Guidelines)

Topsoil Sample Location (See Fig. 1)	% sand 0.063-2.0 mm	% silt 0.002-0.063 mm	% clay <0.002 mm	ALC Soil Texture Class
AB10	14	44	42	Clay
AB12	15	37	48	Clay
AB25	10	46	44	Silty Clay

3.5 Interactive Limitations

3.5.1 From the published information above, together with the findings of the detailed soil survey, it has been determined that the quality of agricultural land at the Site is limited by soil wetness.

I. Soil Wetness

3.5.2 A soil wetness limitation occurs where the soil water regime adversely affects plant growth or imposes restrictions on cultivations or grazing by livestock. The ALC grade according to soil wetness at the Site is given in Table 3.3 below (based on Table 6 'Grade According to Soil Wetness – Mineral Soils' in the ALC Guidelines).

Table 3.3: ALC Grade According to Soil Wetness		
Wetness Class	**Texture of the Top 25 cm**	**<126 Field Capacity Days**
III	Sand, Loamy Sand, Sandy Loam, Sandy Silt Loam Sandy Clay Loam/Medium Silty Clay Loam /Medium Clay Loam* Heavy Clay Loam** Sandy Clay/Silty Clay/Clay	2 3a (2) 3b (3a) 3b (3a)
Key: (x) For naturally calcareous soils with more than 1% $CaCO^3$ and 18% - 50% clay * <27% clay; and ** >27% clay		

3.5.3 In a climate area with 147 FCD, soil profiles with non-calcareous, heavy silty clay loam or clay topsoil overlying slowly permeable subsoils which are waterlogged for long periods over the winter (i.e. Wetness Class IV) are limited by soil wetness to Subgrade 3b. In an isolated occurrence at auger bore 2 (see Figure 1 and Appendix 2), the topsoil is medium clay loam over clay subsoil in Wetness Class III. This profile is limited by soil wetness to Subgrade 3a, but as it is a one-off occurrence, the Subgrade 3a does not change the report findings of the entire site being Subgrade 3b, as set out in paragraph 5.1.4 below.

3.6 Semi-Detailed ALC Grading at the Site

3.6.1 The area of land in each ALC grade has been measured from **Figure 2** and the area (ha) and proportion (% of Site) is given in Table 3.4.

Table 3.4: Semi-Detailed Agricultural Land Classification – Hilfield Solar Farm, Elstree, Hertfordshire		
ALC Grade	**Area A (Ha)**	**Area (%)**
Grade 1 (Excellent)	0	0
Grade 2 (Very Good)	0	0
Subgrade 3a (Good)	0	0
Subgrade 3b (Moderate)	128.0	100
Grade 4 (Poor)	0	0
Grade 5 (Very Poor)	0	0
Other Land / Non-agricultural	0	0
Total	**128.0**	**100**

I. Subgrade 3b

3.6.2 The land classified as Subgrade 3b is limited entirely by soil wetness. Subgrade 3b is mapped over 128.0 ha, or 100% of the agricultural land at the Site.

4 ALC AT THE SITE IN A WIDER GEOGRAPHICAL CONTEXT

4.1 Introduction

4.1.1 The aim of this section is to consider information on agricultural land quality at the Site produced by the former MAFF, now part of Defra.

4.2 Pre-1988 ALC Information

4.2.1 During the 1960's and 1970's MAFF produced a series of maps to show the provisional ALC grade of agricultural land over the whole of England and Wales at a scale of 1:250,000. These provisional ALC maps are suitable for strategic land use planning only, i.e. they appropriate for land areas greater than 80 ha. The Provisional (1:250 000) scale ALC information indicates that agricultural land at the Site is Grade 3 (not differentiated between Subgrade 3a and Subgrade 3b).

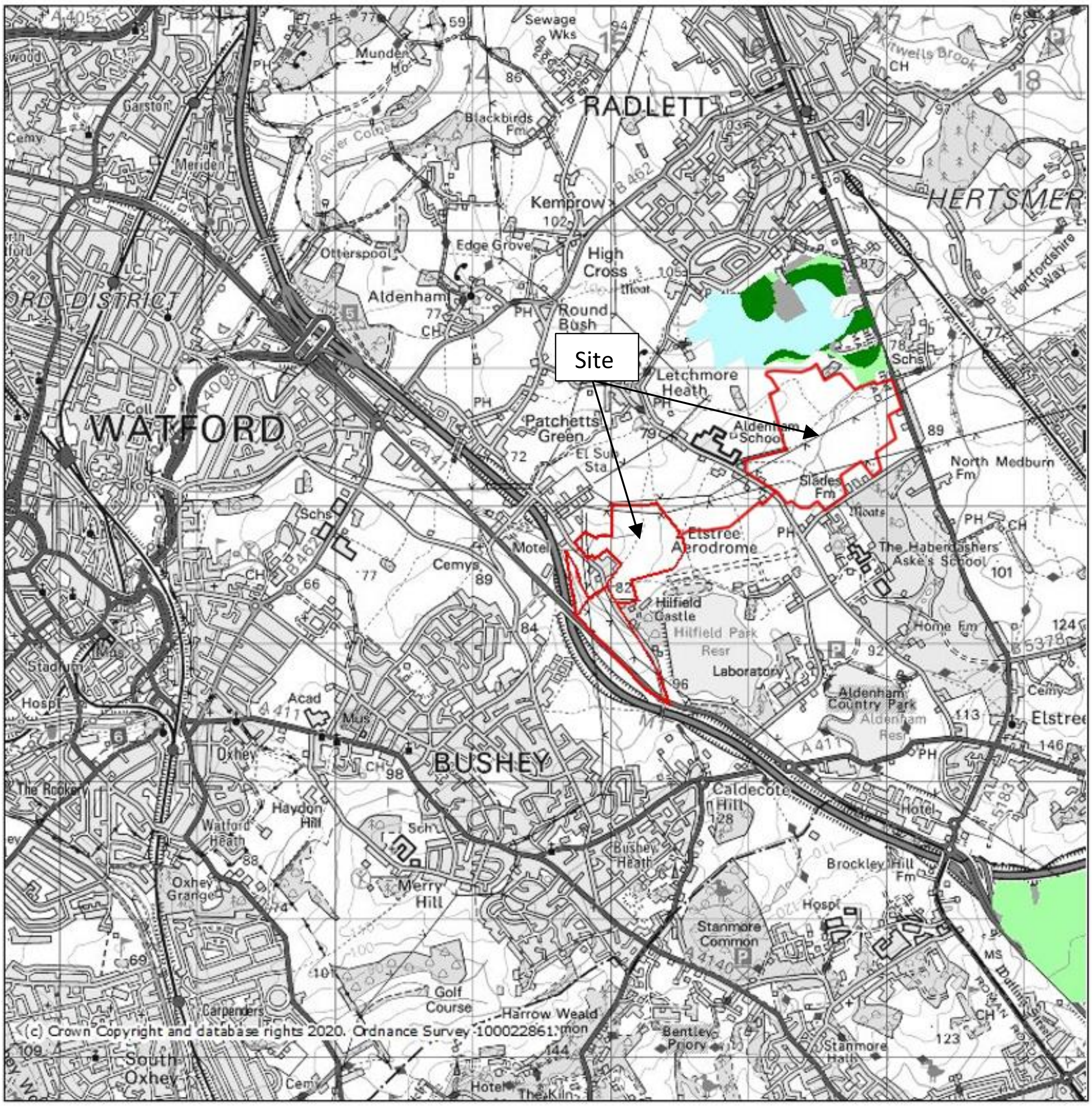
4.3 Post-1988 ALC Information

4.3.1 From the MAGIC website[9], it has been determined that no post-1988 ALC survey has been undertaken by MAFF at the Site. However, MAFF has determined a high proportion of Grade 2, with some Subgrade 3a and Subgrade 3b, to the northwest of the Site (see below).

[9] Source: www.magic.gov.uk Last accessed December 2020

MAGIC

Elstree



Legend
Post 1988 Agricultural Land Classification (England)

- Grade 1
- Grade 2
- Grade 3a
- Grade 3b
- Grade 4
- Grade 5
- Not Surveyed
- Other

0 1 2
km

Projection = OSGB36
xmin = 507500
ymin = 192600
xmax = 521500
ymax = 200700
Map produced by MAGIC on 20 July, 2020.
Copyright resides with the data suppliers and the map must not be reproduced without their permission. Some information in MAGIC is a snapshot of the information that is being maintained or continually updated by the originating organisation. Please refer to the metadata for details as information may be illustrative or representative rather than definitive at this stage.

5 SUMMARY AND CONCLUSIONS

5.1.1 An assessment of agricultural land quality, involving a desktop study and a semi-detailed Agricultural Land Classification (ALC) survey, has been undertaken to determine the quality of agricultural land at Elstree, Hertfordshire ('the Site'). It is located to the north west of Elstree at TQ166976 (approximate centre of the Site).

5.1.2 British Geological Survey (BGS) information at a scale of 1:50,000 indicates that the ALC study area is underlain by the London Clay Formation (clay, silt, and sand) and Lambeth Group (clay, silt, and sand), with no superficial deposits. Therefore, the soil at the Site is formed from London Clay.

5.1.3 The Soil Survey of England and Wales provisional soil map (1:250,000) indicates that the Site is covered by the Windsor association, which comprises of clayey soils that are waterlogged for long periods in winter (Wetness Class IV). The detailed soil survey carried out in July 2020 confirmed the presence of this type of soil at the Site.

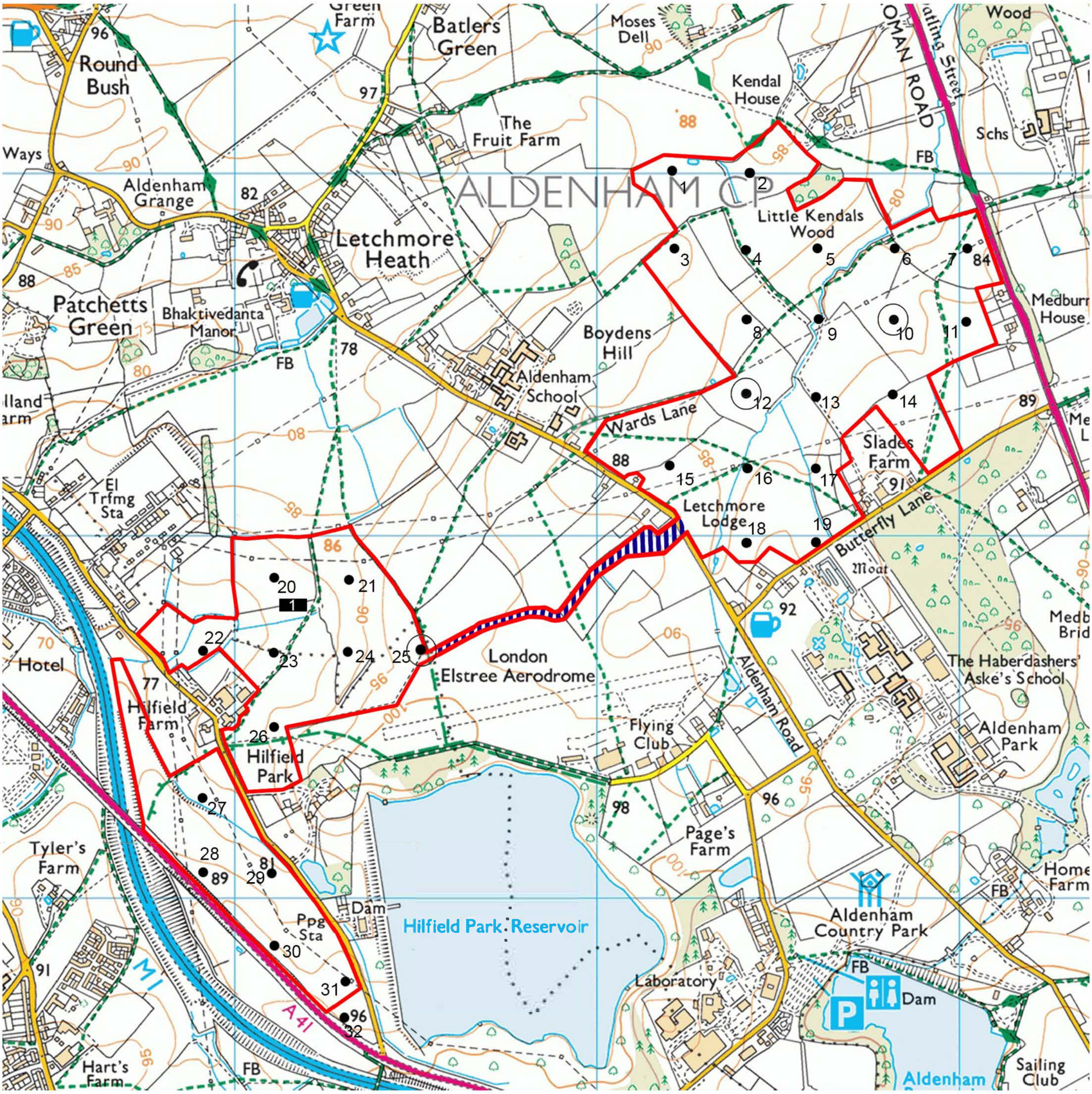
5.1.4 The land classified as Subgrade 3b is limited entirely by soil wetness. Subgrade 3b is mapped over 128.0 ha, or 100% of the agricultural land at the Site.

5.1.5 MAFF Post-1988 (detailed) ALC information shows that agricultural land to the northwest of the Site has a high proportion of Grade 2, with small proportions of Subgrade 3a and Subgrade 3b. Therefore, the occurrence of approximately 128.0 ha Subgrade 3b, or 100% of the Site, represents some of the poorest quality land available in the Elstree area in terms of paragraphs 170 to 171 of the National Planning Policy Framework (2019).

5.1.6 The conversion of arable land to grassland under solar PV panels can improve soil health, such as increasing soil organic matter (SOM), and hence soil organic carbon (SOC), increasing soil biodiversity, and improving soil structure (see **Appendix 5**). This is consistent with aims and objectives for improving soil health in the Government's 25 Year Plan for the Environment.

5.1.7 Therefore, the reversible development of agricultural land at this Site for the proposed Hilfield Solar Farm at Elstree would not significantly harm national interests regarding agricultural land quality and soil.

Figures



Site boundary

Auger location

Topsoil Sample

Soil Pit

Underground Cable Connection Route

N

Client

Elstree Green Ltd

Figure 1

Sample Locations

Project Name

Hillfield Solar Farm, Elstree, Hertfordshire

Project No C718
Dwg. No 1
Scale NTS
Date 17/12/20
Drawn By ELA

R W Askew BSc(Hons) MISoilSci MSc CSCi
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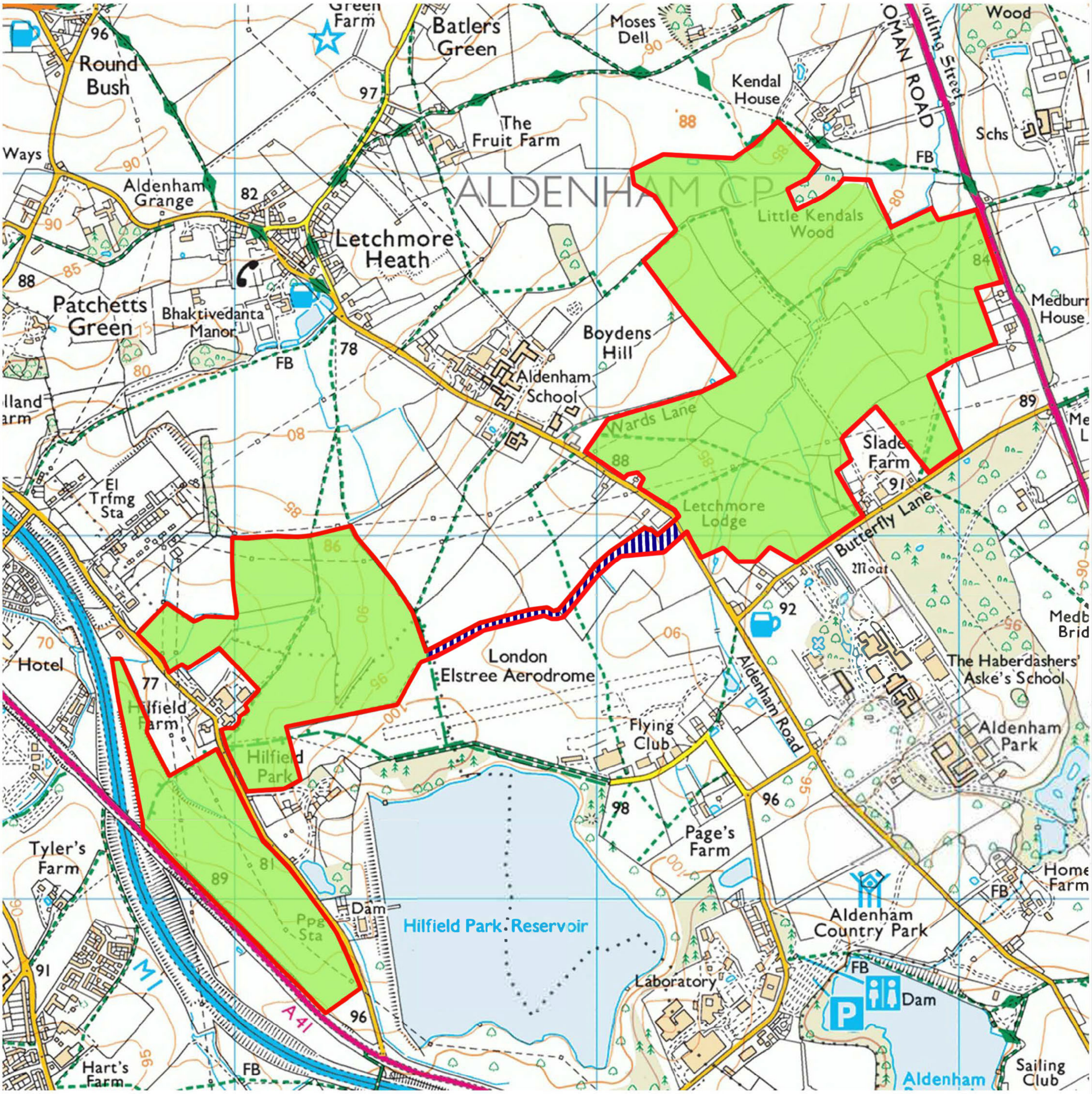

ALC Grade

- Grade 1
- Grade 2
- Subgrade 3a
- Subgrade 3b
- Grade 4
- Grade 5
- Non-agricultural

Site Boundary

Underground Cable Connection Route

N

Client

Elstree Green Ltd

Figure 2:

Agricultural Land Classification

Project Name

Hilfield Solar Farm, Elstree, Hertfordshire

Project No	C718
Dwg. No	2
Scale	NTS
Date	17/12/20
Drawn By	ELA

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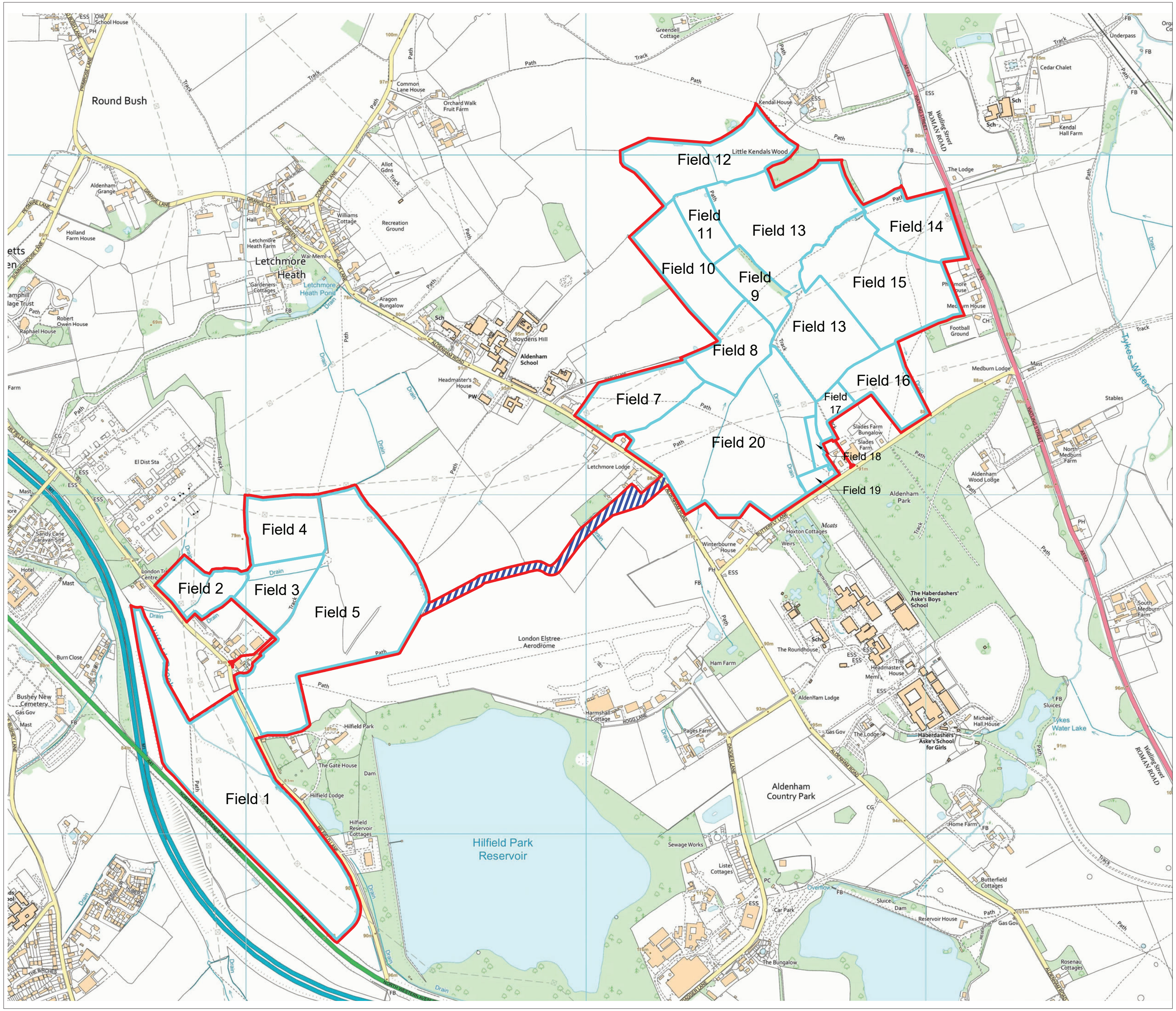
Appendix 1:

Location Plan Showing Field Numbers



General Notes

Field 6 has been removed from scheme

Key

Red Line Area

Field Number

Underground Cable Connection Route

REV	DSGD	DATE	MODIFICATION

PROJECT NAME:
Hilfield Solar Farm

DRAWING TITLE:
Field Arrangement Plan

DRAWING No: 2017/D003

REVISION: v.f

SCALE: 1:4000

FORMAT: A0

DATE: 10 Dec 2020

Drawn By: DP

Checked By: NL

aardvark environment matters

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File:\Z:\Data 2020\2017 Enso Green Holdings - Elstree\Data & Drawings\CAD\2017-D004-v.f-Hilfield Solar Farm.dwg

Appendix 2:
Soil Profile Logs

Project Number	Project Name	Parcel
C718	Hilfield Solar Solar Farm, Elstree	

Date of Survey	Survey Type	Surveyor(s)	Company
21/07/2020	ALC	RDM	Askew Land and Soil

Weather	Relief	Land use and vegetation
Dry, Sunny	Gently undulated	CER (Cereals)

Grid Reference	Postcode	Altitude	Area
TQ166976	WD25 8EW	85	127.8000031

MAFF prov	MAFF detailed	Flooding
Grade 3	None	Flood Zone 1

AAR	AT0	MDw	MDp	FCD	Climate grade
688	1407	106	98	147	1

Bedrock	Superficial deposits
London Clay Formation - Clay	none

Soil association(s) 1:250,000	Detailed soil information
Windsor	none

Revision Number	Date Revised
2	27/07/2020

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC			
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade
1	TQ 16200 98000	516200	198000	90			CER	0	30	30	10YR4/2					Yes	HZCL - Sil	2	2		HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	NON - N	No	No	25	10	2	WC IV	3b	Wetness			3b
								30	80	50	10YR5/2	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								80	120	40	10YR5/2	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor			Yes									
2	TQ 16400 98000	516400	198000	87			CER	0	38	38	10YR3/2					No	MCL - Cla	2	2		HR - All hard rocks or stones (i.e. those which cannot be scratched wi								Not Applic	NON - N	No	No	32	18	1	WC III	3a	Wetness			3a
								38	55	17	10YR5/3	MD - M	10YR5/6			Yes	HZCL - Silty clay loam (heavy)									Firm			Moderate	NON - N	No	No									
								55	90	35	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								90	120	30	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor		No	Yes									
3	TQ 16200 97800	516200	197800	90			CER	0	30	30	10YR4/2	FF - Fe	10YR5/6			Yes	HCL - Cla	2	2		HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	NON - N	No	No	22	7	2	WC IV	3b	Wetness			3b
								30	80	50	10YR5/3	CD - C	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								80	120	40	10YR5/3	CD - C	10YR5/6			Yes	C - Clay									Very firm			Poor		No	Yes									
4	TQ 16396 97800	516396	197800	89			CER	0	25	25	10YR4/2					Yes	HZCL - Sil	5	5		HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	NON - N	No	No	24	9	2	WC IV	3b	Wetness			3b
								25	33	8	10YR4/2	MD - M	10YR5/6			Yes	HZCL - Silty clay loam (heavy)									Friable			Moderate	SC - Slig	No	No									
								33	90	57	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor		No	Yes									
								90	120	30	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor		No	Yes									
5	TQ 16600 97800	516600	197800	87			CER	0	35	35	10YR4/3					Yes	HZCL - Sil	5	2		HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	NON - N	No	No	25	10	2	WC IV	3b	Wetness			3b
								35	45	10	10YR5/3	MD - M	10YR5/6			Yes	C - Clay	10			HR - All hard rocks or stones (i.e. those v					Very firm			Poor	NON - N	No	Yes									
								45	120	75	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor			Yes									
6	TQ 16800 97800	516800	197800	92			CER	0	30	30	10YR4/2					Yes	HZCL - Sil	5	2		HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	NON - N	No	No	23	8	2	WC IV	3b	Wetness			3b
								30	80	50	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								80	120	40	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor		No	Yes									
7	TQ 17000 97800	517000	197800	87			CER	0	33	33	10YR4/3					No	HZCL - Sil	3	3		HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	NON - N	No	No	26	11	2	WC IV	3b	Wetness			3b
								33	80	47	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	SC - Slig	Yes	Yes									
								80	120	40	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor		Yes	Yes									
8	TQ 16400 97600	516400	197600	86			CER	0	29	29	10YR3/2					No	HZCL - Sil	1	1		HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	NON - N	No	No	23	8	2	WC IV	3b	Wetness			3b
								29	60	31	2.5Y4/2	MD - M	10YR5/6			Yes	C - Clay	5			HR - All hard rocks or stones (i.e. those v					Very firm			Poor	NON - N	Yes	Yes									
								60	120	60	2.5Y4/2	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor		Yes	Yes									
9	TQ 16600 97600	516600	197600	81			CER	0	33	33	10YR4/2	MP - M	10YR5/6		10YR4/2	Yes	HZCL - Sil	2	2		HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	SC - Slig	No	No	27	12	2	WC IV	3b	Wetness			3b
								33	80	47	10YR5/3	MP - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	Yes	Yes									
								80	120	40	10YR5/3					Yes	C - Clay									Very firm			Poor		Yes	Yes									
10	TQ 16800 97600	516800	197600	84			CER	0	30	30	10YR4/2					Yes	C - Clay	5	4	1	HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	NON - N	No	No	20	5	2	WC IV	3b	Wetness			3b
								30	38	8	10YR5/2	FD - Fe	10YR5/6			Yes	C - Clay									Friable			Moderate	NON - N	Yes	No									
								38	80	42	10YR6/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								80	120	40	10YR6/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor		No	Yes									
11	TQ 17000 97600	517000	197600	85			CER	0	35	35	10YR4/3	MP - M	10YR5/6			No	HZCL - Sil	4	3	1	HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	SC - Slig	No	No	26	11	2	WC IV	3b	Wetness			3b
								35	60	25	10YR5/3	MP - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								60	120	60	10YR5/3					Yes	C - Clay									Very firm			Poor		No	Yes									
12	TQ 16400 97400	516400	197400	84			CER	0	35	35	10YR4/2					Yes	C - Clay	3	2	1	HR - All hard rocks or stones (i.e. those v					N/A			Not Applic	VSC - Ve	No	No	20	5	2	WC IV	3b	Wetness			3b
								35	80	45	10YR5/3	MP - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								80	120	40	10YR5/3					Yes	C - Clay									Very firm			Poor		No	Yes									

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC			
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade
13	TQ 16600 97400	516600	197400	85			CER	0	30	30	10YR4/2					Yes	HZCL - Sil	3	2	1	HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	24	9	2	WC IV	3b	Wetness			3b
								30	38	8	10YR4/2	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								38	80	42	10YR6/4	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								80	120	40	10YR6/4					Yes	C - Clay									Very firm			Poor			Yes									
14	TQ 16800 97400	516800	197400	87			CER	0	30	30	10YR4/2					Yes	HZCL - Sil	3	2	1	HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	23	8	2	WC IV	3b	Wetness			3b
								30	40	10	10YR5/3	MD - M	10YR5/6			Yes	HZCL - Silty clay loam (heavy)									Very firm			Poor	NON - N	No	Yes									
								40	50	10	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								50	120	70	10YR5/3					Yes	C - Clay									Very firm			Poor			Yes									
15	TQ 16200 97200	516200	197200	87			CER	0	30	30	10YR4/2					Yes	HZCL - Sil	1	2		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	28	13	2	WC IV	3b	Wetness			3b
								30	38	8	10YR4/3					Yes	HZCL - Sil	5			HR - All hard rocks or stones (i.e. those w					Firm			Moderate	NON - N	No	Yes									
								38	40	2	10YR6/4	CD - C	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								40	120	80	10YR6/4					Yes	C - Clay												Poor			Yes									
16	TQ 16400 97200	516400	197200	87			LEY	0	20	20	10YR4/2					Yes	HCL - Clay loam (heavy)									N/A			Not Applic	NON - N	No	No	18	3	2	WC IV	3b	Wetness			3b
								20	40	20	10YR5/2	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								40	120	80	10YR5/2					Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
17	TQ 16600 97200	516600	197200	85			LEY	0	30	30	10YR4/2					Yes	HCL - Cla	1	2		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	22	7	2	WC IV	3b	Wetness			3b
								30	40	10	10YR5/3	MD - Many Distinct				Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								40	80	40	10YR6/2	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								80	120	40	10YR6/2					Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
18	TQ 16400 97000	516400	197000	90			LEY	0	20	20	10YR4/2					Yes	HCL - Cla	2	1		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	17	2	2	WC IV	3b	Wetness			3b
								20	35	15	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								35	120	85	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
19	TQ 16600 97000	516600	197000	89			LEY	0	25	25	10YR4/2					Yes	HCL - Cla	1	1		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	20	5	2	WC IV	3b	Wetness			3b
								25	35	10	10YR5/2	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
								35	120	85	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor	NON - N	No	Yes									
20	TQ 15100 96900	515100	196900	86			CER	0	28	28	10YR5/1					Yes	ZC - Silty	5	4		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	17	2	2	WC IV	3b	Wetness			3b
								28	80	52	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Extremely firm			Poor	NON - N	Yes	Yes									
								80	120	40	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Extremely firm			Poor	NON - N	Yes	Yes									
21	TQ 15300 96900	515300	196900	88			CER	0	28	28	10YR4/2					Yes	ZC - Silty	5	4		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	17	2	2	WC IV	3b	Wetness			3b
								28	80	52	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Extremely firm			Poor	NON - N	Yes	Yes									
								80	120	40	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Extremely firm			Poor	NON - Non-cal		Yes									
22	TQ 14900 96700	514900	196700	87			CER	0	20	20	10YR4/2	FF - Fe	10YR5/6			Yes	ZC - Silty	2	2		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	15	0	2	WC IV	3b	Wetness			3b
								20	80	60	2.5Y5/3	MD - M	10YR5/6			Yes	C - Clay									Extremely firm			Poor	NON - N	Yes	Yes									
								80	120	40	2.5Y5/3	MD - M	10YR5/6			Yes	C - Clay									Extremely firm			Poor	NON - Non-cal		Yes									
23	TQ 15100 96700	515100	196700	86			CER	0	38	38	10YR4/2	FF - Fe	10YR5/6			Yes	HZCL - Sil	5	4		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	26	11	2	WC IV	3b	Wetness			3b
								38	40	2	10YR5/3	MD - M	10YR5/6			Yes	C - Clay	10			HR - All hard rocks or stones (i.e. those w					Very firm			Poor	NON - N	No	Yes									
								40	50	10	10YR5/3	MD - M	10YR5/6			Yes	C - Clay	10			HR - All hard rocks or stones (i.e. those w					Extremely firm			Poor	NON - N	Yes	Yes									
								50	120	70	10YR5/3	MD - M	10YR5/6			Yes	C - Clay												Poor		Yes	Yes									
24	TQ 15300 96700	515300	196700	88			CER	0	30	30	10YR4/2	FF - Fe	10YR5/6			Yes	HZCL - Sil	5	4		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	16	4	2	WC IV	3b	Wetness			3b
								30	120	90	10YR5/3	MD - M	10YR5/6			Yes	C - Clay	10			HR - All hard rocks or stones (i.e. those w					Extremely firm			Poor	NON - N	No	Yes									

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC			
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade
25	TQ 15500 96700	515500	196700	101			CER	0	20	20	10YR4/2	FD - Fe	10YR5/6			Yes	ZC - Silty	5	4		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	9	-7	2	WC IV	3b	Wetness			3b
								20	80	60	10YR5/3	MD - M	10YR5/6			Yes	C - Clay	10			HR - All hard rocks or stones (i.e. those w					Very firm			Poor	NON - N	No	Yes									
								80	120	40	10YR5/3	MD - M	10YR5/6			Yes	C - Clay												Poor		No										
26	TQ 15100 96500	515100	196500	85			CER	0	20	20	10YR4/2	FD - Fe	10YR5/6			Yes	HCL - Clay	10	7	2	HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	12	-3	2	WC IV	3b	Wetness			3b
								20	40	20	10YR5/3	MD - M	10YR5/6			Yes	C - Clay	10			HR - All hard rocks or stones (i.e. those w					Very firm			Poor	NON - N	No	Yes									
								40	120	80	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor		No	Yes									
27	TQ 14900 96300	514900	196300	80			CER	0	38	38	10YR5/2	FF - Fe	10YR5/6			Yes	C - Clay	10	7	2	HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	14	-2	2	WC IV	3b	Wetness			3b
								38	80	42	10YR5/3	MD - M	10YR5/6			Yes	C - Clay	10			HR - All hard rocks or stones (i.e. those w					Extremely firm			Poor	NON - N	No	Yes									
								80	120	40	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Extremely firm			Poor		No	Yes									
28	TQ 14900 96100	514900	196100	85			CER	0	35	35	10YR4/2	FF - Fe	10YR5/6			Yes	HZCL - Sil	5	4	2	HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	26	11	2	WC IV	3b	Wetness			3b
								35	120	85	10YR5/3	MD - M	10YR5/6			Yes	C - Clay				HR - All hard rocks or stones (i.e. those w					Extremely firm			Poor	NON - N	No	Yes									
29	TQ 15100 96100	515100	196100	86			CER	0	38	38	10YR4/2	FF - Fe	10YR5/6			Yes	ZC - Silty	5	4	2	HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	20	5	2	WC IV	3b	Wetness			3b
								38	60	22	10YR5/3	MD - M	10YR5/6			Yes	C - Clay				HR - All hard rocks or stones (i.e. those w					Extremely firm			Poor	NON - N	Yes	Yes									
								60	120	60	10YR5/3	MD - M	10YR5/6			Yes	C - Clay									Extremely firm			Poor		Yes	Yes									
30	TQ 15100 95900	515100	195900	91			CER	0	33	33	10YR4/2					Yes	C - Clay	2	2		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - Non-ca		No	11	1	2	WC IV	3b	Wetness			3b
								33	120	87	10YR5/3	MD - M	10YR5/6			Yes	HZCL - Silty clay loam (heavy)				HR - All hard rocks or stones (i.e. those w					Very firm			Poor	NON - Non-ca		Yes									
31	TQ 15300 95800	515300	195800	89			CER	0	29	29	10YR5/2	CD - C	10YR5/6			Yes	ZC - Silty	5	3		HR - All hard rocks or stones (i.e. those w					N/A			Not Applic	NON - N	No	No	17	2	2	WC IV	3b	Wetness			3b
								29	70	41	10YR5/1	MD - M	10YR5/6			Yes	C - Clay				HR - All hard rocks or stones (i.e. those w					Very firm			Poor	NON - N	No	Yes									
								70	120	50	10YR5/1	MD - M	10YR5/6			Yes	C - Clay									Very firm			Poor		No	Yes									
	END																																								

Mottle form

FF - Few Faint
FD - Few Distinct
FP - Few Prominent
CF - Common Faint
CD - Common Distinct
CP - Common Prominent
MF - Many Faint
MD - Many Distinct
MP - Many Prominent
VF - Very many Faint
VD - Very many Distinct
VP - Very many Prominent

Texture

C - Clay
CHK - Chalk
CS - Coarse Sand
CSL - Coarse sandy loam
CSZL - Coarse sandy silt loam
FP - Fibrous and semifibrous peats
FS - Fine Sand
FSL - Fine sandy loam
FSZL - Fine sandy silt loam
HCL - Clay loam (heavy)
HP - Humified peats
HZCL - Silty clay loam (heavy)
IMP - Impenetrable to roots
LCS - Loamy Coarse Sand
LFS - Loamy fine sand
LMS - Loamy medium sand
LP - Loamy peats
MCL - Clay loam (medium)
MS - Medium Sand
MSL - Medium sandy loam
MSZL - Medium sandy silt loam
MZ - Marine Light Silts
MZCL - Silty clay loam (medium)
OC - Organic clays
OL - Organic loams
OS - Organic sands
PL - Peaty loams
PS - Peaty sands
SC - Sandy clay
SCL - Sandy clay loam
SP - Sandy peats
ZC - Silty clay
ZL - Silt loam

Stone Type

CH - Chalk or chalk stones
FSST - Soft fine grained sandstones
GH - Gravel with non-porous (hard) stones
GS - Gravel with porous stones (mainly soft stone types listed above)
HR - All hard rocks or stones (i.e. those which cannot be scratched with a finger nail)
MSST - Soft, medium or coarse grained sandstones
SI - Soft 'weathered' igneous or metamorphic rocks or stones
SLST - Soft oolitic or dolomitic limestones
ZR - Soft, argillaceous or silty rocks or stones

Ped. Shape

SG - Single grain
GRA - Granular
SAB - Subangular Blocky
AB - Angular Blocky
PRIS - Prismatic
PLAT - Platy
MASS - Massive
NA - N/A

Subsoil Structure Condition

Not Applicable
Good
Moderate
Poor

Soil or Ped. Strength

Loose
Very friable
Friable
Firm
Very firm
Extremely firm
Extremely hard
N/A

Calcareousness

NON - Non-calcareous (<0.5% CaCO3)
VSC - Very slightly calcareous (0.5 - 1% CaCO3)
SC - Slightly calcareous (1 - 5% CaCO3)
MC - Moderately calcareous (5 - 10% CaCO3)
VC - Very calcareous (>10% CaCO3)

Ped. Size

VF - Very Fine
F - Fine
M - Medium
C - Coarse
VC - Very Coarse
NA - N/A

Degree of Ped. Development

W - Weak
M - Moderate
S - Strong
NA - Not applicable

Wetness Class

WC I
WC II
WC III
WC IV
WC V
WC VI

ALC Grades

1
2
3a
3b
4
5
Non-Ag

Gley

None
Gley
N/A

Appendix 3:
Soil Pit Description

Project	Location	Date	Surveyor(s)	Company
C718	Hilfield Solar Farm, Elstree, Hertfordshire	29-Jul-20	RDM	Askew Land and Soil

Pit	WC	Grade	Limitation(s)	Notes
1	IV	3b	soil wetness	Exploratory pit at edge of cereals to examine subsoil structure

Grid Ref.			Altitude	Nearest	Topography				Flora		Weather and conditions			
Square	East	North		point	Gradient	Aspect	Slope form	Surface	Culivation type	Vegetation types	Temp	Sky	Wind	Precipitation
TQ	15191	96988	86m	20	2°	South	Straight	Level	Cultivated	Wheat	Warm	Cloudy	Slight	Dry

Horizon	Depth		Matrix			Gleying			Mottles			Stone content					Calc.	Mn C	Ped/soil structure				Horizon boundary		Biopores	SPL
	Top	Bttm	Texture	Colour	Munsell	Gley	Colour	Munsell	Form	Colour	Munsell	%	H	Type	S	Type			Dev.	Size	Structure	Strength	Distinct	Form		
1	0	30	ZC		10YR5/1							5		Flint/rounde			N									
2	30	50	C		10YR5/3					Ochreous	10YR5/6						N				Massive	Ex firm			< 0.5%	Y

Appendix 4:
Topsoil Particle Size Analysis

ANALYTICAL REPORT

Report Number	**15460-20**	**N717**	**Client C718**
Date Received	**21-JUL-2020**		
Date Reported	**27-JUL-2020**		
Project	**SOIL**		
Reference	**C718**		
Order Number			

Laboratory Reference		**SOIL484458**	**SOIL484459**	**SOIL484460**							
Sample Reference		C718 10	C718 12	C718 25							
Determinand	**Unit**	**SOIL**	**SOIL**	**SOIL**							
Sand 2.00-0.063mm	% w/w	14	15	10							
Silt 0.063-0.002mm	% w/w	44	37	46							
Clay <0.002mm	% w/w	42	48	44							
Textural Class **		C	C	ZC							

Notes

Analysis Notes

The sample submitted was of adequate size to complete all analysis requested.
The results as reported relate only to the item(s) submitted for testing.
The results are presented on a dry matter basis unless otherwise stipulated.

Document Control

** Please see the attached document for the definition of textural classes.

Reported by

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ADAS (UK) Textural Class Abbreviations

The texture classes are denoted by the following abbreviations:

Class	**Code**
Sand	S
Loamy sand	LS
Sandy loam	SL
Sandy Silt loam	SZL
Silt loam	ZL
Sandy clay loam	SCL
Clay loam	CL
Silt clay loam	ZCL
Clay	C
Silty clay	ZC
Sandy clay	SC

For the *sand, loamy sand, sandy loam* and *sandy silt loam* classes the predominant size of sand fraction may be indicated by the use of prefixes, thus:

- vf Very Fine (more than 2/3's of sand less than 0.106 mm)
- f Fine (more than 2/3's of sand less than 0.212 mm)
- c Coarse (more than 1/3 of sand greater than 0.6 mm)
- m Medium (less than 2/3's fine sand and less than 1/3 coarse sand).

The subdivisions of *clay loam* and *silty clay loam classes* according to clay content are indicated as follows:

- M medium (less than 27% clay)
- H heavy (27-35% clay)

Organic soils i.e. those with an organic matter greater than 10% will be preceded with a letter O.

Peaty soils i.e. those with an organic matter greater than 20% will be preceded with a letter P.

For further information on all analyses and services available from NRM Laboratories contact us on:
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Appendix 5:

Soil Health

Soil Health

[1]**Soil Health**

Soil health can be defined as a soil's ability to function and sustain plants, animals and humans as part of the ecosystem. There are five main factors that impact the health of the soil and can have a large influence over its capability and resilience to function, they are:

1. Soil structure
2. Soil chemistry
3. Organic matter content
4. Soil biology
5. Water infiltration, retention and movement through the profile

A healthy soil will have a good combination of all these factors, whilst an unhealthy soil will have a problem with at least one of these. A healthy soil has plenty of air spaces (voids) within it, maintaining aerobic (oxygenated) conditions. A healthy soil will provide a buffer to extremes in temperature (as it allows movement of gases between the soil and the air above) and rainfall (as the soil is well drained). This helps to reduce the impact of extreme weather events.

When a soil has limited air spaces, anaerobic conditions (i.e. oxygen depleted) dominate, leading to waterlogging and stagnation of roots and the proliferation of anaerobic microbes and denitrification (i.e. the loss of nitrogen from the system). A healthy soil will filter water slowly, retaining the nutrients and plant protection products (PPP) applied to the crop. If rainfall moves through the soil profile too quickly, or if it is prevented from entering the soil through compaction or soil sealing, surface runoff increases, taking soil, nutrients and PPP with it. This also increases the risk of flooding.

Summary: A healthy soil has a well-developed soil structure, where soil particles are aggregated into soil peds (structural units) separated by pores or voids. This allows the free movement of water (precipitation) through the soil and facilitates gaseous exchange between the plant roots and the air. These soils are well aerated (oxygenated), which encourages healthy plant (crop) growth and an abundance of soil fauna and aerobic microbes. These soils often have high amounts of soil organic matter (SOM), associated with an accumulation of plant and animal matter, and thus are a good store of soil organic carbon (SOC).

[2]**Soil Organic Matter (SOM)**

Soil carbon is predominantly derived from carbon fixed by plants. This enters the soil as litter or dung, root tissue turnover, root exudates and carbon allocated to mutualistic fungi. Carbon is mixed into the soil and transformed by biological processes, but some is also carried down the profile by downward movement of rainwater. Where these biological processes are retarded, and mixing does not occur, soils can develop organic layers on their surface, and in waterlogged conditions these become deep peat deposits. Soils on limestone and chalk may also contain inorganic carbon as carbonate compounds. Some ammonia oxidising bacteria also fix carbon.

In all habitats, most carbon is stored in soils in the form of soil organic matter (SOM), and peaty soils in particular, are major stores of carbon (Natural England, 2012). Globally, soils contain more organic carbon than the vegetation and atmosphere combined (Swift, 2001). Ten billion tonnes of organic carbon are estimated to be stored in United Kingdom (UK) soils, with over half stored in peat. Soils in England and Wales store 2.4 billion tonnes of carbon of which 58% is in the top 30 cm of soil

(Department for Environment and Rural Affairs (Defra), 2011). Soil carbon is stored in fresh and decomposing litter and as longer-lasting material stored in soil particles, in a complex with clays or in anaerobic waterlogged conditions. England's deep and shallow peaty soils are estimated to contain over 580 million tonnes of carbon (Natural England, 2010), but in surface layers, denser mineral soils contain more carbon than peaty soils (Emmett et al, 2010). In peat, anaerobic conditions caused by waterlogging prevent the breakdown of phenols, which build up and inhibit other decomposition enzymes, while plants producing tannins also inhibit enzyme activity (Defra, 2010A). In lowland fens where waterlogging is due to groundwater, peat can be formed from a wide range of plants that are found in waterlogged conditions. In bogs, where water supply is derived from precipitation only, peat is predominantly formed from Sphagnum mosses and Cotton-grass (Eriophorum spp.), with minor components of other plants reflecting past drier conditions or periods (Natural England, 2013).

Cultivation of soils promotes the release of stored soil carbon by mineralisation of soil organic matter to carbon dioxide (CO^2) (Lal, 2004). The conversion of grassland to arable cropland was the largest contributor to soil carbon losses from land use change in the UK between 1990 and 2000 (Ostle et al, 2009). Carbon in the subsoil (below 15 cm for grassland or 30 cm plough layer for arable) is more stable and less influenced by surface processes (Defra, 2011A).

On mineral soils, Environmental Stewardship is estimated to have reduced England's agricultural greenhouse gas (GHG) emissions by around 11% a year (Defra, 2007), mainly through increases in soil organic carbon delivered by options such as buffer strips that take land out of cultivation.

The greatest benefits in terms of increase in soil carbon can be realised through land use change from intensive arable to grasslands (Conant et al, 2001), woodlands or some biofuels (Defra, 2003). Avoiding disturbance of undisturbed soils, and changing land use to grassland, heathland, woodland or wetland is likely to deliver carbon storage benefits (Natural England, 2012A), including on organo-mineral soils (Defra, 2011B). Conversion from arable to grassland may, however, be offset to some extent by methane emissions associated with livestock production.

There is ongoing research into how grasslands can be managed to increase carbon storage. Defra Project BD5003 (Ward et al, 2006) found that older, and particularly semi-improved grasslands are important carbon stores compared to intensively managed, improved grasslands.

Soil organic matter is a key indicator of many desirable soil functions. It helps to maintain soil structure, provides and stores nutrients, supports biological activity, increases water retention and stores carbon (Gobin et al, 2011). Early results from Natural England's project BD5001 (Natural England, 2016) indicate that grassland soils in good structural condition tend to have more organic matter than soils in moderate or poor condition. Soils with more organic matter tend to be more resistant and resilient to damage, with this effect interacting with soil texture and biological properties (Defra, 2010C).

The best opportunities to increase carbon storage come from planting perennial crops, returning crop residues to the soil and application of organic manures (Defra, 2014).

In the short to medium term (up to 10 years) zero tillage does not result in increased levels of soil carbon compared to conventional tillage (Defra, 2014), but global data suggests that zero tillage results in more total soil carbon storage when applied for 12 years or more (Steinbach and Alvarez, 2006).

Summary: The greatest benefits in terms of increase in soil organic matter (SOM), and hence soil organic carbon (SOC), can be realised through land use change from intensive arable to grasslands. Likewise, SOM and SOC are increased when cultivation of the land for crops (tillage) is stopped and the land is uncultivated (zero tillage). Global evidence suggests that zero tillage results in more total soil *carbon storage when applied for 12 years or more. Therefore, there is evidence that conversion of land from arable to grassland which is uncultivated over the long-term (>12 years), such as that under solar PV arrays, increases SOC and SOM.*

[3]**Biodiversity in the Soil**

Biological function of soils can be enhanced by simple approaches that can be integrated into real farm systems, including adapting organic matter management, cultivation approaches and cropping, with likely benefits to both farming and the environment (Natural England, 2012B).

Soils are habitats for millions of species, ranging from bacteria, fungi, protozoa, and microscopic invertebrates to mites, springtails, ants, worms and plants. It is estimated that more than 1 in 4 of all living species in earth is a strictly soil-dwelling organism (Decaens et al, 2006).

A single gram of soil can contain a billion bacterial cells from up to 10,000 species (Torsvik et al, 1990, 2002).

Soil biota are strongly influenced by land management. Modern farming has sought to replace many soil biota functions with less sustainable technological solutions, which lead to loss of soil biodiversity (Stockdale et al, 2006; Defra 2010c). For example, changes in land management practice and land use can have large effects on soil biodiversity over relatively short-time scales. Reducing the intensity of management, introducing no-tillage management and converting arable land to pasture usually has substantial beneficial effects (Spurgeon et al, 2013).

Microbial diversity in the UK reflects soil conditions, especially pH, but also vegetation, climatic and other environmental factors. Distinct specialist communities occur in more extreme soils with low diversity (Griffiths et al, 2012).

Current levels of understanding of soil biodiversity is low. Out of approximately 11 million species of soil organisms, an estimated 1.5% have been named and classified (Turbé et al, 2010) and most ecological roles are understood only at a general level.

Summary: Soils are habitats for millions of species, ranging from bacteria, fungi, protozoa, and microscopic invertebrates to mites, springtails, ants, worms and plants. Soil biota are strongly influenced by land management. Modern farming has led to the loss of soil biodiversity. Changes in land management practice and land use can have large effects on soil biodiversity over relatively short-time scales. Reducing the intensity of management, introducing no-tillage management, and converting arable land to pasture, such as grassland under solar PV arrays, has substantial beneficial effects.

[4]**Soil Structure**

Soil structure is defined by the way individual particles of sand, silt, and clay are assembled. Single particles when assembled appear as larger particles, called aggregates or peds. Soil structure is most usefully described in terms of grade (degree of aggregation), class (average size) and type of aggregates (form), or shape. The degree of aggregation ranges from structureless, through weak and moderate structure to strong structure. The shape of soil aggregates/peds is often describes as platy, prismatic/columnar, angular/subangular, or granular/crumb structure (Farming and Agriculture Organisation, FAO).

Soil structure refers to the way that soils are bound together. In a well-structured soil, water and air can move freely through cracks and pores. But a poor soil structure prevents water and air movement, and increases the risk of runoff (Defra, 2008). Soil structure can be improved by increasing soil organic matter (SOM) (Cranfield University, 2001).

The Game and Wildlife Conservation Trust's Allerton Project (Game and Wildlife Conservation Trust, 2020) has been involved in investigating the sustainable intensification of agriculture through different experiments. Some research has focused on moving away from conventional agricultural practice, with greater emphasis on no-tillage ('no-till'). One of the fields at the Allerton Project has not been ploughed for the last 14 years and the soil structure is visibly different compared to other soils on the farm. No-till systems can help improve soil fertility, create changes to the structure and properties of the soil due to the stability of the environment, and enhance soil biology. Over time the no-till field has had the highest yields compared to the conventional field equivalent on the farm.

Summary: In a well-structured soil, water and air can move freely through cracks and pores. But a poor soil structure prevents water and air movement, and increases the risk of runoff. Soil structure is improved when the land is uncultivated over time (no tillage), and when soil organic matter content (SOM) is increased through the accumulation of plant material, such has roots, in the soil. The aerobic (oxygenated) decomposition of SOM helps to bind soil particles together into aggregates (peds). Therefore, the conversion of land which is tilled for arable to long-term grassland (no tillage), such as that under solar PV arrays, improves soil structure over time.

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