Longfield Solar Farm

Outline Soil Resource Management Plan

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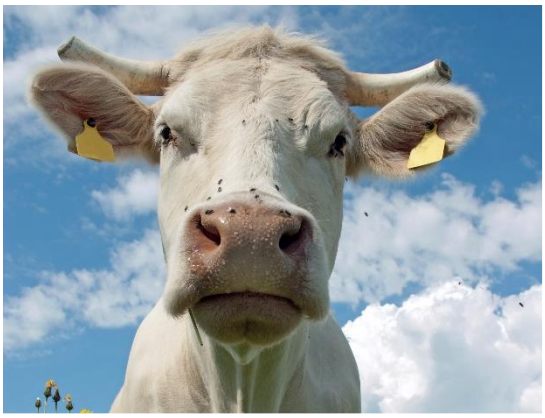


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Outline Soil Resource Management Plan

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EXECUTIVE SUMMARY

The purpose of the outline Soil Resource Management Plan (SRMP) for Longfield Solar Farm is:

- to ensure the protection and conservation of soil resources on site
- identify best practice to maintain the physical properties of the soils on site
- provide on-site reference on the management of the soil resource for site operators

The plan covers, on soil handling, the assessment of soil moisture content, storage of soil in bunds and trafficking. The guidance is applicable throughout the life of the solar farm.

CONTENTS

1 INTRODUCTION

Longfield Solar Farm is a proposed solar farm with energy storage, which will generate and store renewable energy for supply to the National Grid. The solar farm development will comprise the commissioning, operation and decommissioning phases.

The outline proposal includes several temporary construction compounds, office, warehouse and plant buildings, battery energy storage compound, inverters and transformers. In addition, there will be cabling, access routes, fencing and frame mounted solar PV panels.

An Agricultural Land Classification (ALC) survey of the site was undertaken (LSF_ES_Appendix 21A_ALC Survey) by Land Research Associates (2020). Details of the observations are included in the survey report.

A summary of the findings by grade is given:

Grade 2 land includes freely draining soils (Wetness Class (WC) I) with a medium clay loam or medium silty clay loam topsoil. The main limitation to the agricultural use is soil droughtiness. In some places the topsoil is underlain by a slowly permeable layer at depth which results in Wetness Class II.

Subgrade 3a land includes soil with sandy clay loam and medium silty clay loam topsoils over poorly structured subsoils (WC III) or a heavy clay loam topsoil with permeable upper subsoil (WC II). There is a soil wetness limitation affecting the workability of the land and a moderate droughtiness limitation.

Subgrade 3b land includes soils with a heavy clay loam topsoil overlying a clay subsoil and having impeded drainage (WC III). A limited area in the south east of the site has a sandy clay loam topsoil overlying gravel and is limited by droughtiness to Subgrade 3b.

The survey classified the land within the site boundary as:

Table 1 Agricultural Land Classification Grade - whole site area

Agricultural Land Classification Grade	Total Area (ha)	% of site boundary
1	0	0
2	55.2	12
3a	100.5	22
3b	261.6	58
4	0	0
5	0	0
Non Agricultural Land	10.4	2
Not surveyed	25.2	6
Total	452.9	100

The land by ALC grade required for construction is:

Table 2 Agricultural Land Classification grade- land required for construction

Agricultural Land Classification Grade	Total Area (ha)	% of site boundary
1	0	0
2	14.3	11
3a	29.7	22
3b	74.8	55
4	0	0
5	0	0
Non Agricultural Land	8.9	7
Not surveyed	7.4	5
Total	135.1	100

The purpose of the outline Soil Resources Management Plan (SRMP) is to:

- ensure the protection and conservation of soil resources on site;
- identify best practice to maintain the physical properties of the soils on site; and
- provide on-site reference on the management of the soil resource for site operators.

The SRMP follows the principles of best practice[1] [2] to maintain the physical properties of the soil with aim of the restoring the land to its pre-construction condition at the end of the lifetime of the solar farm.

[1] Defra (2009) Construction Code of Practice for the Sustainable Use of Soils on Construction Sites https://www.gov.uk/government/publications/code-of-practice-for-the-sustainable-use-of-soils-on-construction-sites

[2] The Institute of Quarry

ing (2021) Good Practice Guide for Handling Soils in Mineral Workings. h[redacted]

2 SOIL ASSESSMENT

The SRMP establishes a baseline of the soil resources prior to the construction phase and enables grouping of soils into soil units which have similar physical characteristics. As part of the Agricultural Land Classification Survey details on soil texture, depth, drainage characteristics and stone content were recorded. There were 3 main soil types identified in the Soil Resources and Agricultural Land Quality report for the site (LSF_ES_Appendix 21A_ALC Survey Map 2).

The main soil type is described as a heavy soil with impeded drainage and is widespread throughout the site. A second soil type with silty soils is found in four areas – in the north west near Scarlett's Wood, to the east of Bird's Farm and two areas close to Toppinghoehall Wood. The third soil type described as loamy soil over gravel is shown in a limited area near Toppinghoehall Wood and to the south of Lost Wood. This soil type includes a small area of light textured soils with a sandy loam topsoil overlying gravel and is identified in the SRMP as a fourth soil type. Descriptions of the soil types are in Appendix 1.

The soils can be grouped into soil handling units of similar texture, primarily to avoid mixing of different soil textures during removal and storage.

3 SOIL UNITS FOR HANDLING

There are 3 phases - commissioning, operation and decommissioning - within the lifetime of a solar farm, where management of the soil resource is required. To ensure the condition and quality of the soil is preserved the soils should only be handled when dry and friable. To reduce damage to the soil structure the soil moisture state should be assessed on site by a suitably qualified person prior to any work commencing and after rainfall events.

Soils can differ in their susceptibility to compaction depending on their textural class, degree of structural development and water retention properties. Light textured soils with a clay content of less than 18% such as sandy loam are significantly less susceptible to compaction than a heavy textured soil with a clay content of more than 27% such as a heavy clay loam, which have a low resilience to structural damage.

Three soil handling units are identified across the site, which if disturbed, will require separate handling.

Table 3: Soil resilience to structural damage classification

Soil Handling Unit	Resilience to Structural damage during soil handling in a dry condition	Soil texture class
A (Green)	High	Light textured soils: sandy loam
B (Orange)	Medium	Medium textured soils with <27% clay content: sandy clay loam, medium silty clay loam, medium clay loam
C (Red)	Low	Heavy soils with >27% clay content: heavy clay loam

The following soil units have been identified on site with topsoil texture determining the classification:

Unit A - medium sandy loam to a depth of 330mm from the surface over coarse sandy loam and gravel

Unit B - medium clay loam, sandy clay loam or medium silty clay loam to a depth of 300mm from the surface with upper subsoils of similar texture over a lower subsoil of heavy silty clay loam or clay

Unit C - heavy clay loam to a depth of 300mm over upper subsoil of heavy clay loam and lower subsoil of either heavy clay loam or clay.

Unit C is widespread throughout the site with Unit B covering a significant area. Unit C is limited to a small area in the south east. The distribution of the soil handling units is shown on Plan 1 (Appendix 2).

4 SOIL STRIPPING- EARTHWORKS

The Soil Handling Units plan (Appendix 2) shows the units of soil which should be stripped and stored in bunds separately during the commissioning phase.

The following points should be in place prior to the stripping of soil

- the site layout should accommodate designated soil storage areas
- the volume of soil to be stripped and storage requirements can be calculated
- best practice is to use an excavator and dump truck to strip and move soil
- all machinery should operate and travel on subsoil or access routes
- matting may be required on access routes to contain and reduce soil compaction
- vegetation on the areas to be disturbed e.g. compounds, access road etc. should be cut short to less than 100mm as necessary, no more than 2 weeks before stripping
- a record of any soil placed in storage and a plan of the storage bunds should be maintained throughout the life of the solar farm
- the topsoil should be stripped to a depth of approximately 300mm

5 SOIL MOISTURE ASSESSMENT

To minimise the risk of structural damage to the soil the soil when in a suitable condition identified by the soil moisture assessment outlined below.

The following points should be considered on each occasion that soil handling is proposed:

- topsoil stripping will only occur when the soils are as dry as reasonably practicable (normally below the plastic limit and not normally within 24 hours of significant rainfall (i.e. <10mm in a 24 hour period)
- during light rainfall events local level decisions to proceed or stop should be based on the current wetness state of the soils being handled
- there should be no surface water standing in the area to be stripped
- the ground should be sufficiently dry for traffic to travel across without forming ruts
- soil should not be moved when the ground is covered by snow or is frozen

To determine the suitability of the soil for handling the following in-field soil moisture test should be undertaken to assess the moisture content of the soil prior to working.

The method involves rolling a ball of soil into intact threads (3mm diameter), which if possible, indicate the soils are in a plastic and wet condition[3] [4] [5] (see Table 6). A visual examination of the soil taken initially and then an assessment of the soil consistency (the cohesion and adhesion of the soil) as set out in Tables 4, 5 and 6.

Table 4 Visual Assessment of Soil Moisture

Soil Condition	Procedure
If the soil is wet, films of water are visible on the surface of the soil particles or aggregates and/or when a soil sample is squeezed by hand and readily deforms into a 'cohesive' ball	NO HANDLING
Soil peds readily break up or crumble when squeezed in the hand	HANDLING OK
If the sample is moist (a slight dampness when squeezed by hand) but the soil colour does not change upon further wetting	HANDLING OK IF UNDERTAKEN BY TRACKED EXCAVATOR AND CONSISTENCY TEST IS PASSED
If the sample is dry and darkens if water is added the soil is brittle	HANDLING OK IF CONSISTENCY TEST IS PASSED

Table 5 Consistency Test (1)

[3] MAFF 1982 Reference Book 441 Techniques for measuring soil physical properties HMSO

[4] Natural England 2021 Planning and aftercare advice for reclaiming land to agricultural use.

[5] The Institute of Quarrying (2021). Good Practice Guide for Handling Soils Supplementary Note 4 Soil Wetness

Attempt to mould a soil sample into a ball by hand:

Soil Condition	Procedure
Impossible because the soil is too hard or dry	HANDLING OK
Impossible because the soil is too loose (dry)	HANDLING OK
Impossible because the soil is too loose and wet	HANDLING NOT OK
Possible	GO to Table 4

Table 6 Consistency Test (2)

Attempt to roll the ball by hand into a thread of 3mm diameter on a flat non-adhesive surface

Soil Condition	Procedure
Impossible the soil crumbles or disintegrates	HANDLING OK
Possible	NO HANDLING

6 SOIL STORAGE

Topsoil from different soil units should be stored in separate soil bunds and placed on soil in a similar soil unit. Soil may be stored in areas used for landscaping.

The following points should be considered when planning soil storage to keep soil aerated, reduce erosion, runoff and ponding:

- the soil bund should be no higher than 3m for topsoil
- the bund should be shaped to shed water
- be located on dry level ground
- not disrupt any natural surface drainage
- the bund should be seeded with a suitable grass mix
- the bund should be monitored and managed for weeds
- grass on the bund should be managed either by cutting or grazing.
- A record should be kept of soil placed into storage on the site. Each bund should be identified with the soil volume and soil unit.

7 SITE MACHINERY AND VEHICLE MOVEMENT

On any construction site there exists the risk of soil compaction from the use of heavy machinery and traversing land in unsuitable ground conditions. The aim should be to minimise the risk through appropriate site management of operations during the commissioning, operation and decommissioning phases. Much of the site is classified as having a low resilience to structural soil damage and hence the risk of soil compaction.

The management of trafficking on site and traversing the land when the soil is in a suitable dry condition is key to managing the risk of soil compaction. Where land is to be returned to agricultural use at the end of the solar farm life it is important that the risk of soil compaction and its management is considered as part of the pre-construction planning.

As a guide to planning operations it should be noted that the Field Capacity Day figure for the site is about 103 days, which is relatively low for England (Appendix 3).

The term Field Capacity is a measure of the duration of climatic wetness when soils hold the maximum amount of water. In a normal year the soils are likely to return to Field Capacity in early December and remain at Field Capacity until early April. As a broad guide planning of the construction works should take this into consideration and seek to undertake minimal traversing across the site and soil handling during the period early December to early April and/or to develop appropriate procedures to do so such as the use of matting. An on-site inspection of the soil condition prior to vehicle movement across the site is essential.
Using machinery such as dump trucks fitted with tracks or low ground pressure tyres to spread the weight of the machinery should be used.

When travelling across the site all machinery and vehicles should keep to access routes where possible to contain the risk of soil compaction.

8 DECOMMISSIONING

The outline Soil Resources Management Plan will be part of the decommissioning phase and its purpose will be to:

- to ensure the protection and conservation of soil resources
- undertake best practice to maintain the physical properties of the soils
- provide on-site reference on the management of the soil resource for site operators undertaking the decommissioning works

In addition to the best practice guidance in the SRMP, the following points are relevant to the management of soil resources at the decommissioning phase:

- when solar farm infrastructure such as compounds, inverters etc and any ground coverings are removed the subsoil condition should be examined by digging a trial pit
- where appropriate the subsoils may be loosened ideally with a subsoiler set up to appropriate depth and spacing to alleviate compaction or with an excavator ripper attachment
- the surface of the subsoil should be cleared of any debris and large stone
- across the site trial pits to assess the soil profile and any compaction should be undertaken to contribute to a programme of remediation
- should there be deep compaction (>450mm depth) in the soil profile the use of specialist equipment should be considered
- grass on the soil bunds will be sprayed off 10 days before soil reinstatement
- examine the conditions of the soil under the bunds and take remedial action such as loosening if required
- where there have been compounds or fuelling points the subsoil should be sampled and a UKAS and MCERTS (or equivalent) laboratory analysis undertaken for metals, oils and Polycyclic Aromatic Hydrocarbons (PAHs)
- the decommissioning phase and reinstatement of soil should be monitored by a suitably qualified competent person. Records of operations should be kept with photographic evidence
- soil conditions for pile pull out should be dry and friable (to be reviewed as part of the decommissioning plan)
- any void left after pile pull out should be examined and may require in-filling with similar soil
- the condition of field drainage should be assessed and reviewed for any remedial action

APPENDIX 1 SOIL UNIT DESCRIPTIONS

The descriptions are extracted from Document: LSF_ES_Appendix 21A_ALC Survey and refer to the soil types.

Soil Handling Unit A covers a very limited area where there is a sandy loam topsoil. These soils were identified as a loamy soil over gravel in the Agricultural Land Classification survey (observations 204,209 and 389). The pit description refers to the observation point at 392, which has a sandy clay loam topsoil.

For the purposes of soil handling classification, the sandy loam topsoil has been placed in Soil Unit A (high resilience to soil structural damage). The description below describes observation 204.

0-32 cm dark brown (7.5YR3/2) sandy loam: moderately stony; *(pit structural description given as moderately developed medium and coarse granular)*

32- 65 cm dark greyish brown (10YR4/2) coarse sandy loam: moderately stony (flints*); pit structural description weakly developed medium granular structure)*

65cm+ gravel

Freely draining - Wetness Class I (*soil porosity not noted but from pit description will be more than 0.5% pores greater than 0.5mm in diameter*).

Soil Handling Unit B covers areas in the north, centre and south of the site. These soils were identified as a silty soil type. The topsoil texture includes medium silty clay loam and sandy clay loam.

A pit description at observation 129 is given:

0-29 cm greyish brown (10YR5/2) medium silty clay loam; slightly stony (5-10% small and medium sub-angular hard stones and flints); moderately developed fine and medium sub-angular blocky structure; friable

29-52 cm yellowish brown (10YR5/6) medium silty clay loam with few fine yellow (10YR7/6) mottles; very slightly stony (5% small sub-angular hard stones and flints); well developed medium sub-angular blocky structure; friable

52-100cm+ brownish yellow (10YR6/6) medium silty clay loam; common fine diffuse reddish yellow (7.5YR6/8) and light grey (10YR7/2) mottles; very slightly stony (5% small sub-angular hard stones and flints); moderately developed medium angular blocky structure; friable

Soil drainage-ranges from freely draining (Wetness Class I or II to imperfectly drained Wetness Class III where clay is present in the subsoil

Soil Handling Unit C is widespread across the site and includes topsoils which have a low resilience to structural damage. While the area is underlain by chalky glacial till or de-calcified drift, the topsoils are generally non calcareous. A pit description is given for observation 44:

0-31cm dark greyish brown (10YR4/2) heavy clay loam; moderately stony (15% small and medium flints and pebbles); weakly developed coarse sub-angular blocky structure; non-calcareous; firm

31-42cm yellowish brown (10YR5/6) clay with abundant medium distinct yellow (10YR7/6) and grey (10YR5/1) mottles and ped faces; slightly stony (10% small and medium sub-angular flints and small rounded soft chalk); weakly developed very coarse prismatic structure; very firm; slightly calcareous

42-100cm+ yellowish brown (10YR5/6) clay with abundant medium distinct reddish yellow (7.5YR6/8) and grey (10YR6/1) mottles; moderately stony (20% small and medium soft chalk stones); weakly developed very coarse prismatic structure; very firm; calcareous.

APPENDIX 2 PLAN 1

575000

215000

Legend:

- Site Boundary
- Soil Unit A - Light Textured Soils
- Soil Unit B - Medium Textured Soils
- Soil Unit C - Heavy Textured Soils
- Not Surveyed

Terling
Church Green
Braintree Road
Hatfield Road
Witham Ro
Borsham Road
Leighs Road
Terling Hall Road
Drakes Lane
Drakes Lane Industrial Estate
Cranham Road
Russell Green
Boreham Industrial Estate
Waltham Road
Waltham Road Industrial Estate
Crix
Damases Lane
Main Road
New Hall School
Park

Rev	Date	Description	Drn	Chk	App
00	08/02/2022	2740008	ET	SP	MW

Longfield Solar Farm

TITLE: Plan 1:

Soil Handling Units

0 200 400 600 800

Metres

SCALE: 1:20,000 @ A3

N W E S

REV 00

Document Path: C:\OneDrive\RSK Group\Nature Positive - 2740008 Longfield Solar Farm\06 GIS\2740008 - Plan 1 - Soil Handling Units.aprx

APPENDIX 3

Table A: Agro-climatic variables

(Grid reference TL754 134 altitude 52m)

Average Annual Rainfall (AAR)	576 mm
January-June Accumulated Temperature (AT0)	1423 day °C
Field Capacity Days (FCD)	103
Field Capacity Period	mid Dec - late Mar
Moisture Deficit Wheat (MDW)	122 mm
Moisture Deficit Potatoes (MWP)	118 mm
Climate (upper grade limit)	1