Heckington Fen Solar Park

EN010123

Outline Soil Management Plan

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Outline Soil Management Plan

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This document comprises two parts –
Outline Soil Management Plan for the Energy Park including a Stockpile Location Plan
Outline Soil Management Plan for the Offsite Grid Route Corridor which includes the methodology for surveying the soil type prior to construction

HECKINGTON FEN
ENERGY PARK

OUTLINE
SOIL MANAGEMENT PLAN
FOR THE ENERGY PARK

November 2023

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HECKINGTON FEN
ENERGY PARK

OUTLINE
SOIL MANAGEMENT PLAN
FOR THE ENERGY PARK
November 2023

Authorised By

Greenacres Barn, Stoke Common Lane, Purton Stoke, Swindon SN5 4LL
T: 01793 771333 Email: info@kernon.co.uk Website: www.kernon.co.uk

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1 INTRODUCTION

1 Introduction
2 Scope of the oSMP
3 Soil Resources and Characteristics
4 Key Principles
5 Temporary Access Areas and Compounds
6 Access Tracks and Fixed Equipment
7 Solar Arrays
8 Installation of On-Site Trenching
9 Site Fencing
10 Monitoring and Aftercare

Appendices

A Plans from the Agricultural Land Classification
B Description of Soil Type
C Agricultural Good Practice Guidance for Solar Farms (2013)
D Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (extracts only)
E Proposed Layout **and Stockpile Location Plan**

1 INTRODUCTION

1.1 This document provides an outline Soil Management Plan (oSMP) for the Heckington Fen Energy Park project (hereafter referred to as "the Energy Park").

1.2 The measures proposed within the oSMP will be considered prior to the commencement of construction works. If necessary, a detailed SMP will be prepared prior to the start of works and in accordance with this oSMP.

1.3 This oSMP covers the principal construction activities envisaged at the time of preparing the Environmental Statement (ES).

1.4 The appointed construction contractor will be responsible for working in accordance with the environmental controls documented in this oSMP, pursuant to the DCO. The overall responsibility for implementation of the detailed SMP will lie with the appointed contractor as a contractual responsibility to the Applicant, as the Applicant is ultimately responsible for compliance with the Requirements of the DCO.

1.5 The oSMP currently covers the 524 ha of the Energy Park site.

1.6 This oSMP focuses on the areas required temporarily during construction, the access tracks and areas associated with the fixed equipment, the solar arrays, on-site trenching and site fencing.

Purpose of this document

1.7 The objective of the oSMP is to identify the importance and sensitivity of the soil resource and to provide specific guidance to ensure that there is no significant adverse effect on the soil resource as a result of the Proposed Development.

1.8 The oSMP is structured as follows:

(i) section 2 sets out the scope of the oSMP;
(ii) section 3 describes the soil resources and characteristics;
(iii) section 4 sets out key principles;
(iv) sections 5-9 set out the soil management requirements for key aspects of the Proposed Development:

- section 5: temporary access areas and compounds;
- section 6: access tracks and fixed equipment;
- section 7: the solar arrays;
- section 8: on-site trenching;

- section 9: site fencing;

(v) section 10 sets out monitoring and aftercare.

1.9 This oSMP draws on professional experience with the installation of solar panels. It also draws on experience with the installation of underground services (especially pipelines), and with soil movement and restoration of agricultural land in connection with roads, quarries and golf courses.

2 SCOPE OF THE OSMP

2.1 The oSMP sets out a soil resources report including:

- the distribution of the Agricultural Land Classification (ALC);
- the extent and depth of topsoil units; and
- the distribution of different soil types.

2.2 Construction of the Energy Park will require vehicular movement over land (trafficking) for construction, and in places the movement of soils (to create fixed bases, tracks and to trench-in cables). This oSMP sets out:

- a description of the soil types and their resilience to being trafficked or moved;
- an outline description of proposed access routes and details of how access will be managed to minimise impacts on soils;
- a description of works to install panels and how soil damage will be minimised and ameliorated; and
- a methodology for monitoring soil condition, and criteria against which compliance will be assessed.

2.3 The installation of the solar panel framework, and the assembly of the panels, does not require the movement of soils. Those works should not, therefore, result in localised disturbance or effects on soils or agricultural land quality. The oSMP, however, covers vehicle movements and related impacts, as these may affect soils (as distinct from land quality).

2.4 Trenching works to connect the panels to the infrastructure do have the potential to cause localised effects on soils. Whilst such works will not result in adverse effects on the agricultural land classification, localised damage will be minimised by good practice. This oSMP sets out soil resilience, best practice and monitoring criteria.

2.5 In localised areas there is a need for access tracks or bases for infrastructure and equipment. In those localised areas soil will need to be stripped and moved, for stockpiling for subsequent restoration. This oSMP sets out:

- a description of the soil types and their resilience to being stripped and handled;
- an outline map showing the areas proposed for being moved, soil thickness and type;
- a methodology for creating and managing stockpiles of soil;
- an outline methodology for testing soils prior to restoration, and a methodology for respreading and ameliorating compaction at restoration.

2.6 This oSMP focuses on the construction phase and immediate aftercare. There is no requirement for an oSMP for the operational phase, as there should be no requirement to disturb or move soils.

2.7 This oSMP does not cover the ecological areas in any depth because there will be no stripping or movement of soils.

3 SOIL RESOURCES AND CHARACTERISTICS

Climatic Conditions

3.1 The climatic data for the area, using the climate data set for ALC, shows annual rainfall between 575 and 590mm across the Site.

3.2 Soils are at field capacity, i.e. replete with water, for usually 107 days per year, mostly during the period from autumn to early spring. This is the period when soils are most susceptible to damage because they are saturated.

Agricultural Land Quality

3.3 A soil survey and ALC survey (part detailed, part semi-detailed) have been carried out across the area within the Order limits. No survey has as yet been carried out of the connecting cable route.

3.4 The results of the ALC survey are set out in an **Appendix A**.

Extent and Depth of Topsoil Units and Soil Types

3.5 As set out in the ALC, the soils across the site are variable. The site is generally flat, and the entire site is covered with soils of the Wallasea 2 Association. These soils are extensive on reclaimed marine alluvium in the marshlands of Lincolnshire. The soils are clayey with a greyish brown topsoil over greyish or grey and ochreous mottled subsurface horizons. The soils respond to drainage and, if undrained, are wet for longer periods in the winter.

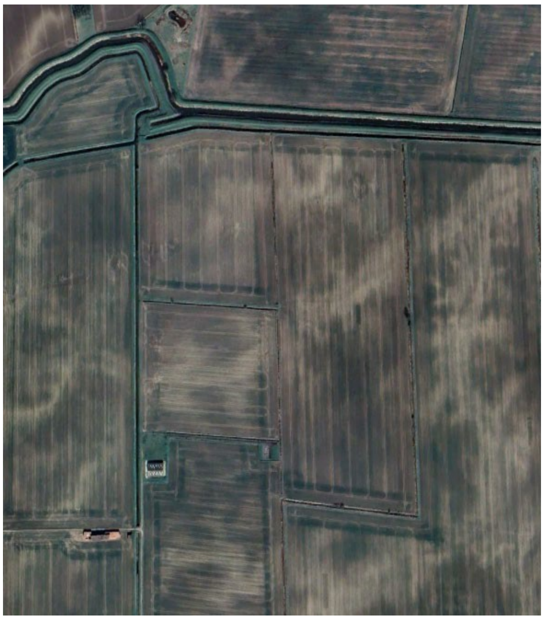
3.6 The texture of the soil varies from medium silty clay loam through heavy clay loams to silty clay, and shows a complex mix of soil textures and drainage status.

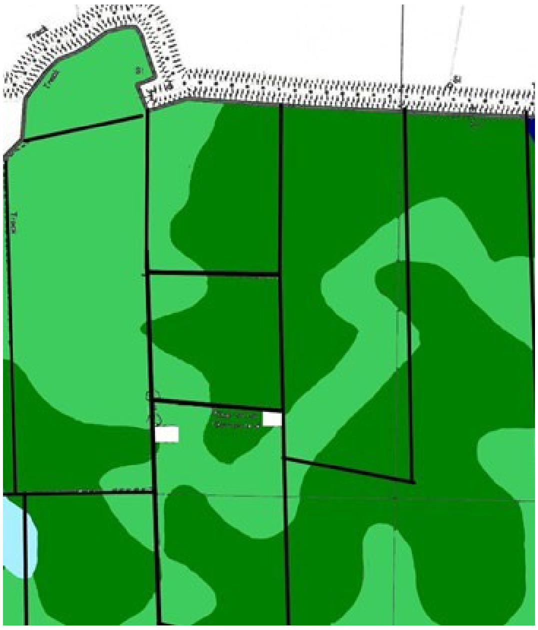
3.7 The variability of the soils over short distances could make for variable and therefore challenging conditions. The variability is evident on the 2022 aerial photograph below.

Insert 1: 2022 Aerial Photograph

3.8 Soil variability is readily seen from the air, but is not easily seen on the ground as the land is flat. An extract from the ALC map and a Google Earth image are below.

Inserts 2 and 3: Google Earth and Extract from ALC





3.9 In practical terms, however, there is not a significant difference between the workability of the soils over the Energy Park site.

3.10 The description of the soils, which are all from the Wallasea 2 Association, is provided in **Appendix B**, taken from the soil memoire. This identifies the ideal landwork season in a normal year, as follows (see the top row).

Insert 4: Landwork Table

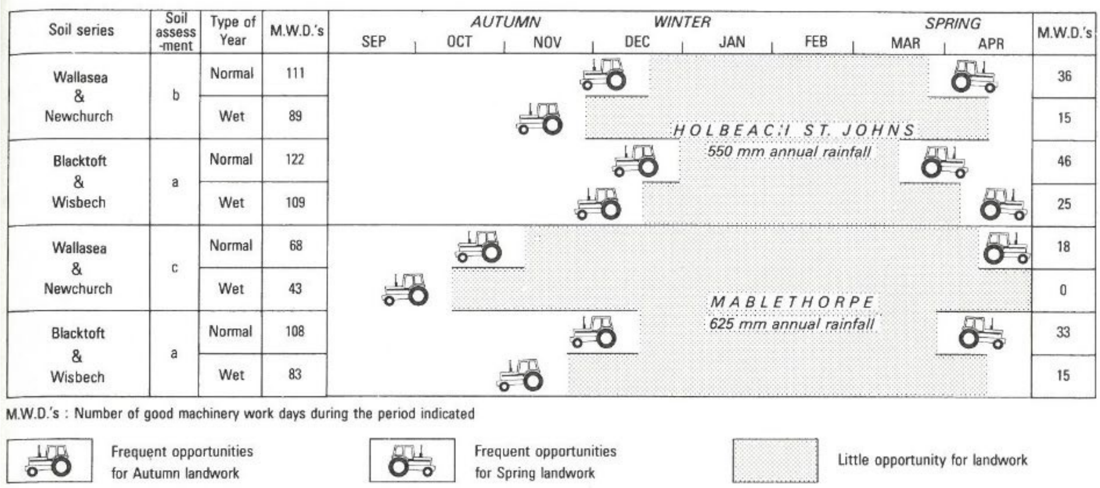


Figure 71. The effects of soil and climate on landwork, Wallasea 2 association

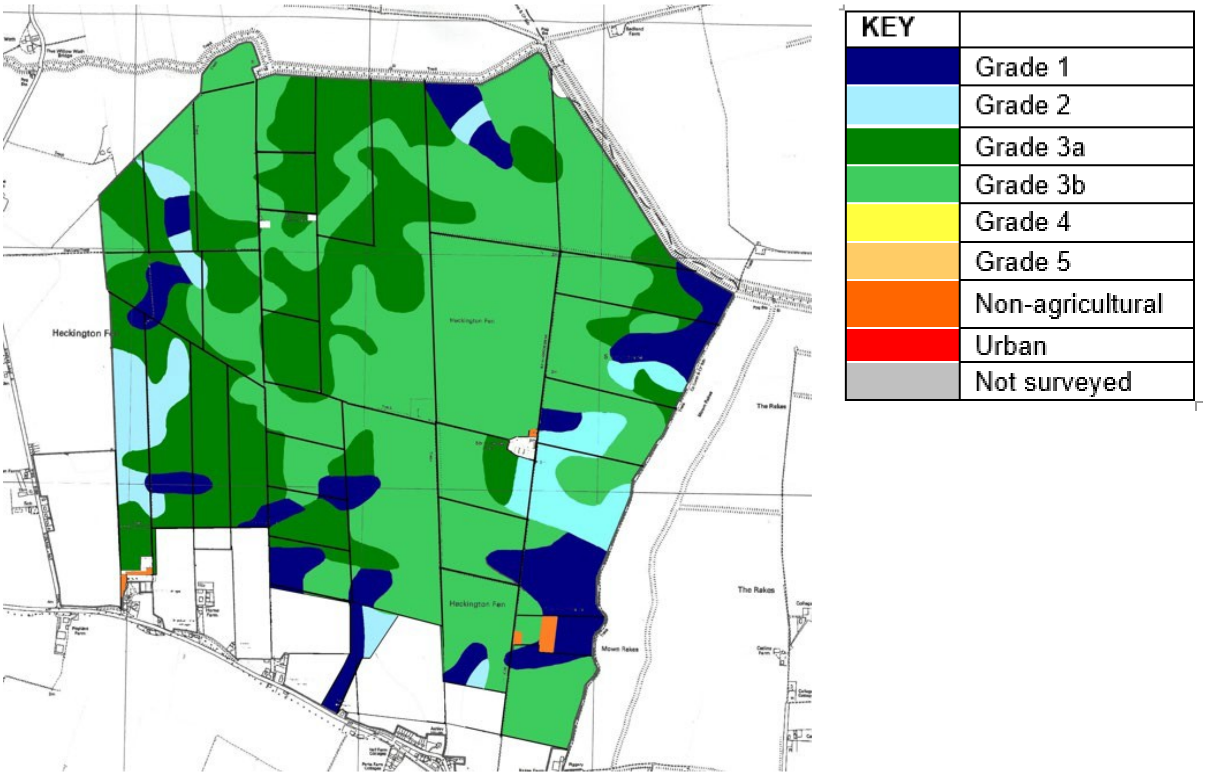
Propensity to Damage

3.11 The Institute of Environmental Management and Assessment (IEMA) have produced a Guide "A New Perspective on Land and Soil in Environmental Impact Assessment" (2022). Table 4 in the guidance identifies that clay and heavy clay loam soils where the Field Capacity Days (FCD) is less than 150 (as here) have a medium resilience to structural damage.

3.12 The IEMA guide identifies that lighter soils, including medium clay loams, are of medium resilience where the FCD is less than 225. Here, where the FCD is 104 - 111 days, these soils will be at low risk of structural damage. This describes most of the soils on the Energy Park site.

3.13 The pattern of soils and land quality distribution is complex, as shown on the aerial image above. However, the soils that will be least prone to compaction if trafficked in the wetter mid-winter months are the lighter soils which generally correlate to the soils along the eastern and western boundaries, where there are patches of Grades 2 and 3a on the ALC plan, a copy of which is reproduced below.

Insert 5: The ALC Plan



3.14 Landwork in all areas between mid-December and late March will need to be carried out carefully, otherwise there may be a need for restorative soil husbandry in the spring.

4 KEY PRINCIPLES

Overview

4.1 For much of the installation process there is no requirement to move or disturb soils. Soils will need to be moved and disturbed to create temporary working compounds, and to create the tracks and small fixed infrastructure bases. Soils will need to be disturbed to enable cables to be laid, but the soils will be reinserted shortly after they are lifted out (i.e. this is a swift process).

4.2 For the majority of the Proposed Development soils do not need to be disturbed. The effects on agricultural land quality and soil structure are therefore limited to the effects of vehicles passage. This is agricultural land, so it is already subject to regular vehicle passage. Therefore, the key consideration is to ensure that soils are passed over by vehicles (trafficked) when the soils are in a suitable condition, and that if any localised damage or compaction occurs (which is common with normal farming operations too), it is ameliorated suitably.

4.3 The key principles for successfully avoiding damage to soils are:

- timing;
- retaining soil profiles;
- avoiding compaction;
- ameliorating compaction; and
- storing soils for subsequent reuse.

Timing

4.4 The most important management decision/action to avoid adverse effects on soils is the timing of works. If the construction work takes place when soil conditions are sufficiently dry, then damage from vehicle trafficking and trenching will be minimal.

4.5 The soils are relatively resilient to vehicle passage for much of the year. Under the ALC the field capacity period, i.e. the days in the year when soils are saturated, is about 107 days per year. The soil memoire for the Wallasea 2 Association (**Appendix B**) identifies limited opportunities for landwork between mid-December and mid to late March.

4.6 The soils are generally resilient, and any damage from vehicle trafficking can generally be made good by mechanical husbandry once the soils start to dry in the spring.

4.7 The following photograph shows areas of archaeological excavation having been dug post-harvest and restored. The soils will be indistinguishable from the surrounding land once a cultivator or combined seed drill has passed over the land.

Insert 6: Restored Archaeological Trench (January 2023)

4.8 **Where it can be achieved, advanced sowing with grass is advantageous for construction purposes. However, in some areas that will not provide the best outcome, and a successful sward may be better achieved by sowing following installation and when works have been completed. The decision will be influenced by the expected timing of construction works, the weather, the time of the year and the date when previous agricultural crops are harvested. As much advance-sowing of the Energy Park as possible will be carried out.**

4.9 Vehicle trafficking of the central part of the site, where the soils are mostly Subgrade 3b, should be carefully managed between mid-December and mid-March.

4.10 Between those times there is an increased risk of creating localised damage to soil structure from vehicle passage. There are obviously a great number of variables, such as recent rainfall pattern, whether the ground is frozen or has standing water, inevitable variations in soil condition across single fields, and the size and type of machinery driving onto the land.

4.11 As a general rule any activity that requires soil to be dug up and moved, such as cabling works, should be avoided during that period or done with great care. Soils handled when wet tend to lose some of their structure, and this results in them taking longer to recover after movement, and potentially needing restorative works (e.g. ripping with tines) to speed recovery of damaged soil structure. They will, however, recover with time.

4.12 In localised instances where it is not possible to avoid undertaking construction activities when soils are wet and topsoil damage occurs then soils can be recovered by normal agricultural management, using normal agricultural cultivation equipment (subsoiler, harrows, power harrows etc) once soils have dried adequately for this to take place. There may be localised wet areas in otherwise dry fields, for example, which are difficult to avoid.

Retaining Soil Profiles

4.13 The successful installation of cabling requires a trench to be dug into the ground. Topsoils vary across the Order Limits, but the coverage is generally 30cm, with subsoils below that being generally similar to depth. As set out in the BRE Agricultural Good Practice Guidance for Solar Farms (extract at **Appendix C**) at page 3:

> "**When excavating cable trenches, storing and replacing topsoil and subsoil separately and in the right order is important to avoid long-term unsightly impacts on soil and vegetation structure. Good practice at this stage will yield longer-term benefits in terms of productivity and optimal grazing conditions**".

4.14 In those areas where the soil is dug up (trenching and for compounds and access roads), the soils should be returned in as close to the same order, and in similar profiles, as it was removed.

Avoiding Compaction

4.15 This oSMP sets out when soils should generally be suitable for being trafficked. There may be periods within this window, however, when periodic rainfall events result in soils becoming liable to damage from being trafficked or worked. In these (likely rare) situations, work should stop until soils have dried, usually within 48 hours of heavy rain stopping.

Ameliorating Compaction

4.16 If localised compaction occurs during construction, it should be ameliorated. This can normally be achieved with standard agricultural cultivation equipment, such as subsoilers (if required), power harrows and rolls.

4.17 The amount of restorative work will vary depending upon the localised impact. Consequently, where the surface has become muddy, for example in the photograph below, this can be recovered once the soil has dried, with a tine harrow and, as needed, a roller or crumbler bar.

Inserts 7 and 8: Inter-row Ground Restoration

4.18 The type of machinery involved is shown below. This shows farming and horticultural versions.

Inserts 9 – 12: Type of Machinery Involved

4.19 If there are any areas within the Energy Park where there has been localised damage to the soils due to vehicle passage, for example a low wet area within a field which despite best efforts could not be avoided, this should be made good and reseeded at the end of the installation stage. This is not uncommon: most farmers will have times when they have to travel around the farm in a tractor in conditions where the tyres make deep impacts. This can happen during harvest time, for example, especially of late crops or in very wet harvest seasons. Whilst this is avoided so far as possible, it occurs and the effects are made good when conditions are suitable.

4.20 With these soils, including the slowly permeable clayey soils, these areas will readily restore. The ruts need to be harrowed level when the ground is dry, and then they will naturally restore.

4.21 Accordingly the ground surface should be generally levelled prior to any seeking or reseeding.

<u>Storing Soil and Restoring Soil</u>

4.22 The quantities of soil involved are limited and topsoil mounds would be a maximum of 1m high. This will not result in the soil becoming anaerobic even in storage in a bund for 40 years. Advice on the stockpiling of soils taken from the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2009) is reproduced in **Appendix D**. These areas will need to be managed at least annually during the life of the Proposed Development to prevent the establishment of woody growth or brambles, in accordance with the oLEMP.

4.23 The following photograph, from January 2023, shows topsoil being stored next to the temporary access track for the Viking Link cable works to the immediate east of the Energy Park.

Insert 13: Temporary Topsoil Storage (January 2023)

4.24 The mound should be kept clear of woody vegetation. It is acceptable to sow the mound with grass seed.

4.25 The mound should not be moved for restoration unless the soil is sufficiently dry. Testing to the centre of the mound with a soil auger should take place before the soil is moved.

5 TEMPORARY ACCESS AREAS AND COMPOUNDS

<u>The Areas</u>

5.1 The temporary access areas, and the temporary working compounds, are shown on the Plans in **Appendix E**.

<u>Construction Methodology</u>

5.2 These areas are intended for short-term construction activity only.

5.3 The top 10-15cm of topsoil is removed by machinery and stored in a low bund alongside the track or working yard area. Then a membrane is laid down. Onto this is placed a mix of as-dug stone topped, if needed, with smaller stone which is spread and rolled level. At the end of the construction, the stone is dug up and removed, the membrane removed, the area is loosened by a subsoiler or plough, and the topsoil spread back over before being harrowed with standard agricultural machinery. It can then be reseeded.

5.4 This is shown below.

Inserts 14 and 15: Topsoil and Matted Track

<u>Soil Management</u>

5.5 Construction will commence when soils are suitably dry to be moved without smearing. This will normally be after mid to late March. In wet years this may be later.

5.6 Areas for temporary works, including any site compound or access track if required, will be stripped to a depth of circa 10 - 15cm. The soil will be stockpiled to the side of the area ready for restoration. This should take place in dry conditions.

5.7 The area will then be covered with suitable permeable matting to prevent stones from mixing with the soil. Stone will then be laid on the matting to create the temporary working area.

5.8 For restoration the stone and matting will be removed. A soil advisor should review this area once the matting is removed. If required they will advise whether there needs to be any loosening of the area before the topsoil is replaced over the top. The area will then be harrowed with standard agricultural spring-tine harrows or a power harrow, to loosen the topsoil and level the area. The area can then be sown to grass.

Inserts 16 and 17: Harrows and Power Harrows

5.9 Horticultural-scale equipment is available that could run between the strings of PV panels if necessary.

6 ACCESS TRACKS AND FIXED EQUIPMENT

<u>The Areas</u>

6.1 The access tracks, infrastructure of solar panels are located as shown on the Plan in **Appendix E**.

<u>Construction Methodology</u>

6.2 The access tracks are created by stripping off some or all of the topsoil and then adding an aggregate-based surface. Usually, the aggregate will be placed onto a permeable membrane, which allows water penetration but which prevents the aggregate from mixing with the topsoils or upper subsoils.

6.3 The topsoil will be stored in mounds normally up to 3m high, as described below. A typical mound is shown below, with a maximum height limit to ensure that soils in the centre remain aerobic. The topsoil will be stored in the centre of the site next to the Energy Storage Compound.

Insert 18: Typical Soil Bund (Manor Farm Soil, Llanvapley)

6.4 This soil is therefore kept in a suitable condition for reinstatement once the access track has been removed at the end of the development, as described below. Extracts from the Defra Construction Code of Practice are set out in **Appendix D**.

6.5 The small areas of fixed equipment normally stand on concrete shoes. As these areas will be restored in the future, the construction is carried out as follows:

(i) topsoil to c 10-15cm is removed. This will be stored in a bund no more than 2m high at an agreed location, for use in future restoration;

(ii) the base of stone is then added, and forming put around before concrete is poured to create the pad;
(iii) the equipment is then placed on top;
(iv) further security fencing is added once the cabling and connections are complete.

6.6 There may be alternative fixings in some locations, for example where legs are pile driven. They will create no greater damage, and may be possible without the need to move soils.

6.7 The inverters and other heavy equipment is delivered to the Order Limits and taken to the concrete pad areas by suitable agricultural equipment or along the access tracks.

Soil Management

6.8 Soil should be stripped in layers when the soil is sufficiently dry and does not smear. This is a judgement that is easily made. If the soils can be rolled into a sausage shape in the hand which is not crumbly, or if rubbing a thumb across the surface causes a smudged smooth surface (a smear), the soil is too wet to strip or move. Topsoil depths vary but a stripping depth of 30cm will be a suitable maximum depth for topsoil in most cases, although rarely will it need to be stripped to such a depth.

6.9 Soil stripping should be carried out in accordance with Defra "Construction Code of Practice for the Sustainable Use of Soils on Construction Sites" (Defra, 2009).

6.10 The removed soil should be stored in bunds in accordance with the Construction Code of Practice. The detailed SMP will need to identify the location for a number of central storage areas, or more numerous smaller bunds. Bund heights of circa 3 metres maximum will normally be suitable.

6.11 In the unlikely event that excavation below topsoil depth is required, then subsoils should be stored in separate bunds to topsoils.

6.12 These areas need to be managed at least annually to prevent the growth of woody vegetation, such as brambles or shrubs.

6.13 At the decommissioning stage, it will also be important to move the soil when it is in a suitable condition. To allow time for the bund to dry out after the winter, moving the bund should not occur before the beginning of May.

6.14 The concrete bases will need to be broken up. This will most likely involve breaking with a pneumatic drill or back-actor bucket to crack the base, after which it can be dug up and loaded onto trailers and removed.

6.15 The ground beneath the base may then benefit from being subsoiled, to break any compaction. This can be done by standard tractor-mounted equipment, such as the following examples.

Inserts 19 and 20: Tractor Mounted Equipment

6.16 About 4 weeks before restoration takes place the bunds should be strimmed and any grass and weed growth removed, and the remaining vegetation should be killed with a weedkiller. This will aid restoration and prevent weed spread.

6.17 The soil can then be spread over the subsoiled base and made good with standard spring-tine harrow or power harrow machinery.

7 SOLAR ARRAYS

The Areas

7.1 The PV Arrays will be distributed across the Solar PV Site as shown on the Plan in **Appendix E**.

Construction Methodology

7.2 The process involves the following stages:

(i) marking-out and laying out of the framework. For this a vehicle needs to drive across the field possibly with a trailer, from which the legs are off-loaded by hand, or by use of a Bobcat such as that shown below delivering legs;

Insert 21: Bobcat Delivering Legs

(ii) pile driving in the legs. This involves a pile driver, knocking the legs down to a depth up to 3m. The machinery is shown below;

Inserts 22 – 24: Pile Driving in the Legs

(iii) the frame is then constructed. The frame is brought onsite, bolted together, and the panels bolted on, as per the series of photographs below.

Inserts 25 - 27: Constructing the Frame

7.3 For much of the year this stage of the installation should create no soil structural damage, as shown below.

Inserts 28 and 29: Ground After Construction

Soil Management

7.4 Installation of panels should take place so far as possible when soil conditions are suitable (i.e. the soil is not so wet that vehicles cause tyre marks, such as shown below, deeper than about 10cm when travelling across the land).

Insert 30: Track Marks

7.5 In most years work access to the land is not restricted between mid to late March and mid-December. Between those periods the ground conditions will normally be resilient to vehicle trafficking.

7.6 Between mid-December and mid to late March the soils are more likely to be saturated and the propensity to being damaged, albeit in a way capable of rectification, is greatest. As a general rule, the eastern and western parts of the Energy Park site are the areas least susceptible to damage from being driven over during this mid-winter period.

7.7 If ground conditions are suitable legs can be installed in winter, as the following photograph shows (this is a site near Retford following heavy rain, photographed January 2023). *Insert 31: Legs Being Installed January 2023*

7.8 Occasionally in this country we experience prolonged rainfall in the summer months that saturate soils. If following a rainfall incident installation is causing rutting deeper than 10cm, activity should ideally stop to allow soils to dry. The delay can only be judged on an individual basis, because there are so many variables.

7.9 It is very unlikely that trafficking during construction when soils are relatively dry will result in compaction sufficient to require amelioration. However, if rutting has resulted the soil should be levelled by standard agricultural cultivation equipment such as tine harrows, once the conditions suit, and prior to seeding. This can be done with standard agricultural machinery, or with small horticultural-grade machinery such as is shown below.

Inserts 32 and 33: Horticultural Machinery

7.10 The objective is to get the surface to a level tilth for seeding/reseeding as necessary, as was shown earlier and is shown below.

Inserts 34 and 35: Inter-row Ground Restoration

7.11 Grass growth will then recover or establish rapidly.

7.12 If for operational reasons trafficking of soils does cause surface damage, that can be restored. It is also unlikely to result in any structural damage long term. The apparent soil damage shown in Insert 34 above, with a wider view below, is shown in the subsequent photo from seven years later. We have reviewed the soils and there has been no long-term soil damage or ALC downgrading.

Inserts 36 and 37: Winter Installation (2015) and Operational Site (2022)

7.13 Where there is surface damage at this level, there may be a need for harrowing or shallow subsoiling to be carried out the following spring, prior to surface cultivation and seeding.

8 INSTALLATION OF ON-SITE TRENCHING

<u>The Areas</u>

8.1 This section refers to the cabling running within the Energy Park, including the Low Voltage Distribution Cables.

<u>Construction Methodology</u>

8.2 Cabling is done mostly with either a mini digger or a trenching machine. Trenches are typically at depths of up to 1.2m where soil depth permits, although the CCTV trenching around the periphery could be shallower. An example trench, with the topsoil, placed on one side (0-20/25cm) and subsoil on the other (below 20-25cm), is shown below, and with the soil put back after cable installation.

Inserts 38 and 39: Cable Installation

8.3 The type of machinery used for trenching is shown below, taken from the BRE National Solar Centre "Agricultural Good Practice Guidance for Solar Farms" (2013) (this is reproduced as **Appendix C**).

Insert 40: Machinery Used

Cable trenching, showing topsoil stripped and set to one side, with subsoil placed on the other side ready for reinstatement (photo courtesv of British Solar Renewables)

8.4 The trenches are narrow (a maximum of 1m), and in most cases, it is not considered likely that any grass seed will be needed. The grass in the topsoil will recover rapidly as the following photograph, taken 4 weeks after the trenches were back-filled, shows.

Insert 41: Grass After 4 Weeks

(These photos were taken on heavy, clay soils with poorly draining subsoil, and the work was photographed in July and August 2015.)

Soil Management

8.5 All trenching work will be carried out when the topsoil is dry and not plastic (i.e. it can be moulded into shapes in the hand).

8.6 The top 30cm will be dug off and placed on one side of the trench, for subsequent restoration. There is no need to strip the grass first.

8.7 The subsoils will then be dug out and placed on the other side of the trench, as per the example below.

Insert 42: Subsoils Dug out of the Trench

8.8 Once the cable has been laid, the subsoils will be placed back in the trench. Where there is a clear colour difference within the subsoils, so far as practicable the lower subsoil will be put back first and the upper subsoil above that, which is likely to happen anyway as the lower soil is at the top of the pile.

8.9 The subsoils if dry and blocky may be pressed down by the bucket to speed settlement.

8.10 The topsoil will then be returned onto the top of the trench. It is possible that the topsoil will sit 5-10cm higher than the surrounding level initially. This should be left to allow it to settle naturally as the soils become wetter.

8.11 If there is a surplus of topsoil this may be because the lower subsoils were dry and blocky and there are considerable gaps in the soil. These will naturally restore once the lower soils become wet again. If the trench backfilling will result in the soil being more than 5-10cm proud of surrounding levels, which is unlikely but possible, the topsoil should not be piled higher. It should be left to the side, and the digger would return once the trench has settled and add the rest of the topsoil onto the trench at that point.

8.12 Any excess topsoil should not be piled higher than 5 – 10cm above ground level.

8.13 If considered appropriate, a suitable grass seed mix could be spread by hand over any parts of the trenches that would seem likely to benefit from extra grass.

9 SITE FENCING

<u>The Areas</u>

9.1 Fence designs can vary, but they all involve a post being inserted into the ground. Pole mounted internal facing closed circuit television (CCTV) systems installed at a height of up to 3.5m are also likely to be deployed around the perimeter of the operational areas. Access gates will be of similar construction and height as the perimeter fencing.

<u>Construction Methodology</u>

9.2 The site fencing is likely to be metal mesh or deer fencing. This can be erected at any time, if soil conditions allow. The following photographs show fencing installed early in the process.

Inserts 43 and 44: The Fencing

9.3 Similarly CCTV poles are inserted in the same way.

Inserts 45 and 46: CCTV Poles and Fencing

Soil Management

9.4 If the movement of vehicles is not causing significant rutting (i.e. more than 10cm), then fencing could be erected outside of the key working period.

9.5 Any rutting that results from fencing can be made good with standard agricultural equipment.

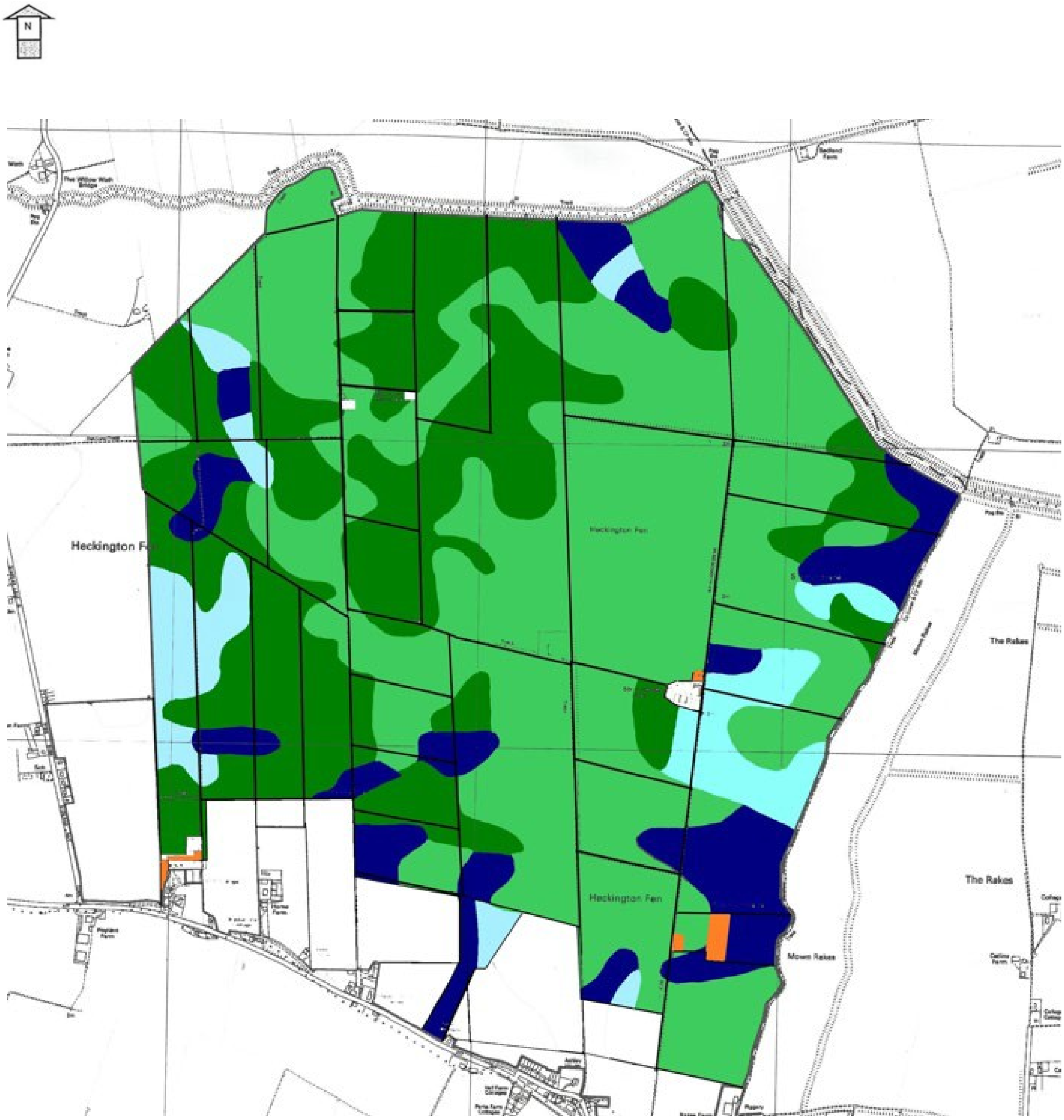
10 MONITORING AND AFTERCARE

10.1 The grassland under the PV panels will be managed by sheep grazing. Areas of grassland not grazed will be managed in line with the LEMP and CEMP, as secured by DCO requirement.

10.2 There is no requirement for annual monitoring or reviews of aftercare in respect of soil management.

Appendix A

Plan KCC3076/07



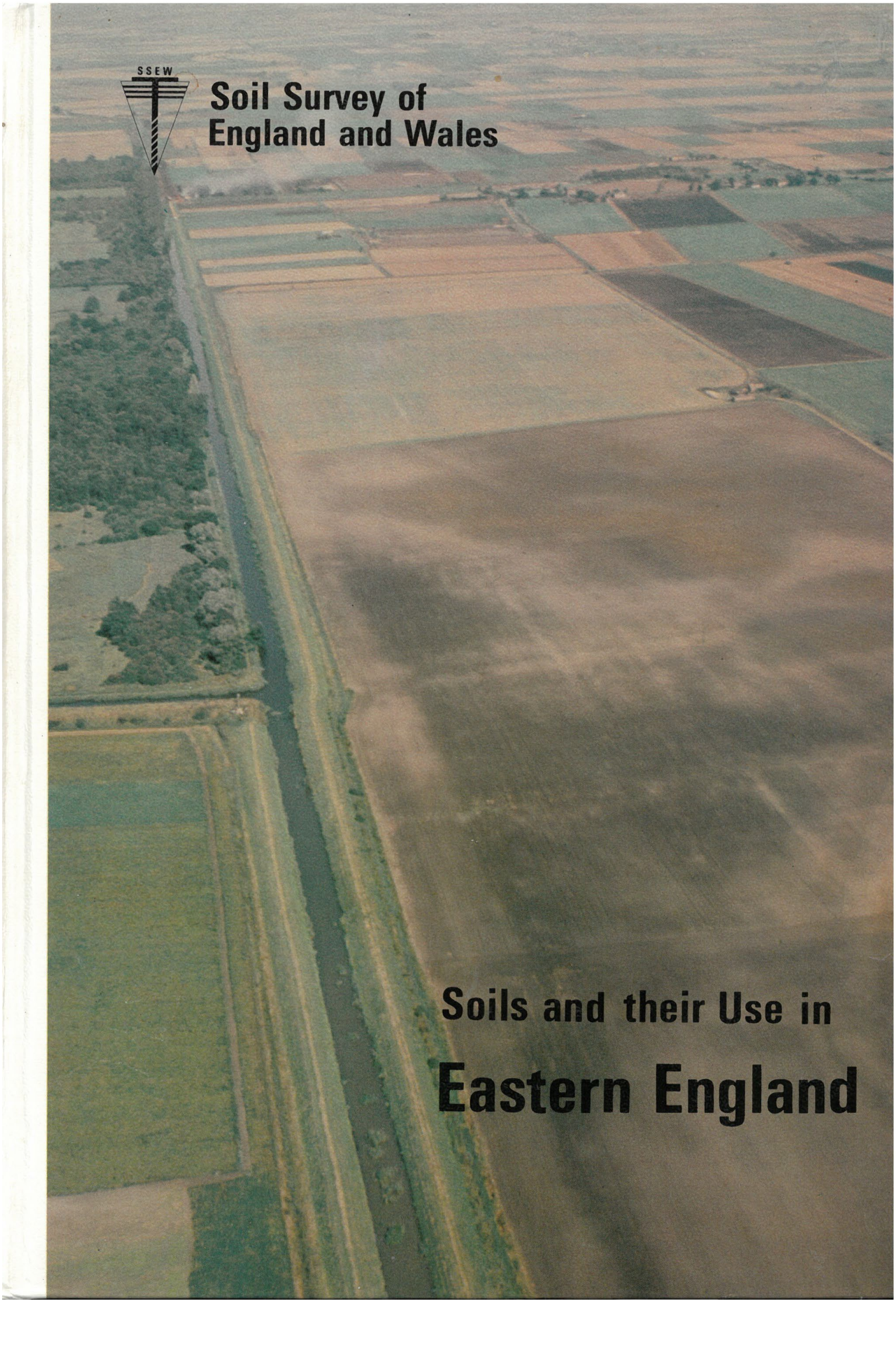
KEY		Ha	%
	Grade 1	58	11.1
	Grade 2	39	7.4
	Grade 3a	160	30.5
	Grade 3b	265	50.6
	Grade 4		
	Grade 5		
	Non-agricultural	2	0.4
	Urban		
	Not surveyed		

PLAN	**KCC3076/07**		
TITLE	Agricultural Land Classification		
SITE	Heckington Fen		
CLIENT	Ecotricity Group		
NUMBER	**KCC3076/07 01/23hr**		
DATE	January 2023	**SCALE**	NTS

KERNON COUNTRYSIDE CONSULTANTS LTD
GREENACRES BARN, PURTON STOKE, SWINDON, WILTSHIRE, SN5 4LL
Tel 01793 771 333 Email: info@kernon.co.uk

Appendix B

Description of Soil Types


SSEW
Soil Survey of
England and Wales
Soils and their Use in
Eastern England

and if sequentially direct drilled the soils benefit from being loosened periodically. Shallow cultivations and minimum tillage techniques are commonplace. Some land is affected by salinity which, followed by leaching, has led to clay deflocculation, and the stopping of drains by dispersed clay, eventually causing patchy waterlogging and crop failure on arable land. Grassland productivity is limited by summer drought but, because of the poaching risk, grazing by cattle is restricted to the summer months. Occasional liming is needed, but manganese deficiency can occur in over-limed spots. The soils contain little phosphorus but reserves of potassium and magnesium are large.

§ 133. WALLASEA 2 ASSOCIATION
813g

This association is extensive on reclaimed marine alluvium in the marshlands of Lincolnshire (Fig.45), Cambridgeshire and Norfolk, and is also present in Romney Marsh, the Essex marshes and in Holderness. The land is generally level but there are occasional ridges on the sites of former creeks. The soils are mainly Wallasea series, pelo-alluvial gley soils; Newchurch series, pelo-calcareous alluvial gley soils; Blacktoft series, gleyic brown calcareous soils; and Wisbech series, calcareous alluvial gley soils. Wallasea and Newchurch soils are clayey with a greyish brown topsoil over greyish or grey and ochreous mottled subsurface horizons; Newchurch series is calcareous. Blacktoft soils are calcareous and fine silty with grey colours and mottling in the subsoil. Wisbech soils are also calcareous, but have greyish and mottled coarse silty horizons below the plough layer, often with sedimentary laminations. Wallasea series predominates and Newchurch, Blacktoft and Wisbech soils are common. Dymchurch (Clayden and Hollis 1984), Snargate (§ 114), Agney, (§ 104) Stockwith (§ 46), Tanvats (§ 114) and Paglesham (Sturdy 1976) series also occur. Brief descriptions of the principal soils are given elsewhere in the text. Wallasea series in § 125, Newchurch series in § 28, Blacktoft series in § 28 and Wisbech series in § 104.

Wallasea soils consistently constitute over half of the association, but the proportion of other soils varies widely throughout the country. Generally, Wisbech and Blacktoft series are found on or near former creeks (rodhams), with Wallasea and Newchurch soils in the intervening areas. The incidence of creek ridges, and so the proportion of coarser soils, increases seawards where Blacktoft soils cover a third of the land, except in Lincolnshire where the similar Agney series is more common. The proportion of the less common Wisbech soils also increases seawards. Inland towards high ground, clayey soils are predominant, Wallasea soils being most common in Lincolnshire and Cambridgeshire, but in Norfolk, Newchurch and Wallasea soils are co-dominant. In places in Lincolnshire, Wallasea soils have developed from former Downholland soils (§ 48) from which topsoil organic matter has been lost by oxidation. Wisbech soils are rare in north Lincolnshire and non-calcareous soils, including Pepperthorpe (§ 125) and Tanvats series, become more common. Near Huttoft, where islands of Devensian till rise through the alluvium, some Holderness soils (§ 75) are included. Creek ridges are uncommon in Essex and Wisbech soils are rare. Calcareous fine silty Agney soils cover one sixth of the land and non-calcareous Tanvats and Paglesham soils also occur. Locally there are a few saline soils and, where leaching has occurred, subsoil structure has deteriorated causing silting of drains, waterlogging and reduced crop yields.

Key to component soil series

	Subsoils non-calcareous above 40 cm	1
	Subsoils calcareous above 40 cm	2
1.	Clayey	WALLASEA
	Fine silty	Tanvats
	Fine loamy over clayey	Paglesham
	Fine silty over clayey	Pepperthorpe
2.	Silty throughout	3
	With clayey horizons	5
3.	Coarse silty	WISBECH
	Fine silty	4
4.	Subsoil faintly mottled above 60 cm or distinctly mottled between 40 and 80 cm	BLACKTOFT
	Prominently mottled or greyish above 40 cm	Agney
5.	Clayey throughout	NEWCHURCH
	Silty over clayey	Stockwith

Soil water regime

Most of the land is pump-drained and the more permeable Blacktoft and Wisbech soils are well drained (Wetness Class I). Wallasea and Newchurch soils are less permeable but respond to underdrainage; drained soils are occasionally waterlogged (Wetness Class II) but undrained soils are waterlogged for long periods in winter (Wetness Class III or IV). Droughtiness assessments for selected crops are given in Table 38. Droughtiness slightly restricts the growth of arable crops in Wallasea and Newchurch soils. Wisbech soils have large available water reserves and are non-droughty whilst Blacktoft soils are intermediate in droughtiness. Grassland suffers from drought on all soils in south Lincolnshire, Norfolk and Essex but growth is less restricted in the higher rainfall area of north Lincolnshire.

Cultivation and cropping

The effects of soil and climate on the time available for landwork is shown in Figure 71. With adequate underdrainage, Wallasea and Newchurch soils are moderately easy to work. There are adequate days for safe cultivation in autumn and spring, but in north

Lincolnshire the moist climate reduces the opportunity for spring cultivation, particularly in wet years, and the soils are marginal for spring-sown crops. The land is generally used for winter cereals and ley grassland, but sugar beet, peas and field brassicas are grown in the drier districts. The use of heavy machinery often causes topsoil compaction and surface wetness on the heavier soils especially Wallasea series though they can be direct drilled very successfully if subsoiled periodically. Newchurch soils which are calcareous have a more stable structure. Wisbech and Blacktoft soils are less suitable for direct drilling because of the problems associated with this system on silty soils.

Table 38
Profile Available Water (A.P. mm), Crop-adjusted Mean Moisture Deficit (M.D. mm) and Droughtiness Class for extensive crops–Wallasea 2 Association

Location Grid Ref.	**Wallasea series** Holbeach St Johns TF350180	**Newchurch series** Holbeach St Johns TF350180	**Blacktoft series** Holbeach St Johns TF350180	**Wisbech series** Holbeach St Johns TF350180
Winter wheat				
A.P.	160	150	190	270
M.D.	126	126	126	126
Droughtiness	slightly droughty	slightly droughty	non-droughty	non-droughty
Spring barley				
A.P.	160	150	190	270
M.D.	119	119	119	119
Droughtiness	slightly droughty	slightly droughty	non-droughty	non-droughty
Potatoes				
A.P.	115	115	140	200
M.D.	127	127	127	127
Droughtiness	moderately droughty	moderately droughty	slightly droughty	non-droughty
Sugar beet				
A.P.	195	180	235	335
M.D.	127	127	127	127
Droughtiness	non-droughty	non-droughty	non-droughty	non-droughty
Oilseed rape				
A.P.	160	150	190	270
M.D.	109	109	109	109
Droughtiness	non-droughty	slightly droughty	non-droughty	non-droughty

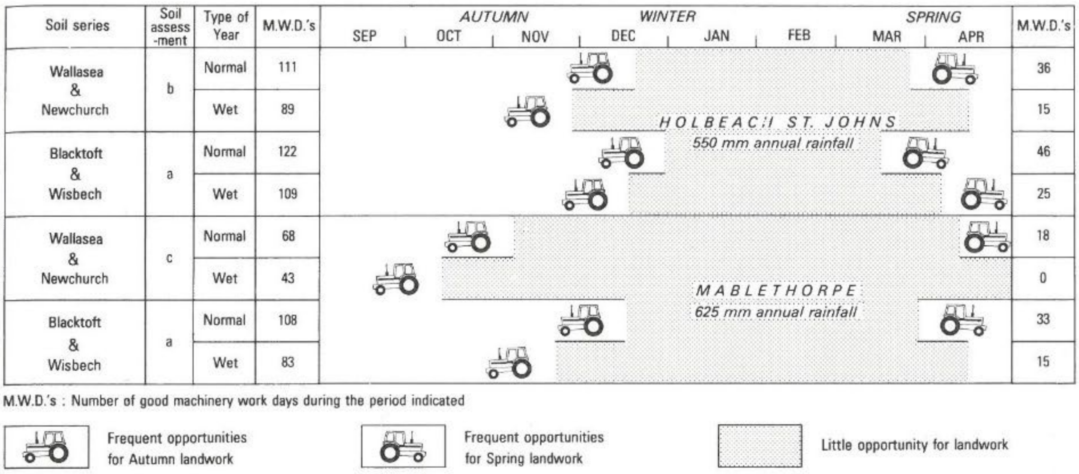


Figure 71. The effects of soil and climate on landwork, Wallasea 2 association

§ 134. WANTAGE 1 ASSOCIATION (342c)

This association consists of greyish, well drained silty soils on the Lower Chalk mainly in south Oxfordshire, north Wiltshire, Kent and Buckinghamshire. In Bedfordshire, Hertfordshire, and Cambridgeshire the association occurs in small patches. North of Luton it forms a narrow strip of gently sloping land at the foot of the chalk escarpment. Near Luton the soils form the side of a ridge and the association continues sporadically to the south-west, fronting the Chiltern Hills (Avery 1964). The principal soil is Wantage series (§ 135), loamy grey rendzinas with an extremely calcareous silty clay loam subsoil and chalk at moderate depth. The land is affected locally by springs and winterbournes so Burwell (§ 113) soils are found on valley floors and on gentle slopes. Shallow Upton soils, grey rendzinas, are confined to convex valley sides below the main Chalk scarp.

The soils of the association are predominantly well drained (Wetness Class I), but there are patches of less permeable Burwell soils on some valley floors and flat valley sides which when field drainage is effected are largely well drained (Wetness Class I).

The main crops are cereals, grown continuously or in rotation. Yields of winter wheat are consistently high and those of spring barley about average. The soils are easy to work and any surface capping usually breaks up as the soil dries. There is adequate time for autumn and spring landwork. There is little risk of poaching in grassland but there is some drought limitation on the shallowest soils. The association is fully described by Jarvis, M.G. *et al.* (1984).

Appendix C

Agricultural Good Practice Guidance for Solar Farms (2013)

bre

www.bre.co.uk/nsc

Agricultural Good Practice Guidance for Solar Farms

NFU

EUROPEAN UNION
Investing in Your Future

European Regional Development Fund 2007-2013

BRE NATIONAL SOLAR CENTRE

Principal Author and Editor Dr Jonathan Scurlock, National Farmers Union

This document should be cited as: BRE (2014) Agricultural Good Practice Guidance for Solar Farms. Ed J Scurlock

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With thanks to:

Marcus Dixon and Neil Macdonald of British Solar Renewables; Liza Gray of Lightsource; Julie Rankin and Amy Thorley of Lark Energy; Kate Covill of Orta Solar; Ben Cosh of TGC Renewables; Ben Thompson of Foresight Group; Simon Stonehouse of Natural England; Leonie Greene of the Solar Trade Association; and Tom Fullick, Gary Ford and Richard Wordsworth of the NFU.

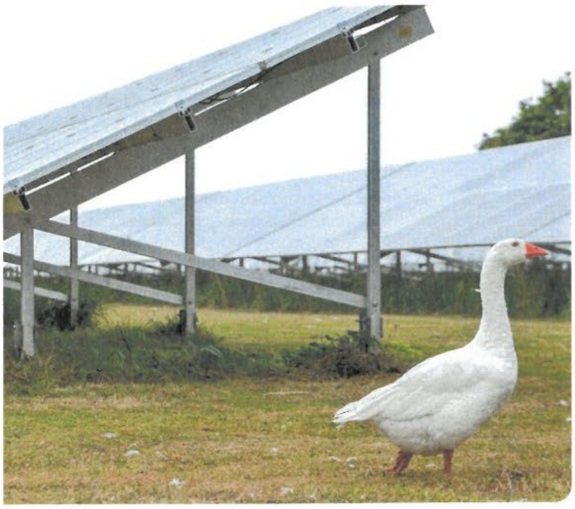
With thanks to NSC Founding Partners:

Context

This document describes experience and principles of good practice to date for the management of small livestock in solar farms established on agricultural land, derelict/marginal land and previously-developed land.

Proposed for publication as an appendix to existing best practice guidelines by the BRE National Solar Centre[1], it should be read in conjunction with BRE (2014) Biodiversity Guidance for Solar Developments (eds. G.E. Parker and L. Greene).

The guidance presented here has been developed with, and endorsed by, a number of leading UK solar farm developers and organisations concerned with agriculture and land management.



Introduction

Field-scale arrays of ground-mounted PV modules, or "solar farms", are a relatively recent development, seen in Britain only since 2011, although they have been deployed in Germany and other European countries since around 2005. In accordance with the "10 Commitments" of good practice established by the Solar Trade Association[2], the majority of solar farm developers actively encourage multi-purpose land use, through continued agricultural activity or agri-environmental measures that support biodiversity, yielding both economic and ecological benefits.

It is commonly proposed in planning applications for solar farms that the land between and underneath the rows of PV modules should be available for grazing of small livestock. Larger farm animals such as horses and cattle are considered unsuitable since they have the weight and strength to dislodge standard mounting systems, while pigs or goats may cause damage to cabling, but sheep and free-ranging poultry have already been successfully employed to manage grassland in solar farms while demonstrating dual-purpose land use.

Opportunities for cutting hay or silage, or strip cropping of high-value vegetables or non-food crops such as lavender, are thought to be fairly limited and would need careful layout with regard to the proposed size of machinery and its required turning space. However, other productive options such as bee-keeping have already been demonstrated. In some cases, solar farms may actually enhance the agricultural value of land, where marginal or previously-developed land (e.g. an old airfield site) has been brought back into more productive grazing management. It is desirable that the terms of a solar farm agreement should include a grazing plan that ensures the continuation of access to the land by the farmer, ideally in a form that that enables the claiming of Basic Payment Scheme agricultural support (see page 2).

[1] BRE (2013) Planning guidance for the development of large scale ground mounted solar PV systems. www.bre.co.uk/nsc

[2] STA "Solar Farms: 10 Commitments" http://www.solar-trade.org.uk/solarFarms.cfm

Conservation grazing for biodiversity

As suggested in the Biodiversity Guidance described above, low intensity grazing can provide a cost-effective way of managing grassland in solar farms while increasing its conservation value, as long as some structural diversity is maintained. A qualified ecologist could assist with the development of a conservation grazing regime that is suited to the site's characteristics and management objectives, for incorporation into the biodiversity management plan.

Avoiding grazing in either the spring or summer will favour early or late flowering species, respectively, allowing the development of nectar and seeds while benefiting invertebrates, ground nesting birds and small mammals. Hardy livestock breeds are better suited to such autumn and winter grazing, when the forage is less nutritious and the principal aim is to prevent vegetation from overshadowing the leading (lower) edges of the PV modules (typically about 800-900mm high). Other habitat enhancements may be confined to non-grazed field margins (if provision is made for electric or temporary fencing) as well as hedgerows and selected field corners.

Agricultural grazing for maximum production

The developer, landowner and/or agricultural tenant/licensee may choose to graze livestock at higher stocking densities throughout the year over much of the solar farm, especially where the previous land use suggested higher yields or pasture quality. Between 4 and 8 sheep/hectare may be achievable (or 2-3 sheep/ha on newly-established pasture), similar to stocking rates on conventional grassland, i.e. between about March and November in the southwest and May to October in North-East England.

The most common practice is likely to be the use of solar farms as part of a grazing plan for fattening/finishing of young hill-bred 'store' lambs for sale to market. Store lambs are those newly-weaned animals that have not yet put on enough weight for slaughter, often sold by hill farmers in the Autumn for finishing in the lowlands. Some hardier breeds of sheep may be able to produce and rear lambs successfully under the shelter of solar farms, but there is little experience of this yet. Pasture management interventions such as 'topping' (mowing) may be required occasionally or in certain areas, in order to avoid grass getting into unsuitable condition for the sheep (e.g. too long, or starting to set seed).

Smaller solar parks can provide a light/shade environment for free-ranging poultry (this is now recognised by the RSPCA Freedom Foods certification scheme) – experience to date suggests there is little risk of roosting birds fouling the modules. Broiler (meat) chickens, laying hens and geese will all keep the grass down, and flocks may need to be rotated to allow recovery of vegetation. Stocking density of up to 2000 birds per hectare is allowed, so a 5 megawatt solar farm on 12 hectares would provide ranging for 24,000 birds.

Solar farm design and layout

In most solar farms, the PV modules are mounted on metal frames anchored by driven or screw piles, causing minimal ground disturbance and occupying less than 1% of the land area. The rest of the infrastructure typically disturbs less than 5% of the ground, and some 25-40% of the ground surface is over-sailed by the modules or panel. Therefore 95% of a field utilised for solar farm development is still accessible for vegetation growth, and can support agricultural activity as well as wildlife, for a lifespan of typically 25 years.

As described above, the layout of rows of modules and the width of field margins should anticipate future maintenance costs, taking into account the size, reach and turning circle of machinery and equipment that might be used for 'topping' (mowing), collecting forage grass, spot-weeding (e.g. of 'injurious' weeds like ragwort and dock) and re-seeding. Again, in anticipation of reverting the field to its original use after 25 years, many agri-environmental measures may be better located around field margins and/or where specifically recommended by local ecologists. All European farmers are obliged to maintain land in "good agricultural and environmental condition" under the Common Agricultural Policy rules of 'cross compliance', so it is important to demonstrate sound stewardship of the land for the lifetime of a solar farm project, from initial design to eventual remediation.

The depth of buried cables, armouring of rising cables, and securing of loose wires on the backs of modules all need to be taken into consideration where agricultural machinery and livestock will be present. Cables need to be buried according to national regulations and local DNO requirements, deep enough to avoid the risk of being disturbed by farming practice – for example, disc harrowing and re-seeding may till the soil to a depth of typically 100-150 mm, or a maximum of 200 mm. British Standard BS 7671 ("Wiring Regulations") describes the principles of appropriate depth for buried cables, cable conduits and cable trench marking. Note also that stony land may present a risk of stone-throw where inappropriate grass management machinery is used (e.g. unguarded cylinder mowers).

Eligibility for CAP support and greening measures

From 2015, under the Common Agricultural Policy, farmers will be applying for the new Basic Payment Scheme (BPS) of area-based farm support funding. It has been proposed that the presence of sheep grazing could be accepted as proof that the land is available for agriculture, and therefore eligible to receive BPS, but final details are still awaited from Defra at the time of writing. Farmers must have the land "at their disposal" in order to claim BPS, and solar farm agreements should be carefully drafted in order to demonstrate this (BPS cannot be claimed if the land is actually rented out). Ineligible land taken up by mountings and hard standing should be deducted from BPS claims, and in the year of construction larger areas may be temporarily ineligible if they are not available for agriculture.

Defra has not yet provided full details on BPS 'greening' measures, but some types of Ecological Focus Areas may be possibly located within solar farms, probably around the margins, including grazed buffer strips and ungrazed fallow land, both sown with wildflowers. Note that where the agreed biodiversity management plan excludes all forms of grazing, the land will become ineligible for BPS, and this may have further implications for the landowner, such as for inheritance tax.

Long-term management, permanent grassland and SSSI designation

Since solar farms are likely to be in place typically for 25 years, the land could pass on to a succeeding generation of farmers or new owners, and the vegetation and habitat within the fenced area is expected to gradually change with time. According to Natural England, there is little additional risk that the flora and fauna would assume such quality and interest that the solar farm might be designated a SSSI (Site of Special Scientific Interest) compared with a similarly-managed open field. However, there could be a possible conflict with planning conditions to return the land to its original use at the end of the project, e.g. if this is specified as 'cropland' rather than more generically as 'for agricultural purposes'. If the pasture within a solar farm were considered to have become a permanent grassland, it may be subject to regulations requiring an Environmental Impact Assessment to restore the original land use, although restoration clauses in the original planning consent may take precedence here. It is proposed that temporary (arable) grassland should be established on the majority of the land area that lies between the rows of modules. This would be managed in 'improved' condition by periodic harrowing and re-seeding (e.g. every 5 years), typically using a combination disc harrow and seed drill.

Other measures to maintain the productivity of grassland, without the need for mechanised cultivations or total reseeding, could include: maintaining optimum soil fertility and pH to encourage productive grass species; seasonally variable stocking rates to prevent over/under-grazing with the aim of preventing grass from seeding and becoming unpalatable. Non-tillage techniques to optimise grass sward content might include the use of a sward/grass harrow and air-seeder to revive tired pastures. When applying soil conditioners (e.g. lime), fertilisers or other products, consideration should be taken to prevent damage to or soiling of the solar modules.

Good practice in construction and neighbourliness

Consideration should also be given to best practice during construction and installation, and ensuring that the future agricultural management of the land (such as a change from arable cropping to lamb production) fits into the local rural economy. Site access should follow strictly the proposed traffic management plan, and careful attention to flood and mud management in accordance with the Flood Risk Assessment (e.g. controlling run-off by disrupting drainage along wheelings), will also ensure that the landowner remains on good terms with his/her neighbours.

Time of year should be taken into account for agricultural and biodiversity operations such as prior seeding of pasture grasses and wildflowers. Contractors should consider avoiding soil compaction and damage to land drains, e.g. by using low ground pressure tyres or tracked vehicles. Likewise, when excavating cable trenches, storing and replacing topsoil and subsoil separately and in the right order is important to avoid long-term unsightly impacts on soil and vegetation structure. Good practice at this stage will yield longer-term benefits in terms of productivity and optimal grazing conditions.

Evidence base and suggested research needs

A number of preliminary studies on the quantity and quality of forage available in solar farms have suggested that overall production is very little different from open grassland under similar conditions. A more comprehensive and independent evidence base could be established through a programme of directed research, e.g. by consultants (such as ADAS) or interested university groups (e.g. Exeter University departments of geography and biosciences), perhaps in association with seed suppliers and other stakeholders. Productivity of grasses could be compared between partial shade beneath the solar modules and unshaded areas between the rows. Alternatively daily live weight gain could be compared between two groups of fattening lambs (both under the same husbandry regime) on similar blocks of land, with and without solar modules present.

Case Steiger Quadtrac used to deliver inverters and other heavy equipment to site under soft ground conditions (photo courtesy of British Solar Renewables)

Cable trenching, showing topsoil stripped and set to one side, with subsoil placed on the other side ready for reinstatement (photo courtesy of British Solar Renewables)

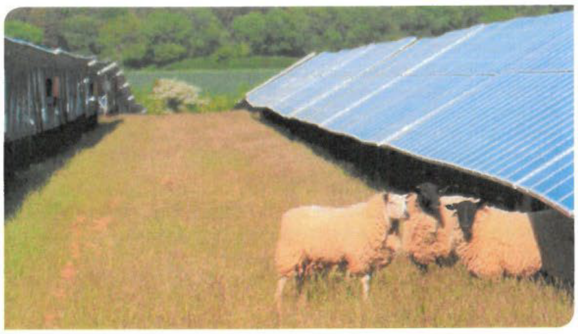
Agricultural case studies

Benbole Farm, Wadebridge, Cornwall

One of the first solar farms developed in Britain in 2011, this 1.74 megawatt installation on a four-hectare site is well screened by high hedges and grazed by a flock of more than 20 geese. A community scheme implemented by the solar farm developers enabled local residents to benefit from free domestic solar panels and other green energy projects.

Higher Hill, Butleigh, Somerset

Angus Macdonald, a third-generation farmer, installed a five megawatt solar farm on his own land. Located near Glastonbury, the site has been grazed by sheep since its inception in 2011.



Eastacombe Farm, Holsworthy, Devon

This farm has been in the Petherick family for four generations, but they were struggling to survive with a small dairy herd. In 2011/12, a solar developer helped them convert eight hectares of the lower-grade part of their land into a 3.6 megawatt solar farm with sheep grazing, which has diversified the business, guaranteeing its future for the next generation of farmers.

Newlands Farm, Axminster, Devon

Devon sheep farmer Gilbert Churchill chose to supplement his agricultural enterprise by leasing 13 hectares of grazing land for a 4.2 megawatt solar PV development, which was completed in early 2013. According to Mr Churchill, the additional income stream is "a lifeline" that "will safeguard the farm's survival for the future".

Trevemper Farm, Newquay, Cornwall

In 2011, the Trewithen Estate worked with a solar developer to build a 1.7 megawatt solar farm on 6 hectares of this south-facing block of land, which had good proximity to a grid connection. During the 25-year lease, the resident tenant farmer is still able to graze the land with sheep at his normal stocking density, and is also paid an annual fee to manage the pasture.

Yeowood Solar Farm, North Somerset

Completed in 2012, this 1.3 megawatt installation on 4 hectares of land surrounds a poultry farm of 24,000 laying hens, which are free to roam the land between and underneath the rows of solar modules, as well as other fields. The Ford family, farm owners, also grow the energy crop miscanthus to heat their eco-friendly public swimming pool and office units.

Wyld Meadow Farm, Bridport, Dorset

Farmers Clive and Jo Sage continue to graze their own-brand Poll Dorset sheep on this 4.8 megawatt solar farm, established on 11 hectares in 2012. The solar farm was designed to have very low visual impact locally, with an agreement to ensure livestock grazing throughout the project's lifetime.

Wymeswold Solar Farm, Leicestershire

The author pictured in July 2014 at Britain's largest connected solar farm. At 33 megawatts, this development provides enough energy to power 8,500 homes. Built on a disused airfield in 2013, this extensive installation over 61 hectares (150 acres) received no objections during planning and is grazed by the landowner's sheep – just visible in the background.

BRE National Solar Centre
Foundation Building, Eden Project,
Bodelva, St Blazey
PL24 2SG

T +44 (0)1726 871830
E nsc@bre.co.uk
www.bre.co.uk/nsc
Twitter @natsolarcentre

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Appendix D
Defra Construction Code of Practice for the Sustainable Use of soils on Construction Sites (extracts only)

www.defra.gov.uk

Construction Code of Practice for the Sustainable Use of Soils on Construction Sites

BIS | Department for Business Innovation & Skills

wrap — Material change for a better environment

defra — Department for Environment Food and Rural Affairs

5.4 Soil stockpiling

Why?

1. Soil often has to be stripped or excavated during the construction process. In order to enable its reuse on site at a later stage, soil needs to be stored in temporary stockpiles to minimise the surface area occupied, and to prevent damage from the weather and other construction activities.

How?

2. The main aim when temporarily storing soil in stockpiles is to maintain soil quality and minimise damage to the soil's physical (structural) condition so that it can be easily reinstated once respread. In addition, stockpiling soil should not cause soil erosion, pollution to watercourses or increase flooding risk to the surrounding area.

3. When soil is stored for longer than a few weeks, the soil in the core of the stockpile becomes anaerobic and certain temporary chemical and biological changes take place. These changes are usually reversed when the soil is respread to normal depths. However, the time it takes for these changes to occur very much depends on the physical condition of the soil.

4. Handling soil to create stockpiles invariably damages the physical condition of the soil to a greater or lesser extent. If stockpiling is done incorrectly the physical condition of the soil can be damaged irreversibly, resulting in a loss of a valuable resource and potentially significant costs to the project. The Soil Resource Survey and Soil Resource Plan should set out any limitations that the soil may possess, with respect to handling, stripping and stockpiling.

5. The size and height of the stockpile will depend on several factors, including the amount of space available, the nature and composition of the soil, the prevailing weather conditions at the time of stripping and any planning conditions associated with the development. Stockpile heights of 3-4m are commonly used for topsoil that can be stripped and stockpiled in a dry state but heights may need to be greater where storage space is limited.

6. Soil moisture and soil consistency (plastic or non-plastic) are major factors when deciding on the size and height of the stockpile, and the method of formation. As a general rule, if the soil is dry (e.g. drier than the plastic limit) when it goes into the stockpile, the vast majority of it should remain dry during storage, and thereby enable dry soil to be excavated and respread at the end of the storage period. Soil in a dry and non-plastic state is less prone to compaction, tends to retain a proportion of its structure, will respread easily and break down into a suitable tilth for landscaping. Any anaerobic soil also usually becomes re-aerated in a matter of days.

7. Soil stockpiled wet or when plastic in consistency is easily compacted by the weight of soil above it and from the machinery handling it. In a compacted state, soil in the core of the stockpile remains wet and anaerobic for the duration of the storage period, is difficult to handle and respread and does not usually break down into a suitable tilth. A period of further drying and cultivation is then required before the soil becomes re-aerated and acceptable for landscaping.

Stockpiling methods

8. There are two principal methods for forming soil stockpiles, based on their soil moisture and consistency.

9. Method 1 should be applied to soil that is in a dry and non-plastic state. The aim is to create a large core of dry soil, and to restrict the amount of water that can get into the stockpile during the storage period. Dry soil that is stored in this manner can remain so for a period of years and it is reuseable within days of respreading.

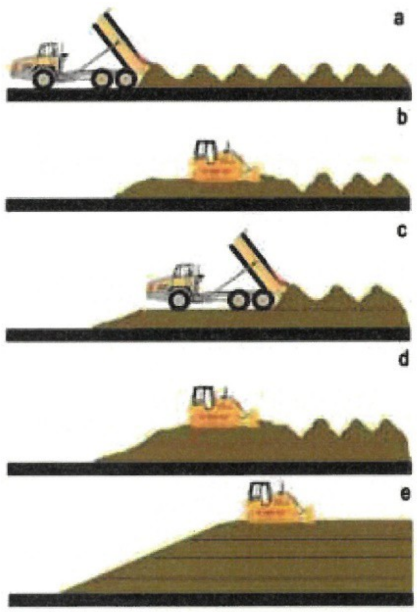
10. Method 2 should be applied if the construction programme or prevailing weather conditions result in soil having to be stockpiled when wet and/or plastic in consistency. This method minimises the amount of compaction, while at the same time maximising the surface area of the stockpile to enable the soil to dry out further. It also allows the soil to be heaped up into a 'Method 1' type stockpile, once it has dried out.

Soil stockpiling

Soil should be stored in an area of the site where it can be left undisturbed and will not interfere with site operations. Ground to be used for storing the topsoil should be cleared of vegetation and any waste arising from the development (e.g. building rubble and fill materials). Topsoil should first be stripped from any land to be used for storing subsoil.

Method 1 – Dry non-plastic soils

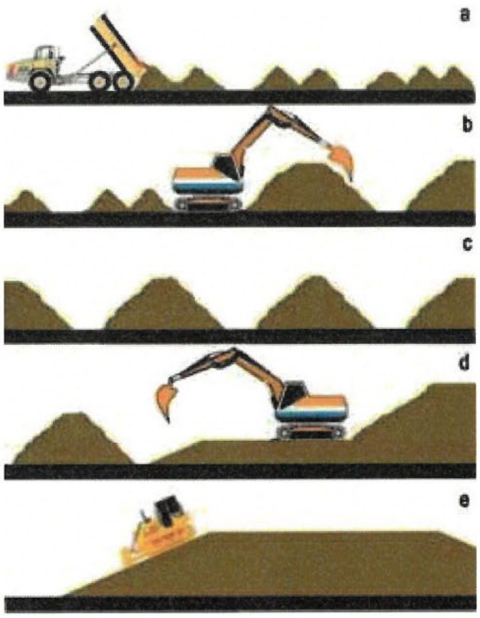
The soil is loose-tipped in heaps from a dump truck (a), starting at the furthest point in the storage area and working back toward the access point. When the entire storage area has been filled with heaps, a tracked machine (excavator or dozer) levels them (b) and firms the surface in order for a second layer of heaps to be tipped. This sequence is repeated (c & d) until the stockpile reaches its planned height. To help shed rainwater and prevent ponding and infiltration a tracked machine compacts and re-grades the sides and top of the stockpile (e) to form a smooth gradient.



Method 2 – Wet plastic soils

The soil is tipped in a line of heaps to form a 'windrow', starting at the furthest point in the storage area and working back toward the access point (a). Any additional windrows are spaced sufficiently apart to allow tracked plant to gain access between them so that the soil can be heaped up to a maximum height of 2m (b).
To avoid compaction, no machinery, even tracked plant, traverses the windrow.

Once the soil has dried out and is non-plastic in consistency (this usually requires several weeks of dry and windy or warm weather), the windrows are combined to form larger stockpiles, using a tracked excavator (d). The surface of the stockpile is then regraded and compacted (e) by a tracked machine (dozer or excavator) to reduce rainwater infiltration.



Stockpile location and stability

11. Stockpiles should not be positioned within the root or crown spread of trees, or adjacent to ditches, watercourses or existing or future excavations. Soil will have a natural angle of repose of up to 40° depending on texture and moisture content but, if stable stockpiles are to be formed, slope angles will normally need to be less than that. For stockpiles that are to be grass seeded and maintained, a maximum side slope of 1 in 2 (25°) is appropriate.

Stockpile protection and maintenance

12. Once the stockpile has been completed the area should be cordoned off with secure fencing to prevent any disturbance or contamination by other construction activities. If the soil is to be stockpiled for more than six months, the surface of the stockpiles should be seeded with a grass/clover mix to minimise soil erosion and to help reduce infestation by nuisance weeds that might spread seed onto adjacent land.

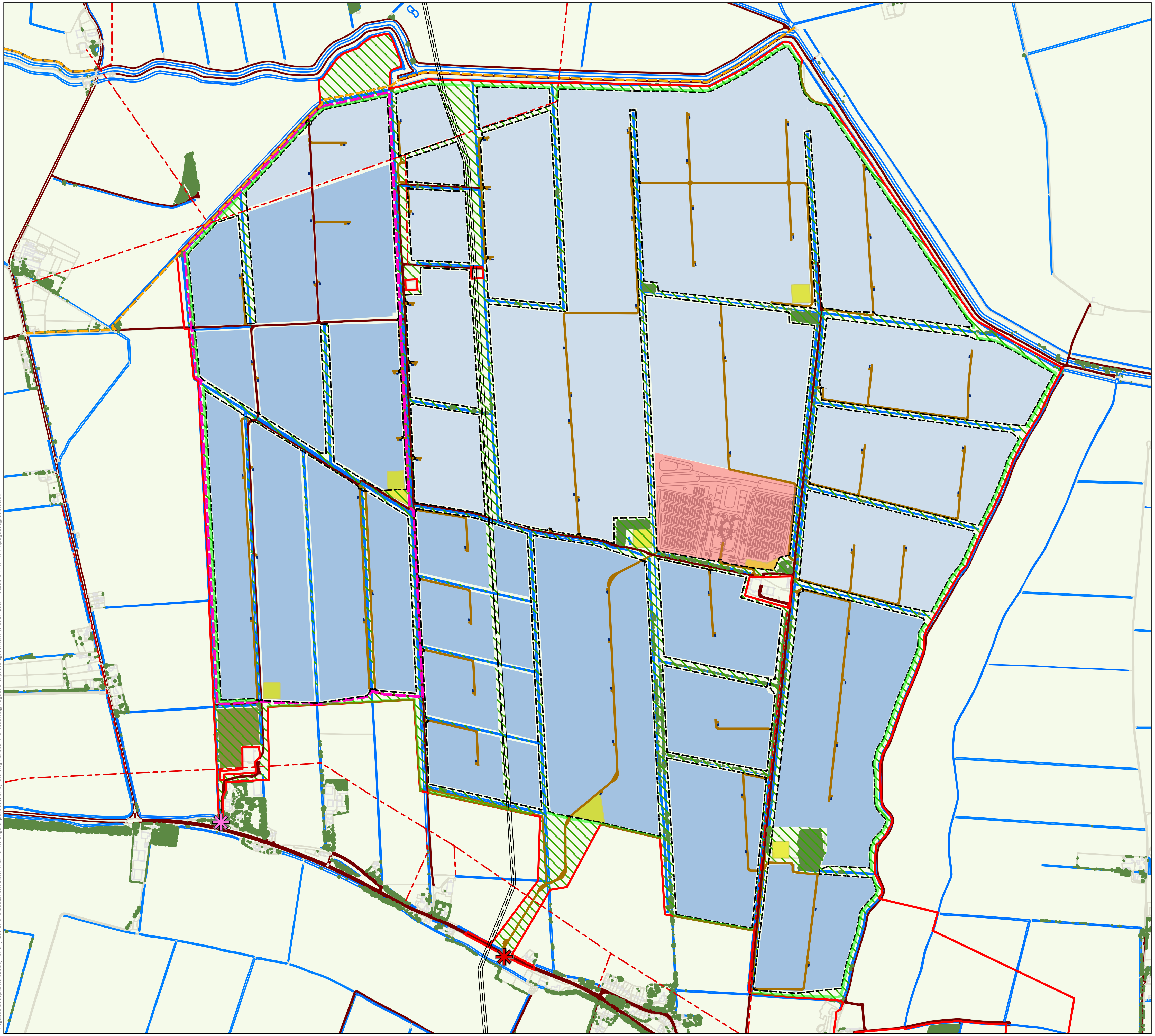
13. Management of weeds that do appear should be undertaken during the summer months, either by spraying to kill them or by mowing or strimming to prevent their seeds being shed.

Clearly defined stockpiling of different soil materials

Long term stockpile of stripped topsoil left with only weed vegetation

Appendix E

Proposed Layout



KEY

- Order Limits
- Security Fence
- Proposed Site Entrance
- Temporary Access
- Existing Road / Track
- Access Tracks
- Solar Park Zone Max Height 3.5m
- Solar Park Zone Max Height 3m
- Public Right of Way
- Proposed Permissive Footpath
- Habitat Enhancement Area
- Existing Vegetation
- Community Orchard
- Water Feature / Ditch
- Culvert
- Gas Pipeline
- 11kV Overhead Lines
- Inverters and Transformation Station
- Site Main Substation / Energy Storage Compound
- Construction and Operational Compounds
- Proposed Hedge

NOTES:
Buffers to development:
- 9m to BSIDB maintained open watercourses
- 8m to all other watercourses
- 12.2m to gas pipeline (total 24.4m easement strip)
- 5m to 11kV overhead line

Hedgerows would be up to 3m in width when mature and would be maintained up to 4m in height.

The Solar Development Area will include some localised electrical infrastructure such as inverters, transformers, energy storage and smaller substations.

DCO Document Reference: 6.2.2
APFP Regulation: 5(2)(a)

FIGURE 2.1 INDICATIVE SITE LAYOUT

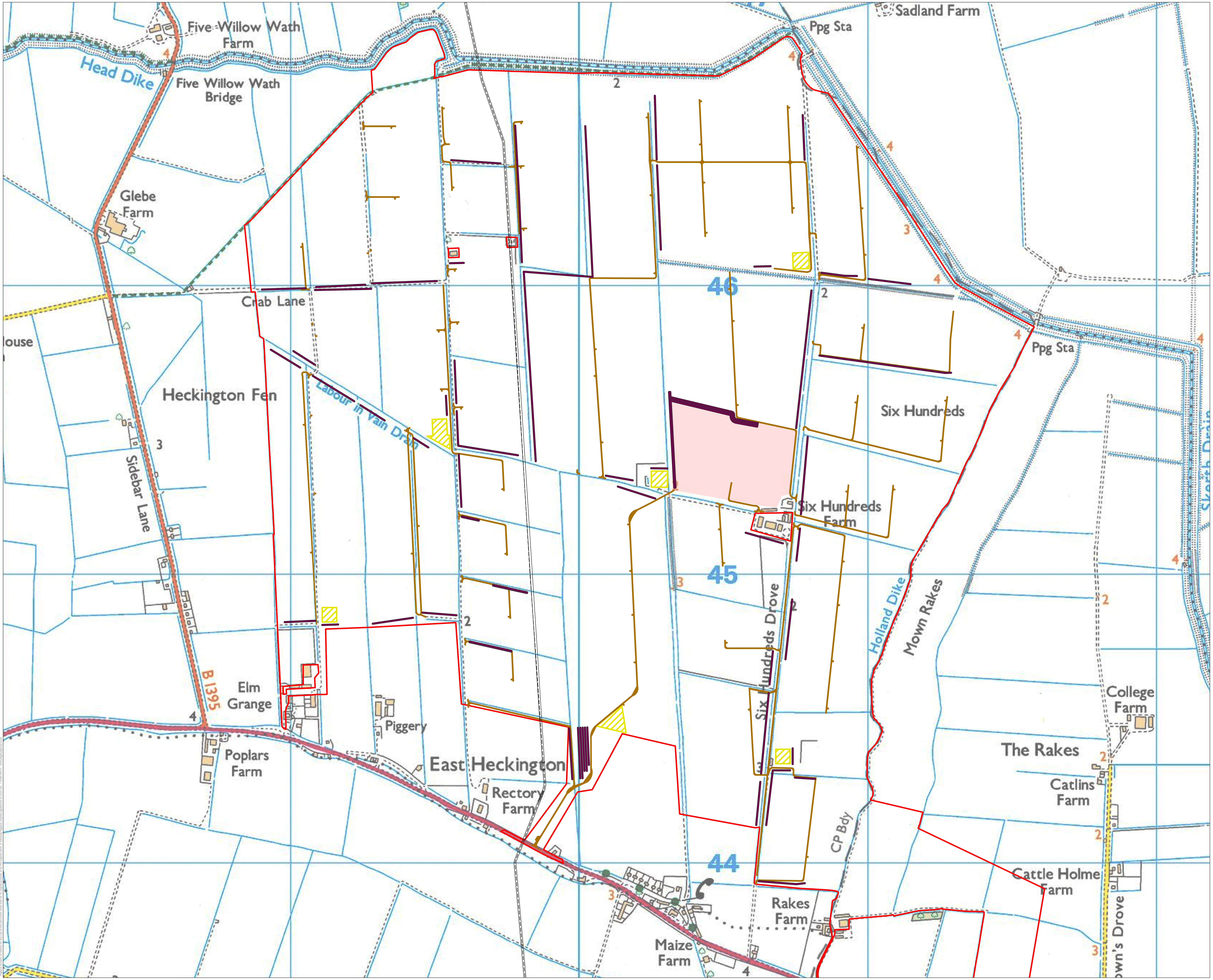
DATE	SCALE	SHEET	REVISION
03/02/2023	1:12,000@A3	-	J

DRAWING NUMBER
P20-2370_03

0 0.5 km

ecotricity

PEGASUS GROUP



KEY

- Order Limits
- Indicative Stockpile Locations - max height 3m
- Indicative Construction Compounds
- Indicative Track Locations
- Site Main Substation / Energy Storage Compound
- Gas Pipeline

NOTES:

REVISIONS:

DCO Document Reference: x.x

APFP Regulation: xxx

Stockpile Locations

DATE	SCALE	SHEET	REVISION
03/11/2023	1:6,000@A1	-	**V1**

DRAWING NUMBER
P20-2370_110

N

0 — 0.25 km

ecotricity

PEGASUS GROUP


Greenacres Barn, Stoke Common Lane, Purton Stoke, Swindon, Wiltshire SN5 4LL
Telephone: 01793 771333 • Email: info@kernon.co.uk • Website: www.kernon.co.uk

Part 2 - Outline Soil Management Plan for the Offsite Grid Route Corridor

HECKINGTON FEN
ENERGY PARK

REVISED
OUTLINE
SOIL MANAGEMENT PLAN
(OFFSITE GRID ROUTE CORRIDOR)

September 2023

KERNON
COUNTRYSIDE
CONSULTANTS
LIMITED

KERNON
COUNTRYSIDE CONSULTANTS LIMITED

HECKINGTON FEN ENERGY PARK

REVISED

OUTLINE SOIL MANAGEMENT PLAN (OFFSITE GRIDROUTE CORRIDOR)

September 2023

Authorised By …………..

Greenacres Barn, Stoke Common Lane, Purton Stoke, Swindon SN5 4LL
T: 01793 771333 Email: info@kernon.co.uk Website: www.kernon.co.uk

*Directors - **Tony Kernon** BSc(Hons), MRAC,, MRICS, FBIAC **Sarah Kernon***
*Consultants – **Ellie Chew** BSc(Hons), **Amy Curtis** BSc(Hons)*

1 INTRODUCTION

Annexes

1 INTRODUCTION

1.1 This document provides an outline of the proposed Soil Management Plan (SMP) for the Heckington Fen Offsite Grid Connection Route Corridor “the Route”.

1.2 The Route will connect from the Heckington Fen Energy Park to the extension at the existing substation on Bicker Fen.

1.3 The Route needs to cross under roads, rivers and a railway, and there are therefore construction areas where deep excavations and boring machinery will be involved.

1.4 There will be a need for some fixed above ground infrastructure along the route. This will be located at field edges, as far as possible, so as not to disrupt the ongoing agricultural use of the land, which will return once installation is complete.

1.5 For much of the route there will be a 25m working corridor with a trench of maximum dimensions 1.5m wide to install a cable.

1.6 This outline of the SMP describes the survey work that will be carried out prior to drafting the SMP, and the consultation process that will be inbuilt prior to finalising the SMP before works commence.

1.7 This outline SMP is structured as follows:

- (i) section 2 describes the route;
- (ii) section 3 sets out the soil resources and characteristics, and the soil survey that will be undertaken;
- (iii) section 4 sets out the proposed consultation process;
- (iii) section 5 sets out key principles;
- (iv) and section 6 sets out the management required.

1.8 This oSMP is submitted as part of the DCO process in advance of detailed field surveys for soils. The significant amount of soil information recorded for the Energy Site, coupled with the recent installation of cables nearby, means that we can be confident that soil management can be carried out in a way that the ALC grading, and soil properties, will not be significantly or long-term adversely affected.

1.9 Accordingly field survey in advance of the DCO approval is not necessary.

2 THE PROPOSED ROUTE

2.1 This outline SMP relates to a route to connect the proposed Energy Park to the existing substation at Bicker Fen.

2.2 A corridor is considered within the Order Limits of this DCO application and has been considered in this outline SMP, but the indicative route is shown below.

Insert 1: Indicative Route

2.3 The survey corridor, and photographs along the Route, are set out in **Annex A**.

2.4 The cable will be buried in a trench. At points the trench will be deep to allow for the cable to be buried under obstacles including the A17, the railway and the South Forty Foot Drain. At these points it is expected that an open cut trench will not be used, instead an alternative cabling solution will be used such as drilling the cable under these existing features.

2.5 In respect of the current use of the farmland along the Route all of it is arable farmland.

3 SOIL RESOURCES AND CHARACTERISTICS

Climatic Conditions

3.1 The climatic data for the area, using the climate data set for ALC, shows annual rainfall between 575 and 590mm across the Energy Park site and the Route.

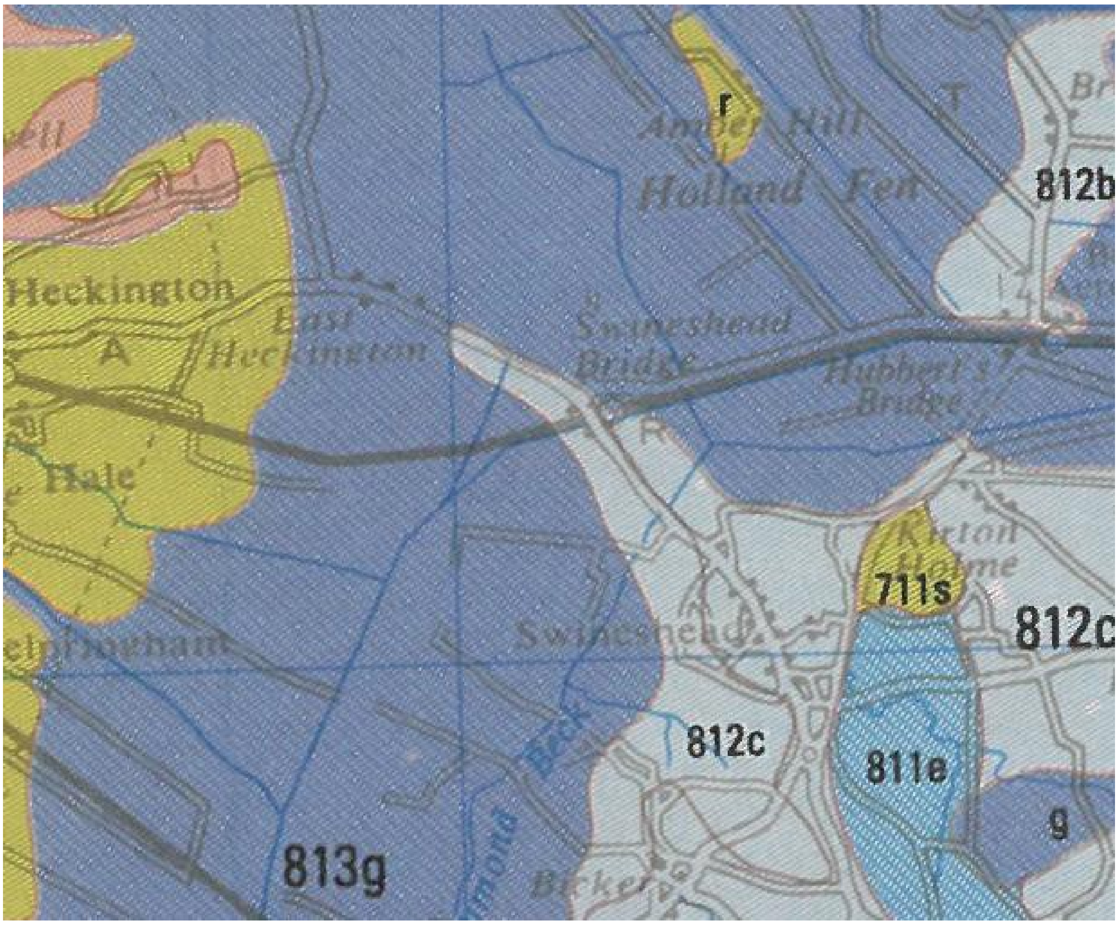
3.2 Soils are at field capacity, i.e. replete with water, for usually 107 days per year, mostly during the period from autumn to early spring. This is the period when soils are most susceptible to damage because they are saturated.

Soil Types

3.3 It is evident from surveys of the Energy Park site that the land quality is very variable, influenced by the historic passage of waterbodies. The aerial photographs in **Annex A** show the variability well.

3.4 The published soil map shows the area is mostly of the 813g Wallasea 2 Association, with a band of 812c Agney Association soils between the A17 and the railway, as shown below.

Insert 2: Published Soil Map Excerpt



Extent and Depth of Topsoil Units and Soil Types

3.5 It is evident from survey over the Energy Park site and nearby, and the available aerial photography, that the soils across the Energy Park site are variable. The Energy Park site is generally flat, and most is covered with soils of the Wallasea 2 Association. These soils are extensive on reclaimed marine alluvium in the marshlands of Lincolnshire. The soils are clayey with a greyish brown topsoil over greyish or grey and ochreous mottled subsurface horizons. The soils respond to drainage and, if undrained, are wet for longer periods in the winter.

3.6 The area of Agney Association are calcareous alluvial gley soils, generally well drained and silty in nature.

3.7 The texture of the Wallasea 2 soil varies from medium silty clay loam through heavy clay loams to silty clay and shows a complex mix of soil textures and drainage status.

3.8 The variability of the soils over short distances could make for variable and therefore challenging conditions. The variability is evident on the aerial photographs in **Annex A**.

3.9 The description of the soils, which are from the Wallasea 2 Association and Agney Association, are provided in **Annex B**, taken from the soil memoire. This identifies the ideal landwork season in a normal year, as follows (see the top row), for Wallasea soils. Agney soils are generally similar.

Insert 3: Landwork Table

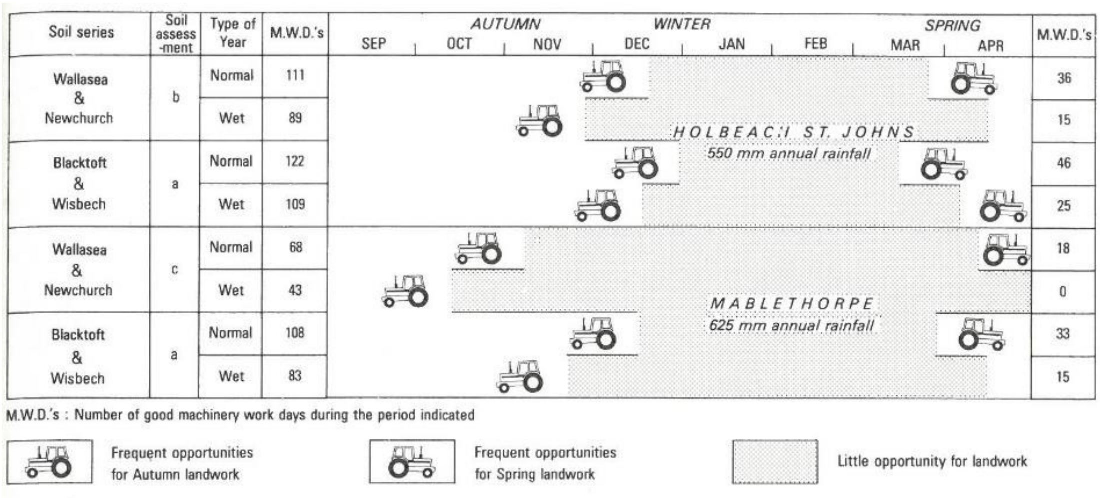


Figure 71. The effects of soil and climate on landwork, Wallasea 2 association

Propensity to Damage

3.10 The Institute of Environmental Management and Assessment (IEMA) have produced a Guide "A New Perspective on Land and Soil in Environmental Impact Assessment" (2022). Table 4 in the guidance identifies that clay and heavy clay loam soils where the Field

Capacity Days (FCD) is less than 150 (as here) have a medium resilience to structural damage.

3.11 The IEMA guide identifies that lighter soils, including medium clay loams, are of medium resilience where the FCD is less than 225. Here, where the FCD is 104 - 111 days, these soils will be at low risk of structural damage. This describes most of the soils along the Route.

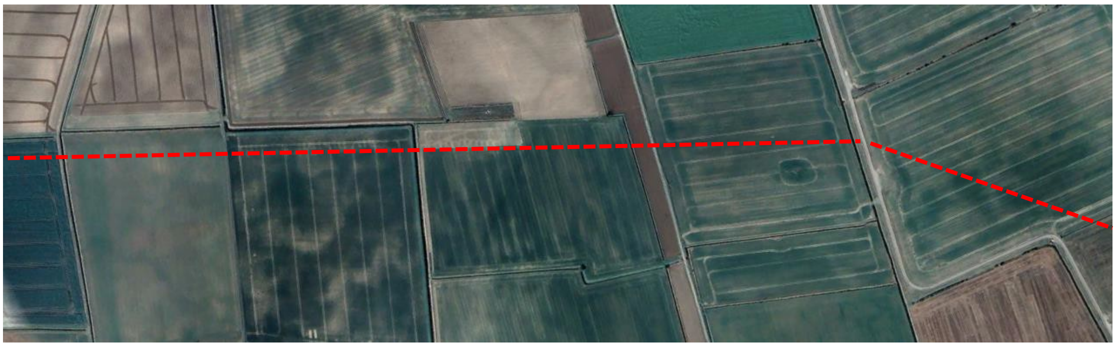
3.12 The pattern of soils and land quality distribution is complex, as shown on the aerial images. However, the soils that will be least prone to compaction if trafficked in the wetter mid-winter months are the lighter soils.

3.13 As cable installation is a linear process, and cannot stop and start easily, the most susceptible soils dictate the methodology for the whole Route.

<u>Proposed Soil Survey</u>

3.14 Based on soil survey of the proposed Heckington Fen Energy Park, it is known that soils can vary over short distances. This reflects the historic action of water, which is evident from a 2022 Google Earth image such as the extract below.

Insert 4: Section of Proposed Route



3.15 Prior to submission of the SMP for consultation, a soil survey will be completed along the line of the proposed cable using a soil auger and, as needed, a spade, sampling where possible down to 1.2m. The soil survey will sample on a regular 100m grid pattern, along the central line of the proposed cable route.

3.16 Where works will extend wider than 50m either side of this sampling route, additional sampling points will be undertaken.

3.17 The survey will identify the soil resource. In particular it will identify and map:

- topsoil type;
- topsoil depth;
- subsoil type and depth;
- any limitations from poor drainage.

3.18 This detailed survey will be written up and will inform the SMP.

4 CONSULTATION PROCESS

4.1 This oSMP sets out the key principles.

4.2 Underpinning a good Soil Management Plan is a detailed knowledge of the soils involved.

4.3 Therefore prior to any works being commenced, it is intended that the draft SMP be submitted for comment from the following organisations:

- Natural England;
- Lincolnshire County Council.

4.4 The SMP will then be amended as necessary, with reconsultation as necessary, and approved prior to works starting.

5 KEY PRINCIPLES

5.1 The installation of the cable requires soils to be disturbed and deep excavations for the trench. There will be deep engineering operations to bore under the drains, road and railway.

5.2 There are numerous buried services in this area, including the Triton Knoll cable. The installation of these services have been achieved successfully, with no evident damage to agricultural land and operations.

5.3 For successful restoration to a farming use, the key is to restore the topsoil and upper subsoil to the same profile, without compaction, as they are before construction commences. Plants will root down to about 1 – 1.2 metres, but the top 60cm is the most important for plant growth. This is usually a topsoil and upper subsoil layer.

5.4 The key principles for successfully avoiding damage to soils are:

- timing of works involving moving soils;
- storing soils;
- retaining soil profiles during restoration;
- avoiding compaction;
- ameliorating compaction.

Timing

5.5 The most important management decision/action to avoid adverse effects on soils is the timing of works involving moving soils. If the construction work takes place when soil conditions are sufficiently dry, then damage from vehicle trafficking, moving and trenching will be minimal.

5.6 The soils are relatively resilient to vehicle passage for much of the year. Under the ALC Guidelines the field capacity period, i.e. the days in the year when soils are saturated, is about 104 - 111 days per year. The soil memoire for the Wallasea 2 Association (**Annex B**) identifies limited opportunities for landwork between mid-December and mid to late March. Similar periods apply to the Agney Association soils.

5.7 The soils are generally resilient, and any damage from vehicle trafficking can generally be made good by mechanical husbandry once the soils start to dry in the spring.

5.8 The period when soils are least likely to be wet is between March and November, but with seasonal variations (the English weather being unpredictable). To the extent that it is feasible, topsoil movement should be targeted for this window. Topsoil stripping could be phased ahead of deeper trenching works.

5.9 It may not be feasible to limit trenching works to these periods. In so far as it is possible, handling of the upper subsoils (30-60cm depth) should also be carried out when the soils are not saturated. They should be stored separately to the topsoils, and if dug out when wet, allowed to dry in bunds of no more than 1 metre in height prior to storage at any greater depth

5.10 Replacement of the upper subsoil and topsoil should be undertaken in reverse order, and so far as is possible carried out when soils are dry, as they will then restore more rapidly and require less restorative mechanical work.

5.11 Guidance on stockpiling is set out in the Construction Code of Practice For the Sustainable Use of Soils on Construction Sites, Defra (2009), an extract from which is at **Annex C**.

5.12 In instances where it is not possible to avoid undertaking construction activities when soils are wet and topsoil damage occurs then soils can be recovered by normal agricultural management, using normal agricultural cultivation equipment (subsoiler, harrows, power harrows etc) once soils have dried adequately for this to take place. There may be localised wet areas in otherwise dry fields, for example, which are difficult to avoid.

Avoiding Compaction

5.13 This oSMP sets out when soils should generally be suitable for being trafficked. There may be periods within this window, however, when periodic rainfall events result in soils becoming liable to damage from being trafficked or worked. In these (likely rare) situations, work involving handling soils (e.g. stripping, replacing) should stop until soils have dried, usually within 48 hours of heavy rain stopping.

Ameliorating Compaction

5.14 If localised compaction occurs during construction, it should be ameliorated. This can normally be achieved with standard agricultural cultivation equipment, such as subsoilers (if required), power harrows and rolls.

Storing Soil and Restoring Soil

5.15 The quantities of soil involved are limited and topsoil mounds would be a maximum of 1m – 2m high. This will not result in the soil becoming anaerobic even in storage in a bund for more than 12 months. Advice on the stockpiling of soils taken from the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2009) is reproduced in **Annex C**. These areas will need to be managed during the life of the Proposed Development to prevent the establishment of woody growth or brambles.

5.16 The following photograph, from January 2023, shows topsoil being stored next to the temporary access track for the Viking Link cable works to the immediate east of the Energy Park.

Insert 5: Temporary Topsoil Storage (January 2023)

5.17 The mound should be kept clear of woody vegetation. It is acceptable to sow the mound with grass seed.

5.18 The mound should not be moved for restoration unless the soil is sufficiently dry. Testing the centre of the mound with a soil auger should take place before the soil is moved.

6 MANAGEMENT REQUIREMENTS

Timing

6.1 The works of soil stripping and trench excavation should be carried out, so far as possible,between March and November.

6.2 The works of trench infilling and soil restoration should be carried out, so far as possible, between March and November.

Avoiding Damage

6.3 Trackways required outside the dry period should be created from laying stone onto matting, such as shown below.

Insert 6: Trackway

Soil Storage

6.4 Topsoils, upper and lower subsoils should be stored in separate bunds.

6.5 Topsoil and subsoil should only be handled when dry. Storage in bunds, such as shown above, will ensure that the soils are kept dry and remain aerobic.

Depth of Soils

6.6 Topsoil should be removed to a depth of 30 – 40cm, which will be clear from the colour during excavation.

6.7 The upper subsoil, a similar depth of 30cm, should be stored separately.

Restoration

6.8 The lower and upper subsoils should be replaced in reverse order, to restore the current profile. Topsoil should then be replaced to the depth removed, and as close as possible to the original position the soil came from.

6.9 The soil will then be cultivated. The photograph below shows part of the Viking Link under restoration.

Insert 7: Part of the Viking Link, Under Restoration

ANNEX A

Survey Notes

Introduction

1 The Route was the subject of a walk-over survey in January 2023. At the request of agents, no digging was permitted. The walk-over took place on Monday 16th January and Tuesday 17th January 2023.

Photographs and Description

2 The area surveyed is shown on the aerial plans below. Only those areas where access had been granted were walked over. Other areas were inspected and photographed without going onto the ground.

3 The area surveyed, and photographs taken, are shown below. This is an approximation of the refined Route, and detailed plans should be studied for a definitive boundary. The Route is divided into sections.

Section 1

4 Section 1 runs from the edge of the Energy Park south to the railway, as shown below.

Insert A: Area Surveyed and Photograph Locations

Position 1: Rought ley grassland, likely due to the Viking Link works to the east

Position 2: Ploughed land east of the Viking Link construction track

Position 3: Cereals. This section of the route has heavier soils and drainage, albeit after high levels of rainfall, is imperfect

Position 4: In plough. There are lighter patches and some variability in the soils, as seen. The soils remain loamy and moderately free draining

In cereals. Loamy field with variability and some low patches

Position 5: Stubble/fallow field, similar to the field to the north

Position 6: Stubble/fallow field, similar to the field to the north

Position 7: In cereal. This field is generally well drained except near the gateway, with friable soils

Position 8: Looking south over cereal field. Aside from the gateway the field was generally dry. These are the Agney Association soils.

Section 2

5 Section 2 runs from the railway south through four arable fields, as shown below.

Insert B: Area Surveyed and Photograph Locations

Position 9: Looking south over cereal field, previously in potatoes

Position 10: Looking north, currently stubble

Position 11: Looking north, over stubble

Position 12: Looking south over cereal and ploughed land

Section 3

6 This covers the four fields shown below. Access was not permitted to the two northern fields at the time of survey, but it was evident that they were in a similar variable soil pattern to surrounding land.

Insert C: Area Surveyed and Photographs Locations

Position 13: Looking north over cereals

Position 14: Looking south over cereals

Position 15: Looking South from North Drove

Section 4

7 Section 4 runs from the field north of Bicker Drove round to the substation connection. The land within the Order Limits within the Bicker Fen substation is owned by National Grid as an operational substation. It is therefore not considered within this oSMP.

Insert D: Area Surveyed and Photograph Locations

Position 16: Looking north from Bicker Drove over cultivated land

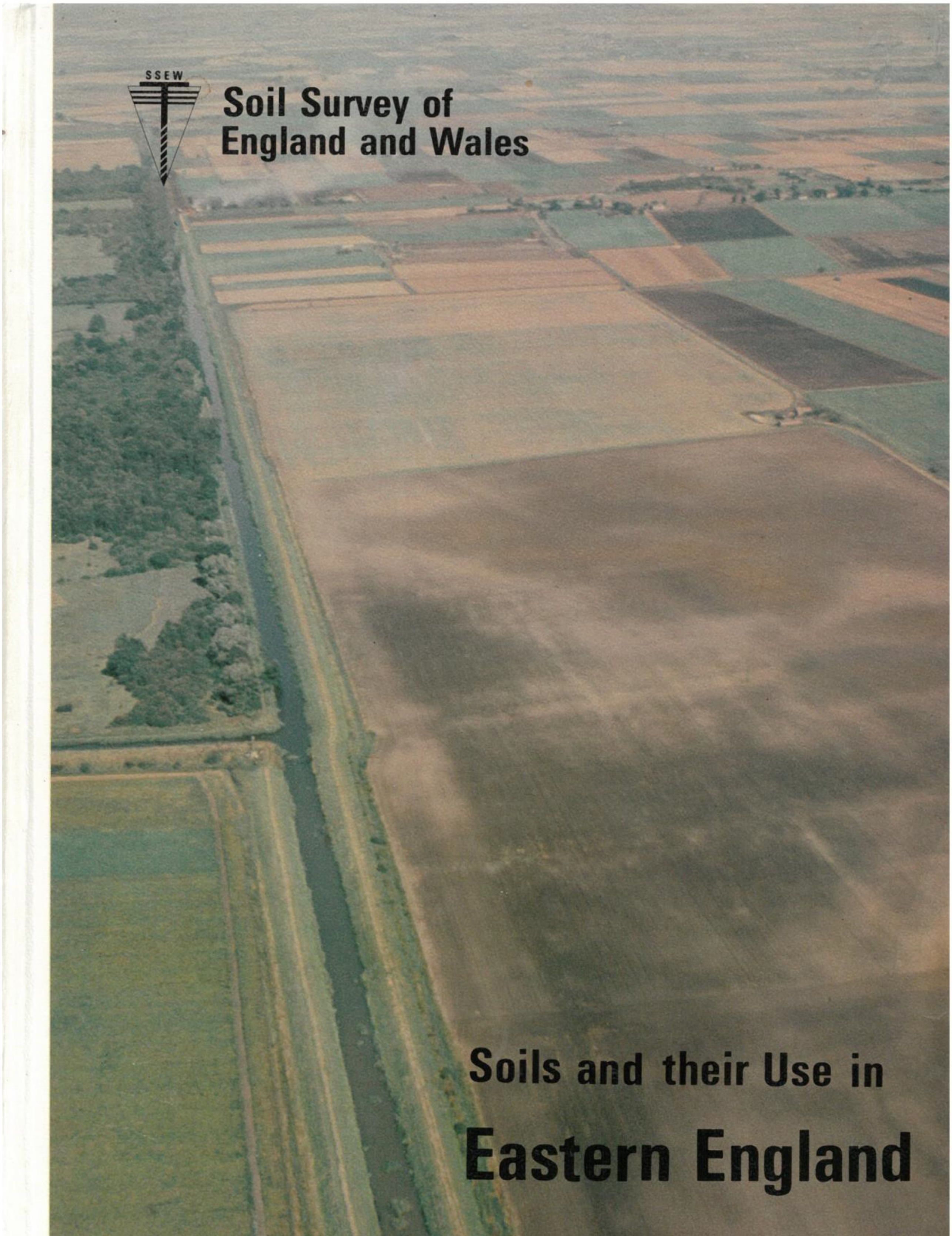
Position 17: Looking south over the arable land. There are cables under this field already

Position 18: Cereal land (left of the dyke) near to the substation

Position 19: Small grassland area at the substation

ANNEX B

Description of Soil Types


SSEW
Soil Survey of
England and Wales
Soils and their Use in
Eastern England

series (Plate 28). The Chalk outcrop is close by and chalky Reach (§ 113) and Wilbraham series (Clayden and Hollis 1984) form up to a fifth of these parcels. Further south, near Soham, the strongly acid Mendham series (§ 91) occurs locally.

Key to component soil series

	Peat thicker than 40 cm	1
	Mineral soils; sandy	2
1.	Amorphous peat	ADVENTURERS'
	Fibrous peat with grass and sedge remains	ALTCAR
2.	With dark, humose or peaty topsoil	ISLEHAM
	With grey, distinct topsoil	Blackwood

Soil water regime,

The soils are permeable and, apart from a few places where there is a clay subsoil, the land can be drained by ditches alone. With efficient arterial drainage as in much of the Fens, the soils are well-drained (Wetness Class I). The Adventurers' and Altcar soils are water-retentive and crops other than grass do not normally suffer from drought. Isleham soils, where well-drained, have less water available to plants. They are slightly droughty for cereals, moderately to very droughty for potatoes and very droughty for grass. Because they are not humose, Blackwood soils are correspondingly droughtier. The effect of drought is well shown by patchy crop growth on land with hummock and hollow microrelief, as groundwater is relatively lower in raised sandy soils than in the peaty hollows.

Cultivation and cropping

Where well-drained, the soils are easily worked, especially Isleham and Blackwood series which are accessible shortly after rain. There are thus few restrictions to cultivating the land and harvesting crops. These are mainly cereals, but sugar beet, potatoes and field vegetables are grown, and carrots and celery are characteristic on the peat soils. Cereals do not always finish well and sugar beet, although yielding heavily, has a low sugar content. Manganese deficiency occurs where the soils are calcareous. Wind erosion is a hazard especially in dry springs and care must be taken not to start fires as a burning peat subsoil is difficult to extinguish.

§ 11. AGNEY ASSOCIATION
812c

Agney association consists mainly of calcareous alluvial gley soils belonging to Agney and Wisbech series developed in marine alluvium on flat reclaimed land at 2 to 8 m O.D.

near the coast in parts of Humberside, Lincolnshire, Essex and Wales. The soils are stoneless and silty with brownish plough layers over greyish brown mottled horizons with blocky or relic laminar structure.

Typically, Agney association has about half Agney and one third Wisbech soils; Blacktoft (§ 28), Newchurch (§ 28), Romney (§ 28), Stockwith (§ 46), Tanvats (§ 125) and Wallasea (§ 125), and some Paglesham (Sturdy 1976) and Loggans (Staines 1979) series also occur. Brief descriptions of the two main soils are given in the Normoor association (§ 104). The degree of development of soil structure in Agney and Wisbech series depends upon the time since reclamation. On recently reclaimed land the original laminated sedimentary layers occur directly below the cultivated horizon, but on older sites, blocky soil structure has developed to 50 or 60 cm depth.

In Lincolnshire, where land has been reclaimed since 1970, around the Wash and in a small area near Boston, the association is composed consistently of Agney and Romney or Wisbech soils in a complex pattern. Many Agney soils have coarse silty layers below 50 cm depth. As elsewhere, the lighter Wisbech and Romney soils are on the sites of former creeks. In north-east Lincolnshire near Tetney and Marshchapel, there are low mounds up to 3 m above general marsh level formed by the medieval salt industry (Plate 9). The soils of these salterns are similar to Blacktoft series. Near Donna Nook, the alluvium overlies dune sand and near the coast Loggans series is included. Occasional Wallasea and Newchurch soils are also found.

In Essex the association is mainly on the Dengie peninsula and the seaward side of Foulness and Havengore Islands. On parts of the Dengie peninsula Romney and Newchurch series are common, and near the southern end of the peninsula the association is bounded to the west by shell ridges. On Foulness and Havengore islands there are a few Newchurch soils, and soils with clayey over fine silty layers are common.

Key to component soil series

	Subsoils calcareous above 40 cm	1
	Subsoils non-calcareous above 40 cm	6
1.	Prominently mottled or greyish above 40 cm	2
	Subsoil faintly mottled within 60 cm or distinctly mottled between 40 and 80 cm	5
2.	With silty horizons	3
	Other soils	4
3.	Fine silty	AGNEY
	Coarse silty	WISBECH
	Silty over clayey	Stockwith
4.	Sandy	Loggans
	Clayey	Newchurch
5.	Coarse silty	Romney
	Fine silty	Blacktoft

6. Fine silty	Tanvats
Clayey	Wallasea
Fine loamy over clayey	Paglesham

Soil water regime

The soils are very porous with numerous root channels and burrows formed under saltmarsh before reclamation. The land is mostly drained by ditches and pumps and the soils are rarely waterlogged (Wetness Class I). Parts of the Dengie peninsula suffer occasional flooding through breaches of the sea defences. The available water reserves of the Agney series are large and the soil is non-droughty for cereals and sugar beet. Shallow-rooting crops such as potatoes may suffer drought. In the dry climate of Essex crops on Agney soils suffer slightly more from droughtiness than in Lincolnshire. There are only minor limitations on grassland growth and utilization in Lincolnshire, but in Essex, droughtiness checks summer growth. Wisbech soils are well suited to grassland as well as other crops, because of their large moisture reserves.

Cultivation and cropping

The soils are easy to cultivate, though the heavier Agney soils are less so than Wisbech soils. The laminated subsoils of recently reclaimed soils compact readily below the plough layer. There are ample days available for cultivation in autumn and spring. The soils are not well suited to direct drilling because of their high silt content and the risk of compaction.

In Lincolnshire cereals, sugar beet and potatoes are grown and the land is used extensively for field vegetables, particularly brassicas. The Agney soils are not ideal for onion crops because sticky topsoils make it difficult to get a clean crop. In Essex arable crops, including cereals, potatoes and some sugar beet are grown. Lucerne and grass are grown locally. Many parts of Foulness Island have rough grazing around military installations.

§ 12. ALTCAR 1 ASSOCIATION
1022a

The Altcar association is extensive on the Somerset Moors, in the Norfolk Fens and the Lancashire mosses. There are also small areas in Northern England, Cheshire, Staffordshire and the Welsh Borderland. It covers about 223 km^2 nationally, at heights usually less than 6 m O.D. The soils are formed in fen peat, one to two metres thick, most of which has been drained and reclaimed. The Altcar series (§ 10), earthy eu-fibrous peat soils in grass sedge peat, dominate with Adventurers' series (§ 10), earthy eutro-amorphous peat soils, where the subsoil is humified. The association covers 27 km^2 in Methwold Fens, Norfolk (Plate 7), where some land remains under semi-natural woodland but most is cultivated. Because of shrinkage and oxidation following effective and if sequentially direct drilled the soils benefit from being loosened periodically. Shallow cultivations and minimum tillage techniques are commonplace. Some land is affected by salinity which, followed by leaching, has led to clay deflocculation, and the stopping of drains by dispersed clay, eventually causing patchy waterlogging and crop failure on arable land. Grassland productivity is limited by summer drought but, because of the poaching risk, grazing by cattle is restricted to the summer months. Occasional liming is needed, but manganese deficiency can occur in over-limed spots. The soils contain little phosphorus but reserves of potassium and magnesium are large.

§ 133. WALLASEA 2 ASSOCIATION
813g

This association is extensive on reclaimed marine alluvium in the marshlands of Lincolnshire (Fig.45), Cambridgeshire and Norfolk, and is also present in Romney Marsh, the Essex marshes and in Holderness. The land is generally level but there are occasional ridges on the sites of former creeks. The soils are mainly Wallasea series, pelo-alluvial gley soils; Newchurch series, pelo-calcareous alluvial gley soils; Blacktoft series, gleyic brown calcareous soils; and Wisbech series, calcareous alluvial gley soils. Wallasea and Newchurch soils are clayey with a greyish brown topsoil over greyish or grey and ochreous mottled subsurface horizons; Newchurch series is calcareous. Blacktoft soils are calcareous and fine silty with grey colours and mottling in the subsoil. Wisbech soils are also calcareous, but have greyish and mottled coarse silty horizons below the plough layer, often with sedimentary laminations. Wallasea series predominates and Newchurch, Blacktoft and Wisbech soils are common. Dymchurch (Clayden and Hollis 1984), Snargate (§ 114), Agney, (§ 104) Stockwith (§ 46), Tanvats (§ 114) and Paglesham (Sturdy 1976) series also occur. Brief descriptions of the principal soils are given elsewhere in the text. Wallasea series in § 125, Newchurch series in § 28, Blacktoft series in § 28 and Wisbech series in § 104.

Wallasea soils consistently constitute over half of the association, but the proportion of other soils varies widely throughout the country. Generally, Wisbech and Blacktoft series are found on or near former creeks (rodhams), with Wallasea and Newchurch soils in the intervening areas. The incidence of creek ridges, and so the proportion of coarser soils, increases seawards where Blacktoft soils cover a third of the land, except in Lincolnshire where the similar Agney series is more common. The proportion of the less common Wisbech soils also increases seawards. Inland towards high ground, clayey soils are predominant, Wallasea soils being most common in Lincolnshire and Cambridgeshire, but in Norfolk, Newchurch and Wallasea soils are co-dominant. In places in Lincolnshire, Wallasea soils have developed from former Downholland soils (§ 48) from which topsoil organic matter has been lost by oxidation. Wisbech soils are rare in north Lincolnshire and non-calcareous soils, including Pepperthorpe (§ 125) and Tanvats series, become more common. Near Huttoft, where islands of Devensian till rise through the alluvium, some Holderness soils (§ 75) are included. Creek ridges are uncommon in Essex and Wisbech soils are rare. Calcareous fine silty Agney soils cover one sixth of the land and non-calcareous Tanvats and Paglesham soils also occur. Locally there are a few saline soils and, where leaching has occurred, subsoil structure has deteriorated causing silting of drains, waterlogging and reduced crop yields.

Key to component soil series

	Subsoils non-calcareous above 40 cm	1
	Subsoils calcareous above 40 cm	2
1.	Clayey	WALLASEA
	Fine silty	Tanvats
	Fine loamy over clayey	Paglesham
	Fine silty over clayey	Pepperthorpe
2.	Silty throughout	3
	With clayey horizons	5
3.	Coarse silty	WISBECH
	Fine silty	4
4.	Subsoil faintly mottled above 60 cm or distinctly mottled between 40 and 80 cm	BLACKTOFT
	Prominently mottled or greyish above 40 cm	Agney
5.	Clayey throughout	NEWCHURCH
	Silty over clayey	Stockwith

Soil water regime

Most of the land is pump-drained and the more permeable Blacktoft and Wisbech soils are well drained (Wetness Class I). Wallasea and Newchurch soils are less permeable but respond to underdrainage; drained soils are occasionally waterlogged (Wetness Class II) but undrained soils are waterlogged for long periods in winter (Wetness Class III or IV). Droughtiness assessments for selected crops are given in Table 38. Droughtiness slightly restricts the growth of arable crops in Wallasea and Newchurch soils. Wisbech soils have large available water reserves and are non-droughty whilst Blacktoft soils are intermediate in droughtiness. Grassland suffers from drought on all soils in south Lincolnshire, Norfolk and Essex but growth is less restricted in the higher rainfall area of north Lincolnshire.

Cultivation and cropping

The effects of soil and climate on the time available for landwork is shown in Figure 71. With adequate underdrainage, Wallasea and Newchurch soils are moderately easy to work. There are adequate days for safe cultivation in autumn and spring, but in north

Lincolnshire the moist climate reduces the opportunity for spring cultivation, particularly in wet years, and the soils are marginal for spring-sown crops. The land is generally used for winter cereals and ley grassland, but sugar beet, peas and field brassicas are grown in the drier districts. The use of heavy machinery often causes topsoil compaction and surface wetness on the heavier soils especially Wallasea series though they can be direct drilled very successfully if subsoiled periodically. Newchurch soils which are calcareous have a more stable structure. Wisbech and Blacktoft soils are less suitable for direct drilling because of the problems associated with this system on silty soils.

Table 38
Profile Available Water (A.P. mm), Crop-adjusted Mean Moisture Deficit (M.D. mm) and Droughtiness Class for extensive crops–Wallasea 2 Association

Location Grid Ref.	**Wallasea series** Holbeach St Johns TF350180	**Newchurch series** Holbeach St Johns TF350180	**Blacktoft series** Holbeach St Johns TF350180	**Wisbech series** Holbeach St Johns TF350180
Winter wheat				
A.P.	160	150	190	270
M.D.	126	126	126	126
Droughtiness	slightly droughty	slightly droughty	non-droughty	non-droughty
Spring barley				
A.P.	160	150	190	270
M.D.	119	119	119	119
Droughtiness	slightly droughty	slightly droughty	non-droughty	non-droughty
Potatoes				
A.P.	115	115	140	200
M.D.	127	127	127	127
Droughtiness	moderately droughty	moderately droughty	slightly droughty	non-droughty
Sugar beet				
A.P.	195	180	235	335
M.D.	127	127	127	127
Droughtiness	non-droughty	non-droughty	non-droughty	non-droughty
Oilseed rape				
A.P.	160	150	190	270
M.D.	109	109	109	109
Droughtiness	non-droughty	slightly droughty	non-droughty	non-droughty

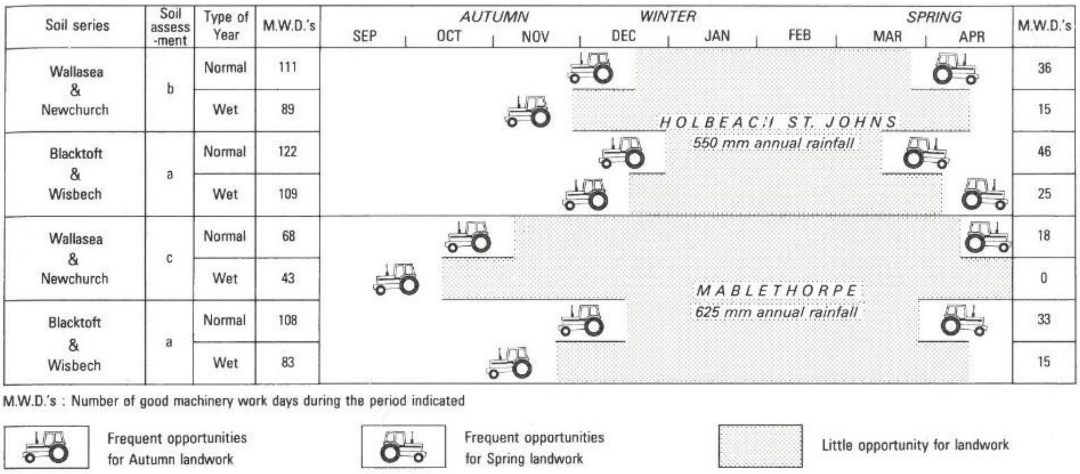


Figure 71. The effects of soil and climate on landwork, Wallasea 2 association

§ 134. WANTAGE 1 ASSOCIATION (342c)

This association consists of greyish, well drained silty soils on the Lower Chalk mainly in south Oxfordshire, north Wiltshire, Kent and Buckinghamshire. In Bedfordshire, Hertfordshire, and Cambridgeshire the association occurs in small patches. North of Luton it forms a narrow strip of gently sloping land at the foot of the chalk escarpment. Near Luton the soils form the side of a ridge and the association continues sporadically to the south-west, fronting the Chiltern Hills (Avery 1964). The principal soil is Wantage series (§ 135), loamy grey rendzinas with an extremely calcareous silty clay loam subsoil and chalk at moderate depth. The land is affected locally by springs and winterbournes so Burwell (§ 113) soils are found on valley floors and on gentle slopes. Shallow Upton soils, grey rendzinas, are confined to convex valley sides below the main Chalk scarp.

The soils of the association are predominantly well drained (Wetness Class I), but there are patches of less permeable Burwell soils on some valley floors and flat valley sides which when field drainage is effected are largely well drained (Wetness Class I).

The main crops are cereals, grown continuously or in rotation. Yields of winter wheat are consistently high and those of spring barley about average. The soils are easy to work and any surface capping usually breaks up as the soil dries. There is adequate time for autumn and spring landwork. There is little risk of poaching in grassland but there is some drought limitation on the shallowest soils. The association is fully described by Jarvis, M.G. *et al.* (1984).

ANNEX C

Defra Construction Code of Practice for the Sustainable Use of soils on Construction Sites (extracts only)

www.defra.gov.uk

Construction Code of Practice for the Sustainable Use of Soils on Construction Sites

BIS | Department for Business Innovation & Skills

wrap Material change for a better environment

defra Department for Environment Food and Rural Affairs

5.4 Soil stockpiling

Why?

1. Soil often has to be stripped or excavated during the construction process. In order to enable its reuse on site at a later stage, soil needs to be stored in temporary stockpiles to minimise the surface area occupied, and to prevent damage from the weather and other construction activities.

How?

2. The main aim when temporarily storing soil in stockpiles is to maintain soil quality and minimise damage to the soil's physical (structural) condition so that it can be easily reinstated once respread. In addition, stockpiling soil should not cause soil erosion, pollution to watercourses or increase flooding risk to the surrounding area.

3. When soil is stored for longer than a few weeks, the soil in the core of the stockpile becomes anaerobic and certain temporary chemical and biological changes take place. These changes are usually reversed when the soil is respread to normal depths. However, the time it takes for these changes to occur very much depends on the physical condition of the soil.

4. Handling soil to create stockpiles invariably damages the physical condition of the soil to a greater or lesser extent. If stockpiling is done incorrectly the physical condition of the soil can be damaged irreversibly, resulting in a loss of a valuable resource and potentially significant costs to the project. The Soil Resource Survey and Soil Resource Plan should set out any limitations that the soil may possess, with respect to handling, stripping and stockpiling.

5. The size and height of the stockpile will depend on several factors, including the amount of space available, the nature and composition of the soil, the prevailing weather conditions at the time of stripping and any planning conditions associated with the development. Stockpile heights of 3-4m are commonly used for topsoil that can be stripped and stockpiled in a dry state but heights may need to be greater where storage space is limited.

6. Soil moisture and soil consistency (plastic or non-plastic) are major factors when deciding on the size and height of the stockpile, and the method of formation. As a general rule, if the soil is dry (e.g. drier than the plastic limit) when it goes into the stockpile, the vast majority of it should remain dry during storage, and thereby enable dry soil to be excavated and respread at the end of the storage period. Soil in a dry and non-plastic state is less prone to compaction, tends to retain a proportion of its structure, will respread easily and break down into a suitable tilth for landscaping. Any anaerobic soil also usually becomes re-aerated in a matter of days.

7. Soil stockpiled wet or when plastic in consistency is easily compacted by the weight of soil above it and from the machinery handling it. In a compacted state, soil in the core of the stockpile remains wet and anaerobic for the duration of the storage period, is difficult to handle and respread and does not usually break down into a suitable tilth. A period of further drying and cultivation is then required before the soil becomes re-aerated and acceptable for landscaping.

Stockpiling methods

8. There are two principal methods for forming soil stockpiles, based on their soil moisture and consistency.

9. Method 1 should be applied to soil that is in a dry and non-plastic state. The aim is to create a large core of dry soil, and to restrict the amount of water that can get into the stockpile during the storage period. Dry soil that is stored in this manner can remain so for a period of years and it is reuseable within days of respreading.

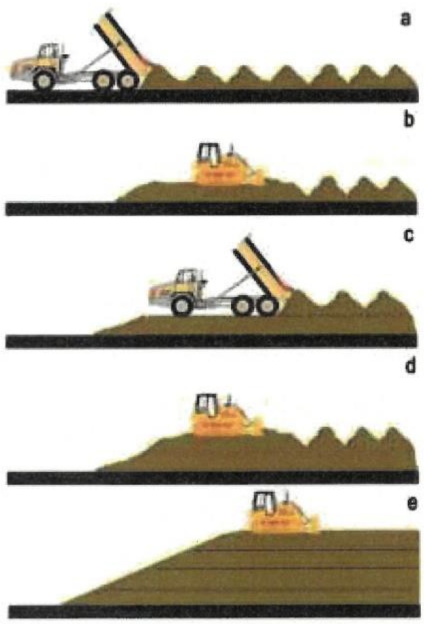
10. Method 2 should be applied if the construction programme or prevailing weather conditions result in soil having to be stockpiled when wet and/or plastic in consistency. This method minimises the amount of compaction, while at the same time maximising the surface area of the stockpile to enable the soil to dry out further. It also allows the soil to be heaped up into a 'Method 1' type stockpile, once it has dried out.

Soil stockpiling

Soil should be stored in an area of the site where it can be left undisturbed and will not interfere with site operations. Ground to be used for storing the topsoil should be cleared of vegetation and any waste arising from the development (e.g. building rubble and fill materials). Topsoil should first be stripped from any land to be used for storing subsoil.

Method 1 – Dry non-plastic soils

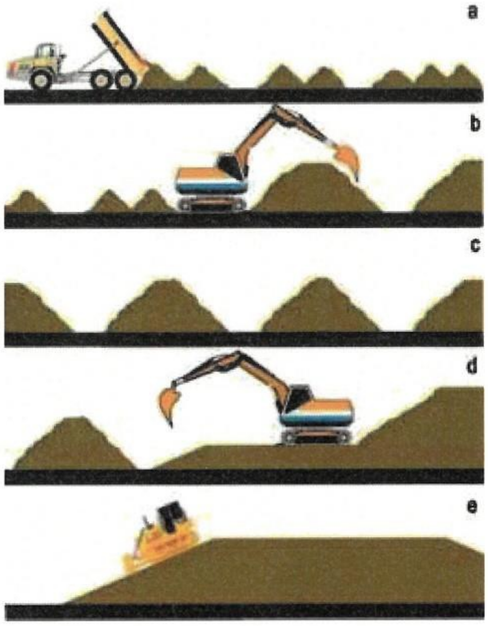
The soil is loose-tipped in heaps from a dump truck (a), starting at the furthest point in the storage area and working back toward the access point. When the entire storage area has been filled with heaps, a tracked machine (excavator or dozer) levels them (b) and firms the surface in order for a second layer of heaps to be tipped. This sequence is repeated (c & d) until the stockpile reaches its planned height. To help shed rainwater and prevent ponding and infiltration a tracked machine compacts and re-grades the sides and top of the stockpile (e) to form a smooth gradient.



Method 2 – Wet plastic soils

The soil is tipped in a line of heaps to form a 'windrow', starting at the furthest point in the storage area and working back toward the access point (a). Any additional windrows are spaced sufficiently apart to allow tracked plant to gain access between them so that the soil can be heaped up to a maximum height of 2m (b).
To avoid compaction, no machinery, even tracked plant, traverses the windrow.

Once the soil has dried out and is non-plastic in consistency (this usually requires several weeks of dry and windy or warm weather), the windrows are combined to form larger stockpiles, using a tracked excavator (d). The surface of the stockpile is then regraded and compacted (e) by a tracked machine (dozer or excavator) to reduce rainwater infiltration.



Stockpile location and stability

11. Stockpiles should not be positioned within the root or crown spread of trees, or adjacent to ditches, watercourses or existing or future excavations. Soil will have a natural angle of repose of up to 40° depending on texture and moisture content but, if stable stockpiles are to be formed, slope angles will normally need to be less than that. For stockpiles that are to be grass seeded and maintained, a maximum side slope of 1 in 2 (25°) is appropriate.

Stockpile protection and maintenance

12. Once the stockpile has been completed the area should be cordoned off with secure fencing to prevent any disturbance or contamination by other construction activities. If the soil is to be stockpiled for more than six months, the surface of the stockpiles should be seeded with a grass/clover mix to minimise soil erosion and to help reduce infestation by nuisance weeds that might spread seed onto adjacent land.

13. Management of weeds that do appear should be undertaken during the summer months, either by spraying to kill them or by mowing or strimming to prevent their seeds being shed.

Clearly defined stockpiling of different soil materials

Long term stockpile of stripped topsoil left with only weed vegetation

Greenacres Barn, Stoke Common Lane, Purton Stoke, Swindon, Wiltshire SN5 4LL
Telephone: 01793 771333 • Email: info@kernon.co.uk • Website: www.kernon.co.uk