APPENDIX 8.2
OUTLINE SOIL RESOURCE AND MANAGEMENT PLAN

ALLESTON SOLAR FARM, PEMBROKESHIRE

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October 2024

KERNON COUNTRYSIDE CONSULTANTS LIMITED

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Authorised By APK 10/24

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CONTENTS

1 INTRODUCTION

1.1 This document provides an outline Soil Resources and Management Plan (oSRMP) for the proposed Alleston Solar Farm, Pembrokeshire (hereafter referred to as 'the Proposed Development').

Purpose of Report

1.2 The objective of the oSRMP is to identify the importance and sensitivity of the soil resource and to provide specific guidance to avoid the risk of significant adverse effect on the soil resource as a result of the Proposed Development.

1.3 The oSRMP has been produced following the comments of the Soil, Peatland and Agricultural Land Use Planning Unit of the Welsh Government, 20th July 2023 appended to the Addendum Scoping Direction of 21st December 2023. That response confirmed that the Agricultural Land Classification (ALC) report (at that time covering the majority of the Site) had been validated, and that Best and Most Versatile (BMV) agricultural land was identified within the Site. The response requested additional construction information including the number and spacing of piles installed, the extent of trenching, tracks, areas for construction compounds etc.

1.4 The response requested a soil management scheme to be prepared and be considered as part of the ES process. This should set out how soils should be conserved and reinstated. It should be presented in sufficient detail and should include:

- soil stripping programmes – volumes and types of soils affected;
- soil handling techniques and procedure;
- size, location, construction, management and period of soil storage dumps;
- proposed after-use and restoration programme, including techniques and aftercare programme.

Structure of the Report

1.5 The oSRMP is structured as follows:

(i) section 2 sets out the reasons for and the scope of the oSRMP;
(ii) section 3 describes the soil resources and characteristics;
(iii) section 4 sets out key principles;
(iv) sections 5 - 8 set out the soil management requirements for key aspects of the Proposed Development:
- section 5: construction compounds;
- section 6: access tracks and fixed equipment;

- section 7: solar arrays;
- section 8: on-site trenching;

(v) section 9: substation;

(vi) section 10: parcel-by-parcel soil management;

(vii) sections 11, 12 and 13 set out operational and maintenance phase management and the principles required for decommissioning.

1.6 This oSRMP 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. It draws from the detailed Agricultural Land Classification (ALC) survey by AMET Property (updated January 2024) of the site, and on other published data as referenced in this report.

Summary

1.7 Subject to planning consent and the discharge of conditions the installation process is expected to commence with initial enabling works in the springtime. If weather permits this will include creating the access tracks. The bulk of the piles are expected to be installed within 6 to 9 months of commencement, and whilst soils are dry, in spring to autumn. The construction phase may last longer, depending upon the start date and winter working restrictions.

1.8 The operators recognise the need to carry out such work when soil conditions are suitable and are committed to that.

Note about Why Soils are Important

1.9 Soils are an important resource. The Environment Agency estimates that UK soils currently store about 10 billion tonnes of carbon, equal to about 80 years of greenhouse gas emissions[1]. Yet many biological processes and soil functions are thought to be under threat. 4 million hectares are at risk of compaction, including grassland areas. Therefore, soils need to be managed so as not to damage or lose those important functions.

Advice and Guidance Drawn Upon

1.10 This document has drawn upon:

- Construction Code of Practice for the Sustainable Use of Soils on Construction Sites, Defra (2009);

[1] State of the Environment: Soils, Environmental Agency (2019)

- Working with Soils Guidance Note on Benefiting from Soil Management in Development and Construction, BSSS (2022);
- Building on Soil Sustainability: principles for soils in planning and construction, Lancaster University and partners (2022);
- Agricultural Good Practice for Solar Farms, BRE (2014);
- Good Practice Guide for Handling Soils in Mineral Workings, The Institute of Quarrying (2021).

1.11 The oSRMP has also given consideration to the research document 'The Impact of Solar Photovoltaic (PV) sites on agricultural soils and land quality', March 2023[2].

1.12 This oSRMP draws on published data and detailed soil survey carried out by Amet Property (January 2024).

[2] Soil Policy Evidence Programme, Welsh Government (2023)

2 SCOPE OF THE OSRMP

2.1 This oSRMP sets out:

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

2.2 The installation of the solar panel framework, and the assembly of the panels, does not require the movement or disturbance of soils. Those works should not, therefore, result in localised disturbance or effects on soils or agricultural land quality. The oSRMP however particularly covers vehicle movements and related impacts, as those could result in compaction.

2.3 Trenching works to connect the panels to the infrastructure do have the potential to cause localised effects on soils. Localised damage will be minimised by good practice. This oSRMP sets out soil resilience, good practice and monitoring criteria. It considers the effect of trenching works.

2.4 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 oSRMP 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.

2.5 This oSRMP focuses on the construction phase and immediate aftercare, and on the decommissioning phase, especially to set principles to avoid creating compaction. There will be some long-term storage of soil for restoration uses at the decommissioning phase. Any soil removal at construction for future restoration (eg of the tracks) will be stored on site and labelled for subsequent return.

3 SOIL RESOURCES AND CHARACTERISTICS

<u>The Site</u>

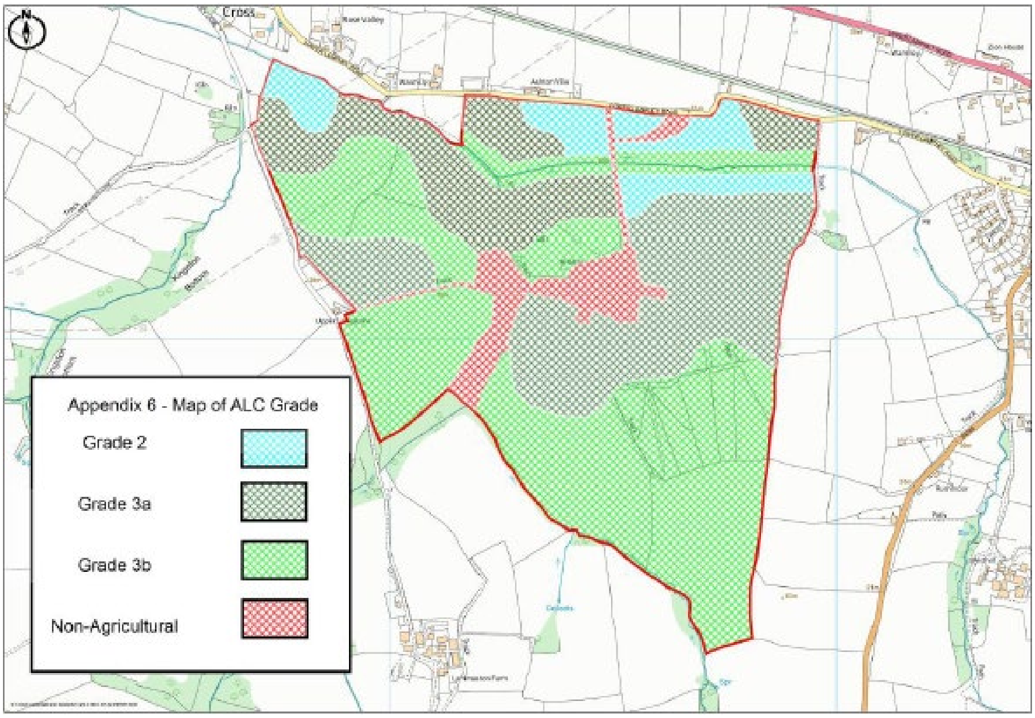
3.1 The site is shown on the plan below. This covers the whole of Alleston Farm.

Insert 1: The Site

Land Quality

3.2 The whole site has been the subject of a detailed Agricultural Land Classification survey. This is reproduced in **Appendix SMP1**. The results are shown below.

Insert 2: ALC Results 7



Soils and Physical Limitations

3.3 The ALC describes the soils in detail.

3.4 For the purposes of ALC, the climate of the site includes:

- annual rainfall of 1,117mm;
- a Field Capacity Days (FCD) period of 225 – 227 days.

3.5 Parts of the site are limited, in ALC terms, by slopes in excess of 7 degrees.

3.6 The topsoil across the site was fairly consistent. The colour differed from dark brown to dark reddish brown, and the topsoil texture varied from medium clay loam to heavy clay loam (ALC 7.2). The difference in clay content between these two soils was 2–3%, so only marginal changes in texture.

3.7 Greater differences were identified in the subsoil, however:

- brown or reddish-brown clay or heavy clay loam with medium angular blocky structure;
- dark yellowish brown coarse sandy loam, typically in the northeast corner.

3.8 The difference is shown below, from Appendix 4b of the ALC.

Insert 3: Heavy Clay Loan Topsoil and Clay Subsoil

Insert 4: Medium Clay Loam Over Coase Sandy Loam Subsoil

Areas for Solar PV Arrays

3.9 Only part of the site is proposed for solar PV arrays. The land quality of the areas proposed for solar PV arrays is shown below.

Insert 5: ALC of the Solar PV Arrays Area

KEY	
	Grade 1
	Grade 2
	Grade 3a
	Grade 3b
	Grade 4
	Grade 5
	Non-agricultural
	Urban
	Not surveyed

3.10 These areas are considered in individually in section 10.

3.11 Areas 1, 2, 3, 4, 5, 7 and 8 are in arable use at present, with photographs below.

Photo 1: Area 1 Looking Southwest

Photo 2: Area 2 Looking Southwest

Photo 3: Area 3 Looking South

Photo 4: Area 4 Looking West

Photo 5: Area 5 Looking North

Photo 6: Area 7 Looking Southeast

Photo 7: Area 8 Looking East

3.12 Area 6 is grazed with horses and is typically subdivided with electric fence tape.

Photo 8: Area 6 Looking Northeast

4 KEY PRINCIPLES

Terminology

4.1 In this oSRMP the following terminology is used:

- soil trafficking, which means vehicular passage over soils, but not physical disturbance;
- soil handling, which describes where soil is physically moved, such as by a mechanical digger.

Overview

4.2 For much of the installation process there is no requirement to handle (ie 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 (MV Transformer Stations and HV Substation). Soils will need to be handled to enable cables to be laid (trenching), but those soils will be reinserted shortly after they are lifted out (ie this is a swift process). More significant works will be required to create the 33-132kV Substation.

4.3 For those limited areas where soil needs to be disturbed to create tracks and bases, the soil will be stored in suitably managed bunds on the site. The soil needs to be looked after because it will be needed at the decommissioning phase to restore the land under the tracks and bases back to agricultural use, unless otherwise agreed with the landowner.

4.4 It is unlikely that subsoil will need to be removed to create the shallow tracks and bases, but if subsoil does need to be moved and stored, it will be stored separately to the topsoil, and clearly marked.

4.5 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 vehicle passage (ie trafficking). 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. Aside from the construction and decommissioning periods, vehicle movement is very limited.

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

- timing;

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

Timing

4.7 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 non-existent or minimal.

4.8 The timing of soil moving activities needs to be fairly flexible, as each season is different to the previous year. With large projects flexibility is often difficult, so the timing and soil handling measures will always have to be to the optimum so far as practicable.

4.9 Generally across the site the topsoil depth is mostly 30 to 35cm, as set out in the SMP. The topsoils are a mix of medium clay loam (<27% clay) and heavy clay loam (27-35% clay).

4.10 The Institute for Quarrying "Good Practice Guide for Handling Soils in Mineral Workings" (2021) provides the following table for optimum times for stripping (eg for the track and substation bases). This table shows an optimum time for stripping soils to be late May/June to early October, but in some years these dates can be extended.

Insert 6: Extract IQ Table 4.1

	Climatic Zones		
Soil Clay Content	**1**	**2**	**3**
Soil Depth <30cm			
<10%	Mid Apr - Early Oct	Late Mar – Early Nov	Late Mar – Early Dec
10 -27%	Late May - Early Oct	Early May – Early Nov	Early Apr – Early Dec
Soil Depth 30-60cm			
<10%	Late Apr - Early Oct	Mid Apr – Early Nov	Early Apr – Early Dec
10-27%	Late May - Early Oct	Early May – Early Nov	Early Apr – Early Dec
>27%	Late June – Early Oct	Early June – Early Nov	Late May – Early Dec
Soil Depth >60cm			
<10%	Late Apr - Early Oct	Mid Apr – Early Nov	Early Apr – Early Dec
10-18%	Late May - Early Oct	Early May – Early Nov	Early Apr – Early Dec
18-27%	Late June – Early Oct	Early June – Early Nov	Late May – Early Dec
>27	Mid July – Mid Sept	Early July – Mid Oct	Late June – Mid Oct

Table 4.1: Indicative on-average months when vegetated mineral soils might be in a sufficiently dry condition according to geographic location, depth of soil and clay content

4.11 The installation of panels does not require land to be stripped, and so the time period is not as restricted. In most years an April to October window will be perfectly acceptable and this may be extended at either end if rainfall conditions, and soil wetness. The soils are generally fairly free draining and there will be many opportunities to work over the land outside these optimum windows. The current cropping involves farm machinery working outside these windows with no evidence of structural damage having been caused.

4.12 The soils are relatively resilient in summer to vehicle passage.

4.13 Any damage from vehicle trafficking in winter, which will be avoided so far as practicable, can generally be made good by mechanical husbandry once the soils start to dry in the spring.

4.14 In winter and early spring there is however 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. However, landwork in this period is most likely to result in the need for restorative works post installation and, so far as practicable, will be avoided.

4.15 As a general rule any activity that requires soil to be dug up and moved, such as cabling works (trenching), should be reduced so far as practicable during that period. 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 (eg ripping with tines) to speed recovery of damaged soil structure.

4.16 In localised instances where it is not practicable 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.

Determining if Soils are Suitable

4.17 Soils should be friable when moved.

4.18 With clayey soils of this type, if you can roll soil into a ball or a sausage easily and the soil holds that shape, it is too wet to travel over or move soils. This is illustrated in the photograph below. It is followed by a photograph indicating the type of physical impression the tractor movement can make in unsuitable conditions. Further guidance is given in Sheet A of the Good Practice Guide to Handling Soils in Mineral Workings, Institute of Quarrying (2021).

Inserts 7 and 8: Indication of When Soils are Too Wet

Retaining Soil Profiles

4.19 The successful installation of cabling requires a trench to be dug into the ground. Topsoils vary only slightly across the site and the coverage is generally 25-30cm.

4.20 As set out in the BRE Agricultural Good Practice Guidance for Solar Farms 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**".

4.21 In those areas where the soil is dug up (trenching , MV Transformer Stations, HV Substation, 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

4.22 This oSRMP sets out when soils should generally be suitable for being trafficked. There may be periods within this window, however, when periodic prolonged rainfall events result in soils becoming liable to damage from being trafficked or worked. In these (likely rare) situations, work should only continue with care, to minimise structural effects on the soils, until soils have dried, usually within 48 hours of heavy rain stopping.

Ameliorating Compaction

4.23 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.

4.24 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. So far as possible this sort of damage should be avoided.

Inserts 9 and 10: Inter-row Ground Restoration: Example image of poor practice taken from a different site

4.25 With a principal construction programme from April to October this type of more extensive soil damage is unlikely to occur.

4.26 If there is any localised problem, the type of machinery involved in restoration is shown below. This shows farming and horticultural versions.

Inserts 11 and 12: Type of Machinery Involved

4.27 If there are any areas 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 practicable, it occurs, and the effects are made good when conditions are suitable.

4.28 The ground surface should be generally levelled prior to any seeding or reseeding.

4.29 Examples of areas that have been cultivated following the installation of panels, are shown below. These are the main vehicle trafficking routes. As can be seen, the area under and mostly between the panels, is not damaged.

Inserts 13 and 14: Localised Repairs (solar farm in Sussex)

Retaining Soils

4.32 At decommissioning stages the areas that will form the bases for the fixed infrastructure, can be returned to agricultural use. For this to be successful, the soils must have been retained on site, properly recorded or labelled so that they can be returned to the approximate position from where they came and stored properly for the lifetime of the scheme in an appropriately sized and managed bund.

4.33 No soil removed to construct the tracks will be removed from the site. It will all be stored on site for use at the decommissioning phase.

4.34 The storage bunds will be managed to prevent the growth of woody vegetation.

5 CONSTRUCTION COMPOUNDS

Construction Methodology

5.1 Two temporary construction compounds will need to be created at the start of construction and reinstated at the end.

5.2 Construction compounds are built by stripping topsoil and storing that in a bund on the edge of the site. A matting is then laid down, and stone imported and levelled, as shown below.

Insert 15: Newly laid Construction Compound (Elsham-Lincoln Pipeline)

5.3 The matting prevents the stone from mixing with the subsoil, as shown below.

Insert 16: Matting

5.4 Topsoil is stored in a bund, as shown below. Guidance on this can be found in Box B1 of Sheet 2 of the Good Practice Guide for Handling Soils in Mineral Workings (Institute of Quarrying, 2021), *Insert 17: Topsoil Storage Bund (example from Lincolnshire)*

Movement of Soils

5.5 The soils need to be sufficiently dry to handle. If you can roll soil into a ball or a sausage easily and the soil holds that shape, it is too wet to travel over or move soils, as described earlier. If the ball crumbles, as below, the soil is suitable for being moved. This is illustrated in the photograph below.

Insert 18: Indication of When Soils are Suitable

5.6 The topsoils will be stripped to a depth of 30-40cm and placed in bunds on the edge of the compound, as shown above.

5.7 Short term storage of soil is shown in Insert 17 above. If the soil is likely to be stored for in excess of six months, then, depending upon timing, it should be seeded with grass. This binds the soil together and minimises erosion.

5.8 Therefore if the construction compound is not to be removed before the wet weather in the autumn, the bunds should be seeded with grass, as per the example below (Insert 19), prior to the winter.

Insert 19: Grass-seeded Bund (photographed in Devon)

Removal

5.9 The removal of the construction compound should be timed for dry weather. That may be the following spring.

5.10 At the end of the construction process, the aggregate will be removed. This can be seen in progress below (Insert 20).

Insert 20: Start of Restoration of Construction Compound (example from Staffordshire)

5.11 The base area should be loosened when soils are dry, and the topsoil then spread over the site to the original depth. This should be lightly cultivated.

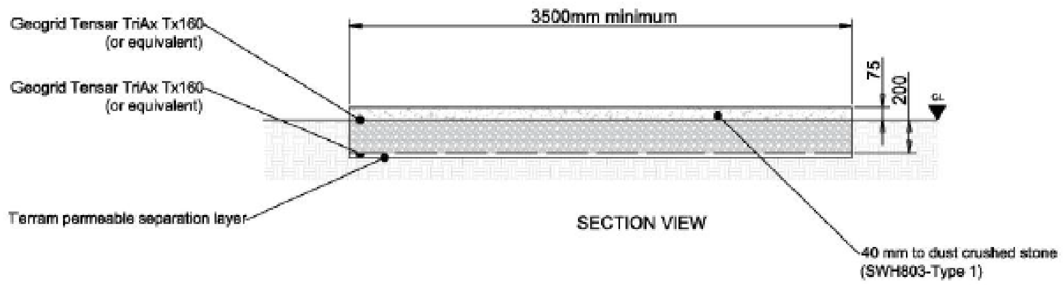
5.12 Panels can then be installed over the construction compound, or the area returned to agricultural use.

6 ACCESS TRACKS AND FIXED EQUIPMENT

Construction Methodology

6.1 The access tracks are created by stripping off some or all of the topsoil (to a depth of 200mm) 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. The cross-section is shown below.

Insert 21: Access Track Cross Section



6.2 The small areas of fixed equipment normally stand on a gravel base area, as shown below. As these areas will be restored in the future, the construction is carried out as follows:

(i) topsoil to c10-15cmcm is removed. This will be stored in a bund no more than 3m high (typically 1-1.5m) at an agreed location, for use in future restoration;

(ii) a permeable terram layer is then laid;

(iii) the base of stone is then added, and forming put around before concrete is poured to create the pad, or stone is added to create the pad;

(iv) the equipment is then placed on top;

(v) further security fencing, where required, is added once the cabling and connections are complete.

6.3 A typical example of fixed equipment from an operating solar farm, is shown below.

Inserts 22: Typical Inverter Container (example from Monmouthshire)

Soil Management

6.4 Soil should be stripped 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 generally too wet to strip or move without risk of structural damage. Topsoil depths are consistent across the site and 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.

6.5 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). The removed soil should be stored in bunds in accordance with the Construction Code of Practice.

6.6 The tracks involve the movement of soils. Therefore, the soils are more susceptible to damage from mechanical moving. The topsoil will, however, be stored for the duration of the operational period. Accordingly, if for operational reasons it is necessary to commence the construction of tracks and bases when soils are not in optimal condition, the soil to be stored should be stored initially in bunds of maximum 1 metre high.

6.7 This will allow the soils to dry. Shallow bunds can then be moved again once they are dry into larger bunds for long-term storage.

6.8 Once the soils are sufficiently dry, typically after two or three weeks, it will be possible to move the soils to long-term storage bunds.

6.9 As a general rule soil should not be moved during or within 24 hours of heavy rain.

Bund Management

6.10 Soil bunds should be no more than 3m in height to prevent anaerobic conditions in the base of the bund. The bund should be sown with a suitable grass mix. This should be managed at least annually to prevent the growth of woody vegetation (eg brambles).

6.11 Examples of bunds are shown below.

Insert 23 and 24: Soil Bund Example (examples from Lincolnshire and Devon)

Reinstatement

6.12 Reinstatement of topsoil at the decommissioning phase should involve the following:

(i) removal of the stone from the track, and the membrane;

(ii) subsoiling in dry conditions along the route of the track and base areas to loosen the subsoil;

(iii) replacement of dry topsoil from the bunds, levelled and cultivated;

(iv) a second light compaction alleviation, eg with a tined cultivator, if needed;

(v) sowing with a crop or grass to get rooting into the profile as soon as practicable after replacement.

7 SOLAR ARRAYS

The Areas

7.1 The PV Arrays will be distributed across the Site in accordance with the proposed layout on the supporting plans.

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 piles are off-loaded by hand, or by use of a Bobcat such as that shown below delivering piles;

Insert 25: Bobcat Delivering Legs (example from Wiltshire)

(ii) pile driving in the piles. This involves a pile driver, knocking the piles down to an appropriate depth. The machinery is shown below;

Inserts 26 - 28: 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 29 - 31: Constructing the Frame. Note this is a very low panel

7.3 The installation should be carried out when the ground conditions are suitable (ie the soil is not so wet that vehicles cause tyre marks, such as shown below, deeper than about 10cm when travelling across the land). This will normally be between April and October, which is a few weeks after soils should be dry and a few weeks before they would normally become wet. If conditions are suitable, this stage of the installation should create no soil structural damage or compaction, as shown below.

Inserts 32 and 33: Ground After Construction (example from Wiltshire)

Soil Management

7.4 As discussed earlier, the sausage test should be used to determine suitability of the soils for working or access. In simple terms, if the soil is so wet that vehicles cause tyre marks, such as shown below, deeper than about 10cm when travelling across the land, conditions are not yet suitable.

Insert 34: Track Marks (examples from Pembrokeshire)

7.5 In most years work access to the land is not restricted between April and October. Between those periods the ground conditions will normally be resilient to vehicle trafficking.

7.6 Between October and April 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, vehicular travel in these periods should be limited as much as practicable. It is recognised that rainfall is the factor that wets the soils, so a dry spring will offer different conditions to a wet spring, and this may mean that soil structural damage will inevitably result. This is outside the projected construction period.

7.7 If there is prolonged rainfall in the summer months it can saturate soils. If following a rainfall incident installation is causing rutting deeper than 10cm, activity should be minimised so far as practicable to allow soils to dry.

7.8 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 35 and 36: Horticultural Machinery

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

7.10 Grass growth will then recover or establish rapidly.

8 INSTALLATION OF ON-SITE TRENCHING

The Areas

8.1 This section refers to the cabling running within the consented area.

Construction Methodology

8.2 Cabling is done mostly with either a mini digger or a trenching machine. Trenches will typically be at depths of up to 1.0m where soil depth permits, although the CCTV trenching around the periphery could be shallower. An example trench, with the topsoil, placed on one side (0-30cm) and subsoil on the other (below 30cm), is shown below, and with the soil put back after cable installation.

Inserts 37 and 38: Cable Installation (example from Wiltshire)

8.3 It is important that topsoils are placed separately to the subsoils, and that they are then put back in reverse order, ie subsoils first.

8.4 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).

Insert 39: Machinery Used (extract from BRE Good Practice Guidance)

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)

8.5 The trenches are typically narrow (mostly 40-70cm). If the topsoil was from grassland the grass will probably recover rapidly without the need to reseed. In bare soils the trench can be cultivated with the wider area for seeding to grass post installation.

Insert 41: Grass After 4 Weeks (natural recovery)

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

Soil Management

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

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

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

Insert 41: Subsoils Dug out of the Trench

8.9 The base of the excavated trench will be lined with sand bedding imported to the site from a local licensed supplier. 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.

8.10 If dry and lumpy the subsoils will be pressed down by the bucket to speed settlement. If the soils are settling well no pressing-down is required.

8.11 The topsoil will then be returned onto the top of the trench. It is likely, and right, that the topsoil will sit a few centimetres higher than the surrounding level. This should be left to allow it to settle naturally as the soils become wetter.

8.12 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.

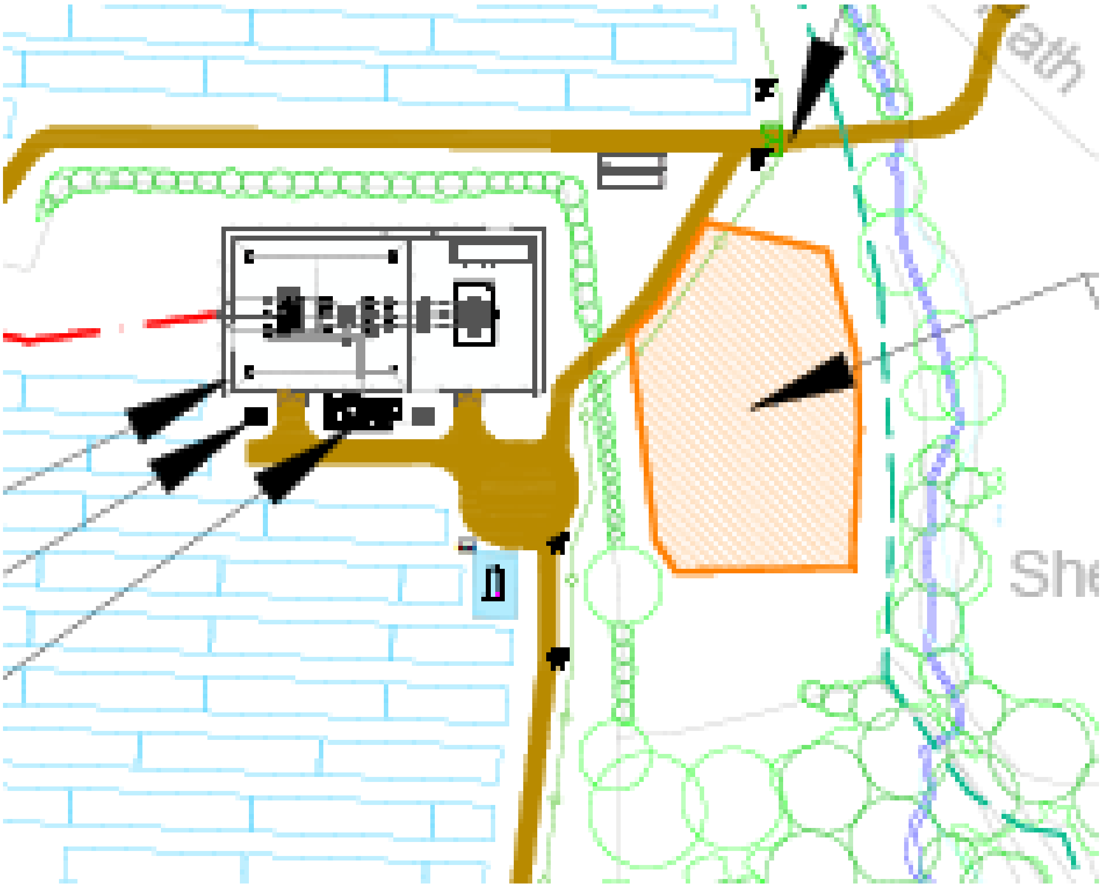
8.13 Any excess topsoil should not be piled higher than 5 – 10cm above ground level.

8.14 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 SUBSTATION AND BATTERY COMPOUND

9.1 The 33 – 132kV substation and related works.are shown below.

Insert 42: Substation Proposals



9.2 This involves an area of about 0.2 ha, measured to the hedgeline. This area will need to be level and have a hard surface.

9.3 Topsoil stripping will take place to create the area and will be stored in a bund either beside the compound or against the edge of the field.

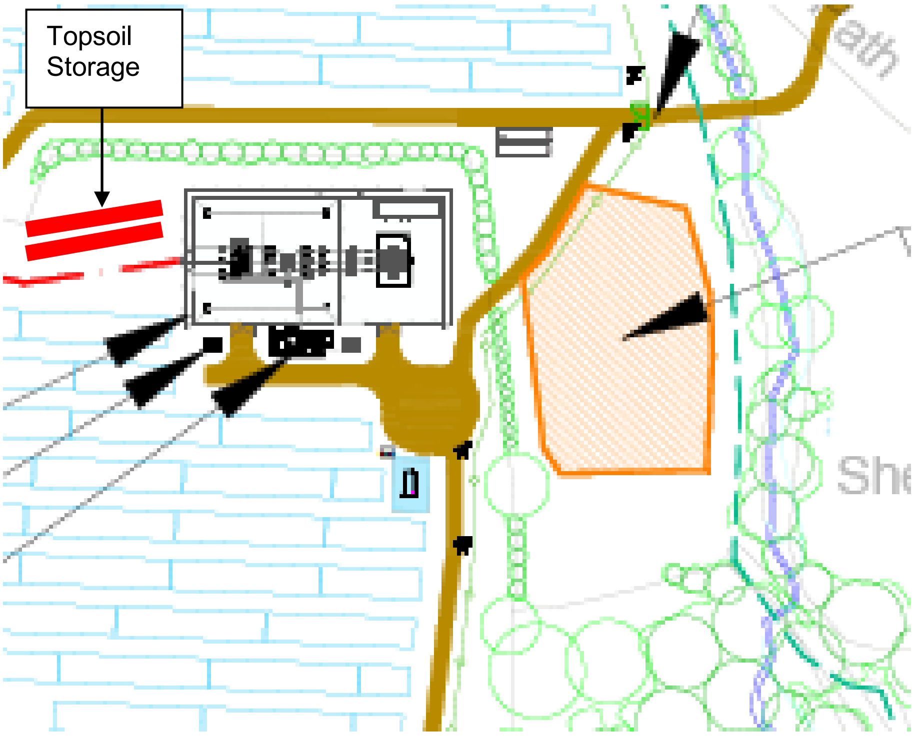
9.4 It will be necessary to level the site. This may involve a small amount of movement of subsoils within the compound area (ie cut and fill), but no subsoils will need to be stored.

Insert 43: Example of Compound in Construction (example from Lincolnshire)

9.5 The volume of topsoil for storage will be of the order of 650 cubic metres, based on a compound size of around 2,000 sqm and at a strip depth of 30cm.

9.6 Assuming a maximum bund height of 2m, and a level width of 3m at the top, with a slope of 45 degrees, the cross section will be 8 cubic metres per metre run. A bund length of the order of 80 metres in total would be required. This is indicated below, but the final location can be determined in the SMP.

Insert 44: Topsoil Storage Bunds (suggestion only at this stage)



9.7 The bund should be managed, involving being cut at least once per year to prevent woody growth (eg brambles, elder) and to maintain grass growth, as this helps dissipate runoff and prevent erosion of the sides.

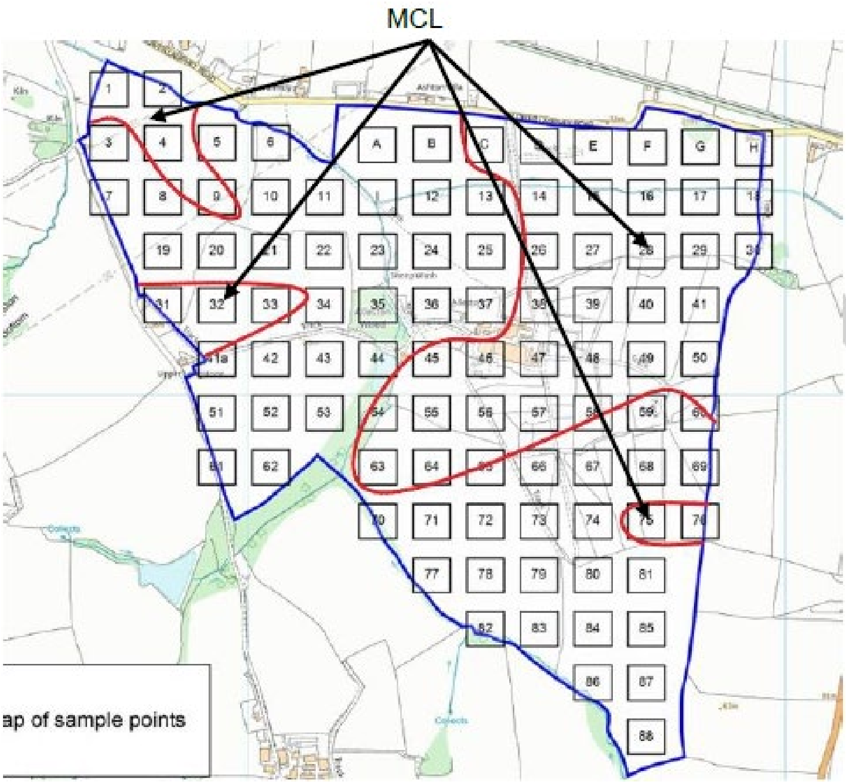
9.8 An example of long-term soil storage, this from a solar farm at Llanvapeley, Monmouth, is shown below.

Inserts 45 and 46: Long-Term Soil Storage (example from Monmouthshire)

10 FIELD-BY-FIELD MANAGEMENT

10.1 Across the wider site, the medium clay loam and heavy clay loams identified in the ALC were distributed as follows.

Insert 48: Areas of Medium Clay Loam (MCL)



10.2 The pattern is such that only Area 8, below, is fully medium clay loam without areas of heavy clay loam.

Insert 49: ALC of Panel Areas

KEY	
	Grade 1
	Grade 2
	Grade 3a
	Grade 3b
	Grade 4
	Grade 5
	Non-agricultural
	Urban
	Not surveyed

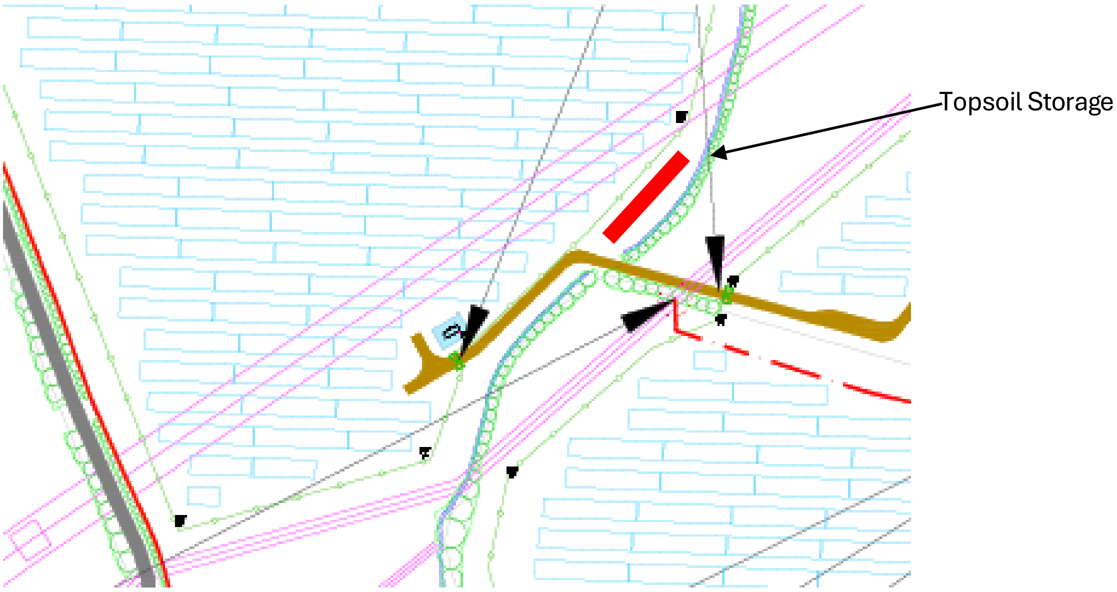
10.3 As can also be seen, only Area 8 contains wholly BMV land.

Area 1

10.4 The works to Area 1 involve the creation of a short section of track, plus the panels, as shown below.

10.5 Track construction is normally the first construction activity, and this facilitates movement around the site. Track construction should, ideally, take place between May and October, with the panels inserted between April and October, so far as possible. No land of BMV quality will be disturbed other than for cable installation. Soil removed for the track and transformer bases can be stored in a bund, potentially as indicated below.

Insert 50: Works for Area 1 (showing possible topsoil storage)

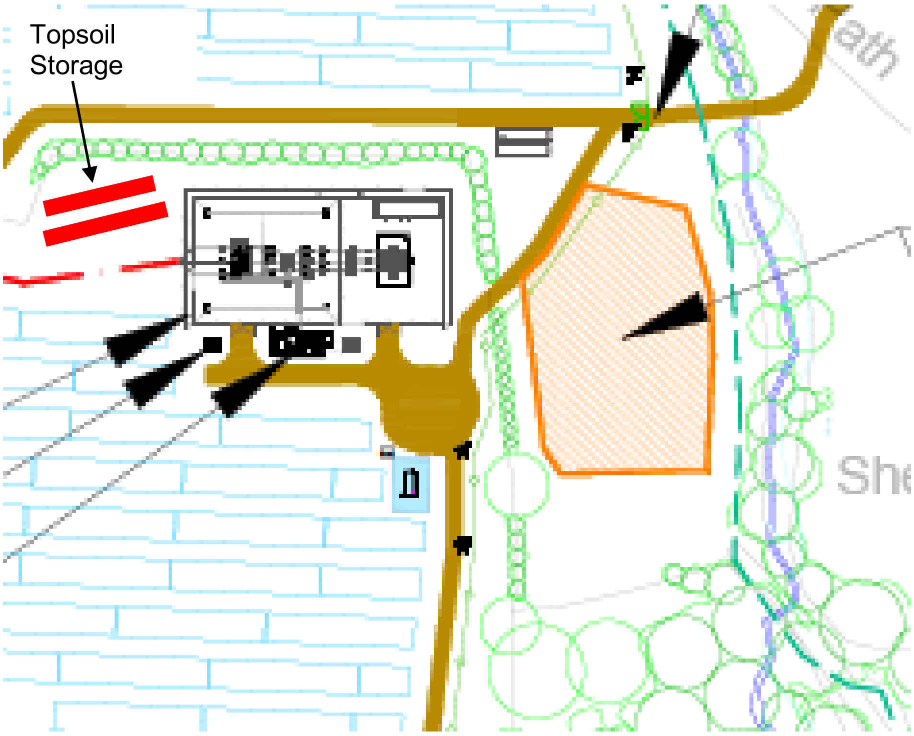


Areas 2 and 3

10.6 The works for Areas 2 and 3 include the track and the substation, as well as panels. A similar timing should be followed, so far as possible, to avoid the need for restorative soil management. It is unlikely to be possible to avoid surface damage to topsoils near the stream crossing, but early installation of the access track will minimise this.

10.7 Topsoils removed from the track and substation should be stored such that Subgrade 3a topsoils are not mixed with Subgrade 3b soils, but as all are heavy clay loams this is not critical. The suggested topsoil storage areas are shown.

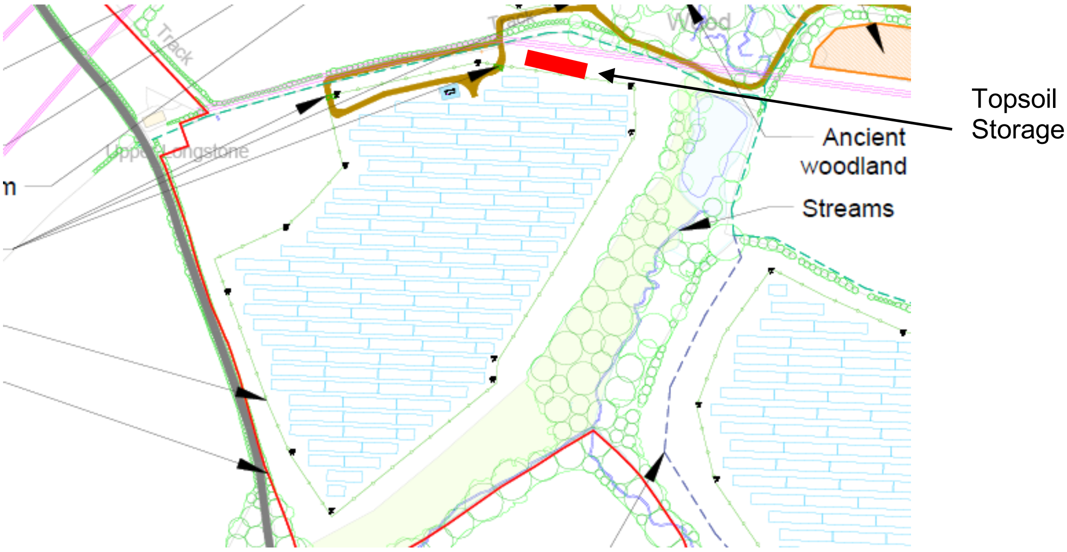
Insert 51: Works for Areas 2 and 3 Showing Possible Topsoil Storage



Area 4

10.8 Area 4 is all heavy clay loam and Subgrade 3b. The only soil removed is for a turning head. Topsoil could be stored as shown below.

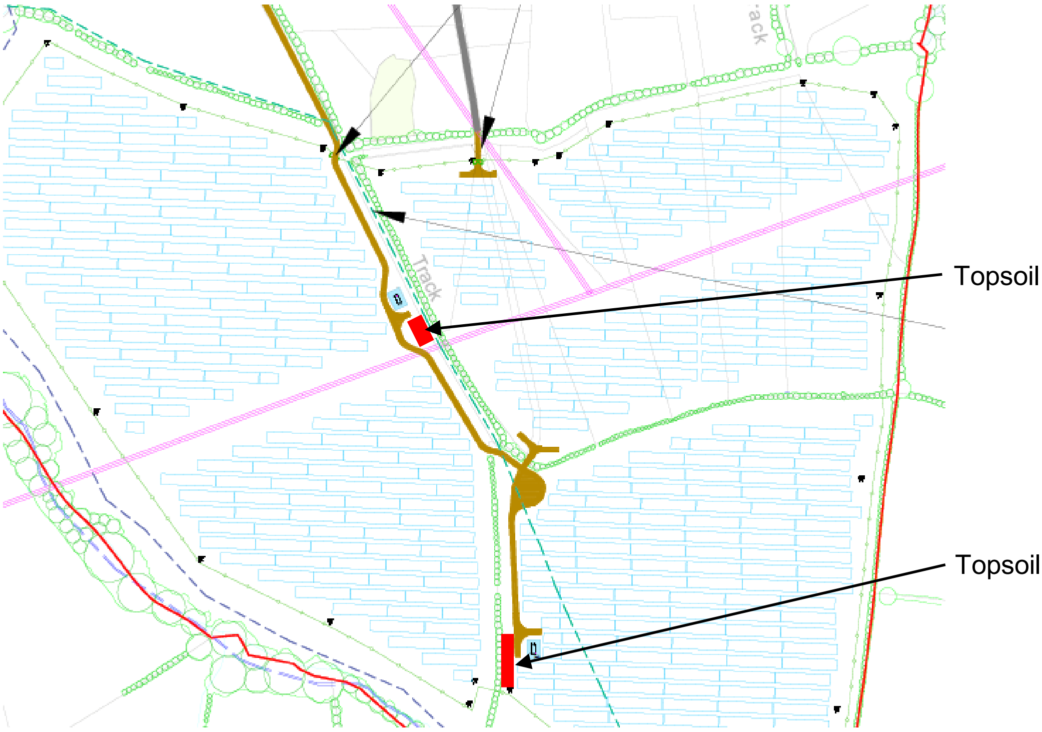
Insert 52: Area 4 (showing possible topsoil storage)



Areas 5, 6 and 7

10.9 The tracks and transformers in this area are all on Subgrade 3b land. Most of the area is heavy clay loam. Suggested topsoil storage areas are shown below.

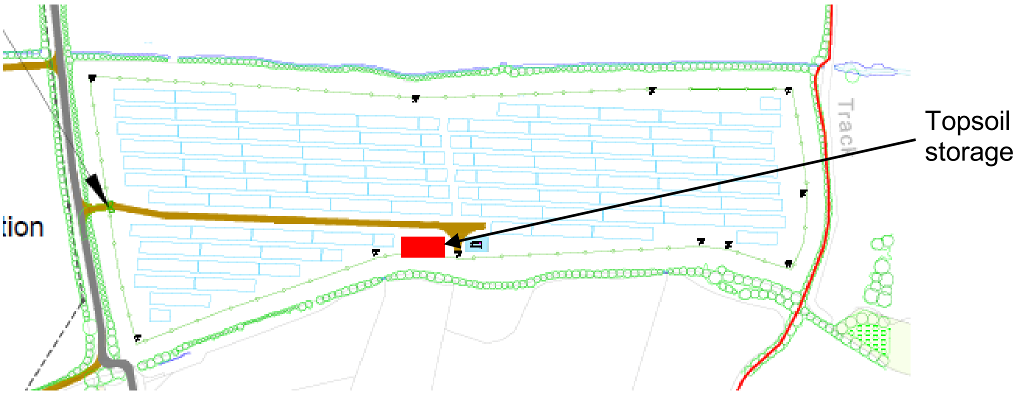
Insert 53: Areas 5 – 7 (showing possible topsoil storage)



Area 8

10.10 Area 8 is wholly of BMV quality. The area is medium clay loam, so slightly more resilient than the heavy clay loam areas. Physical disturbance will be minimal, as shown below, being just a turning head. The soil from this, about 100 m^3, could easily be stored on site, possibly as shown below.

Insert 54: Area 8 (showing possible topsoil storage)



11 OPERATIONAL PHASE: LAND MANAGEMENT

Solar PV Arrays

11.1 The land under the panels will be managed, which could include sheep grazing.

11.2 The panel design and height will permit sheep grazing, as per the example below.

Insert 55: Sheep Grazing Under Panels (example from Bedfordshire)

11.3 Any localised weed treatment can be carried out at the appropriate time of the year using a quad-mounted sprayer, or by hand using a strimmer or knapsack sprayer.

Ongoing Maintenance

11.4 There are many different cleaners on the market, some tractor based and some operated from smaller machines, such as below.

Insert 56: Cleaning of Solar Arrays (example of a machine)

11.5 All the fields are wet in places, and therefore the cleaning should be timed so far as practicable to avoid the December to April period for the site. This is normal because the objective is to clean the panels before the peak summer generating period.

11.6 If vehicles, including farm vehicles, cause ruts in the soil these will naturally repair in time, especially as there is the potential for the land to be grazed by sheep and their feet are excellent at levelling land. Alternatively, a light harrow or rolling will restore the ruts, when the soil is still soft enough to roll but hard enough to not rut more.

Insert 57: Ruts Caused by Vehicles (example from Staffordshire)

11.7 If vehicles have caused rutting it is probably, as per the example above, only localised. In the photograph above this is a wet spot, and on the land either side of the ruts within the row there is no evidence of wheel indentation. If these areas are not levelled, they will tend to sit with water in them.

11.8 Localised, small rutting should be repaired by either treading-in the edges with feet, by light rolling or harrowing, or adding a small amount of soil simply to fill-in the depression so that water does not collect there.

11.9 Deeper rutting will require either light harrowing in the drier period, or some soil adding, or both, before reseeding.

<u>Emergency Repairs</u>

11.10 For the duration of the operational phase there should be only localised and infrequent need to disturb soils, such as for repair of a cable. Any works involving trenching should be carried out, ideally, when the soils are dry but recognising that any works will be those of emergency repair, that may not be possible.

11.11 Accordingly if new cabling is needed and has to be installed in wet periods, soil will need to be disturbed, such as the example below.

Insert 58: Trench During Wet Period (example from Bedfordshire)

11.12 Any area disturbed should be harrowed or raked level once the soils have dried and be reseeded. These areas will be small, and this can probably be done by hand.

12 OPERATIONAL PHASE: SOIL STORAGE

12.1 The critical part of successful long-term storage of soils is to place the soils into storage bunds when the soils are dry.

12.2 Ongoing maintenance should ensure that the bunds remain free from woody vegetation (eg brambles, elder) and that the soil bunds do not erode. For this reason, the bunds should be seeded with a grassland mix, as the roots of the grasses will help bind the surface and prevent water channels forming.

12.3 At least once per year the bund should be managed, ideally by mowing or strimming.

12.4 An example of a bund that is seven years old, is shown below.

Insert 59: Soil Bund Example (example from Monmouthshire)

13 DECOMMISSIONING PRINCIPLES

13.1 The effects of climate change in 40 years' time may mean that these dates applicable in 2024, are no longer applicable.

13.2 The objective is to remove panels and restore all fixed infrastructure areas to return the land to the same ALC grade and condition as it was when the construction phase commenced.

Removal of Panels

13.3 A qualified soil scientist should advise prior to decommissioning time. The effects of climate change in 40 years' time may mean that these dates, applicable in 2024, are no longer applicable.

13.4 Once the panels have been unbolted and removed, the framework will then be a series of legs, as shown below.

Inserts 60 and 61: The Framework (examples from Wiltshire and Nottinghamshire)

13.5 These will be removed by low-ground pressure machines, in a reverse operation to the installation. These machines will provide a pneumatic tug-tug-tug vertically upwards. This will break the seal between soil and leg, and once that surface tension is released the leg will come out easily.

13.6 The legs will be loaded onto trailers and removed.

13.7 There will be no significant damage to the soils, and no significant compaction.

<u>Removal of Cables</u>

13.8 Cables buried less than 1 metre deep will be removed. This is likely to need a trench to be dug. This will be done is done mostly with either a mini digger or a trenching machine. Cabling will mostly be at depths of 0.8m where soil depth permits, although the CCTV trenching around the periphery could be shallower. An example trench, with the topsoil placed 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.

Insert 62: Example Trench

Insert 63: Topsoil Replaced

13.9 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).

Insert 64: Machinery Used for Trenching

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)

13.10 Once the trench has been backfilled it can be left for cultivation with the rest of the field post removal of panels.

Removal of Fixed Infrastructure

13.11 Switchgear, such as that shown below, will need to be removed.

Insert 65: Switchgear

13.12 Low ground pressure vehicles, and cranes, will be needed to lift the decommissioned units onto trailers, and removed from site. An example is shown below.

Insert 66: Example of Low Ground Vehicles

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

13.12 Any concrete bases will need to be broken up. This will most likely involve breaking with a pneumatic drill to crack the concrete, after which it can be dug up and loaded onto trailers and removed.

13.14 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 67 and 68: Example of Tractor Mounted Equipment

Tracks

13.15 The tracks will be the last fixed infrastructure removed. The tracks will have been used for vehicle travel during the decommissioning stage. The tracks will also be used for removal of material from the tracks themselves, which will be removed from the furthest point first.

13.16 The stone will be removed and any matting removal. The base will then be loosened by subsoiler or deep tine cultivators, depending on specific advice given by the soil expert at the time following and analysis of soil compaction and condition.

Reinstatement of Soils

13.17 Topsoil from the storage bunds will then be returned and spread to the depth removed (typically 10-15cm). The area will then be cultivated, probably in combination with the whole of each field.

Fences and Gates

13.18 This will be removed in the summer months, after the panels have been removed. This will involve a tractor and trailer. The CCTV cabling is shallow buried and will probably pull out without the need for trenching, but if required tranches will be dug, as described above, and replaced in order once the cables have been removed.

Cultivation

13.19 The fields will be handed back to the farmers. Whether they are handed back as grassland or sprayed off and cultivated, will be determined in discussions with each landowner.

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