Mallard Pass Solar Farm

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Applicants Updated Outline Soil Management Plan (oSMP) [Tracked]

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MALLARD PASS SOLAR FARM, ESSENDINE

OUTLINE SOIL MANAGEMENT PLAN

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KERNON COUNTRYSIDE CONSULTANTS LIMITED

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MALLARD PASS SOLAR FARM

OUTLINE SOIL MANAGEMENT PLAN

Table of Contents

1 INTRODUCTION

1.1 This document provides an outline Soil Management Plan (oSMP) for Mallard Pass Solar Farm (hereafter referred to as 'the Proposed Development'). A SMP will be produced for the Proposed Development in accordance with a Requirement of the Development Consent Order (DCO) prior to commencing construction, which will be required to be in accordance with this oSMP submitted as part of the DCO Application.

1.2 The measures proposed within the oSMP will be agreed upon prior to the commencement of construction and decommissioning works with the relevant local planning authority. The SMP will be prepared following the appointment of a principal construction contractor, prior to the start of works and in accordance with this oSMP.

1.3 This oSMP covers the principal construction and decommissioning activities envisaged at the time of preparing the ***Environmental Statement (ES)*** **[EN010127/APP/6.1].** This oSMP is intended to be a live document, such that modifications and necessary interventions can be made as construction and decommissioning is carried out.

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 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. A suitably-experienced soil specialist will be engaged to advise on soil handling, including advising on when soils are sufficiently dry to be handled, as required.

1.5 The Order limits are shown on Figure 1 and described in ***Chapter 3: Description of Order Limits*** of the ES. They comprise the Solar PV Site, Mitigation and Enhancement Areas, Highway Works Site and the Grid Connection Corridor.

1.6 The Proposed Development and construction activities are described in ***Chapter 5: Project Description*** of the ES.

1.7 Large areas within the Order limits do not involve any movement or trafficking (being passed over by vehicles) of agricultural land and soils, and will remain in agricultural use. This oSMP, therefore, focuses on the areas required temporarily during construction, the access tracks and areas associated with the Solar Stations, the PV Arrays, onsite trenching and site fencing. It does not cover the retained arable fields within the mitigation and enhancement areas because no soil movement will be involved and the oCEMP includes a measure to control trafficking within the mitigation and enhancement areas.

1.8 An outline Excavation Material Management Plan (oEMMP) has been prepared in support of this oSMP. The oEMMP sets out how excavation waste will be handled. EMMPs (based on the oEMMP) will be prepared alongside the SMPs, both of which will be produced for each phase (or more than one phase) of the Proposed Development pursuant to a Requirement of the Development Consent Order (DCO) prior to commencing construction.

Purpose of this document

1.9 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.

1.10 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 Solar Stations;
- section 7: the PV Arrays;
- section 8: onsite trenching;
- section 9: site fencing;

(v) section 10 sets out monitoring and aftercare.

1.11 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 This oSMP covers the construction and decommissioning phases of the Proposed Development. Operational activities such as the maintenance of soil mounds are covered by the ***outline Operational Environmental Management Plan (oOEMP)*** **[[EN010127/APP/7.7].** There is no requirement for an oSMP for the operational phase, as there should be no requirement to disturb or move soils.

2.2 For the majority of the Order limits there will be no movement of soils. This oSMP 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; and
- a methodology for monitoring soil condition, and criteria against which compliance will be assessed.

2.3 The installation of the Mounting Structures, and the assembly of the PV Tables, 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 oSMP covers vehicle movements, trenching, foundations and related impacts.

2.4 Trenching works to connect the PV Tables to the Solar Stations and Onsite Substation 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 within the Solar Stations. 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;
- 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 and the decommissioning phase. 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 retained arable fields within the mitigation and enhancement areas because there will be no stripping or movement of soils and the oCEMP includes a control measure to control trafficking within these areas. Where there is an internal access track within the mitigation and enhancement areas, vehicle movements will be restricted to the access tracks.

3 SOIL RESOURCES AND CHARACTERISTICS

Climatic Conditions

3.1 The climatic data for the area, using the climate data set for Agricultural Land Classification (ALC), shows annual rainfall between 575 and 590mm across the Order limits.

3.2 Soils are at field capacity, ie replete with water, for usually 104 - 111 days per year, 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 Soil surveys and ALC surveys (part detailed, part semi-detailed) have been carried out across the area within the Order limits (see ***Chapter 12: Land Use and Soil*** of the ES. No survey has been carried out of the Grid Connection Corridor, which is part of National Grid's land and is not in agricultural use.

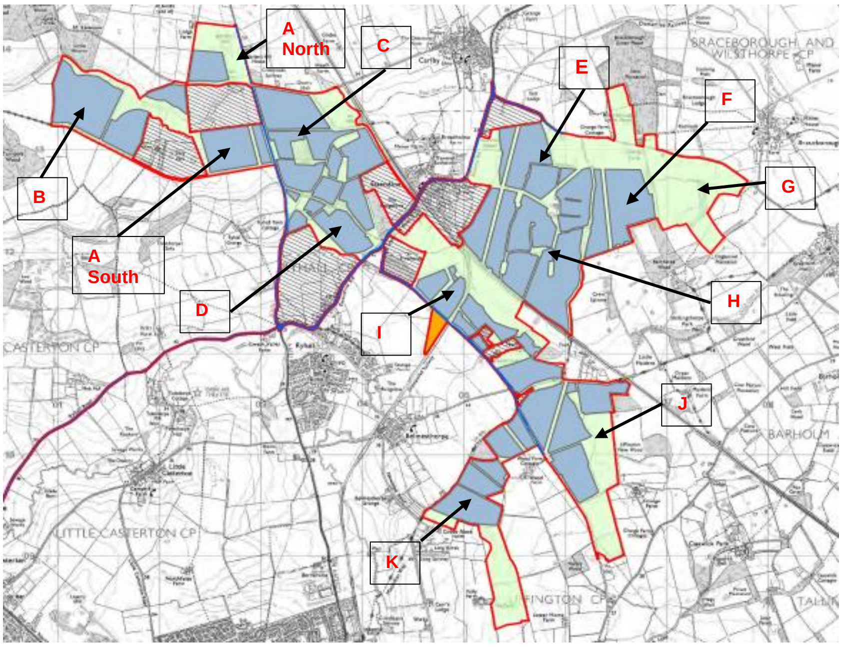
3.4 The results of the ALC survey are set out in an ***Appendix 12.4: ALC Survey*** of the ES Appendices **[EN010127/APP/6.2]** and shown in ***Figure 12.1*** of the ES Figures **[EN010127/APP/6.3].**

Extent and Depth of Topsoil Units and Soil Types

3.5 As set out in the ALC, the soils within the Order limits are predominantly developed over limestone of a number of different geological types and are quite variable spatially over short distances, e.g. due to variations in soil depth to impenetrable rock, stone/rock content and wetness class. This leads to a quite complex pattern of ALC Grade 2, Subgrade 3a, Subgrade 3b and Grade 4. This is due to a combination of factors, particularly soil droughtiness and topsoil stone content on Elmton and Sherborne soils over limestone, and soil wetness on wetter and heavier (clayey) Denchworth soils over mudstone and Fladbury soils developed in river alluvium.

3.6 For ease of assessment, the soil survey divided the Order limits into eleven parcels as shown on the plan below. This is derived from the soil information and properties assessed as part of the ALC and soil survey, including auger and pit evaluation.

Insert 1: Survey Areas Identified



3.7 The predominant soils for the topsoil and upper subsoil in each area are recorded in the table below.

Table 1: Predominant Soil Type

Area	Topsoil		Upper Subsoil	
	Depth (cm)	**Predominant Texture**	**Depth (cm)**	**Predominant Texture**
A (North)	0-35	HCL/C	30-60 (occ deeper)	C
A (South)	0-35	MCL and HCl	35-60	MCL/HCL/C
B	0-35	MCL and HCL	35-60+	MCL/HCL/occ C
C	0-35	MCL/HCL, C to the south	35-50+	C
D	0-25	HCL/C	25-50	C,
E	0-30	MCL/HCL/C	30-50+	C, occ SLC
F	0-30	MCL/C	30-60	HCL/C
G	0-30	MCL/HCL	30-60	MCL/HCL/C
H	0-25/30 (variable)	MCL/HCL/C	25-50+	HCL/C
I	0-25	C	25-50+	C
J	0-25	HCL/C	25-50+	C
K	0-30	C	25-50	C

C - Clay

HCL - Heavy clay loam

MCL - Medium clay loam

SCL - Sandy clay loam

Propensity to Damage

3.8 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.

3.9 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.

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 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 Soils will need to be moved and disturbed to create temporary working compounds, and to create the access tracks and small fixed infrastructure bases within the Solar Stations. The effects on agricultural land quality and soil structure may also arise from 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.

4.24.3 Soil handling, movement and trafficking will be undertaken under the supervision of an appropriately experienced soil specialist to advise on and supervise soil handling, including identifying when soils are dry enough to be handled.

4.34.4 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

4.44.5 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 dry, then damage from vehicle trafficking and trenching will be minimal.

~~4.5~~4.6 The soils are relatively resilient to vehicle passage for much of the year. Under the ALC the field capacity period, ie the days in the year when soils are saturated, is about 104112 to 1118 days per year. This is normally between the beginning of November and the end of February.

4.64.7 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 trenching has been completed. As much advance-sowing of the Site as possible will be carried out. This will not be possible in all areas and the decision over which areas to sow will be a local decision, to be taken closer to the start of works. 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.

4.74.8 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.

4.84.9 The general objective should be that construction activities requiring vehicles to travel across open fields should be limited between November and the end of February, or outside of that period if the ground conditions are clearly not suitable and vehicles are causing ruts.

4.94.10 Similarly 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 too. 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.

4.11 Soils that are too wet can usually be rolled into a sausage shape, such as shown below, or become rutted when trafficked, as shown in the photographs below. If water is sitting in the tramlines or standing on the surface of the land the soils will likely be too wet for handling. These soils often stick to boots when crossing arable land.

Photos 1 to 3: Soil When too Wet for Handling

~~4.10~~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

4.114.13 The successful installation of cabling at depths of up to 130cm 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 B**) 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**".

4.124.14 In those areas where the soil is dug up (trenching and for compounds and access tracks), 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.

4.16 Areas of the Order limits which are not to be stripped or used for stockpiling, access tracks or construction compounds, will be clearly marked by signs and barrier tape to avoid trafficking.

Ameliorating Compaction

4.134.17 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.

4.18 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 2 and 3: Inter-row Ground Restoration

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

Inserts 4 – 7: Type of Machinery Involved

~~4.15~~4.20 If there are any areas within the Order limits 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.

~~4.16~~4.21 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.

~~4.17~~4.22 Accordingly the ground surface should be generally levelled prior to any seeking or reseeding.

Storing Soil and Restoring Soil

4.23 Soil removed from an area should, so far as possible, be replaced in the same area. This will minimise the potential for soil variability, which can affect the way fields (especially arable fields) are farmed. Therefore, soil storage should either be close to where the soil will be restored, or otherwise well labelled and recorded so that the soil can be replaced as close as possible to where it originated from.

4.184.24 The quantities of soil involved are limited and topsoil mounds would be a maximum of 1.5m high. This will not result in the soil becoming anaerobic even in storage in a mound for 25 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 C**. 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 ***oOEMP*** and ***oLEMP***.

4.25 The proposed stockpile locations, volumes and soil type(s) will be set out in the SMP (s) prepared at detailed design of the Proposed Development. Stockpiled soils will be labelled and protected from trafficking. Any soil stockpiles in place for more than 6 months will be seeded.

4.26 Temporary soil heaps will be stored at least 10 metres from watercourses to avoid the risk of sediment pollution.

4.27 The restoration will ensure that soil is returned as close as possible to the area from where it came, and to the same profile as the land adjacent to the restored area. This will result in the soil profile and land quality being returned to the comparable quality and properties of the adjacent land.

5 TEMPORARY ACCESS AREAS AND COMPOUNDS

Construction Methodology

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

5.2 The top 10-15cm of topsoil is removed by machinery and stored in a low mound 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.

Soil Management

5.3 Construction will commence when soils are suitably dry to be moved without smearing. This will normally be between the beginning of March and the end of October for the medium clay areas, and from mid-March to late October for the clayey areas.

5.4 Prior to the commencement of stripping soils any tall vegetation shall be removed.

5.5 Areas for temporary works, including any construction compound or access track if required, will be stripped to a depth of circa 10 - 15cm or deeper if necessary. The soil will be stockpiled to the side of the area ready for restoration (likely to be a matter of months later).

5.6 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.

5.7 For restoration the stone and matting will be removed. A soil advisor should review this area once the matting is removed. 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 8 and 9: Harrows and Power Harrows

5.8 Horticultural-scale equipment is available that could run between the PV Tables if necessary.

6 ACCESS TRACKS AND SOLAR STATIONS

6.1 Prior to constructing tracks any tall vegetation will be removed. The access tracks are then 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.

6.2 The topsoil will be stored in mounds up to 1.5m high, as described below. A typical mound is shown below, with a maximum height limit to ensure that soils in the centre remain aerobic. Where storage is to be long-term (six months or more) these mounds should be seeded with a suitable grass seed mix.

Insert 10: Typical Soil Mound

6.3 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 C**.

6.4 The equipment within the Solar Stations normally stand on concrete bases. As these areas will be restored in the future, the construction is carried out in accordance with the Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites as follows:

(i) tall vegetation / crops should be cleared prior to topsoil stripping.

(i)(ii) Depending upon the depth required for the base, the full depth of topsoil will be removed. In some cases a lesser depth of removal will be appropriate. This will be stored in a mound no more than 1.5m high at an agreed location, for use in future restoration;

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

(iii)(iv) the equipment is then placed on top;

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

6.5 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.

6.6 The inverters and other heavy equipment is delivered to the Order limits and taken to the concrete pad areas by low-ground-pressure agricultural equipment, such as that shown below (courtesy of BSR), or along the access tracks.

Insert 11: Low Ground Pressure Agricultural Equipment

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

Soil Management

6.66.7 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.

6.76.8 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).

6.86.9 The removed soil should be stored in mounds in accordance with the Construction Code of Practice. The SMP will need to identify the location and profiling for the mounds. Mound heights of circa 1.5m maximum will normally be suitable. These mounds need to be recorded and labelled appropriately so that the soils can be returned as close as possible to the areas from where they were removed, at the restoration stages.

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

6.106.11 These areas need to be managed at least annually to prevent the growth of woody vegetation, such as brambles or shrubs, in accordance with the ***oOEMP*** and ***oLEMP***.

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

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

6.136.14 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 12 and 13: Tractor Mounted Equipment

~~6.14~~6.15 About 4 weeks before restoration takes place the mounds should be strimmed (in accordance with the ***oDEMP*** which requires ECoW supervision) and any grass and weed growth removed, and the remaining vegetation should be killed off.

~~6.15~~6.16 The soil can then be spread over the subsoiled base, and made good with standard spring-tine harrow or power harrow machinery.

7 PV ARRAYS

Construction Methodology

7.1 The process involves the following stages:

(i) marking-out and laying out of the framework of the Mounting Structures. 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 14: Bobcat Delivering Legs

(ii) pile driving in the legs. This involves a pile driver, knocking the legs down to a maximum 2.5m. The machinery is shown in the inserts below.

Inserts 15 – 17: Pile Driving in the Legs

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

Inserts 18 - 20: Constructing the Mounting Structure

7.2 The Mounting Structure upon which the PV Modules will be mounted will be pile driven or screw mounted into the ground to a maximum depth of 2.5m, subject to ground conditions. The option to install concrete blocks known as "shoes" may also be considered, avoiding the need for driven and screw anchored installation, therefore minimising ground disturbance. Provided that 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), these construction activities will not result in any structural damage or compaction of soils.

Inserts 21 and 22: Ground After Construction

Soil Management

7.3 Distribution of PV Modules can commence, assuming that soil 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).

Insert 23: Track Marks

7.4 In most years work can start from the beginning of March in the medium clay areas, and from a week or two later (ie mid-March) in the clay areas. See **Appendix A**. Distribution of PV Modules can then continue until the end of October in most years.

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

7.6 It is very unlikely that trafficking during construction 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 24 and 25: Horticultural Machinery

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

Inserts 26 and 27: Inter-row Ground Restoration

8 INSTALLATION OF ON-SITE TRENCHING

Construction Methodology

8.1 Cabling is done mostly with either a mini digger or a trenching machine. Trenches will mostly be at depths of 0.8 – 0.9m and can be up to 1.3m, 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 28 and 29: Cable Installation

8.2 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 30: Machinery Used

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)

8.3 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 (Insert 31), taken 4 weeks after the trenches were back-filled, shows.

Insert 31: 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

8.4 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).

8.5 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.

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

Insert 32: Subsoils Dug out of the Trench

8.7 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.

8.8 The subsoils will be pressed down by the bucket to speed settlement.

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

8.10 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.

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

8.12 A suitable grass seed mix should be spread by hand over any parts of the trenches in accordance with the ***oLEMP***.

9 SITE FENCING

Construction Methodology

9.1 Fence is likely to be a 'deer fence' (wooden posts and metal wire mesh) and will be up to 2m in height. 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 PV Arrays. Access gates will be of similar construction and height as the perimeter fencing.

9.2 This can be erected at any time, if soil conditions allow. The following photographs show the fencing installed early in the process.

Inserts 33 and 34: The Fencing

9.3 Similarly CCTV poles are inserted in the same way.

Insert 35: CCTV Pole and Fencing

Soil Management

9.4 If the movement of vehicles is not causing significant rutting (ie 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 MANAGEMENT AND MONITORING

10.1 The ***oOEMP*** and ***oLEMP*** set out how the grassland under the PV Arrays are likely to be managed during operation of the Proposed Development.

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

Appendix A

Distribution of Soil Types

KEY	
	Heavy Clay Soils
	Medium Clay Soils

PLAN	KCC3051/05		
TITLE	Distribution of Soil Types		
SITE	Mallard's Pass		
CLIENT	LDA Design		
NUMBER	KCC3051/05 07/22tk		
DATE	July 2022	SCALE	NTS

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Appendix B

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

BRE National Solar Centre would like to sincerely thank colleagues from the following organisations who have made significant contributions to the development of this guidance:

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
[redacted]

BRE Trust
The BRE Trust uses profits made by BRE Group to fund new research and education programmes, that will help it meet its goal of 'building a better world together'.

Appendix 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.

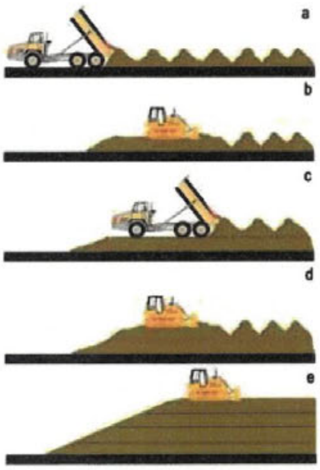
10. Method 2 should be applied if the construction programme or prevailing weather conditions result in soil having to be stockpiled when wet and/or plastic in consistency. This method minimises the amount of compaction, while at the same time maximising the surface area of the stockpile to enable the 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

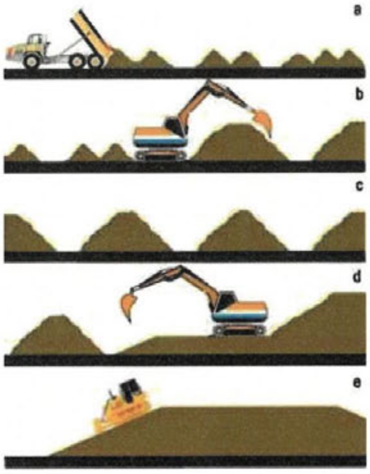
The soil is loose-tipped in heaps from a dump truck (a), starting at the furthest point in the storage area and working back toward the access point. When the entire storage area has been filled with heaps, a tracked machine (excavator or dozer) levels them (b) and firms the surface in order for a second 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

Appendix D

Outline Excavated materials Management Plan

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