Greatford Parish Council Deadline 9 submission.

Comments upon the proposed 60 year time frame of the Mallard Pass solar farm development, the and effects at decommissioning upon future ALC grading and soil quality.

Summary:

These comments are made with reference to ADAS report 'The impact of solar photovoltaic (PV) sites on agricultural soils and land quality' Date: March 2023 Report code: Work Package Three SPEP2021-22/03.

The ADAS report detailed above report raises significant concerns regarding the soil disturbance caused by the installation of piles to support solar arrays, and more significantly the removal of piles at decommissioning 40 to 60 years later.

Concerns centre around the likely corrosion that will occur during the proposed 60 year life of the development, how piles will be removed at decommissioning, and how this could affect the future ALC grading of the soils, and specifically the significant proportion of BMV soils across the proposed site.

The report also raises concerns regarding compaction and how this could affect future ALC grading if it occurs during construction, operation or decommissioning; and also how soils beneath solar panels will degrade through lowered biological activity through restricted water and light during the life of the proposed development.

1. Section 2.4.2 of the ADAS report states:-

"The number of piles required is determined by the site layout. One case study in WP2 gave the number of piles as 492 piles per ha. Many planning applications for solar PV sites usually include an elevation plan of the solar panel and give the number of PV panels as an illustration, but not the number of piles required".

Clearly the number of piles deployed for the construction of the proposed development will directly affect the degree of land disturbance and potential ALC downgrading at decommissioning, particularly after 60 years when there will be a high degree of corrosion to the supports which in all likelihood will have to be dug out of the ground as corrosion will make it too difficult or impossible to pull them out.

1.1 Section 2.4.5 of the ADAS report states:-

"The extraction of the piles is likely to be more problematical than the initial installation (per. comm. P. Woodfield, Technik GS). Pile extraction is undertaken typically with a 13-ton excavator and vibrating pile driver attachment, which removes one beam and then tracks to the next one (per. comm. I. Woolley, Twig Group). A vibrating plate shakes the soil at removal stage, to ensure that the soil stays in place with little disturbance as the H beam is lifted out of the ground, this reduces the risk of soil attaching to the H beam and resulting in a larger area lifting.

In clay soils there will be softening and swelling to close the void overtime partially or wholly. Plugging can occur in clay soils where the soil may stick to the pile and be withdrawn with the pile, in effect pulling out a solid unit defined by the flanges and width of the pile. The volume of the soil pulled out is greater than in sandy soils and can produce a local ground settlement as soil swells or collapses to fill the void unless measures are taken to fill the void at the time of withdrawal. The clay or soil adhering to the pile can be cleaned off and returned to the hole and then the void is minimal *as bulking takes up part of the volume, but this may mix topsoil and subsoil unless carefully managed."*

Topsoil & subsoil mixing during pile extraction (if they can be extracted without breaking off after 60 years) would lead to downgrading of the ALC after decommissioning. Also a depression left where each post was could lead to localised wet areas (puddles) across the site which would also affect the future ALC.

1.2 The ADAS report then goes on to state:-

There is no known reported experience of pile pull out within the solar industry in the UK. A study of civil structures in Japan, where the ground is 'soft' and many structures use pile foundations, reported that 'filling' the void was effective in reducing ground subsidence and that the 'filler' must suit the ground conditions (Inazumi et al, 2017). At this stage in the life of the ground-mounted solar PV industry, the impact of pile pull-out on agricultural land and soil is a 'grey' area with few conclusions having been drawn to date.

A precautionary approach should apply here? There is no experience of pile extraction in the solar industry and certainly no experience in extracting 40 or 60 year old piles.

Perhaps an answer would be to install additional 'sample' piles across the different soil types of the site, and these could be extracted every 5 years to assess the level of corrosion and to ascertain when the cross over between pile 'pulling' and the requirement to dig piles out digging might be? This could be a method of determining the lifespan of the site?

Post replacement is not factored into any of the developments plans, post replacement should be considered alongside panel replacement. Removing and / or replacing posts will have a detrimental impact upon both ALC grading and also any archaeology that is in the vicinity of the posts supporting the solar arrays if / when they need to be removed or replaced.

2. Section 2.4.4 of the ADAS report states:-

"During the operational life of a solar PV site there is likely to be minimal disturbance of the site. The wooden posts of deer/security fencing will require replacing through the lifetime of the development due to rot. Frequency of replacement will be greatest in wet or exposed sites. Excavation of the post hole will be required and then re-compaction of the soil leading to localised compaction around the hole and along the access track".

The wooden fence posts described in the application from Mallard Pass solar farm are likely to be require replacement every ten years or so to remain serviceable. During the 60 year life of the development the posts could be replaced 5 or 6 times, presumably not in the same place, which would result in a significant amount of compaction along the fence lines of the development. Compaction is to be avoided as it cannot be remediated easily in this situation and affect the permeability of the soils.

2.1 Section 2.4.4 of the ADAS report also states:-

"Land between and underneath the PV panels is often grazed by sheep and where there are high numbers of sheep a solid compaction layer 2 cm to 6 cm over a wide area may result (Defra, 2021). There is likely to be some instances of run-off from the solar panels, which could result in the

compaction of soils at the base of the panels (Choi et al,2020). Over time rivulets can form along the trailing edge of the panel with potential risk of soil erosion creating rills and gullies across the site."

The report evidences these findings with the following image showing an example of poor vegetation establishment and soil erosion beneath solar panels in the first year of operation..

Figure 6: Channels created by panel runoff within 12 months of site operation commencing

The above image shows a situation where foliage has failed to develop underneath the solar array. This is highly likely to be the situation where grassland establishment takes place after construction (as indicated in the GEMP). If this is how poorly established vegetation looks after 12 month then in subsequent years it will be very could be much worse.

Until vegetation is established, the rainwater falling onto the panels will erode the unprotected soil beneath the panels and carry it as surface runoff into the ditches, and ultimately the West Glen river that drains the proposed development site. This will increase the risk siltation and flash flooding downstream of the proposed development.

2.3 Section 2.5 of the ADAS report states:-

"The main cause of compaction is the compressive forces applied to the soil from the wheels or tracks of machinery. Hakansson (1985) found that an axle load of 10 tonnes increased soil bulk density to a depth of 50 cm. Compaction may be very persistent in the subsoil and possibly permanent (Hakansson et al 1988). Where there is 'industrial compaction' the depth of compaction can extend to depths of 1m (Spoor, 2006) and may persist for up to 30 years (Batey, 2009).

Field identification of soil compaction includes evidence of waterlogging on the surface or in subsurface horizons, an increase in soil strength or bulk density, low visible porosity, poor structural conditions, soil colour and rooting pattern (Batey, 2009).

Techniques for loosening compacted soils to depths of about 45cm are established, but at lower depths correcting problems may not be effective and economic and engineering equipment is required. As well as the forces applied to the soil, the soil water content and bearing capacity are critical at the time the pressure is applied – this is true for both the instance of compaction and the alleviation of compaction.

The impact of soil compaction is well documented (Batey, 2009) and crop growth, yield and quality may be adversely affected. There are also wider environmental implications relating to water and air quality".

Wet soils can become anaerobic and in these situations methane is produced (reference to air quality). Methane is 80 time more potent than CO_2 as a GHG. If MP cause significant compaction leading to a slowly permeable layer (SPL) in the top soil then the organic carbon cycling through the soil could be released as Methane.

3.0 Section 3 of the ADAS report details several possible scenarios where a soil is compacted during construction. Relevant extracts from these scenarios are as follows:-

"The scenarios assume that unremediated (sub)soil compaction has resulted in a slowly permeable layer (SPL) at a shallower depth in the soil profile than was previously the case. The depth to a SPL is key to assessing soil water regime and ultimately ALC grade according to soil wetness. A SPL prevents the downwards movement of water in the soil profile and can lead to surface water perched at shallow depth for periods of the year, particularly autumn through to spring, and particularly problematic in wetter soil types or wetter areas of England and Wales. This can negatively impact the flexibility of agricultural land, potentially lowering quality and ALC grade".

If significant compaction occurs during the construction phase the soils across the proposed development site will be wetter for longer periods of time as drainage will be impeded and a SPL cold be introduced. A soil that is wet for long periods of time will be less flexible and more problematic for cultivation which will lead to a reduction in a future (post decommissioning) ALC grade.

3.1 A further scenario within Section 3 of the ADAS report deals with compaction and soil droughtiness:-

"A similar set of scenarios could be made of the potential residual impact of unremediated (sub) soil compaction on ALC grade according to soil droughtiness. The assessment of soil droughtiness considers climate, soil texture and, again, soil structure, consistency and porosity."

A compacted layer that restricts plant rooting and therefore access to soil water (and nutrients) which will increase soil droughtiness and reduce any future ALC grade. A similar situation can be observed in a potato crop when cultivations have taken place in slightly too wet conditions.

3.2 Section 3.2.2 of the ADAS report states:-

"Several scenarios for 'undisturbed' soils are presented in Appendix 5 (Table B) to demonstrate the residual impact of an introduced SPL (caused by unremediated subsoil compaction) on BMV agricultural land. For 'undisturbed' soils reference is made to soil colour (gleying), textural, structural and porosity characteristics for determining the soil wetness limitation."*

* Gleying is the reduction of iron in the absence of oxygen (ie in wet anaerobic soils) and produces a grey layer in the soil. The orange compounds associated with rusting are iron reduction in the presence of oxygen. Soil scientists will deduce that a grey layer in a soil indicates it has been wet for prolonged periods of time.

Several scenarios are presented where compaction has led to an SPL being present during the life of solar farm, and how this will affect ALC grading post decommissioning.

The extract below focusses on the scenario deemed most relevant to the MP site.

"For 'undisturbed' soils reference is made to soil colour (gleying5), textural, structural and porosity characteristics for determining the soil wetness limitation.

The scenario is a pre-construction soil profile placed in Wetness Class I, which has a medium textured topsoil:

In a drier part of England, with an FCD of 125, where there is gleying present below a depth of 40cm and a slowly permeable layer starting between a depth of 35cm to 42cm the soil at decommissioning is placed in Wetness Class III and Subgrade 3a. Prior to commissioning the ALC grade is given as Grade 1, hence there is an impact on the versatility of the BMV land at decommissioning."

This section of the report seems to indicate that the higher the ALC grade prior to construction, the greater the likely affect (downgrading) on the ALC grade post construction if compaction is caused during construction, operation or decommissioning. Therefore it is vital that compaction across the proposed development site is avoided.

3.3 Section 3.5 of the ADAS report states:-

"One of the key impacts on BMV agricultural land is soil compaction, which can vary considerably from very minimal and short term to severe, which possibly cannot be rectified.

Compaction in the subsoil below about 45cm is unlikely to be practicable and economic to alleviate (Batey, 2009) and is unlikely to respond quickly to natural recovery through the freeze-thaw cycle. Where compaction is present at depth it is a long-term limitation and it is taken into account in the ALC Guidelines (MAFF, 1988) through reduced permeability in the wetness assessment and crop available water in soil droughtiness assessment. There will be compaction at the time of construction, which may remain for the lifespan of the development. Further compaction may result at the decommissioning phase.

Business Wales (2018) and Froehlich et al (1985) reported that natural recovery of a compacted soil is complex and a slow process. Batey (2009) refers to 30 years for a compacted soil to recover, where 'industrial' compaction extends to depths of 1m or more (Spoor, 2006). Hakansson (1988) reported that compaction may be very persistent in the subsoil and permanent.

A study undertaken by Defra (2016) considered compaction in grassland on 300 grassland fields. The study considered how grassland management may be used to influence soil compaction and how management can be targeted to alleviate or avoid compaction. The careful management of machinery use in terms of when and how many times soils are trafficked was a key influence on the level of soil compaction."

As has been stated in previous submissions to the inspectorate, compaction should be avoided at all costs, as once compacted the soil will stay compacted for a very long time, leading to all of the problems highlighted in previous submissions.

4.0 Section 4.2 of the ADAS report deals with the claimed carbon sequestering benefits attributed to long term grassland beneath and around solar arrays:-

"Defra (2009) reported that the quantity of C that can be stored in any soil is finite. Following a change in management practice levels C can increase (or decrease) towards an equilibrium value at about 100 years depending on the soil type, land use and climate.

Maintaining an increased SOM level, due to a change in management practice, will be dependent on continuing that practice indefinitely. Only if land is taken permanently out of arable cultivation or rotation will the benefits of C storage be realised over the long-term. Soil organic matter is more rapidly lost than it is accumulated (Freibauer et al, 2004).

A study by Gosling et al (2017) considered the potential for the conversion of arable cropland to grassland to sequester carbon in the short to medium term. The study reported no difference in soil organic carbon stocks in the top 30cm of the soil profile in grassland up to 17 years old and arable cropland at sites across the UK.

Key points from studies on land use changes and soil carbon include:

• The initial increases in the early years do not continue

• To maintain an increase in the level of soil carbon the land has to be taken permanently out of arable cultivation or rotation

• Soil organic matter is more rapidly lost than it is accumulated"

Any carbon benefit attributed to soils carbon sequestration calculations should be zero.

4.1 Section 4.3 of the ADAS report discusses:- The influence of shading and microclimates beneath panels on soil microbial activity.

"Armstrong et al (2016) investigated the effects of solar PV arrays on microclimate and the consequences for carbon (C) cycling at Westmill Solar Park. The research found that PV arrays can cause both seasonal and diurnal variation in the ground-level microclimate such that there was an effect on terrestrial C cycling. One of the conclusions of the project is that the effects of solar PV sites on plant–soil processes, which underpin key ecosystem services, is poorly understood.

he microclimatic variability within a solar PV site arises from a lower temperature under the PV arrays. The above ground plant biomass was four times higher in the gap between arrays and the control areas compared to the biomass under the PV arrays. The soil temperature is cooler under the PV arrays and between the PV arrays during the winter due to the interception of shortwave radiation by the solar PV arrays. The cooling is likely to be significant in terms of ecosystem function with the temperature differences affecting key plant-soil processes from productivity to decomposition (Marrou et al 2013)."

This confirms our concerns that plant & soil processes will be significantly impeded beneath the proposed solar panel arrays, and further underlines how the proposed practice of sowing grass underneath panels just before, at, or post construction will not result in a vegetative cover capable of performing the functions required as it will not grow. This is probably what the scenario in the figure 6 image above.

4.2 Section 4.4 of the ADAS report has details of The influence of solar developments on soil loss and erosion.

"Runoff from solar panels has an influence on soil erosion. Water is known to run along the edge of the panels then fall to the ground at localised points and form rivulets. This has the potential to cause soil erosion, the risk of which is strongly influenced by slope and soil type. Choi (2020) reported erosion and one of the case studies in WP2a (Estuary Farm7) considered the possibility of runoff from solar panels causing compaction of soils at the base of the panels and resulting in rivulets forming along the edge of the rows of panels. While there may not be a significant increase in runoff, small channels will have formed with potential of soil loss. This problem is likely to be more severe in erodible soils such as sandy soils on slopes before a vegetation cover establishes. However, the steepness of the slope would be an even stronger influence. The risks are repeated at the construction and decommissioning phases."

Again this underlines how critical it is to establish vegetation well before construction so as to avoid surface runoff and erosion.

5.0 Section 5.2 of the ADAS report asks the question:- Are solar PV sites reversible to Agriculture without residual impact? The evidence base is discussed and concludes:-

"The key residual impact on the land is soil compaction. Defra (2016) reported that careful management of machinery use in terms of when and how many times soils are trafficked was a key influence on the level of soil compaction on grassland.

A review by Nawaz et al. (2021) refers to time scales of 5 to 18 years for soils to recover from compaction with the aid of agricultural machinery and for soil to recover from compaction naturally (without aid) 100 to 150 years."

This again underlines how important it is to avoid compaction as it can take 15 to 18 years to sort out by mechanical means if they are able to be deployed in a solar farm, and up to 150 year without recourse to mechanical remediation.

5.1 Section 5.3 of the ADAS report discusses:- The main issues influencing reversion to agriculture.

"At decommissioning all materials are expected to be removed including the removal of piles from the soil. Most standard steel products corrode, particularly in the upper part of the pile and this may adversely affect the ability to extract the piles after 40 years. (Non-corrosive materials could be used but have cost implications). It may be that piles fracture and are difficult to extract without additional digging. An engineering solution, where extraction is adversely impacted, would be to partially cut down the piles and provide a capping layer of soil (per comm. P Woodfield, Technik GS). Any residual piles are likely to have a negative impact on whether the land is physically reversible to agriculture unless buried sufficiently deep to enable cultivations and drainage. Where residual piles could not be buried to a depth to allow cultivations the grading of the land would take into account the severity of the limitation. Land with severe or very severe limitations, which restrict the range of crops, is placed into either Grade 4 or Grade 5 in the MAFF Agricultural Land Classification system. To bury the piles to a sufficient depth would mean excavating to a depth of at least 1.0-1.2 metres. This would result in significant soil disturbance if many of the piles were affected in this way."

Posts are highly likely to corrode over the 60 year proposed lifespan of this proposed development, and they are highly likely to be difficult to extract at decommissioning. This report suggests that they can either be dug out, causing much soil disturbance and further trafficking & compaction, or cut off below ground which will limit how the land can be farmed in the future, This significantly reduce the

ALC grade of the land across the site and could make it extremely difficult to farm for future generations.