Bubney Solar Farm

FLOOD RISK ASSESSMENT

On Behalf Of Renewable Connections Developments Limited

March 2021 | P20-1083

clive onions
consulting civil engineer

Renewable Connections

Bubney, Whitchurch, Shropshire, SY13 3AB

Solar Farm Flood Risk Assessment

Clive Onions Ltd is complying with Government guidance and continuing to work and support UK business during the Covid-19 crisis and to help enable a speedy return to normal business, when safe to do so. We are working from home and will not visit site, but we are using video conferencing etc to keep in touch and share information.

19th March 2021 V3

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Contents

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Version history

Version	Date	Prepared by	Approved by	Comment
D1	26.10.20	HB	CO	Issued for approval
V1	11.03.21	HB	CO	Updated layout
V2	18.03.21	HB	CO	Updated layout
V3	19.03.21	HB	CO	Updated drawings incorporated

Issue history

Version	Date	Issued to	Method
D1	26.10.20	Renewable Connections	Email pdf
V1	11.03.21	Ditto	Ditto
V2	18.03.21	Ditto	Ditto
V3	19.03.21	Ditto	Ditto

1. Introduction

A solar farm is proposed on greenfield land west of Whitchurch in Shropshire, with a power rating of up to 30MWp and a lifespan of 40 years.

It is noted that this proposal includes 'rotating' solar arrays which track the sun. This results in a significantly lower rain shadow than conventional static arrays, and the orientation of the arrays is north-south, rather than east - west.

Clive Onions Limited has been appointed to prepare this Flood Risk Assessment (FRA) to accompany a planning application for the solar farm and show that the proposal is safe and does not increase flood risk off site.

According to the Environment Agency (EA) Flood Map for Planning the site is in Flood Zone 1 at low risk of flooding. Most of the site is shown to be at very low risk of surface water flooding, with some small areas of ponding and streaming at low to high risk of surface water flooding, according to the EA Surface Water Flooding Map.

This report describes the current characteristics and virtues which will be delivered by the solar farm proposal.

2. Site Location and Setting

The site is located near Whitchurch in Shropshire at postcode SY13 3AB.

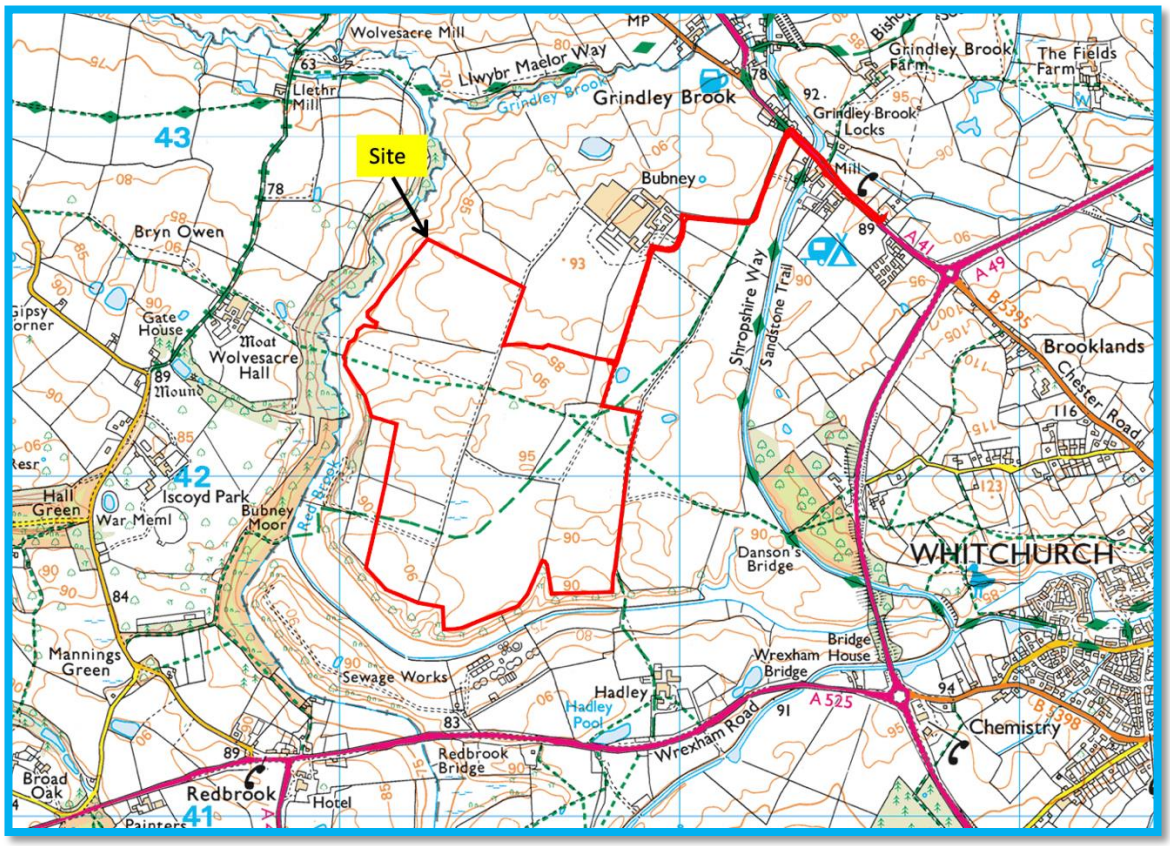

Fig 1 Site location with cable route to the north to the connection point (Streetmap).

The site is located in the following setting:

- North of the site is agricultural land falling to the north and west, beyond which is Grindley Brook.
- East of the site is farmland with land falling away to the Llangollen Canal, and the town of Whitchurch beyond.
- South of the site the land falls steeply to Red Brook, beyond which is a sewage treatment works set in farmland.
- West of the site is Red Brook within a woodland corridor with farmland beyond.

The site can therefore be described as being situated in a rural area west of Whitchurch with watercourses north, south and west, and the Llangollen Canal to the east, on land tending to fall to the west.

3. Existing Development and Ground Conditions

The site is irregular in shape and is approximately 1080m north-south and 800m east-west with a total approximate area of 65.2ha. The land can be seen in the above map to be very gently undulating with a nominal fall to the west and south.

The existing site comprises farmland used for arable purposes. Areas of potential ponding can be seen in the gentle undulations of the land.

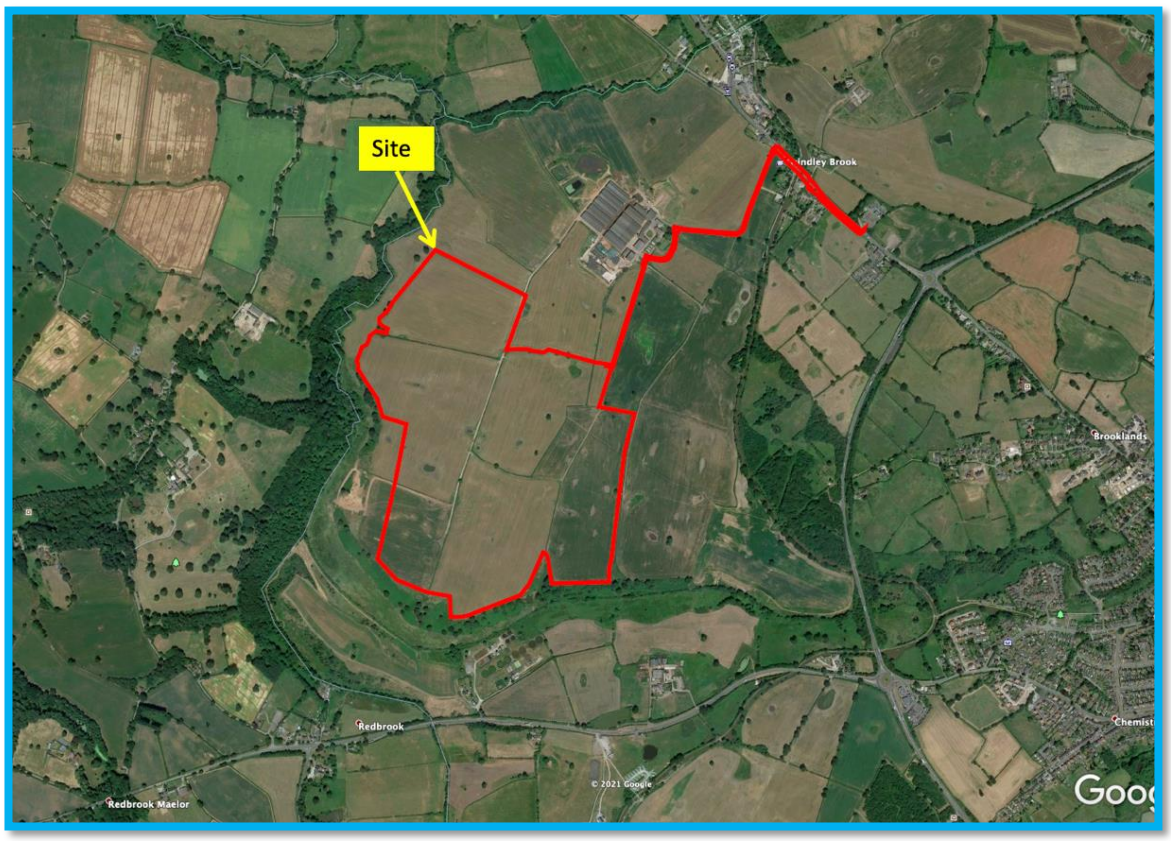

Fig 2 Satellite view of site showing site set back from the watercourse to the south and west, and woodland to the west (Google Earth).

The British Geology Survey shows the geology to be halite-stone and mudstone bedrock with superficial deposits of diamicton, sand and gravel. The Cranfield Soilscape Viewer shows the soils to be loamy and clayey with impeded drainage in the northeast of the site, loamy and clayey with naturally high groundwater in the south and loamy and freely draining in the west.

4. Proposed Development

A 30MWp solar farm is proposed. The proposed arrays are aligned north-south, and rotate to track the Sun.

These contrast with conventional solar arrays in reducing the rain shadow and encourage better distribution of light and rainfall.

The arrays are approximately 0.55m – 2.4m in height as they rotate; the heights vary with local undulations in the ground surface and the rotation. The solar arrays have frequent movement joints along the arrays, to allow the individual panels to manage thermal expansion along the array, which are fundamental for their operation. These joints allow rainwater to disperse and avoid concentrated flows landing on the ground.

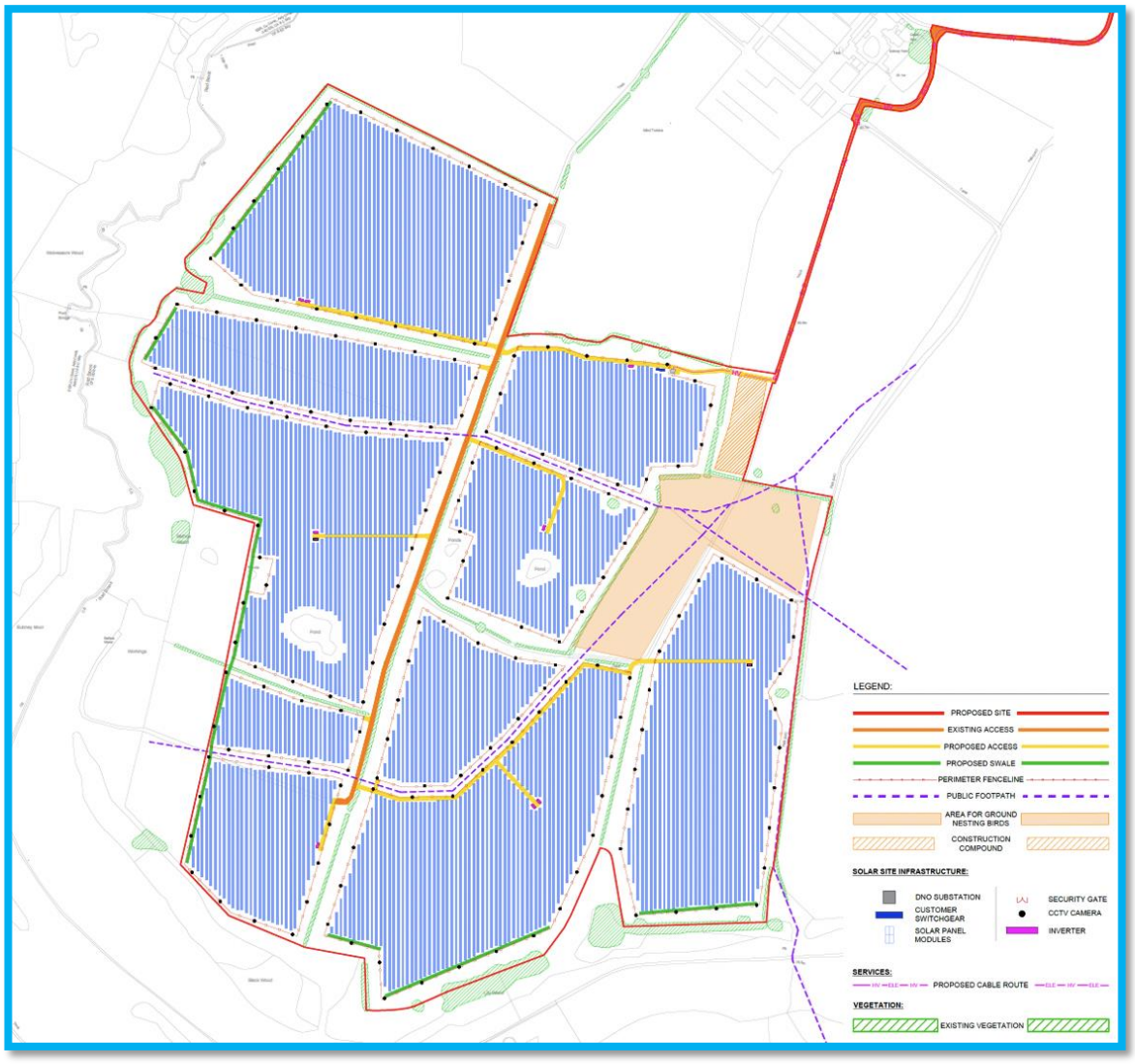

Fig 3 Proposed site plan.

Fig 4 Similar but not identical arrangement showing principle. The gaps between eh panels can be seen.

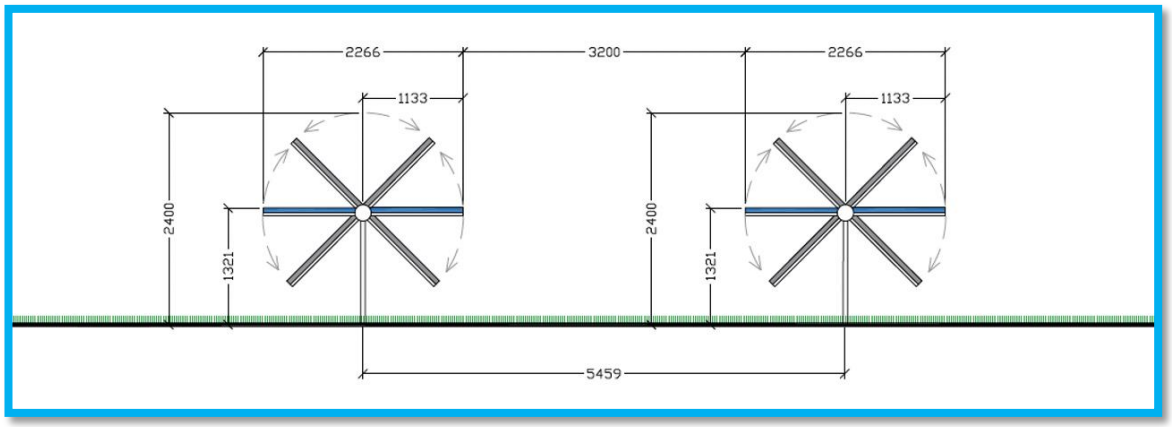

Fig 5 Cross-section through typical arrays, showing panels to be approximately 0.55m above the existing ground surface (although this varies) and with 3.2m gaps between arrays to reduce the effect of shading.

The layout will include inverter/transformer units which are containerised and delivered to site assembled. The batteries and ancillary cabins are also delivered containerised.

A cable route runs approx. 900m along private access track to the north, and then about 350m along the A41 highway. Conventional trenching is proposed which will be reinstated to match the existing or proposed surfacing as appropriate. The trenching in the road will be installed in accordance with the highway authority approvals.

The containers will be supported on slim concrete pads with a 300mm thick permeable granular base (with 30% voids) and general surround to ensure that runoff is stored during storms and infiltrates into the underlying or adjacent soil and also evaporates.

The gravelled areas with raised units are fundamental to ensure that the underside of the units can be inspected for safety, to reduce the risk of corrosion and to provide a firm (but low-cost) surface for servicing etc, which also aids the drainage characteristics described above.

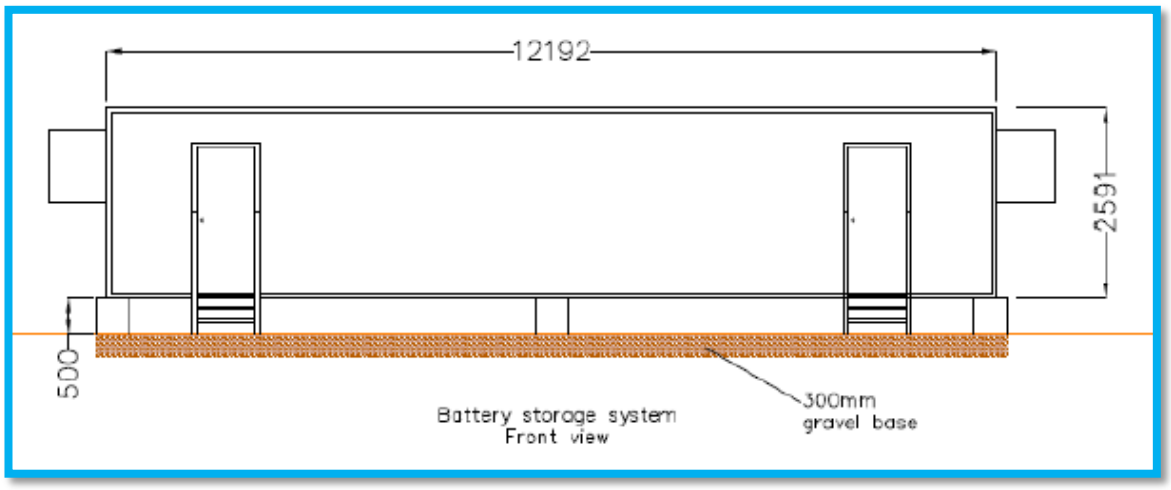

Fig 6 Typical containerised unit supported on slim pads with 500mm void over 300mm permeable gravel blanket (30% voids).

Fig 7 Typical containerised unit on pads over permeable gravel bed.

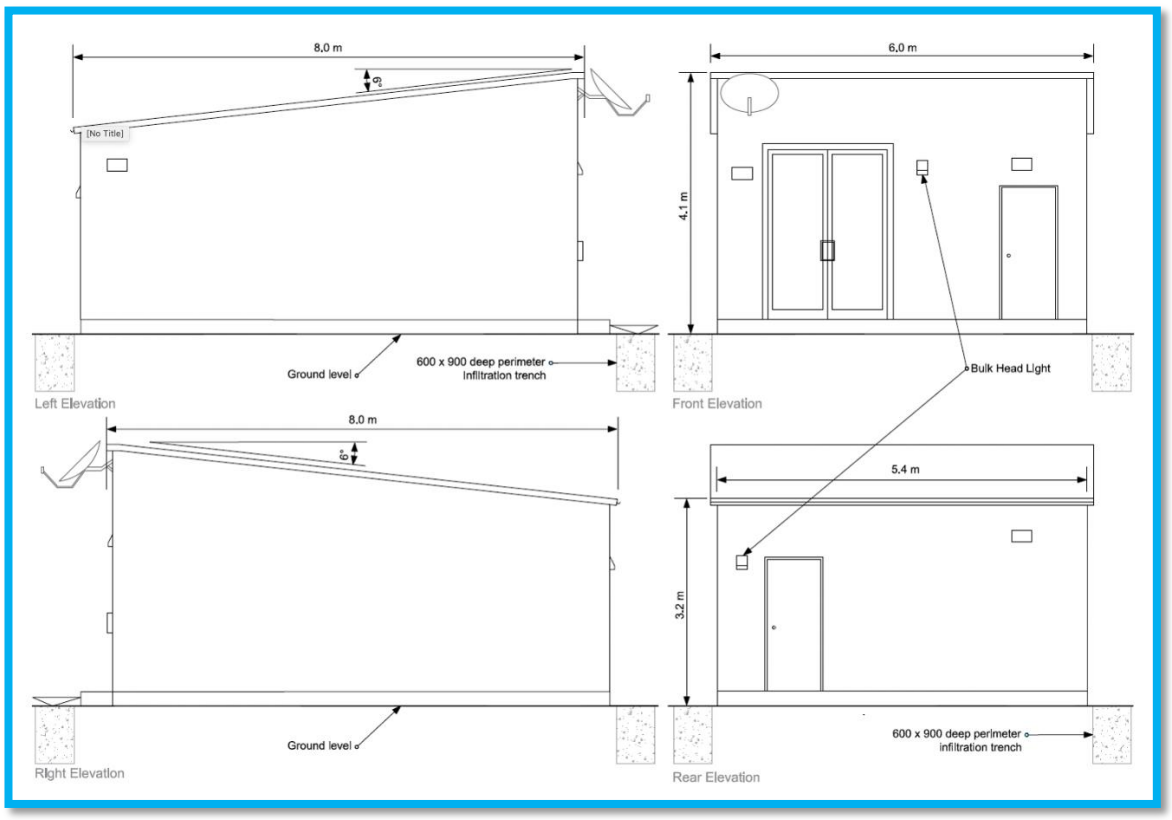

Fig 8 DNO substation 6m x 8m in plan with 600m x 900mm deep perimeter infiltration trench.

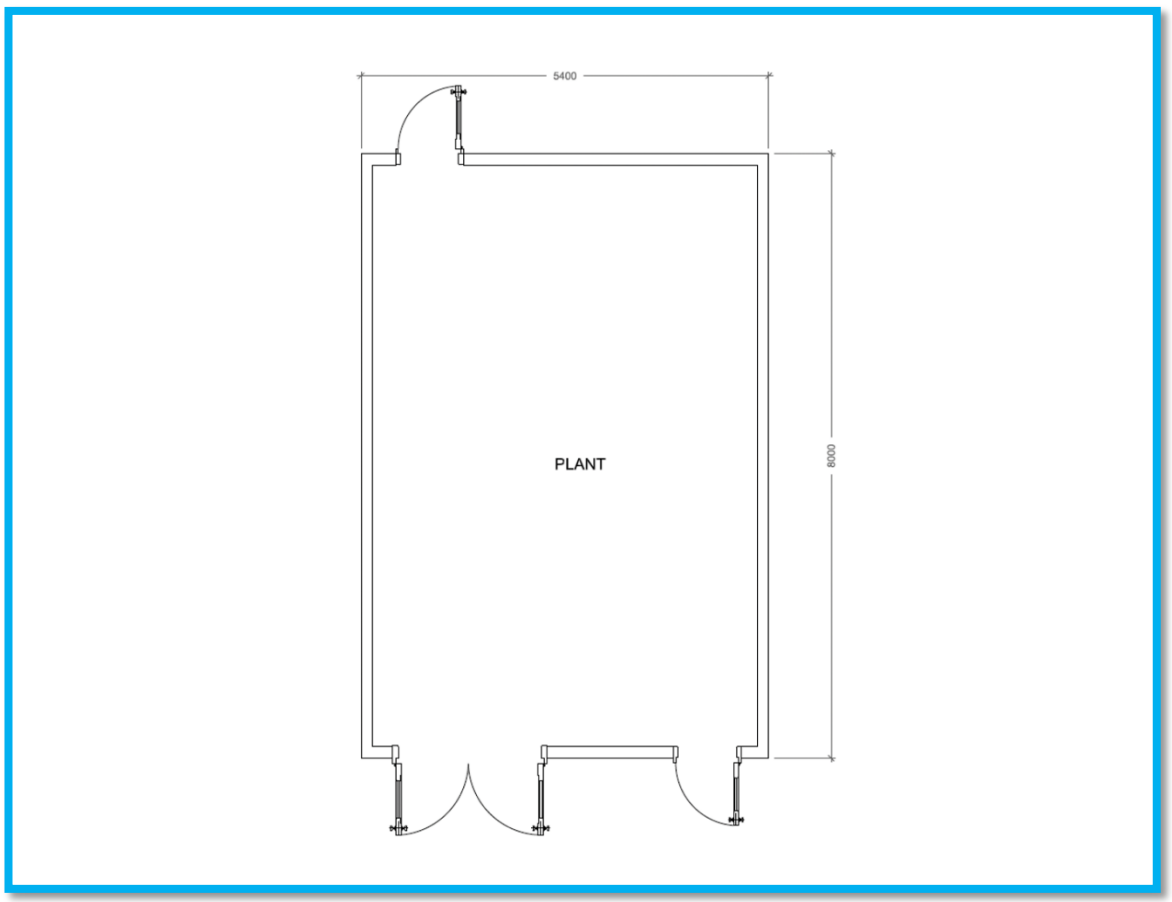

Fig 9 DNO substation floor plan.

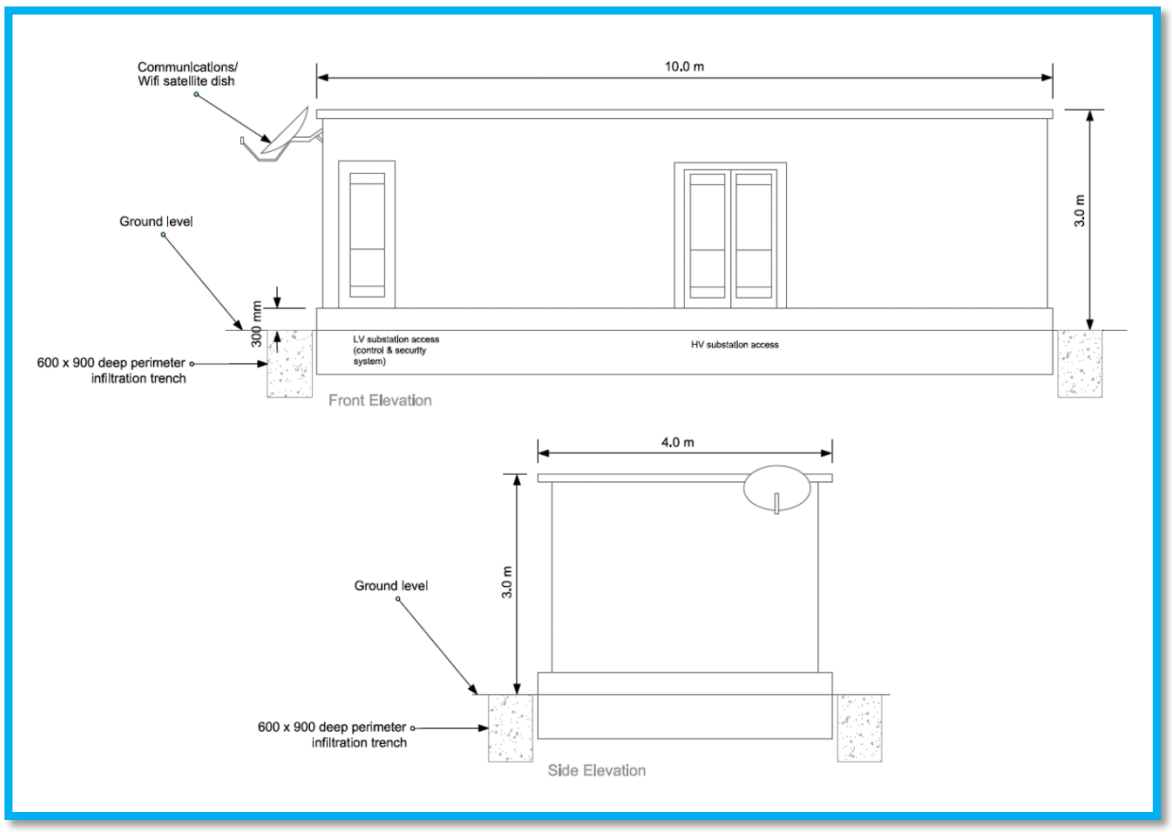

Fig 10 Customer substation 10m x 4m in plan with perimeter permeable gravel infiltration trench 600mm wide and 900mm deep.

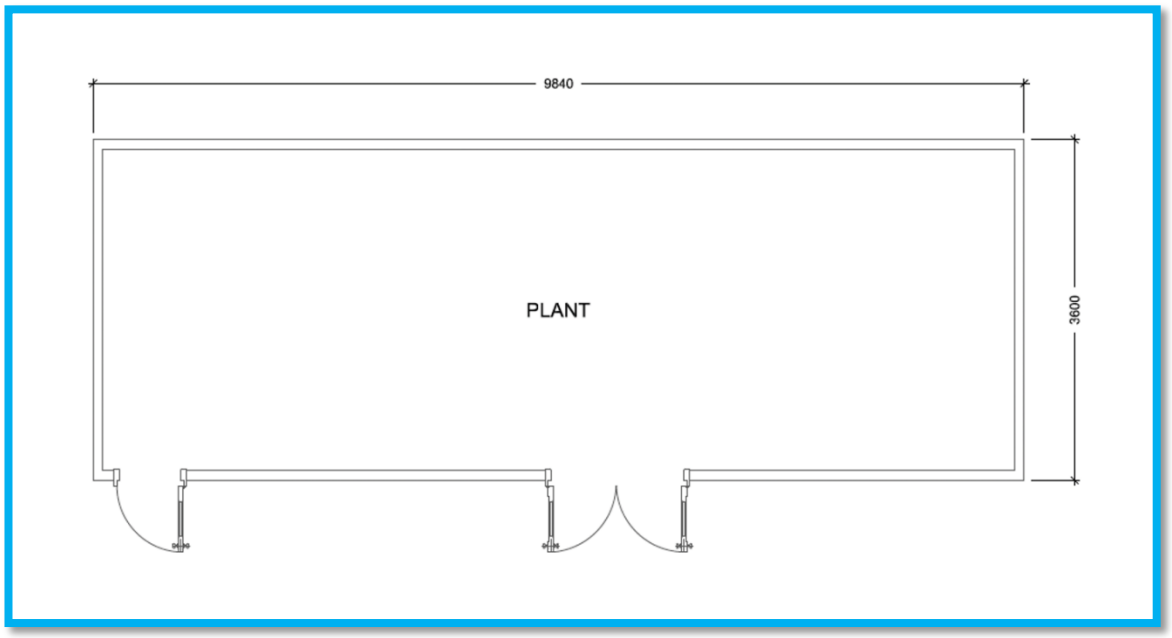

Fig 11 Customer substation floor plan.

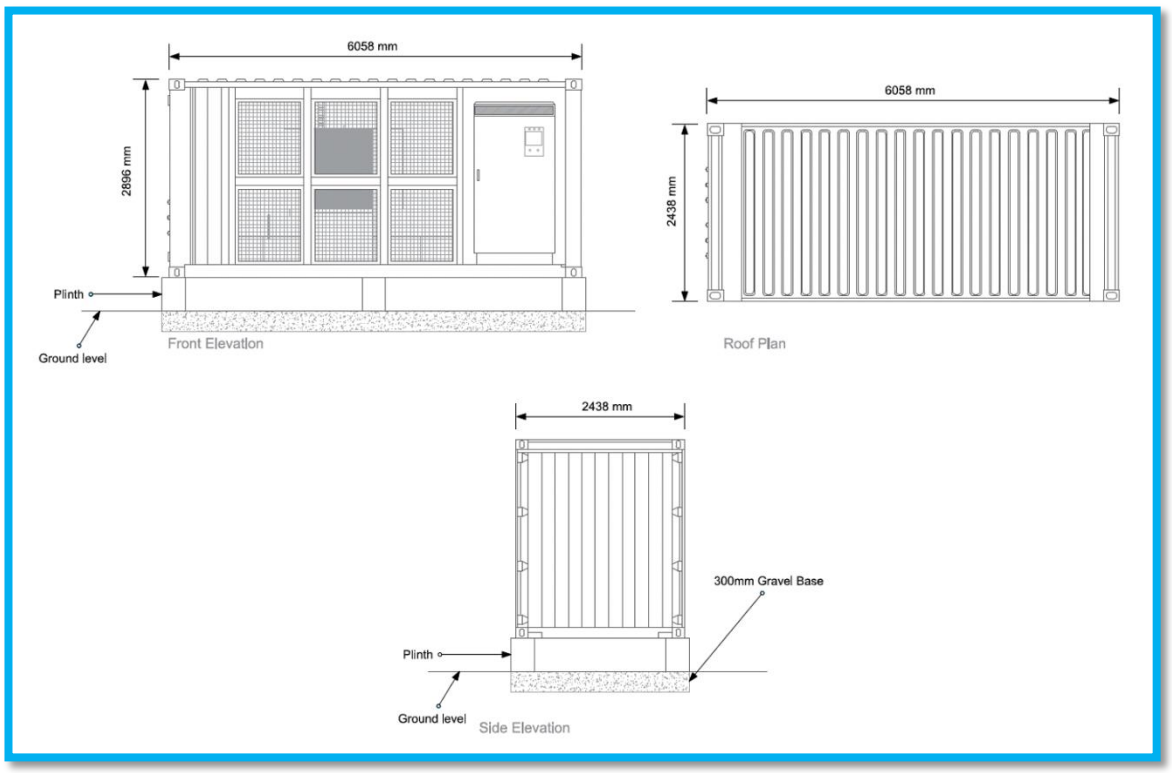

Fig 12 Inverter elevations and dimensions layout. These are to be supported on plinths founded within a 300mm bed of permeable gravel to infiltrate runoff as for containerised units above.

Underground cables will link the inverters with the grid connection. Where cables pass under ditches/watercourses a 'no-dig' technique will be adopted, with the cable 1.5m below the bed of the ditch. 'No-dig' techniques avoid the need for Land Drainage Consent. Where possible existing farm access routes and ditch crossings will provide the routes for the cables.

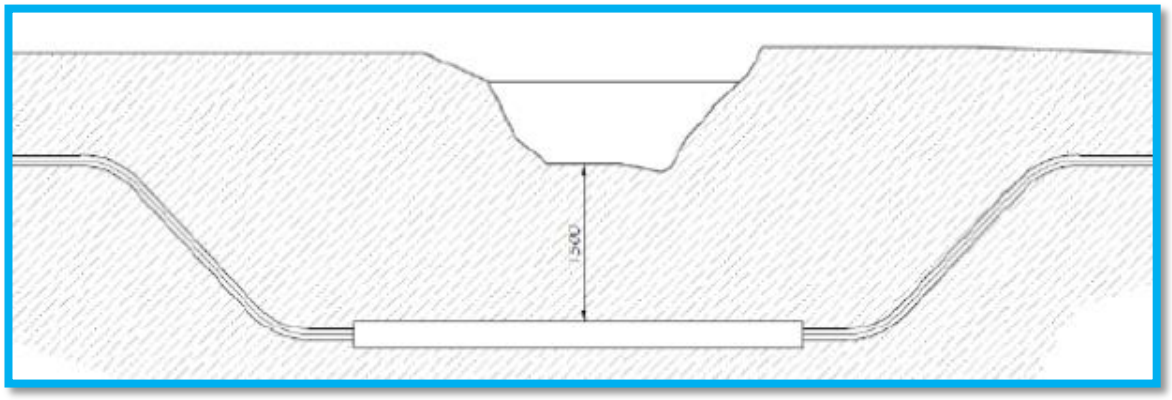

Fig 13 Typical section of a ditch crossing by a cable using no-dig techniques.

Access tracks will be minimised and will serve the electrical units (e.g. inverters), following existing farm track routes where possible. They will be formed in permeable material (with 30% voids) 300mm deep to provide rainfall storage and encourage infiltration and level with the existing surface. They tend to green over due to low use adding to the management of rainfall.

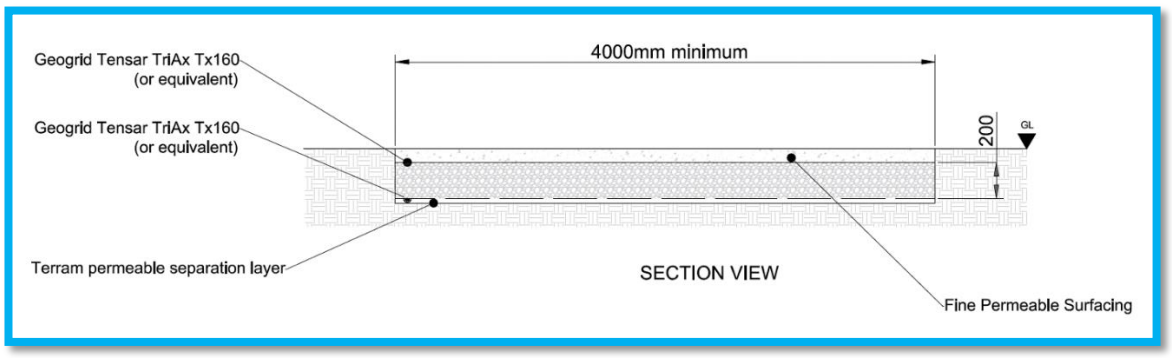

Fig 14 Permeable access track details.

Deer netting with large open mesh will be installed around the solar farm. The fences will have small mammal gates (200mm x 200mm) approximately every 50m to enable free access. The fences are set back 5m from the hedges to allow for maintenance of the hedges, and the arrays are set back to a minimum of 5m from the fences to allow for general surveillance. The fences are raise 100mm generally above the ground to allow surface water to flow and small animals to roam.

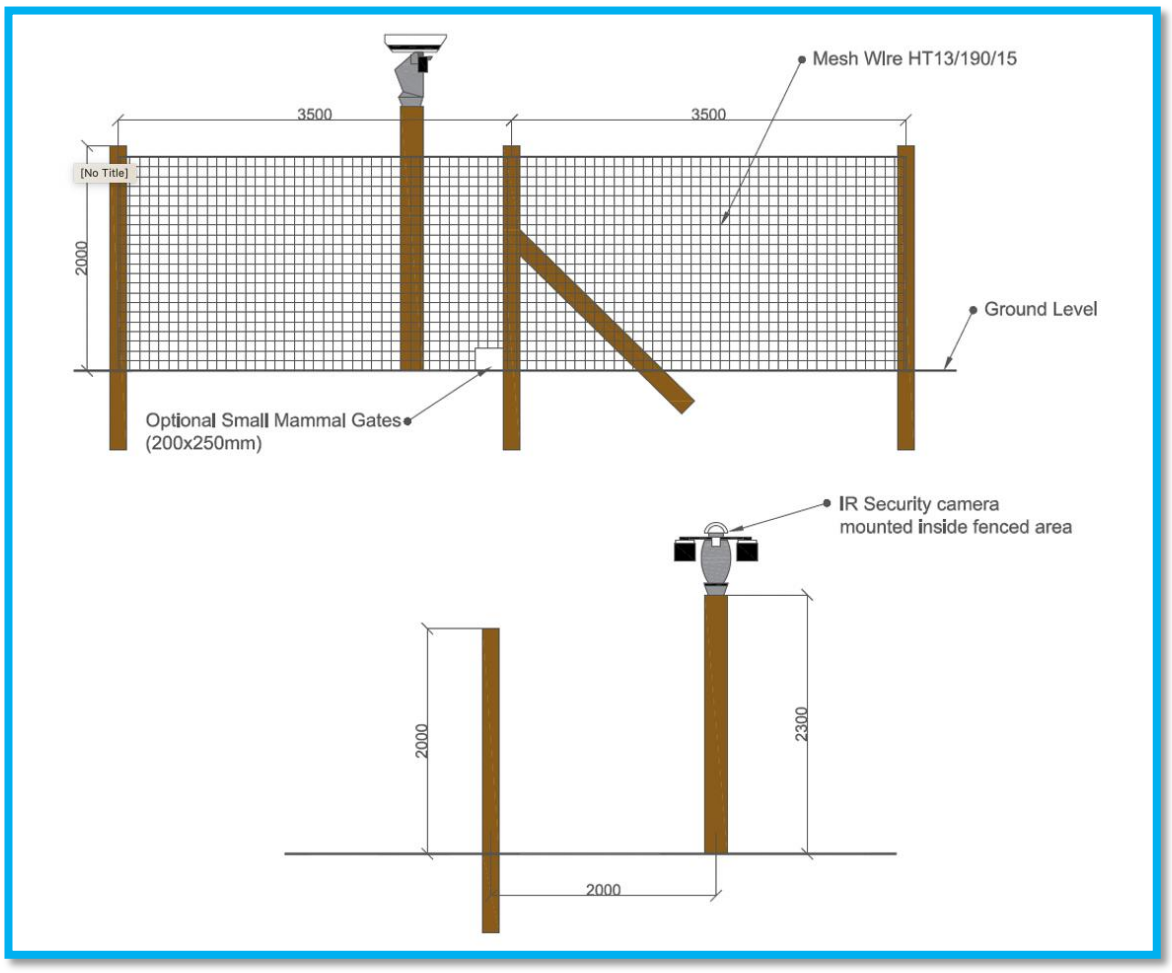

Fig 15 Security fence and CCTV standard details.

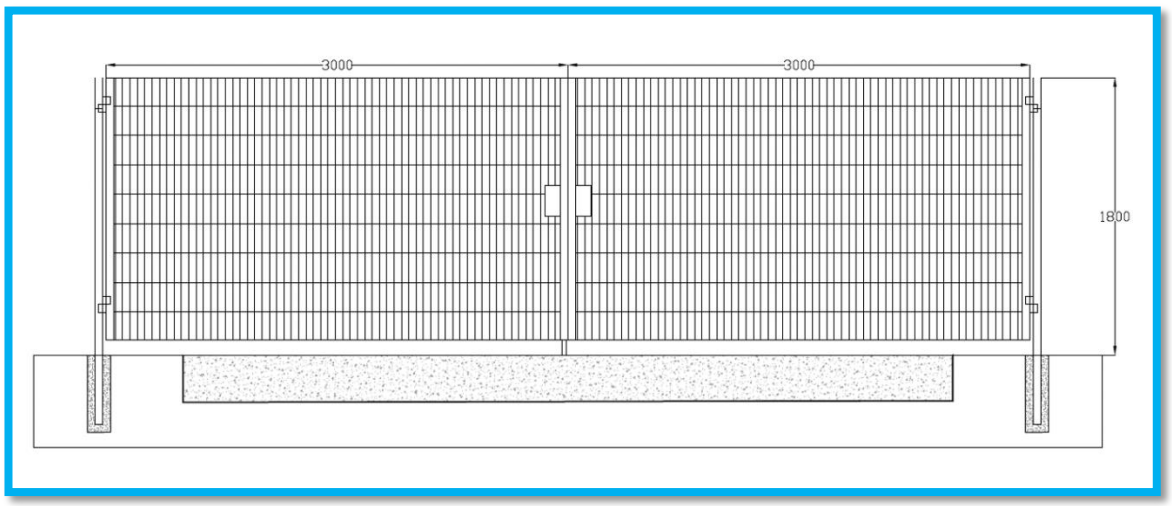

Fig 16 Access gate elevations – access track will be level with existing surface.

On completion of the solar farm the ground will be inspected, prepared and seeded and native vegetation encouraged to flourish. The solar farm will create a species rich grassland in line with the objectives of the Shropshire Biodiversity Action Plan and will create a haven for wildlife.

The soil will improve in quality and its ability to absorb rainfall will also improve, as described in 'The Soil and Water Balance – The Science Behind Soil Friendly Farming' by the Game and Wildlife Conservation Trust. The SOWAP by Cranfield University showed that this approach to land management reduced runoff by up to 90%.

The native vegetation will be maintained to deliver the improving conditions described above.

5. Flood Risk

According to the EA Flood Map for Planning the site is in Flood Zone 1 at low risk of flooding. All forms of development are appropriate in Flood Zone 1, according to the NPPF.

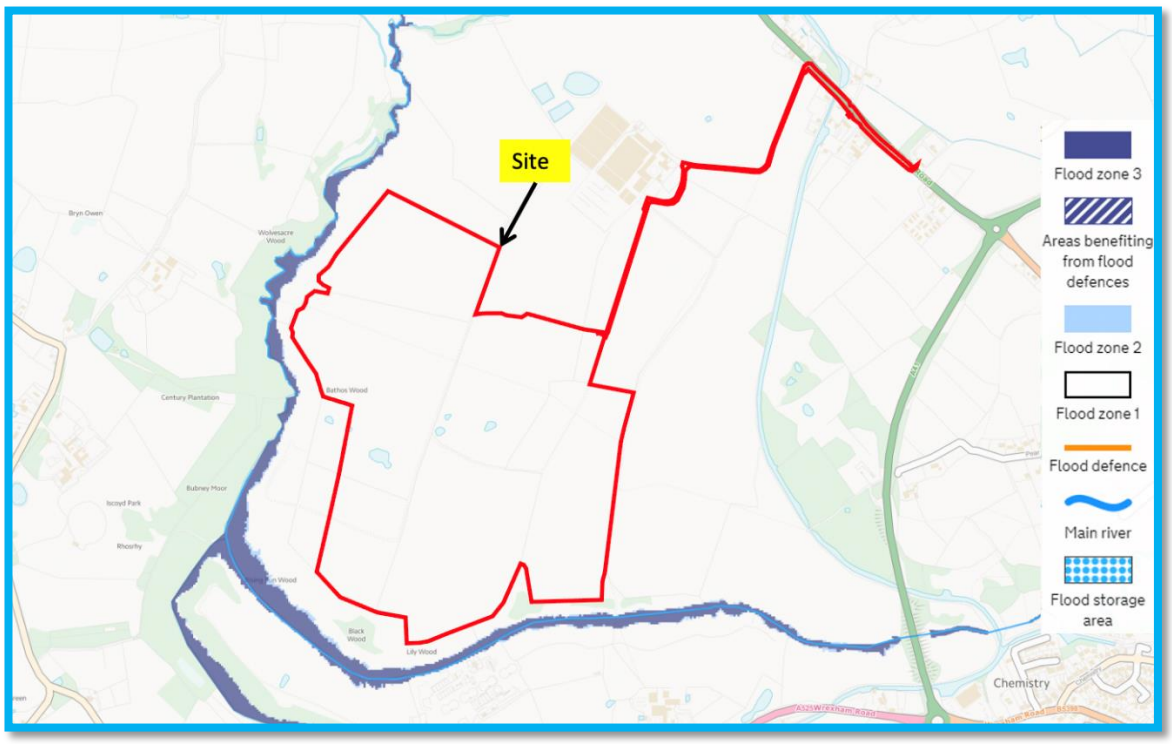

Fig 17 EA Flood Map for Planning showing the site all within Flood Zone 1.

The EA Surface Water Flooding Map shows most of the site to be at very low risk of surface water flooding with some low to high risk areas of ponding evident throughout the site.

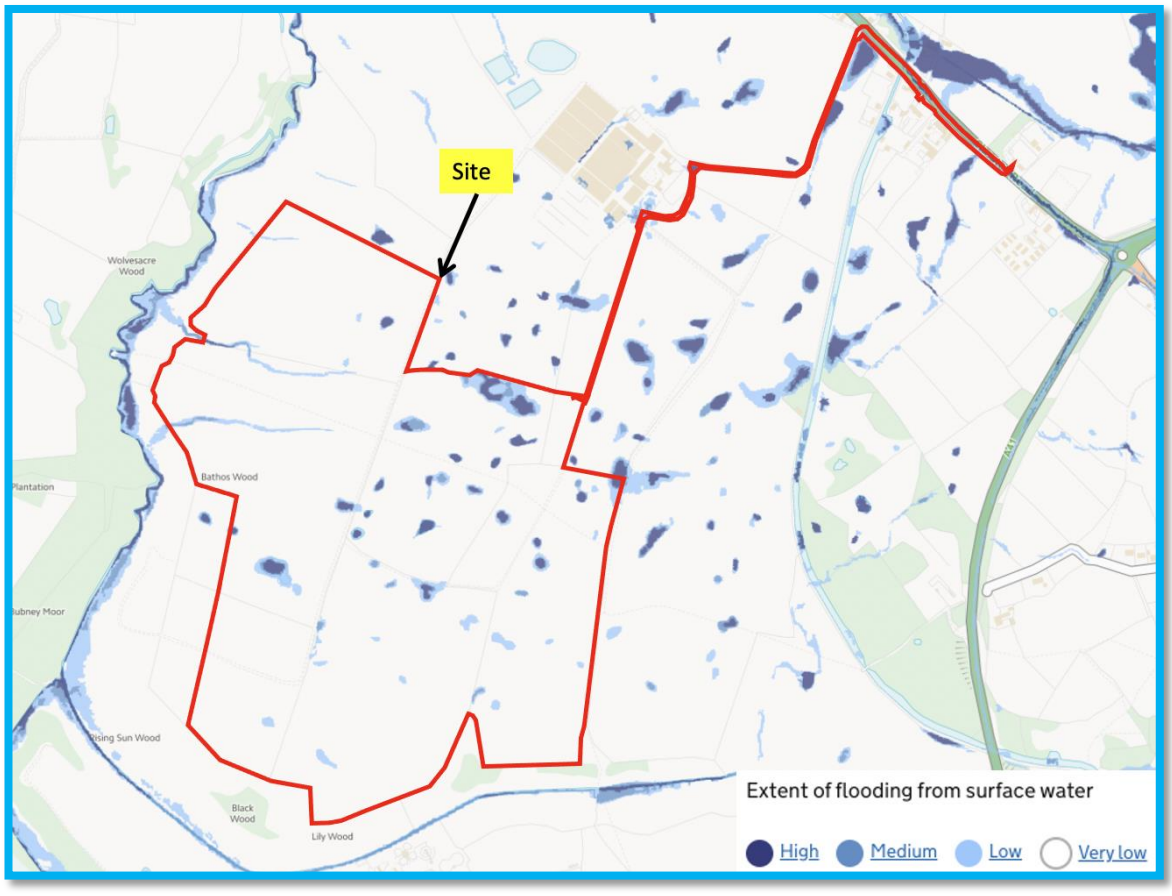

Fig 18 EA Surface Water Flooding Map showing potential localised ponding.

In the Medium Risk Scenario (1 in 100 year event) the ponding is shown to be below 900mm deep. The arrays will avoid any areas at risk of surface water flooding in the Medium Risk Scenario. The arrays should not be in areas at risk of more than 300mm of water.

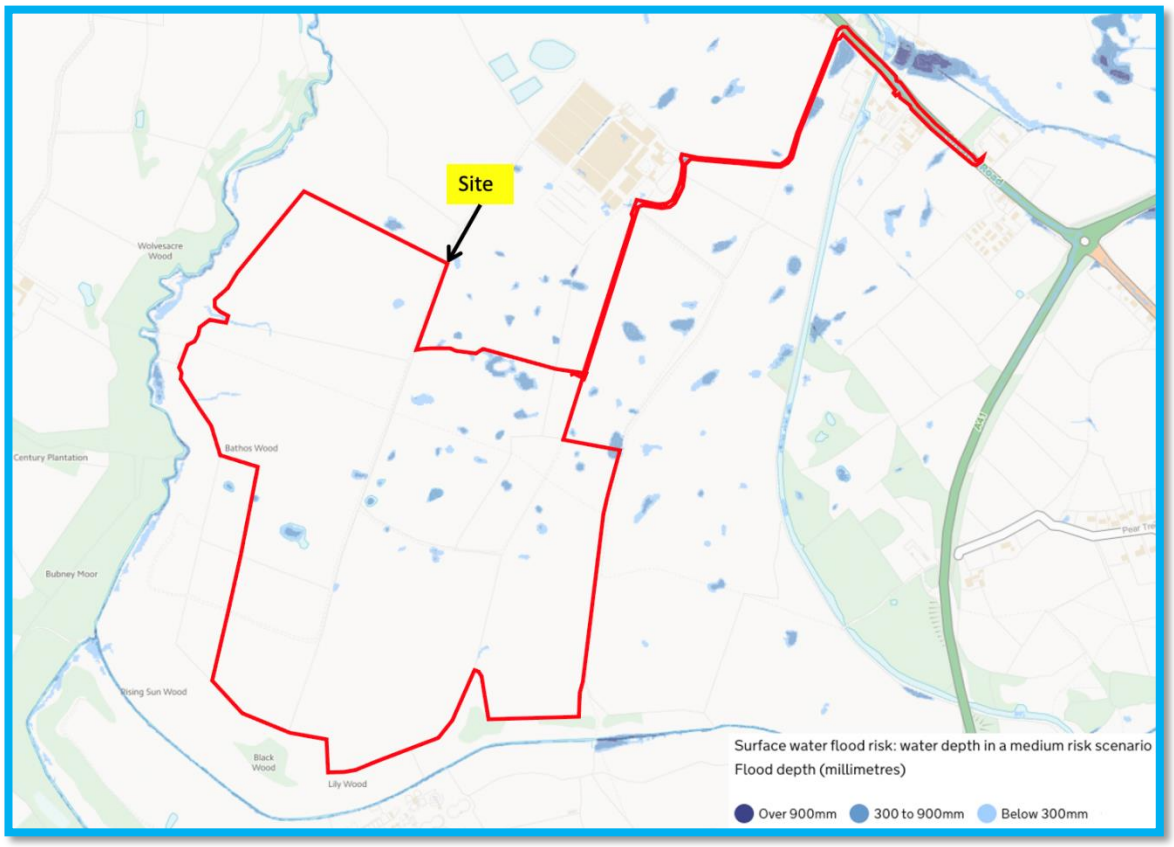

Fig 19 EA Surface Water Flooding Map – Medium Risk Scenario (1 in 100 year event) showing less significant ponding.

The change from farming to solar farm will improve soil quality and reduce the occasions when runoff occurs, will reduce the rate of runoff and the frequency of runoff.

Precautionary swales will be installed along the west and south sides of the solar farm to manage any potential runoff during construction and the early stages of the farm. These will incorporate weirs and manage potential runoff by infiltration and evapotranspiration. These will be 'ridge and furrow' type swales.

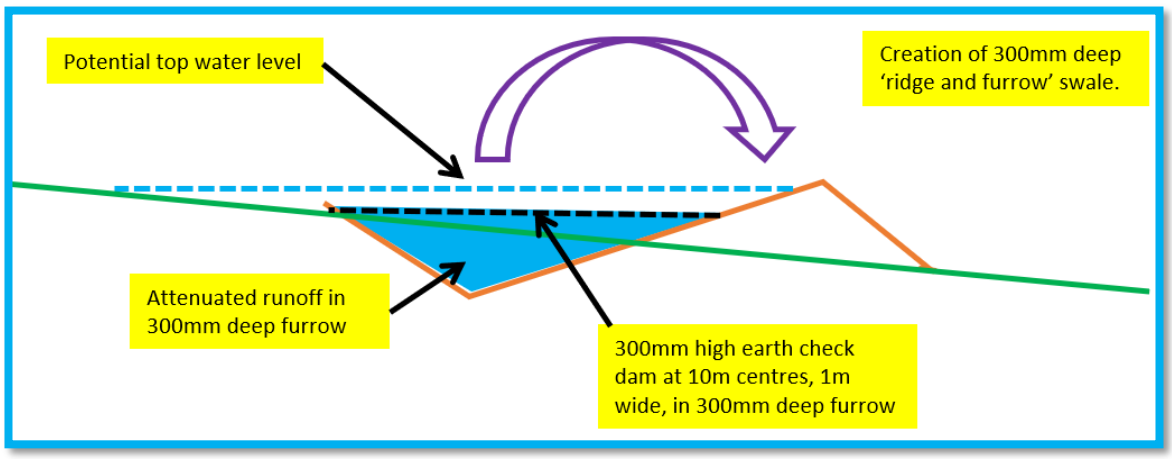

Fig 20 Typical ridge and furrow swale along west and south sides.

Fig 21 Typical swale with check dams – these can be earth and gravel dams to encourage attenuation, infiltration, evapotranspiration and evaporation (Eden Project).

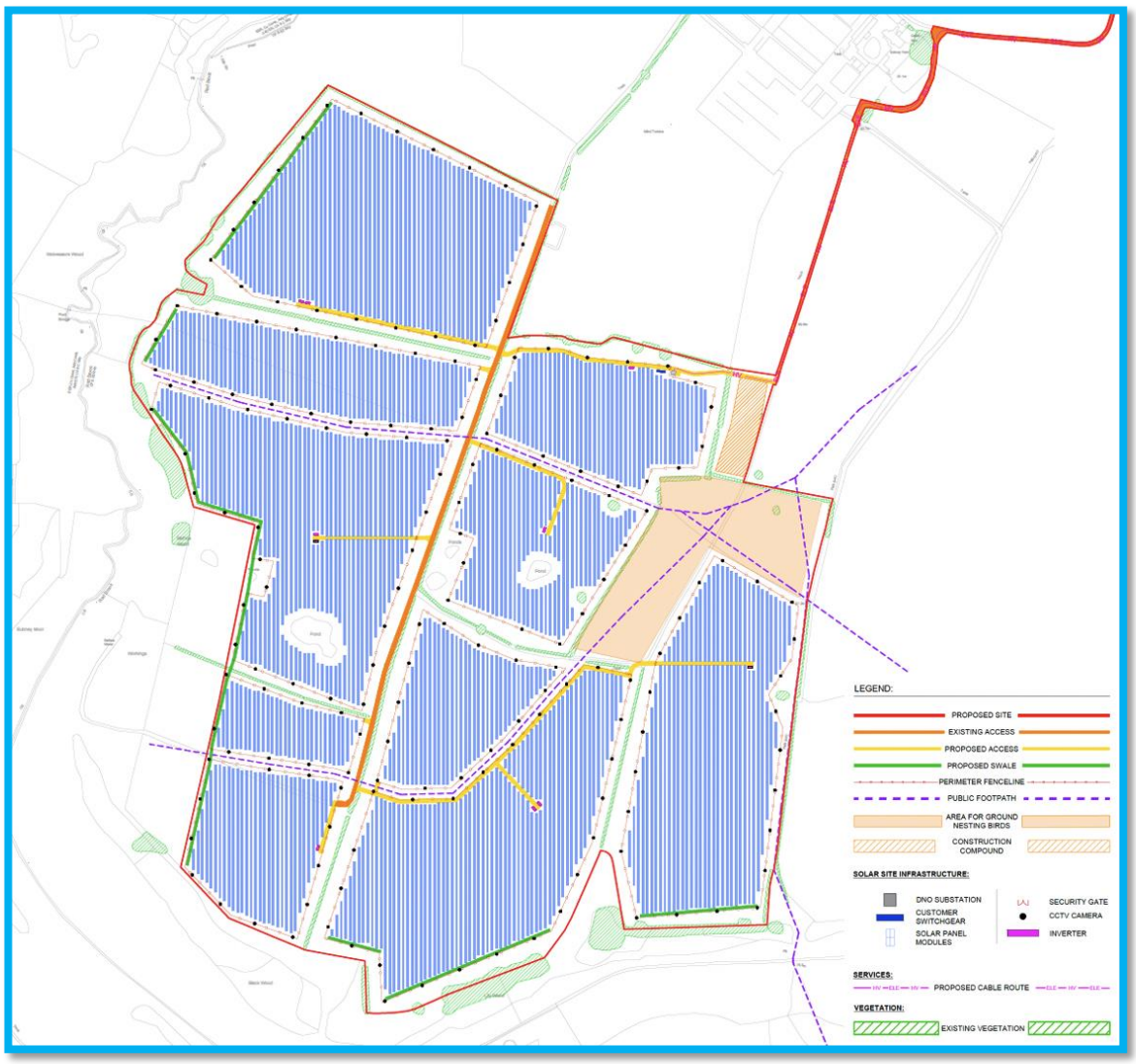

Fig 22 Indicative layout – note that the arrays are excluded from the significant pond areas, and from the hedgelines and field boundary ditches. The green lines represent ridge and furrow swales on the low side of the site.

6. Examples of Solar Farms

The following examples show typical east-west arrays, but highlight the flourishing vegetation and absence of channelling etc.

Fig 23 Solar farm on 1 in 8 slopes showing continuous vegetation across the farm (Merthyr Tydfil). This was particularly attractive almost immediately to butterflies, bees and skylarks.

Fig 24 Avonmouth solar farm showing continuous vegetation under panels in a low-lying area. Note these arrays are only 450mm off the ground, reducing the light to the underside, but with no lack of flourishing vegetation.

The above images show that whatever the slope (and the climate) the vegetation flourishes below the arrays and does not cause channels etc.

7. Policy

Flood Policy relates to the protection of people and property. The National Planning Policy Framework (NPPF) and its Planning Practice Guidance (PPG) give guidance on flood risk and steer development away from areas at risk of flooding.

The solar farm is shown to be within EA Flood Zone 1 according to the EA Flood Map for Planning, and therefore at low risk of flooding. It is therefore appropriate development on this site.

Rainwater runoff from the panels will fall onto the vegetated ground, mimicking the existing mechanism of rainwater falling directly onto the vegetated field, as recognised by the Environment Agency in the BRE guidance on solar farms.

> **n) Drainage, Surface Water Run-off and Flooding**
>
> The Environment Agency has advised that, due to the size of solar PV farms, planning applications will be expected to be accompanied by a Flood Risk Assessment. This will need to consider the impact of drainage. As solar PV panels will drain to the existing ground, the impact will not in general be significant and therefore this should not be an onerous requirement.

The proposal will bring an improvement in the soil quality and therefore an improved natural management of rainfall runoff, and betterment downstream with reduce runoff rates and reduced occasions when runoff occurs. The improvement in the soil quality capturing more CO2 than does normal farming.

Ceasing intense farming will reduce pollution from pesticides, fertilizers, animal feed, animal waste, etc and significantly improve the quality of the rainwater entering the environment; it will enhance biodiversity in the receiving watercourses. This is particularly important in reducing phosphates and nutrients in the receiving watercourses.

Ceasing intense grazing will allow the soil to improve and absorb more rainfall through natural processes of worms etc. This, combined with avoiding farm machinery forming 'tramlines', will eliminate compaction of the soil, and allow the soil to improve in quality and manage rainfall by improved infiltration (problems emphasised in The Soil and Water Balance – The Science Behind Soil Friendly Farming)

Avoiding bare earth in the fields over autumn and winter will also reduce the silt runoff and reduce the need for clearing ditches and watercourse downstream.

The proposal therefore brings significant water management and biodiversity enhancements and therefore brings betterment in compliance with the guidance in the NPPF. The improved biodiversity is in harmony with the Shropshire Biodiversity Action Plan.

8. Access

The Solar farm is operated remotely and does not need attendance at site for its reliable operation.

Routine inspections are made at the solar farm about every fortnight. However, if the weather is stormy or inclement, this is not conducive to safe inspections in such an area. The Operator therefore monitors the weather and only attends when conditions are suitable and safe.

9. Construction

The initial phase of the works will be installation of the permeable access track and the perimeter swales where specified.

The site will remain as pasture to provide a base for the construction process. To minimise damage to the soil structure within the solar farm site, deliveries within the site will be made by tracked or low ground pressure machines (i.e. with large tyres), to impose low pressures on the soil – analogous to farming machinery. A delivery sequence by vehicles should be devised which minimises repeat journeys over the field to reduce rutting and damage to the vegetation and soil structure.

The Contractor will prepare a Construction Environment Management Plan (CEMP) which will include precautions against the potential risk of silt running form the fields in the watercourse. The proposed layout shows significant buffers to the watercourses, which will naturally reduce the risk of silt runoff entering the watercourses, but the Contractor will also be required to consider silt fences etc to install if the weather is unfavourable during the works.

On completion of the works the fields will be restored using light farming machinery and prepared appropriately for seeding to encourage early native vegetation growth, restoration of the soil structure and natural creation of an environment to encourage native meadow plants to flourish.

10. Management and Maintenance

The solar farm will be managed by the operator of the solar farm.

It is controlled remotely, so the farm will be visited routinely when conditions are appropriate and safe for the inspection and maintenance activity to be undertaken.

The fields will be inspected routinely, and bare areas will be prepared, seeded and protected such that the vegetation flourishes.

Watercourses/ditches for which the operator is Riparian Owner will be inspected annually in the autumn, and the banks maintained in accordance with guidance from the ecologist and in the Operation and Maintenance Manual. The same approach will be applied to the swales.

11. Conclusions and Recommendations

A solar farm is proposed on land to the west of Whitchurch in Shropshire, which is based on north-south sun-tracking arrays.

The complete site is in Flood Zone 1 according to the EA Flood Map for Planning on generally level land.

According to the EA Surface Water Flooding Map, the majority of the site is at low risk of surface water flooding, with some small areas of ponding. The significant pond areas will be avoided by the arrays.

The proposed change in vegetation to meadow will improve the soil and increase its ability to absorb and manage water. The runoff rates will also be reduced with the potential of reducing flood risk. Swales with weirs will be introduced to the west and south of the site to minimise the risk of runoff and silt entering the watercourses particularly during construction.

The species rich grasses which will flourish within the solar farm are in harmony with the objectives of the Shropshire Biodiversity Action Plan.

The site is operated remotely, and attendance is not required during flooding.

The proposal is therefore safe, provides betterment and delivers renewable energy from a sustainable location; it therefore meets the objectives of the NPPF.

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