Glöyn Byw | Butterfly Solar Farm

Land to the North of the B5426, Wrexham

ES Chapter 04: Scheme Description and Construction Methods

Prepared for

RWE Renewables UK

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CONTENTS

IMAGES

FIGURES (Volume 3)

N/A

APPENDICES (Volume 4)

4.0 SCHEME DESCRIPTION AND CONSTRUCTION METHODS

4.1 Introduction

4.1.1 This chapter of the ES provides a description of the layout and design of the various components of the Proposed Development along with the operational process that would occur. A description of the construction methods, including the measures proposed to mitigate potential construction phase effects is also provided.

4.1.2 The Applicant is seeking planning consent for the installation of a solar photovoltaic electricity generating station (or 'solar farm') with an export capacity of up to 99.9 MW, battery storage and associated ancillary development, including a 132 kV substation. The electricity generated would be enough to meet the needs of over 34,775 typical Welsh homes and result in an approximate saving of over 2.3 million tonnes of CO_2, compared with generation from fossil fuels. The inclusion of batteries ensures the maximum efficiency working with the electricity distribution system to enable surplus energy to be stored and released as needed, and provide vital balancing services to the grid network, avoiding intermittency of supply, and allowing a transition to a net zero renewable energy future.

4.1.3 The site is split up into three areas, namely the Central Array Area (CAA), Eastern Array Area (EAA) and Western Array Area (WAA). The main components of the Proposed Development are:

i) Photovoltaic solar panels and associated support frames
ii) Hybrid Inverter Container Compounds including Battery Energy Storage Systems (BESS) containers, DC-DC converters and associated hybrid inverters
iii) Onsite electrical cabling
iv) An electrical substation compound (132kV) comprising a new substation and control building
v) Spare parts storage container(s)
vi) Wooden post deer/stock fencing
vii) In-ward facing infrared CCTV cameras on 3 m poles
viii) Landscaping and ecological enhancements
ix) Electrical cabling between the solar array areas
x) Electrical cabling to the National Grid Legacy Sub-Station

4.1.4 In addition, there are substantial ecological and landscape enhancements proposed across the three array areas including:

a. In the WAA:
    i. New tree planting.

xi) New native species hedgerow, with the existing hedgerows filled in / improved.

a. In the CAA:
    i. Proposed orchard areas located in the south and south west parts of the CAA.
    ii. New tree planting.

xii) New native species hedgerow, with the existing hedgerows filled in / improved.

xiii) New permissive paths.

a. In the EAA:
    i. New tree planting.

xiv) New native species hedgerow, with the existing hedgerows filled in / improved.

xv) New permissive paths.

4.1.5 In total, approximately 5 km of new hedgerow/tree planting and over 3 km of new permissive paths are proposed. In addition to this over 16 ha of new wildflower meadow is proposed. In additional to the ecological enhancements described above, further wildlife habitat enhancements are outlined below:

xvi) Proposed wildlife meadow margins to provide habitat for the dingy skipper and other butterfly species.

i) Diverse wildflower meadows provide a vital food source for pollinators, helping to fight the decline in insect populations and improve biodiversity and food production. Insect hotels will provide additional habitat for insects throughout the site.

ii) Improved hedgerow networks provide enhanced habitat and foraging for Hedgehogs. Supplementary “hog hotels” will be placed throughout the Site.

iii) Improved pond habitats to protect great crested newts. Reptile and amphibian hibernacula provided nearby ponds for additional shelter.

iv) Open grasslands beneath solar arrays provide the ideal habitat for Hare’s to roam, with mammal gates in fencing to provide free movement.

v) Grizzled skipper butterflies benefitting from open grassland and woodland clearings.

vi) Footpath corridors created through wildflower meadows and bound by hedgerows and/or woodland.
vii) The proposed woodland edge habitat would provide an abundance of fruiting trees and a vital food source for many bird species. Additional bird boxes (including barn owl boxes) will also be placed throughout the Site.
viii) Bat boxes placed throughout the site to provide suitable roosting, breeding, and hibernating areas for bats.
ix) Enhanced woodland edge habitat providing a habitat for small mammals such as the dormouse.
x) Mammal gates provided in all deer fencing.
xi) The preservation of woodland ensures the protection of a key habitat for the small tortoiseshell butterfly.

4.1.6 The BESS would be capable of storing electricity directly from the solar arrays or from the grid during periods of excess energy production. This energy would be available to be rapidly (within a matter of milliseconds) released back into the grid, at periods of high energy demand. Accordingly, the proposed facility assists in stabilising the capacity of the grid and supports a reliant and resilient energy supply system.

4.1.7 The system of communication between the grid and the battery energy storage system is fully automated. The facility can respond automatically to any dip in grid frequency by exporting/importing the required energy to stabilise the grid.

4.1.8 The general layout of the Proposed Development is shown on **Figure 1.2a-c** Illustrative Landscape Masterplan, with details of the various component parts of the Proposed Development illustrated within the following sections of this chapter.

4.1.9 More detailed drawings of these aspects have been included as a drawing pack of draft planning drawings as part of this consultation. These drawings include:

a) Location Plan
b) Planning Layout - Western Array
c) Planning Layout - Central Array
d) Planning Layout - Eastern Array
e) Typical Photovoltaic Table Details
f) Typical Battery-Inverter Station

g) Typical Spares Container
h) Typical Access Gate
i) Typical Access Track
j) Typical Acoustic Fencing
k) Typical Fence, Track & CCTV Details
l) Indicative Cable Trench Section Details
m) Indicative Construction Compound
n) Indicative Substation Compound Details
o) Typical Customer Switchgear
p) Typical Communication Mast Details
q) Illustrative Information Board

4.2 Key Design Considerations

Consideration of Major Accidents and Disasters

4.2.1 Schedule 4 paragraph 8 of the EIA Regulations requires that the ES includes a description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and / or disasters which are relevant to the project concerned. Schedule 4 continues that this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events and the approach to managing emergencies.

4.2.2 The reference to disasters is interpreted to relate to natural events, as indicated by the preamble to the 2014 Directive (2014/52/EU)[1], which states at paragraph 15:

"In order to ensure a high level of protection of the environment, precautionary actions need to be taken for certain projects which, because of their vulnerability to major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes) are likely to have significant adverse effects on the environment".

[1] *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment*

4.2.3 In 2020, additional guidance[2] from the Institute of Environmental Management and Assessment aimed to provide a clearer steer as to what constituted a major accident and disaster and how the topic should be addressed as part of the EIA process.

4.2.4 The guidance states (on page 3):

"A major accident is an event (for instance, train derailment or major road traffic accident) that threatens immediate or delayed serious environmental effects to human health, welfare and/or the environment and requires the use of resources beyond those of the client or its appointed representatives (i.e., contractors) to manage."

4.2.5 The guidance continues:

"A disaster is a man-made/external hazard (such as an act of terrorism) or a natural hazard (such as an earthquake) with the potential to cause an event or situation that meets the definition of a major accident."

4.2.6 Interpretating these definitions, it is unlikely that natural disasters would be a significant risk for the Proposed Development. The Proposed Development is not on, or near, any known geological fault lines, and as a result is unlikely to be affected directly by an earthquake, or indirectly through a tsunami. The Solar Farm would also not be considered a high security risk, though security measures will be incorporated as part of the design to deter thefts and acts of vandalism.

4.2.7 Nonetheless, it is recognised that disasters can occur as a result of human intervention e.g., conflict and war, political influences etc.

4.2.8 In relation to major accidents the EIA Regulations refer to Directive 2012/18/EU (the control of major-accident hazards involving dangerous substances).[3] This directive defines major accidents as:

"An occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by this Directive, and leading to serious danger to human health or the

[2] *IEMA (September 2020) Major Accidents and Disasters in EIA: A Primer*
[3] *Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC*

environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances".

4.2.9 The Proposed Development is located within a politically, geologically, and meteorologically stable part of Europe. Accordingly, the Proposed Development is not at material risk from, for example, civil unrest or war.

4.2.10 In terms of any vulnerabilities specific in this location (i.e., on the Site), the NRW Flood Map for Planning shows the site is at very low risk to flooding from rivers, seas, surface water and small watercourses within the Eastern Array Area (EAA) and Western Array Area (WAA). In the Central Array Area (CAA), the NRW Flood maps shows the site as being at very low risk from seas and rivers. The CAA is predominately at very low risk to flooding from surfacer water and small watercourses, however there are a small number of areas adjacent to the aforementioned watercourses which are shown to be a high risk from flooding from surface water and small watercourses. As described in Chapter 3 (Assessment of Alternatives) the layout of the Proposed Development was amended to ensure the substation and BESS facilities were not located within areas at risk of flooding. Therefore, the development is not considered to be vulnerable to any potential 'natural' events that could result in significant environmental effects.

4.2.11 With regard to major accidents the 2014 Directive describes that:

"It is important to consider their [i.e., the Proposed Development] vulnerability (exposure and resilience) to major accidents and/or disasters, the risk of those accidents and/or disasters occurring and the implications for the likelihood of significant adverse effects on the environment."

4.2.12 Therefore, the focus is on the vulnerability of the Proposed Development to major accidents and/or disasters and the likelihood of significant adverse effects occurring.

4.2.13 The solar panels used within the arrays are inert and would not lead to any major emission, fire, or explosion. All other electrical infrastructure within the Proposed Development would be subject to regular routine maintenance and inspection such that it will not pose a significant risk to creating an accident.

4.2.14 The BESS do have the potential to generate heat and therefore there is a risk of a fire development if the operator does not adopt sufficient management and control measures. The BESS would each include independent cooling systems which are

designed to regulate temperatures to within safe conditions to minimise the risk of fire. The units would also contain fire detection and suppression systems.

4.2.15 Further information on the BESS and how safety would be considered should consent be granted, can be found in the Technical Statement on Battery Energy Storage Systems, which has been submitted as part of this application.

4.2.16 Therefore, it is concluded that the Proposed Development would not give rise to significant adverse effects on the environment deriving from the vulnerability of the development to risks of major accidents and / or disasters.

Climate Change

4.2.17 Schedule 4 of the EIA Regulations requires Environmental Statements to include:

5. A description of the likely significant effects of the development on the environment resulting from, inter alia:

(f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change

4.2.18 This section of the chapter firstly considers the impact of the project on climate change and then goes on to consider the vulnerability of the project to climate change.

Impact of the Proposed Development on Climate Change

4.2.19 The Proposed Development would not result in any direct emissions of greenhouse gases. However, as with most new development there would be indirect emissions associated with the construction and operation of the various development components.

4.2.20 Emissions would arise from the construction of the facility through embedded carbon within construction materials, the operation of construction vehicles and non-road mobile machinery (NRMM) during the construction phases and the transport of construction materials to Site and waste away from the Site.

4.2.21 Sustainable construction and procurement methods would be adopted where possible, with locally sourced materials and services being preferred for both

construction and operation of the Proposed Development. This could be achieved in a number of ways such as:

i) Using prefabricated elements, which reduce waste, vehicle movements and the need for onsite construction materials.
ii) The use of locally sourced construction materials where practicable.
iii) The use of machinery and plant that adhere with prevailing emissions standards and which are maintained in good repair to remain fuel efficient.
iv) Minimising the disturbance to soil resources through careful design and soil management.
v) Reducing construction vehicle emissions through adoption of a Construction Traffic Management Plan.

4.2.22 Minimising waste production during construction would also help reduce the carbon impact by using less materials, avoiding carbon emissions associated with disposal and reducing construction waste vehicle movements.

4.2.23 The operation of the development would generate renewable electricity would have the potential to directly offset 2.3 million CO_2, the equivalent of taking 550,000 cars off the road or planting 39 million trees. Other climate change benefits derived from the development include a reduction in the intensity of agricultural practices at the Site. This has climate change benefits in terms of reduced use of fertilizer (which is a carbon intensive material), carbon sequestration through tree and hedgerow planting and reduced soil disturbance leading to increased soil organic matter.

The Vulnerability of the Project to Climate Change

4.2.24 Weather patterns are continuing to change as a result of climate change, which could result in potential impacts for future development. Therefore, this requires development projects to ensure that they remain resilient to the long-term effects of climate change. The Met Office has produced a series of climate predictions up to 2080 as part of the UK Climate Projections 2018 (UKCP18) project[4]. The latest projections[5] set out a greater chance of warmer wetter winters and hotter summers

[4] https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index
[5] https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18_headline_findings_v4_aug22.pdf

with higher intensity rainfall events and storms becoming more common. Increases in storm surges and sea level rise is also predicted.

4.2.25 In relation to surface water flooding and increased propensity for flooding events resulting from climate change the Proposed Development is not classed as a vulnerable development. A Flood Consequence Assessment and Drainage Strategy was prepared to outline the potential flood risk to the site, the impact of the proposed development on flood risk elsewhere, and the proposed measures which could be incorporated to mitigate the identified flood risk.

4.2.26 The NRW Flood Map for Planning shows that Site is at very low risk to flooding from seas and rivers, with the solar array development areas lying within Flood Zone 1. The Site is shown to be predominantly at very low risk to flooding from surface water and small watercourses. There are some small, isolated areas, generally immediately adjacent to field ditches / small watercourses, shown as Flood Zone 2 and 3 for surface water and small watercourses. On this basis there is unlikely to be any significant effects related to flood risk, with all essential infrastructure components such as BESS units, transformers, inverters, located within areas of low risk.

4.2.27 Operational solar farms have very limited areas of hardstanding, as such there is unlikely to be any offsite impact on flood risk. Furthermore, there is a potential beneficial effect from reduced water infiltration as a result of a change in agricultural practices.

4.2.28 Similarly there are no significant sources of pollution in an operational solar farm, again reduction in the intensity of agricultural practices i.e. reduced use of fertilizer, pesticides and winter crop rotations, can improve water quality.

4.2.29 Construction activities will be controlled by a Construction Environmental Management Plan (CEMP), with appropriate best practice measures adopted to avoid surface water pollution from fuel, oils and chemicals, as well as measures to prevent silt polluting watercourses. A draft CEMP will be submitted with the DNS application, which will document the measures which the construction contractors would be required to implement.

4.2.30 The Proposed Development is not considered to be vulnerable to any other impacts associated with climate change.

4.3 Primary (Inherent) Mitigation

4.3.1 The iterative design of the Proposed Development has incorporated mitigation measures to address environmental sensitivities and constraints at the earliest possible opportunity, so that these can be considered as part of the assessment process. The Illustrative Landscape Masterplan, presented on **Figure 6.5a-c**, highlights the current indicative inherent mitigation measures that form part of the Proposed Development. These measures are discussed further below, and where relevant in more detail in each of the technical assessments included within this ES.

Landscape and visual

4.3.2 The Site has been designed based on the prevalence of medium to large, geometric fields, which are well suited to solar farms in terms of landscape and visual effects.

4.3.3 The Proposed Development would comprise three distinct solar array areas, namely Western, Central and Eastern Array Areas (the WAA, CAA and EAA respectively). Each area was chosen based on the surrounding area being predominately rural and agricultural.

4.3.4 The Proposed Development would introduce solar development into the predominantly rural, agricultural landscape resulting in a noticeable change to character from baseline within the Site, but which would have a limited and generally localised influence on landscape character beyond the proposed solar array areas.

4.3.5 None of the statutory purposes or special qualities of the Clwydian Range and Dee Valley National Landscape would be materially affected by any change in landscape character or visual change arising as a result of the Proposed Development. Nor would the natural beauty of land within the designation boundary be affected by change resulting from the Proposed Development.

Biodiversity

4.3.6 With respect to bird species using the Site, during the accepted nesting season (March to August inclusive) construction would not take place in areas where nesting birds are discovered. This is described in Chapter 07 of the ES.

4.3.7 Existing farm access tracks would be used wherever practicable during construction, maintenance and decommissioning. This would help to utilise existing hedgerow

gaps, which would minimise the loss of breeding habitat for birds. Additionally over 5km of new tree/hedgerow planting is proposed.

4.3.8 The solar arrays have been designed with significant clearance between rows, which will permit vegetation growth beneath the panels and continue to provide bird foraging and potential nesting habitat. By design, solar panels would be positioned at an inclined angle and this, along with the large gaps between rows, would enable birds to distinguish the surface of the solar panels from a water body.

Water Resources and Flood Risk

4.3.9 The Flood Consequences Assessment & Drainage Strategy confirms that the proposed ground-mounted solar arrays will be laid on ram mounted posts ensuring the ground beneath each panel remains permeable. Rainfall runoff from the solar arrays will infiltrate to the land beneath and between the panels. It is therefore considered that the solar arrays will not result in an increase in the surface water runoff rates and volumes.

4.3.10 The proposed inverter containers will be laid on a permeable stone surface.

4.3.11 All access tracks will be formed from permeable stone surfacing and will have infrequent use (minimising compaction). Rainfall on the access tracks will infiltrate through the permeable surface.

4.3.12 The substation compound and hybrid inverter stations will be formally drained with storm water managed to accommodate the 1 in 100 year plus 40% CC event.

4.3.13 Discharge of surface water from the substation and hybrid inverter stations will be made to the ditches which intersect the site. Discharge will be made at a limited rate of 1 l/s for each of the hybrid inverter stations and also the substation compound.

Public Rights of Way

4.3.14 There are a number of Public Rights of Way (PRoW) that cross the Site or run along the site boundary, representing well established and historic community routes. These are illustrated on **Figure 6.5a-c** Illustrative Landscape Masterplan.

4.3.15 All of these PRoW would remain open for public use during both construction and operation of the Proposed Development. No significant temporary or permanent

realignments of Public Rights of Way are proposed, and suitable offsets from footpaths from any development have been incorporated into the design.

Buffer Zones

4.3.16 A number of buffer zones have been established to protect valuable natural resources, including trees and ecologically important field margins. The following minimum buffers have been adopted as standard as part of the design of the Proposed Development:

i) 15 m from woodland, including Ancient Woodland.
ii) Variable buffers for Ancient and Veteran trees, as indicated in the Arboricultural Impact Assessment (**Appendix 4.3**).
iii) 8 m from Watercourses.
iv) 5 m from hedgerows.

4.4 Standard Control Measures

4.4.1 In addition to the embedded mitigation described above, standard control mechanisms would be implemented during construction to mitigate and temporary impacts during this phase of the Proposed Development. The two main standard control measures would be the Construction Environmental Management Plan (CEMP) and the Construction Traffic Management Plan (CTMP).

4.4.2 Adherence to these measures would be mandatory for the Applicant and the chosen contractor, and it would be expected that these control measures would be updated prior to, and during, construction to ensure that they remain up to date. For example, changes in environmental legislation between submission of the planning application and the start of construction would need to be addressed as part of an iteration to the CEMP.

4.4.3 Further details on the CEMP and the CTMP are provided below.

Outline Construction Environmental Management Plan

4.4.4 A draft outline Construction Environmental Management Plan (oCEMP) has been developed for the construction phase of the development and is included as **Appendix 4.1** of this ES.

4.4.5 The purpose of the OCEMP is to manage and report environmental effects of the project during construction. The oCEMP sets out how environmental issues would

be managed in accordance with relevant legislation, regulations and best practice guidance. It would be the responsibility of the main contractor to develop and enforce a finalised version of the CEMP. It is suggested that the requirement for a finalised CEMP to be prepared is subject to a planning condition once the detailed design is completed to allow main contractor input.

4.4.6 The objectives of the CEMP are to:

i) Highlight environmental impacts resulting from the development and identify sensitive receptors within the development site to the construction team.
ii) Reduce and manage environmental impacts through appropriate construction methods.
iii) Reduce and manage environmental impacts through implementing environmental best practice during the construction period.
iv) Undertake ongoing monitoring and assessment during construction to ensure environmental objectives are achieved.
v) Provide emergency procedures to protect against environmental damage.
vi) Provide an environmental management structure for the construction stage.
vii) Recommend mechanisms to reduce risks of environmental damage occurring.
viii) Ensure procedures are in place for consultation with Natural Resources Wales, Wrexham Borough County Council Officers, and other stakeholders throughout the works if necessary.

4.4.7 Prior to the commencement of construction works an environmental walkover would be undertaken to establish any changes in the environmental baseline since the surveys undertaken as part of the EIA and planning submission. This walkover would be used to update any of the defined construction procedures as necessary.

4.4.8 The main contractor would also develop a local community liaison strategy. This strategy would detail how the contractor would engage with the local community to inform them of the construction progress and inform them of any works that may give rise to queries or concerns. The strategy would also set out the means to allow the public to raise any concerns with the contractor and mechanisms to resolve any complaints.

4.4.9 The main contractor would take regard of current guidance published by Natural Resources Wales as well as other UK sources where relevant.

Construction Traffic Management Plan

4.4.10 An initial CTMP has been prepared for submission as traffic management was a key consideration in the emerging design of the Proposed Development and identification of suitable construction access routes. The initial CTMP is included as **Appendix 4.2** to this ES.

4.4.11 The initial CTMP includes information relating to:

i) **Site Context** – A description of the existing site and the surrounding areas transport and highway characteristics.
ii) **The Proposed Development** – An overview of the Proposed Development.
iii) **Proposed Access Route** – description of the associated construction access and constructing routeing.
iv) **Site Management Plan** – description of how site access will be managed, including the measures to minimise the impact of construction on local residents, businesses, and the local highway network.

4.4.12 Reviewed accident data suggests that there is no inherent trend on accident locations in the vicinity of the site. On this basis, it is considered that the adjoining highway network currently operates with no significant highway safety issues which could be exacerbated by the development.

4.4.13 During the construction period, there are expected to be a total of approximately 24 two-way HGV delivery-related movements per weekday and 14 two-way delivery related movement per Saturday, on average. This level of traffic generation is considered to be insignificant.

4.4.14 Staff will be mini-bussed in, with a 4-person per vehicle target where required. It is therefore forecast that the total light movements during the construction period will be 20 one-way or 40 two-way trips per day.

4.4.15 These figures are based on an assumed 39-week construction programme for robustness. Based on a 52-week construction programme, the above figures reduce to 18 two-way per weekday and 10 two-way per Saturday, on average.

4.4.16 Approximately 80 construction-related staff would require access to the Site per day. Assuming vehicle share occupancy of 4 people per vehicle, the proposed construction phase can be expected to result in 40 two-way vehicle trips per day.

4.4.17 The exact origination of development related HGV trips is uncertain at this stage and would be determined by the sourcing of materials and plant by the appointed contractor. HGVs would nonetheless be routed primarily along the Strategic Road Network (SRN), avoiding residential areas where possible and statutory limits on HGV movements (such as weight restrictions).

4.4.18 Construction traffic will route to all parts of the Site via the A483 Junction 2 (SRN) and the B5426. Access to the WAA will then be achieved directly from the B5426 with access to the CAA and EAA being via Marchwiel Hall Road (CAA) and the B5426 / A528 Overton Road / B5130 Kiln Lane (EAA).

4.4.19 Given the low traffic levels generated by the Proposed Development, as discussed elsewhere in this chapter, it is considered that the Proposed Development would not result in any material impact on the above route(s).

4.4.20 A wheel cleaning procedure will be used in order to mitigate the amount of mud that could potentially be deposited on the highways by vehicles exiting the site. An area close to the site exit will be utilised for wheel washing prior to vehicles leaving site. A power washer will be used to wash off any mud from the vehicle's wheels, with excess mud/slurry being collected and disposed of.

4.4.21 Pedestrian safety throughout the construction programme will be paramount. To ensure pedestrian safety during loading and unloading activity, a Banksman / traffic marshal should be present to minimise the likelihood of conflict with pedestrians. Warning signage will be provided locally to the site to ensure that vehicles, pedestrians, and cyclists are aware that construction activity is taking place. The site will be properly secured, helping to ensure that pedestrians and the general public cannot access the construction site unauthorised.

4.4.22 The Applicant, or its representative, will liaise with all neighbouring residents and businesses to ensure they are aware of the construction programme and the development proposals. Communication with local residents and businesses will begin prior to commencement of construction.

4.4.23 Further information regarding traffic and transport implications of the Proposed Development can be found in the Transport Statement, which is provided for consultation as a standalone document.

4.5 Components of the Solar Farm

Solar Panels and Frames

4.5.1 The Proposed Development comprises the installation of static solar PV panels mounted to a steel and aluminium frame. The panels would be tilted at a horizontal angle of approximately 15-25° and would face due south, or 180° from north. The indicative layout of the solar panels is illustrated on **Figure 1.2a-c** and a typical solar panel frame configuration is illustrated below in Image 4.1.

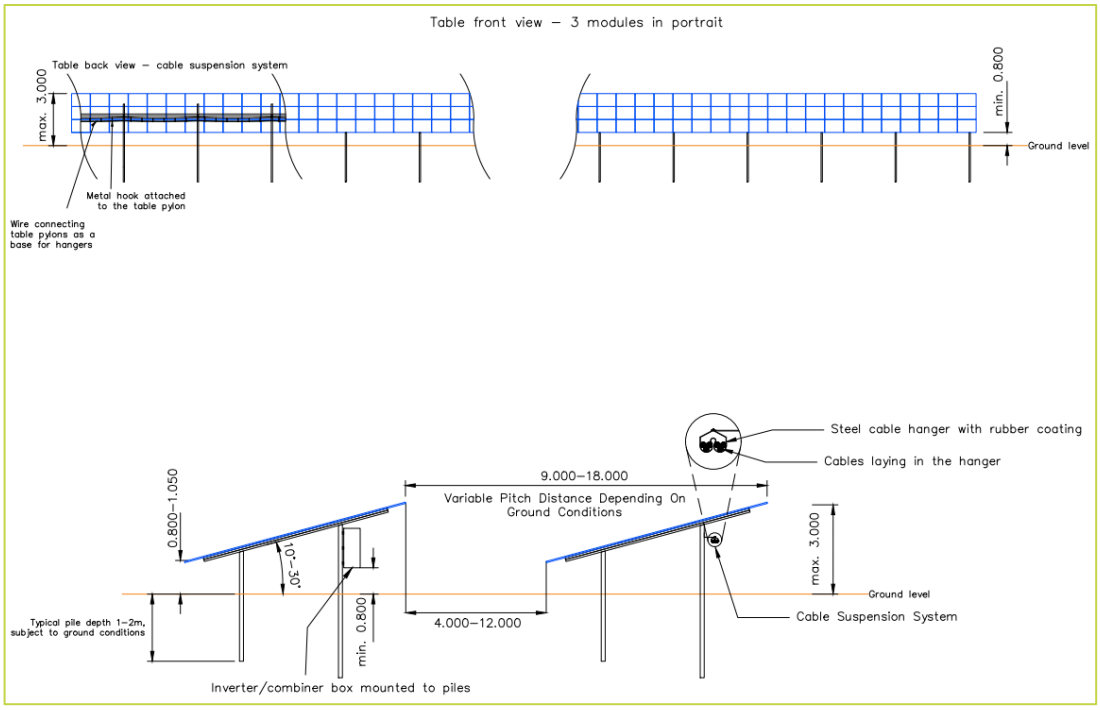

Image 4.1 Photovoltaic table layout

4.5.2 The layout, angle and tilt of the solar panels has been designed to maximise solar efficiency across the solar farm, whilst avoiding adverse impacts in relation to glint and glare. The solar farm layout has been designed by modelling sun paths and the shadowing that this results in. This results in an optimum design of solar exposure of the panels, whilst ensuring there is no overshadowing of adject arrays.

4.5.3 Whilst due south is the optimum direction for solar arrays, often impacts associated with glint and glare require slight amendments to the layout and orientation of solar arrays to avoid adverse impacts at local receptor points. The assessment of glint and glare is reported in **Appendix 4.3**, with the recommended mitigation included as necessary, as shown on **Figures 1.2a-c** and **Figure 6.5a-c**.

4.5.4 The solar PV support frames would be arranged into rows set 4 m to 12 m apart, depending on the location within the Solar Farm and the requirement for access between frames. The lower, front edge of the solar panels would be raised approximately 800 - 1050 mm above ground level, with the rear edge raised to a maximum of 3 m above ground Level. This spacing would enable the area under the panels to be continuously grazed by sheep

4.5.5 The solar PV support frame structures would consist of steel uprights and aluminium or steel cross bars. The steel uprights would comprise hollow 3 mm sheet steel post with a u-shaped cross section.

4.5.6 The posts would be ram driven into the ground using several specialist small scale GPS controlled piling machines to a depth of approximately 1 m to 2 m, depending on ground conditions. The rest of the support frame would then be fitted to the posts to create angled support tables ready for the solar panel installation.

4.5.7 If required, which would usually be in areas where breaking ground might be problematic due to ground conditions, archaeological remains or utilities risk, frames can be mounted on concrete pads that are laid on the surface. However, there is currently no identified need for this method within the Solar Farm.

4.5.8 The solar PV modules would be mounted support frame tables, which would be pre-constructed to help minimise on-site construction activity. The individual solar PV modules within the Proposed Development would likely consist of dark blue, dark grey or black photovoltaic cells, however solar technologies are developing rapidly, and it is not possible to specify the precise panel type, as this will depend on the competitive procurement process and the technology available at the time of construction.

4.5.9 The solar PV modules would be connected in strings and cabling would be secured to the rear of the solar panel and would be protected from grazing livestock by suitable trunking/elevation. From the end of each run the cables would be taken below ground and would be connected to centralised inverters located strategically within the site. If there are areas of archaeological sensitivity, surface mounted cable trunking would be used to avoid any impacts on buried archaeology. The centralised inverters would in turn connect into the substation.

Battery Energy Storage System

4.5.10 The Proposed Development includes 27 battery storage facilities within containerised battery energy storage systems (BESS). These would be situated around the Site and positioned away from residential properties and sensitive receptors. These containers would be equipped with modern heat ventilation and cooling (HVAC) units, and fire suppressant systems, ensuring that they operate at safe temperatures and that safety measures are in place in the unlikely event of a fire breaking out.

4.5.11 The BESS containers (and solar array) would be supported by inverters, transformers and associated infrastructure as illustrated on **Figure 1.2a-c**.

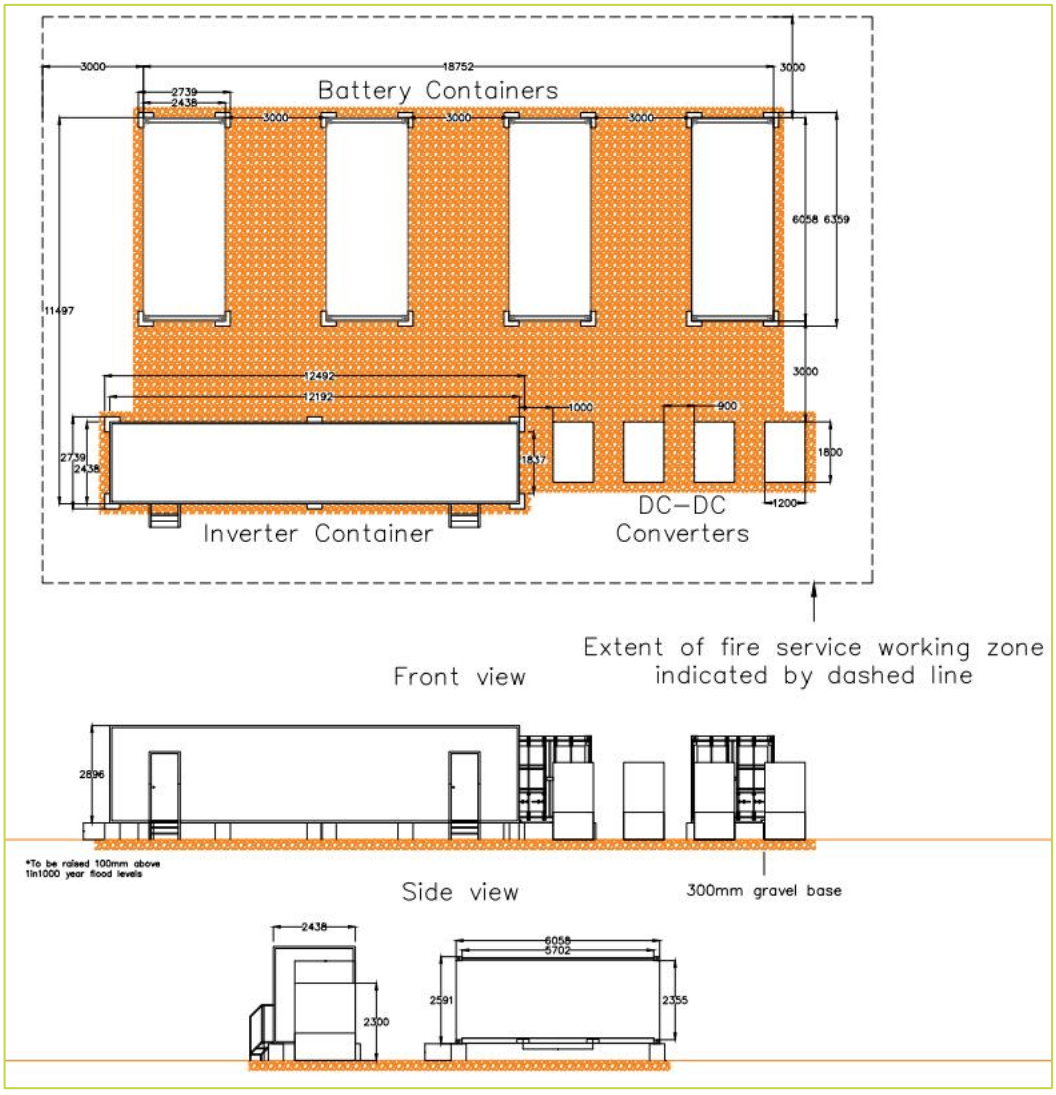

Image 4.2 Typical Inverter / BESS layout

4.5.12 The purpose of battery energy storage would be to capture any unused or excess energy generation from the solar panels and store it, which can then be released to the grid as and when necessary. This will maximise the efficiency of the solar farm. The batteries can also store surplus electricity from the wider electricity distribution network at times of low usage and high generation elsewhere in Wales and then release it back when the grid requires. This practice is called 'grid balancing' and enables increasing deployment of renewable energy throughout the UK.

4.5.13 The BESS units would be connected to the PV system via inverters. The Site would have a grid export capacity of 99.9 MW.

4.5.14 The battery storage components would not require any significant ground works to install as they are prefabricated offsite and then brought to the Site where they are installed on concrete platforms. Some minor ground levelling would be required to ensure the components sit on stable ground.

4.5.15 The BESS units have the potential to generate heat and therefore it is necessary to adopt sufficient management and control measures. The BESS would include cooling systems which are designed to regulate temperatures. The units would also contain highly sensitive fire detection and suppression systems, enabling identification of potential thermal runaway well in advance of any occurrence, and allowing units to be switched off remotely to avoid any such incident. Currently over 1 GW of battery storage is safely operating in the UK.

4.5.16 A Battery Safety Management Plan (BSMP) would be implemented during the operation of the Proposed Development. The BSMP will detail the regulatory guidance reviewed to ensure that all safety concerns around the BESS element of the Proposed Development (including fire risk management) are addressed so far as is reasonably practicable. An Outline BSMP (oBSMP) is provided as part of the information prepared for consultation.

4.5.17 Each individual BESS has a number of methods of managing fire risk, in addition to the inherent base chemistry of the battery cells. These methods include software and hardware fail safes and supplementary fire suppression systems.

4.5.18 Each BESS container would include cooling units and an integral battery management and fire suppression system to maintain optimal operating conditions, irrespective of climatic conditions. This includes:

i) A monitoring and detection system that would shut down components in the event of elevated temperatures that could cause as fire.
ii) A suppression system which, in the unlikely event of a fire, acts by means of specifically designed gas (normally a blend of argon and nitrogen), widely used in the industry, to cool and smother fire. The gas is designed not to harm human health or the environment.

4.5.19 The temperature of the battery cells would be monitored and any temperature variation within an individual module outside optimum operating conditions would trigger a response from the air conditioning units. If there is a continual rise in temperature, or there is a failure of the air-conditioning units, the container would automatically partially of fully shutdown to mitigate against the risk of fire.

4.5.20 In the very unlikely event of a battery fire in one of the modules a fire suppression system would be triggered automatically. The fire suppression system would comprise FM200 gas or similar, which are commonly used in large scale electrical facilities, such as data centres, telecommunication facilities, etc. The system is waterless, therefore there is no risk to soils or ground water as a result of operation. In addition, this type of system uses an agent removes the heat element from the fire, rather than the oxygen, meaning that the system can be deployed if the affected container is occupied. These systems generally reach extinguishing levels in approximately 10 seconds or less, which greatly reduces the potential damage caused by a fire incident.

4.5.21 The inverters control and increase the voltage of the electricity generated by the solar panels before it reaches the on-site substation and ultimately the distribution network. The transformer stations comprise individual steel containers (approximately 12.2 m long × 2.4 m wide x 2.9 m high). The inverter stations would be supported by strip or slab foundations depending on localised ground conditions. The maximum height, with foundations, would be no greater than 3.4 m. The inverter stations would contain the technology necessary to connect the solar farm to the on-site substation. Each inverter station would be finished in a green, with the BS Colour/RAL to be agreed through condition.

4.5.22 Due to rapid advances in technology, it is not possible to specify the precise type of inverter. The detailed electrical design and competitive procurement process will influence the type of inverters deployed; however, the final details would be

controlled through suitably worded planning conditions requiring the final details to be submitted for approval.

Electrical Cabling

4.5.23 On-site cabling would be required to connect the solar panels to the centralised inverters, BESS and the substation and control centre. In addition, a high voltage underground connection to the point of grid connection at the Legacy National Grid Substation is required.

4.5.24 Image 4.3 provides details of indicative cable trenches. Cable trenches would generally run parallel and adjacent to the on-site access tracks and fence lines, which aids maintenance and reduces the likelihood of damage. In addition to electrical cabling the trenches may also carry earthing, data and communications cables and will be backfilled with excavated materials to the original ground level. Marker posts would be placed on either side to clearly demarcate the location of the cable crossing, if required. Cabling will also be required for power and data transfer associated with the CCTV system described below. This will generally follow the perimeter fence lines where the CCTV cameras would be located. If there are areas of archaeological sensitivity, surface mounted cable trunking could be used.

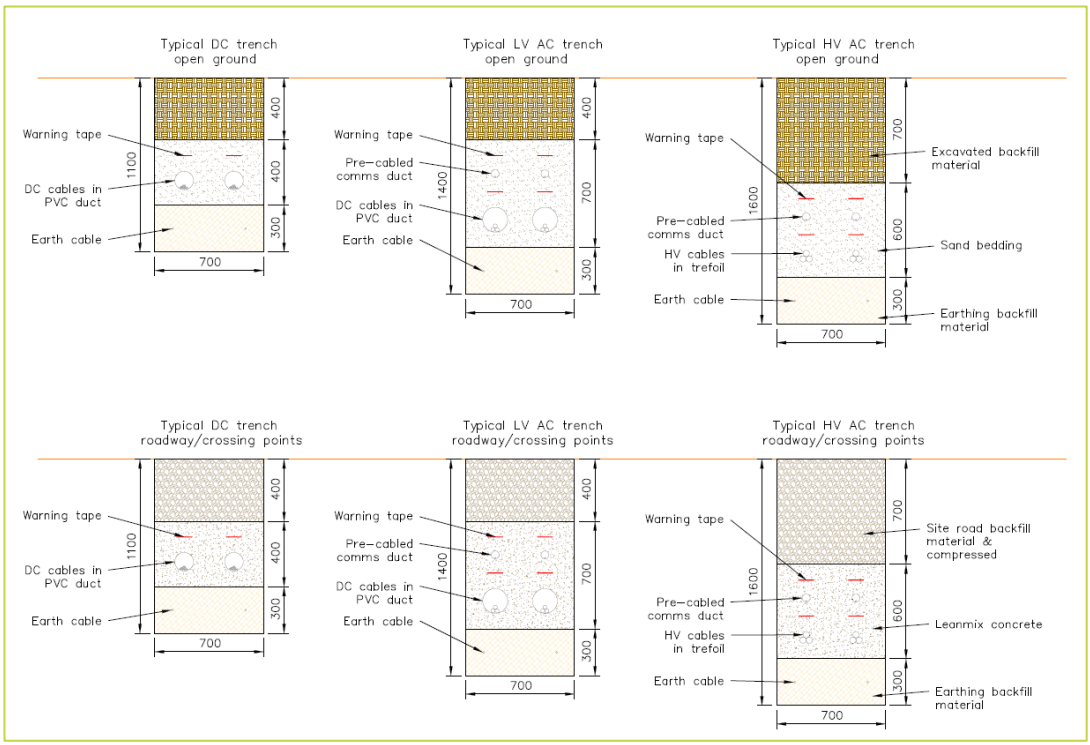

Image 4.3 Cable trench cross section

Operational Compound

4.5.25 The operational compound for the Proposed Development would be located within the south-west of the Site, as shown on **Figure 1.2a-c**. The compound would provide a Battery Energy Storage Facility, Control Room, and the Substation.

4.5.26 The compound would be approximately 75 m × 75 m in area. Except for the concrete foundations for the various elements of equipment, the compound would comprise ground that would be permeable to surface water.

4.5.27 The compound would be fenced for security purpose. It is proposed that the details of the fencing are subject to a planning condition but are likely to comprise a wire mesh form, with matching gates for vehicular and staff access.

Substation

4.5.28 The on-site substation for the Proposed Development is located in the south east corner of WAA. It would be finished in a grey or green finish, with the BS Colour/RAL to be agreed through condition. The final design for the substation would be subject to agreement with the DNO, which would adopt the substation once operational.

Control Centre Building

4.5.29 The Control Centre building would be located adjacent to the Substation building.

4.5.30 The Control Centre would contain equipment necessary for monitoring the performance of the solar farm and BESS. This would not be permanently manned and would be for visiting maintenance engineers. As such welfare facilities would not be included.

4.5.31 The building would be finished in a grey or green finish, with the BS Colour/RAL to be agreed through condition. The overall footprint of the Switchroom Building would be approximately 30 m^2.

4.5.32 The indicative layout of the operational compound is illustrated below in Image 4.4

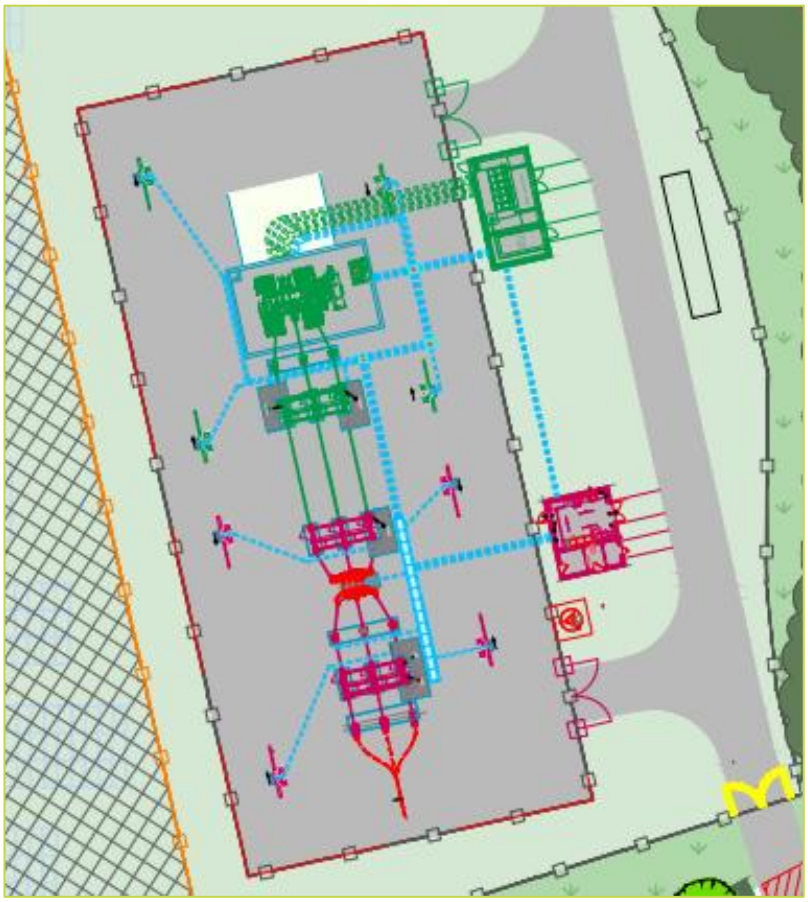

Image 4.4 Indicative operational compound

Access Tracks

4.5.33 Access all parts of the Site via the A483 Junction 2 (SRN) and the B5426. Access to the WAA will then be achieved directly from the B5426 with access to the CAA and EAA being via Marchwiel Hall Road (CAA) and the B5426 / A528 Overton Road / B5130 Kiln Lane (EAA).

4.5.34 Access tracks are located throughout the site with access entrances on local roads. The access tracks have been located so they cause minimal impact to the existing hedgerow and local road network.

Security

4.5.35 Security would be provided by approximately 2 m high deer/stock fencing and pole mounted CCTV cameras. The fencing would be attached to wooden poles that would be located 3.5 m apart. Sections of the fencing would incorporate a mammal gate,

measuring 200 mm X 200 mm to avoid any severance issues for terrestrial mammals.

4.5.36 The CCTV poles would be placed every 50m, have a maximum height of 3 m and would generally have one dome camera focussed along a specific area of the Site. At certain locations two cameras would be deployed so that they can be targeted on specific locations. All cameras would operate using infra-red technology and as such no additional lighting would be required.

Drainage

4.5.37 The solar panels would allow rainwater to fall between gaps to the ground below the panels where it would permeate into the ground. Erosion would be prevented by maintaining the grass sward beneath the panels.

4.5.38 All new site access tracks would be constructed of permeable stone and would infiltrate to ground. The transformer stations, BESS Containers, Switchroom Building, Control Centre and Substation would drain to localised filter drains / stoned surrounds that would allow percolation to ground.

4.5.39 Foul water from the welfare facilities within the control room would be captured in a sealed septic tank and emptied periodically by tanker.

Lighting

4.5.40 Lighting would be limited to the Switchgear Building and Control Buildings. Low level lighting would be positioned above access doors and would only be activated by passive infra-red sensors for security/emergency purposes or when switched on by a maintenance engineer. No areas of the Proposed Development would be permanently lit during operation.

Landscaping

4.5.41 The landscape proposals for the Site are illustrated indicatively on **Figure 6.5a-c** and would be developed in detail prior to commencement of the development.

4.5.42 The soft landscape proposals build on the existing landscape features and comprise:

i) Retention of existing vegetation patterns as far as practicable by maintaining a minimum 5 m buffer between field boundary hedgerows and woodland, and the stock fencing around the development areas.
ii) Improved ecological networks and habitats to enhance and protect a range of birds, insects and small birds.
iii) Creation of buffer zones between fence lines and field boundaries for habitat connectivity, either seeding these areas with species-rich grassland mixes or allowing natural regeneration through a managed rewilding approach.
iv) Gaps in existing hedgerows would be planted up, and the hedgerows would be maintained at a height of approximately 3 m to provide enhanced visual screening.
v) Planting over 5 km of new trees / hedgerow.
vi) Planting belts of specimen trees along field boundaries within the Site to screen local views and provide habitat connectivity.
vii) Use of Native species trees and shrubs to diversify the range of native species in the local area to reduce biosecurity threats from pests and disease.

Grid Connection

4.5.43 The route of the proposed grid-connection cabling is presented on **Figure 1.1**. The point of connection to the National Grid would be via the Legacy Substation located adjacent to the Talwrn Water Tower to the north of Bronwylfa Road (the B5426), approximately 2.7 km to the northwest of the main solar farm area. The solar farm would connect to the substation via an underground electrical cable. The grid connection route would be approximately 4 km from the WAA. For the majority of this route, the underground cable would sit beneath the existing highways boundary.

4.5.44 The electrical connections would be located within the hard surfacing of the highway or footway, or within the highways verge. The precise location of the cable will be dictated, in part, by the presence of other utilities within the highway. The trenching works would be undertaken in short sections, managed using traffic control systems or where considered necessary under road closures supported by diversions. In this regard the cable trenching works would be similar to other regular utilities works undertaken within the highway.

4.5.45 The proposal would include an on-site 132 kV substation, which would comprise an open compound with support stanchions and cabling. The substation would be

located within the WAA located away from the residential property to the east of the WAA and positioned to take advantage of the screening provided by the adjacent woodland. The substation's main structural elements would be painted in a muted mid-tone neutral shade to ensure that they are visually recessive within the landscape.

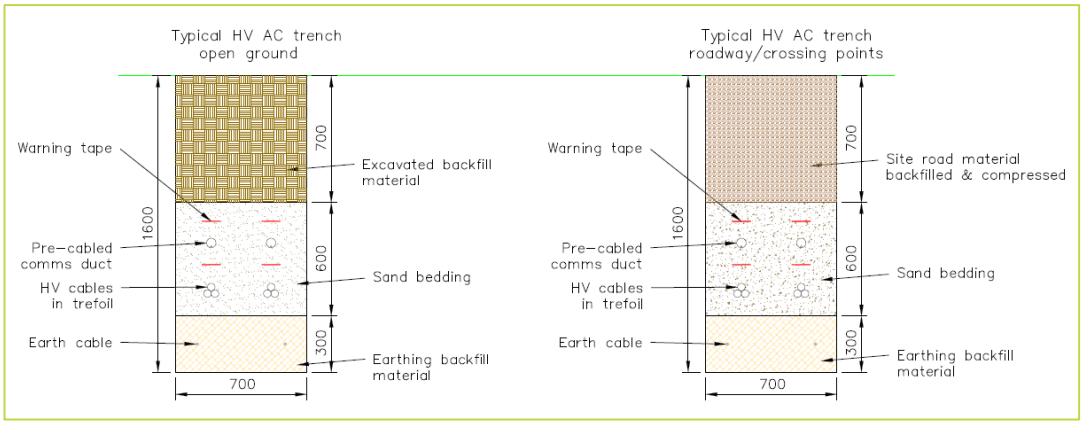

Image 4.5 Grid Connection cable route cross section

Operation of the Solar Park

4.5.46 Once the Proposed Development is constructed access to the Site would be limited to routine solar maintenance and landscape management operations. The Proposed Development would not be permanently staffed. Maintenance access to the Site would be by a small van or similar.

4.5.47 Should more major repairs be required, such as the replacement of transformer stations, more staff and specialist equipment (cranes and low loaders) would be required. This is not anticipated to be a regular occurrence.

4.5.48 The main operational noise would be associated with the centralised inverters, substation, and BESS containers. These noise levels have been determined to be not significant through the design process, with levels emitted by fixed plant predicted to be below background noise levels at sensitive receptors. Further information on noise from fixed plant is included in Chapter 8.0 of this ES.

4.5.49 As set out above the main activity during the operational phase of the development would be sheep grazing below the solar panels and/or periodic mowing or other landscape maintenance. This would retain most of the Site in productive agricultural use.

Image 4.6 Continuation of sheep farming with solar panels

4.6 Construction of the Solar Farm

4.6.1 The following section provides a summary of the key elements of the construction of the Proposed Development. This description is not intended to be prescriptive and the exact construction methods, phasing and programme would be determined by the appointed designers and contractors. However, the following description enables the principal construction phases and methods to be understood and assessed.

Programme

4.6.2 The timing of the construction works would be dependent on the grant of planning permission for the Proposed Development, subsequent contract negotiations and prevailing weather and ground conditions.

4.6.3 The construction period is anticipated to take approximately 39 weeks, including testing and commissioning.

4.6.4 This construction programme would allow for the following key construction-related works to be undertaken:

i) Erection of ‘Heras’ fencing around tree root protection areas.
ii) Establishment of site compound.
iii) Construction of site access tracks.
iv) Erection of deer / stock fencing and gates to site perimeter.

v) Installation of solar panels and frames.
vi) Installation of CCTV poles and cameras.
vii) Installation of centralised inverters and transformer stations.
viii) Installation of cable trenches.
ix) Installation of BESS containers.
x) Installation of control building, switchroom building and substation building.
xi) Grid connection.
xii) Cultivation and seeding.
xiii) Hedgerow and woodland planting.

Construction Hours

4.6.5 Construction activities would take place six days per week, during the following hours:

i) Monday to Friday 07:30-18:00 and Saturday 08:00-14:00; with
ii) No works on Sundays, Public Holidays or Bank Holidays.

4.6.6 Any piling operations would be limited to between 07:30 and 18:00, Monday to Saturday only, with no works on Sundays, Public Holidays or Bank Holidays.

Site Access and Compounds

4.6.7 The Proposed Development is located in a predominantly semi-rural area with local roads commensurate with its location. As a result, the applicant is keen to minimise the potential impact of the development on the local roads, especially during the construction period when the volume of vehicles generated by the development will be highest.

Site Access Arrangements

4.6.8 The proposed Site access locations (A – G) are shown at **Image 4.7**. Each access would serve as both a construction and operational phase access to the respective array areas.

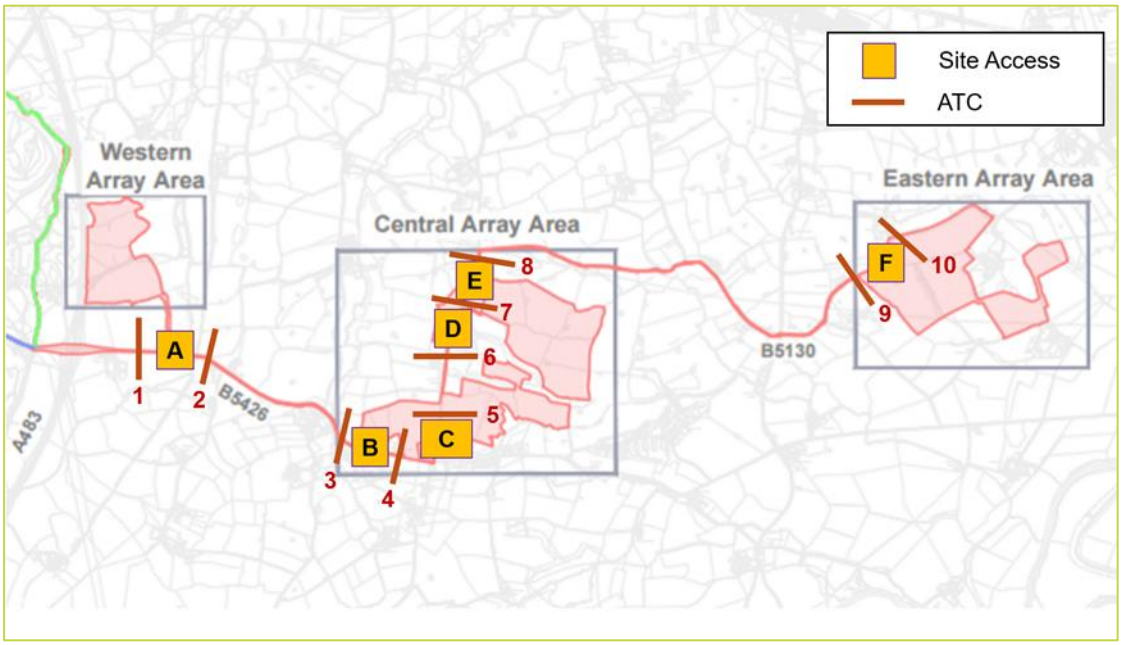

Image 4.7 Proposed Site Access Locations

4.6.9 Full details relating to each Site access design, including matters relating to junction scale / form, visibility splays and swept path analysis are provided within the Transport Statement.

Proposed HGV Routing

4.6.10 The exact origination of development related HGV trips is uncertain at this stage and would be determined by the sourcing of materials and plant by the appointed contractor. HGVs would nonetheless be routed primarily along the SRN, avoiding residential areas where possible and statutory limits on HGV movements (such as weight restrictions).

4.6.11 Construction traffic will route to all parts of the Site via the A483 Junction 2 (SRN) and the B5426. Access to the WAA will then be achieved directly from the B5426 with access to the CAA and EAA being via Marchwiel Hall Road (CAA) and the B5426 / A528 Overton Road / B5130 Kiln Lane (EAA).

4.6.12 A plan showing the routing strategy is included at **Image 4.8**.

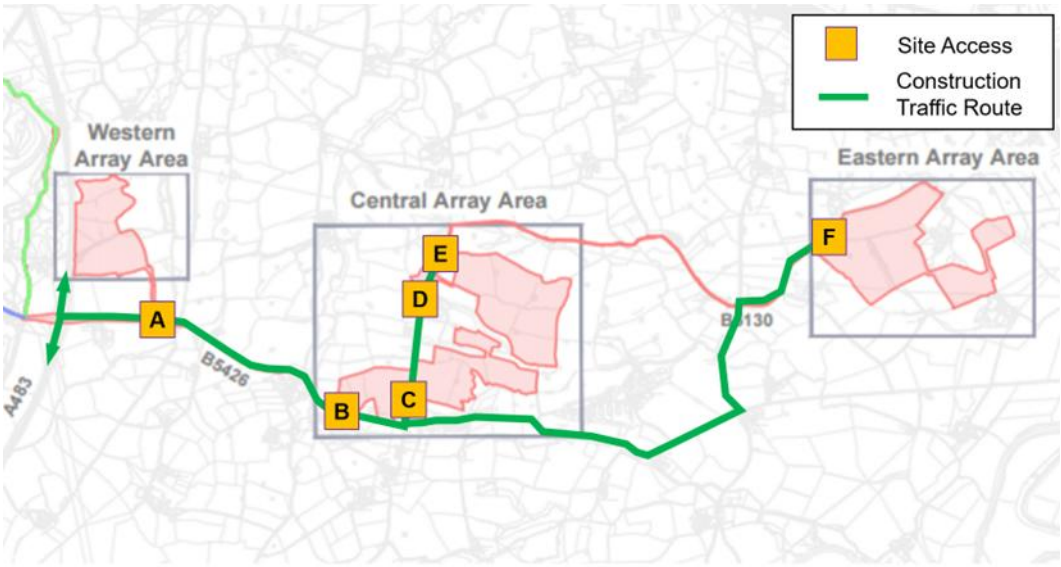

Image 4.8 Construction Phase HGV Routing Plan

4.6.13 Given the low traffic levels generated by the Proposed Development, as discussed in the Transport Statement, it is considered that the Proposed Development would not have any material impact on the above route(s) and no off-site highway infrastructure works are therefore considered to be required.

4.6.14 An indication of a typical site compound layout is shown below in Image 4.9.

Image 4.9 Typical construction compound layout

4.6.15 The temporary construction compounds would contain construction worker welfare facilities, a site office, limited parking, wheel wash area, plant and machinery storage, Heavy Goods Vehicle (HGV) / delivery turning area and waste storage areas.

4.6.16 For security and safety purposes, any live construction areas would be closed to the public throughout the construction phase. Site security staff would patrol the Panel Areas in addition to hazard warning signs and CCTV.

4.6.17 The main compound would include:

i) Temporary offices/buildings providing office, canteen, and welfare facilities for construction operatives.
ii) Parking areas construction workers.
iii) Dedicated waste storage areas.
iv) Fuel and oil chemical stores.
v) Equipment and material laydown areas.

4.6.18 All construction staff would arrive and park at the main construction compound. During periods of maximum construction activity, when manpower requirements would be greatest, staff would be encouraged to car share and/or use minibuses provided by the contractor from a central pickup location away from the Site. These arrangements would be included within a Construction Phase Travel Plan, which would be agreed as part of the consenting process.

4.6.19 At the end of the construction period the construction compound would be decommissioned. Materials would be removed, and the areas would be restored to grassland.

Construction Plant

4.6.20 Plant on site is likely to comprise:

i) A number of small-scale mechanical pile driving rigs for frame supports.
ii) 360° excavators.
iii) Dumper trucks and rollers for access tracks.
iv) Trenching machines.
v) Telehandlers.
vi) Cranes for transformers and Battery Energy Storage System and inverter containers.

Main Construction Works

4.6.21 The main construction phases of the project are described below.

Site Preparation and Development of Construction Compounds

4.6.22 The perimeter of the construction Site would be fenced with the proposed deer/stock fencing. Temporary 'Heras' fencing or similar would be used around compounds and other work areas until the perimeter fencing is erected, and the Site secured.

4.6.23 The construction compound(s) would be created for the initial Site earthworks phase. The compound would provide temporary Site offices, welfare facilities and material and plant storage areas. Dedicated refuelling areas and chemical and oil storage areas would also be provided within the compound as required and these would be fully bunded to comply with Natural Resources Wales requirements.

4.6.24 The numbers and size of this equipment will depend on the works that are being undertaken on site at a given time.

Earthworks, Foundations and Piling

Excavations

4.6.25 The topsoil excavated for the permanent access tracks and foundations for the Transformer Stations, BESS, Substation Building, Control Room and Switchroom buildings would be re-used on site or stored adjacent to the excavations for use in restoration following decommissioning.

Temporary Excavations

4.6.26 Temporary excavations required for construction would be minimal and would primarily be associated with trench excavations for cable runs. Topsoil and subsoil would be stored separately immediately adjacent to the excavation in stockpiles not exceeding 1 m in height. Temporary excavations would be reinstated immediately following construction to restore the previous soil profile. Topsoil would be graded out to marry the excavations with the existing site levels and the areas would be seeded with a meadow grassland seed mix suitable for sheep grazing as detailed above.

Foundations

4.6.27 The foundations for the Transformer Stations, Substation, Control Room and Switchroom buildings would be slab foundations or concrete sleepers, depending on ground conditions.

4.6.28 Foundation slabs and sleepers would be cast in-situ and concrete would be delivered directly to the Site via concrete mixer lorry.

Piling

4.6.29 As set out above the support posts for the solar panel frame would be ram driven into the ground using a number of specialist small scale GPS controlled piling machines to a depth of approximately 1.2 m depending on ground conditions. A typical small scale piling machine used for solar farm construction is illustrated in Image 4.10 below.

Image 4.10 Typical GPS Solar Farm Pile Driver

Lighting

4.6.30 Lighting during construction would need to be sufficient to satisfy health and safety requirements, whilst ensuring impacts on the surrounding environment, including from sky glow, glare and light spillage, are minimised.

4.6.31 Artificial lighting would only be used during the hours of darkness, low levels of natural light or during specific construction tasks to ensure the health, safety and welfare of those on site, including construction staff and visitors.

4.6.32 Appropriate lighting would be installed and operated to ensure that:

i) Access/egress points are clearly visible during operational hours.
ii) Staff and visitors can move safely around the Site.
iii) Site security can be monitored and maintained.
iv) Sufficient area lighting is provided for the Site office and laydown areas.

4.6.33 This would involve the use of mobile task lighting to provide the lighting necessary to satisfy Health and Safety requirements. Mobile lighting would be mounted on telescopic poles.

4.7 Decommissioning

4.7.1 After 40 years, the majority of the Proposed Development would be decommissioned and the Site would be returned to solely agricultural use. Decommissioning would require similar plant to the construction phase and would result in very similar traffic impacts.

4.7.2 With the exception of the on-site substation and associated access track, all above and below ground infrastructure would be removed from Site and, where practicable, would be recycled (99% of solar panel components can currently be recycled). The substation and associated access track would likely be adopted by the DNO upon commissioning and would therefore be removed by the DNO should it be considered surplus to requirements or be subject to a further planning application if needed.

4.7.3 Following decommissioning at the end of the Proposed Development's operational life or when panels need to be replaced due to failures/damage, solid waste will be created. Solar panels comprise a high proportion of glass along with smaller amounts of aluminium and other metals. Around 99% of materials used will be recyclable. As the solar industry expands the recycling market is following. There are an increasing number of specialist recycling firms that are developing technologies to allow the photovoltaic cells to be more easily recycled, enabling an even greater proportion of the solar panels to be recycled. In addition, support frames, fencing, CCTV poles and cabling all contain recyclable materials and stone/concrete can be processed for use as secondary aggregate.

4.7.4 Solid waste generated by decommissioning works can therefore be effectively managed by moving waste up the waste hierarchy through recycling for beneficial use. As such significant effects associated with disposal of waste as a result of the Proposed Development would not occur.

Appendix 4.1 – Draft Outline Construction Environmental Management Plan

Appendix 4.2 – Construction Traffic Management Plan

Appendix 4.3 – Arboricultural Impact Assessment

Appendix 4.4 – Glint and Glare Study