FENWICK SOLAR FARM

Preliminary Environmental Information Report

Volume I Chapter 2: The Scheme

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2. The Scheme

2.1 Introduction

2.1.1 This chapter provides a description of the physical characteristics of the Scheme and the activities that would be undertaken during the construction, operation and maintenance, and decommissioning phases. The description contained within this chapter informs each of the technical assessments within **Preliminary Environmental Information Report (PEIR) Volume I Chapters 6** to **14**.

2.1.2 In this chapter and throughout the PEIR, the following definitions are used to describe the key areas and elements of the Scheme. These are illustrated in **PEIR Volume II Figure 1-3: Elements of the Site**:

a. Solar Photovoltaic (PV) Site – the total area covered by the ground-mounted Solar PV Panels, planting and mitigation areas, Field Stations, Battery Energy Storage System Area (BESS Area), On-Site Substation, and associated infrastructure;

b. Grid Connection Corridor – the area outside the Solar PV Site in which the 400 kilovolt (kV) and associated cables (the Grid Connection Cables) would be installed between the On-Site Substation to the Existing National Grid Thorpe Marsh Substation (approximately 6 km south of the Solar PV Site);

c. Existing National Grid Thorpe Marsh Substation – the Existing Thorpe Marsh substation (owned and operated by National Grid) where the 400 kV Grid Connection Cables would connect to the grid; and

d. The Site – the collective term for the Solar PV Site, Grid Connection Corridor, and Existing National Grid Thorpe Marsh Substation. The boundary of the Site is referred to as the Site Boundary.

2.1.3 This chapter is supported by the following figures in **PEIR Volume II**:

a. **Figure 2-1: Environmental and Planning Constraints**;

b. **Figure 2-2: Public Rights of Way**; and

c. **Figure 2-3: Indicative Site Layout Plan**.

2.1.4 This chapter is supported by the following appendices provided in **PEIR Volume III**:

a. **Appendix 2-1: Framework Construction Environmental Management Plan**; and

b. **Appendix 2-2: BESS and On-Site Substation**.

2.2 The Site Boundary

2.2.1 The Site Boundary, shown on **PEIR Volume II Figure 1-2: Site Boundary Plan**, identifies the maximum extent of land anticipated to be acquired or used for the construction, operation and maintenance, and decommissioning phases. It is important to note this is subject to refinement as the Scheme design and Environmental Impact Assessment (EIA) progress, and comments from stakeholders and the public during consultation are considered. At this stage, significant changes to the Site Boundary from that shown are not anticipated.

2.2.2 Together with the description of the Scheme components set out in this chapter and **PEIR Volume II Figure 1-2: Site Boundary Plan**, the land within the Site Boundary allows for a range of possible development options which could form part of the final Scheme design. This allows for consideration of the potential environmental effects of the full range of options under consideration to enable the assessment and identification of environmental effects.

2.3 Site Description

2.3.1 In total, the Site comprises approximately 536 hectares (ha) of land.

2.3.2 The Solar PV Site area is approximately 421 ha comprised predominantly of agricultural fields. A naming system has been applied to fields within the Solar PV Site, as presented in **PEIR Volume II Figure 1-3: Elements of the Site**: Fields were loosely grouped by ordinal directions – north east (NE), south east (SE), south west (SW), and north west (NW) – and then numbered within each group. Fields SW07 to SW14 were incorporated after the EIA Scoping and non-statutory consultation stages as a result of further optioneering and technical progression of design.

2.3.3 The Solar PV Site is approximately centred on National Grid Reference (NGR) SE 604 161 (**PEIR Volume II Figure 1-1: Scheme Location**). The surrounding landscape largely comprises agricultural fields and small rural villages, including Fenwick, Moss, and Sykehouse, as well as the hamlet of Topham.

2.3.4 At the closest point, the Solar PV Site Boundary is located immediately adjacent to the east of the village of Fenwick and approximately 1 km west and 1 km north of the villages of Sykehouse and Moss respectively. The closest residential properties are located within 10 m of the Site Boundary, however, due to the provision of buffers and land for landscaping and habitat creation/enhancement, the actual distance of separation between residential properties and Solar PV Panels, Field Stations, the On-Site Substation and the BESS Area would be greater, as shown in the indicative layout presented in **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**.

2.3.5 The Grid Connection Corridor runs for approximately 6.3 km from Solar PV Site to the Existing National Grid Thorpe Marsh Substation.

2.3.6 The corridor has a typical width of 100 m. It incorporates a number of wider areas, for example, to allow additional working area for Horizontal Directional Drilling (HDD) and temporary construction compounds, or to avoid sensitive receptors such as habitat designations, residential and commercial properties, and cultural heritage assets. The Grid Connection Corridor will be further refined prior to DCO application submission based upon ongoing studies, surveys and consultation. The width of the Grid Connection Corridor allows for a degree of flexibility as the Scheme design develops; in practice, the working width required for cable installation would be narrower as described in Table 2-1.

2.3.7 The Grid Connection Corridor is shown in **PEIR Volume II Figure 1-2: Site Boundary Plan**. The land within the Grid Connection Corridor is predominantly agricultural in nature and, where practicable, cable routing would be to the edge of fields to minimise impacts. All cables would be buried. There is no requirement for overhead electricity cables to be used or constructed as part of the Scheme.

2.3.8 Should the Grid Connection Line Drop option be feasible (see Paragraph 2.6.31), this would supersede the requirement for Grid Connection Cables and the Grid Connection Line Drop Cables would be confined to the Solar PV Site; in this event, the associated working areas within the Grid Connection Corridor would no longer form part of the Site or Scheme.

2.4 Existing Conditions Within and Surrounding the Site

2.4.1 Key environmental planning constraints within and around the Site are shown on **PEIR Volume II Figure 2-1: Environmental and Planning Constraints Plan**. Further detail regarding the Site and the surrounding areas is provided in the **PEIR Volume I Chapters 6** to **14**.

Landscape

2.4.2 The landscape features within the Site consist predominantly of agricultural fields, mainly under arable production with some areas of pasture, interspersed with individual trees, hedgerows, tree belts (linear) and farm access tracks. The figures contained within **PEIR Volume I Chapters 6** to **14** present the location of existing baseline features in relation to the Site.

Ecology

2.4.3 The Site does not contain any statutory nature conservation designations. The closest designation is Shirley Pool Site of Special Scientific Interest (SSSI) located approximately 2.7 km south west of the Solar PV Site.

2.4.4 There are four non-statutory LWS located wholly or partially within the Site, one of which, Went Valley LWS, is located in the Solar PV Site and three of which are located in the Grid Connection Corridor. Wrancarr Drain and Braithwaite Delves LWS, Trumfleet Pit LWS and Trumfleet Pond LWS are all partially located within the Grid Connection Corridor. Further LWS are located in proximity to the Site.

2.4.5 There is one area of Ancient Woodland located adjacent to the Site, which is also designated as an LWS. This area of woodland is called Bunfold Shaw and is located approximately 15 m from the Solar PV Site.

2.4.6 Further details of the ecology of the Site are reported in **PEIR Volume I Chapter 8: Ecology**.

Cultural Heritage

2.4.7 There are no World Heritage Sites, Registered Parks and Gardens, Registered Battlefields, or Protected Wrecks within the Site or the Cultural Heritage Study Areas (3 km from the Solar PV Site and 1 km from the Grid Connection Corridor and the Existing National Grid Thorpe Marsh Substation). There are no designated heritage assets comprising Scheduled

Monuments, Listed Buildings and Conservation Areas located within the Site, however, there are a number in close proximity to the Site. Whilst the scheduled monument Fenwick Hall moated site and six Grade II Listed Buildings are in close proximity to the Solar PV Site, these assets have been excluded from the Scheme. The scheduled monument Thorpe in Balne moated site, chapel and fishpond, as well as four Grade II and one Grade II* Listed Buildings, are located in close proximity to the Grid Connection Corridor and have also been excluded from the Scheme.

2.4.8 Further information regarding cultural heritage and the heritage assets located within the Site and Cultural Heritage Study Areas is provided in **PEIR Volume I Chapter 7: Cultural Heritage**.

Water Environment

2.4.9 From published Environment Agency flood mapping, the majority of the Solar PV Site is located within Flood Zone 2 (medium risk of flooding) with some areas of Flood Zone 3 (high risk of flooding). These flood zones are predominantly located to the north and east of the Solar PV Site with west and south western areas falling in Flood Zone 1 (low risk of flooding). The Grid Connection Corridor is located largely within Flood Zone 3 with smaller areas of Flood Zone 2 along its central section and approximately 700 m within Flood Zone 1 toward its northern extent. The Existing National Grid Thorpe Marsh Substation is located entirely within Flood Zone 2, however, the surrounding area is designated as a water storage area with flood defences present along adjacent watercourses. Flood Zones within and adjacent to the Site are illustrated in **PEIR Volume II Figure 9-4: Environment Agency Flood Map for Planning (Rivers and Seas)**.

2.4.10 The watercourses within the Site are shown on **PEIR Volume II Figure 9-1: Surface Water Features and their Attributes**. The Solar PV Site is crossed by Fleet Drain and Fenwick Common Drain, and the River Went is located along its northern boundary. The Grid Connection Corridor is crossed by eight watercourses which, from north to south, include Ell Wood & Fenwick Grange Drain, Moss Road & London Hill Drain, Moss Little Common Drain, Hawkehouse Green Dike, Mill Dike, Wrancarr Drain, Engine Dike, and Thorpe Marsh Engine Drain. More detailed information on watercourses and flood risk, including details of consultation with the Environment Agency, Danvm Internal Drainage Board and the Local Lead Flood Authorities (LLFA) (the City of Doncaster Council and North Yorkshire Council) is included in **PEIR Volume I Chapter 9: Water Environment**. A Preliminary Flood Risk Assessment (FRA) and Drainage Strategy are presented as **PEIR Volume III Appendix 9-3: Preliminary Flood Risk Assessment** and **Appendix 9-4: Drainage Strategy**, respectively.

Socio-Economics and Land Use

2.4.11 Nearby recreational and residential receptors include, but are not limited to, farms and associated buildings in the immediate vicinity, the village of Fenwick located immediately adjacent to the west of the Solar PV Site, and the villages of Skyehouse and Moss located approximately 1 km east and 1 km south of the Solar PV Site, respectively. The village of Thorpe in Balne and the hamlets of Hawkhouse Green and Trumfleet are located in proximity to the Grid Connection Corridor. These receptors are shown on **PEIR Volume II Figure 1-1: Scheme Location**.

2.5 Description of the Scheme

The Rochdale Envelope

2.5.1 The design of the Scheme is an iterative process based on preliminary environmental assessments and consultation with statutory and non-statutory consultees, including the public. **PEIR Volume I Chapter 3: Alternatives and Design Evolution** describes this process further, including options that have been considered and discounted or amendments made to the Scheme design to date. A number of the design aspects and features of the Scheme cannot be confirmed until the tendering process for the design and construction of the Scheme has been completed. For example, the enclosure or building sizes may vary, depending on the contractor selected and their specific configuration and selection of plant.

2.5.2 The EIA has been undertaken adopting the principles set out in the Planning Inspectorate's Advice Note 9: Using the 'Rochdale Envelope' ('Advice Note 9') (Ref. 2-1) which provides guidance regarding the degree of flexibility that may be considered appropriate within an application for development consent under the Planning Act 2008 (Ref. 2-2). The advice note acknowledges there may be aspects of the Scheme design that are not yet fixed and, therefore, it may be necessary for the EIA to assess likely worst-case variations to ensure all foreseeable significant environmental effects of the Scheme are assessed.

2.5.3 Aspects of the Scheme that require design flexibility when the EIA is being carried out include, but are not limited to:

a. The arrangement of the Solar PV Panels and panel type/specification, including Solar PV Panel heights. Maximum parameters are therefore assessed;

b. The arrangement of supporting solar PV infrastructure such as inverters, transformers and switchgear;

c. The arrangement of the BESS Area;

d. The arrangement of the On-Site Substation; and

e. The arrangement of the grid connection, i.e. the inclusion of the Grid Connection Corridor and exact routing of the Grid Connection Cables within the Grid Connection Corridor, or provision of a Grid Connection Line Drop.

2.5.4 It is necessary that there will be some flexibility built into the design of the Scheme when submitting the DCO Application so that the detailed design of the Scheme can be informed by technical considerations and post-consent work and take advantage of innovation in technology. Where such flexibility or optionality is required, this is explained in Section 2.6 to Section 2.9 below.

2.5.5 The technical assessments therefore assess an 'envelope' within which the works would take place. As such, the DCO Application and EIA will be based on maximum and, where relevant, minimum parameters. The parameters are set out below.

2.5.6 These parameters are considered in detail by technical authors during the EIA to ensure the realistic worst-case effects of the Scheme are assessed for each potential receptor. This is of particular importance to maintain flexibility due to the rapid pace of change in solar PV and battery storage technology, whilst maintaining a robust and comprehensive assessment of potential effects. The environmental effects of the Scheme will be reported in the Environmental Statement (ES) which will be submitted as part of the DCO Application.

Design Parameters

2.5.7 This section sets out the design parameters that have been assessed within this PEIR. Each Scheme component is described in more detail in Section 2.6 below. Each technical chapter has assessed the design identified to be the likely worst-case scenario for that discipline in order to determine effect significance.

Table 2-1: Design Parameters Used for the PEIR Assessment

Scheme Component	Parameter Type	Applicable Design Parameter
Solar PV Panels	PV Panel type (monofacial/bifacial)	Comprise two layers of toughened, low reflectivity glass with a series of PV cells, wiring, etc. sandwiched between. These are framed with an anodised aluminium frame. Can be monofacial or bifacial. The latter have a clear backing which allows the solar cells to absorb light on the underside/rear of the panel to increase the energy generation.
	Dimensions	Individual panels are between 2.0 and 2.5 m in length and 1.0 to 1.4 m in width.
	Colour	Dark blue, grey, or black in colour. The toughened glass covering the photovoltaic cells would be of low reflectivity.
Solar PV Mounting Structures	Type	Fixed south facing system.
	Material	Galvanised steel.
	Method of installation	Pile driven directly driven into the ground. There is no requirement for the excavation of foundations. Indicative installation depth of 1.8 m to 3.0 m depending upon ground conditions.
Solar PV Tables	The Solar PV Mounting Structures are arranged into Solar PV Tables.	
	Indicative orientation and slope from the horizontal	Fixed south facing with a tilt angle of between 10 and 30 degrees from horizontal.
	Maximum height to the top of the Solar PV Panel (AGL)	3.5 m.

Scheme Component	Parameter Type	Applicable Design Parameter
	Minimum height to the lower edge of the Solar PV Panel (AGL)	0.8 m.
Solar PV Site	Indicative separation distance between rows of Solar PV Tables	The minimum spacing between rows (inner spacing) is 3 m.
	Ground Coverage Ratio (GCR) (the ratio of the Solar PV Panel surface area to the overall area of the Solar PV Site)	GCR would not exceed 65% (i.e. no more than 65% of the Solar PV Site would be covered by Solar PV Panels).
Field Stations (including Field Station Units)	Type	Field Stations are areas of hardstanding up to 20 m by 20 m that would house central inverters, transformers, and switchgear. Field Stations would be distributed throughout the Solar PV Site and would be located a minimum of 250 m from residential properties.
	Indicative number	Up to a maximum of 28 Field Stations. Each Field Station may have up to four Field Station Units or infrastructure may be housed in a different configuration, as explained below.
	Field Station Units	Up to a maximum of 99. The dimensions of the individual Field Station Units are up to 12.5 m by 2.5 m footprint and up to 3.5 m height. When the Field Station components are provided as standalone (i.e. not within a Field Station Unit), their collective square footage may be larger due to spacing between the items (the individual footprints are listed below). The total square footage will be within the 20 m by 20 m Field Station footprint.

Scheme Component	Parameter Type	Applicable Design Parameter
	Colour	Externally finished in keeping with the prevailing surrounding environment, often with a grey or green painted finish.
	Indicative foundations	Concrete foundations (blocks or plinths), ground screws, reinforced concrete piles, or compacted stone/gravel depending on the local geology or land quality.
	Inverters – convert the direct current electricity produced by the Solar PV Panels into alternating current.	
	Type	One option is for central inverters to be pre-assembled with transformers and switchgear in a Field Station Unit. If string inverters are used, these will be either mounted parallel to the array or more likely at the end of the array frame. One single string inverter unit could be utilised for approximately every 10 to 12 Solar PV Tables.
	Dimensions	Central inverters housed within Field Station Units – see dimensions for Field Station Units above. String inverters: 1.5 m length by 0.5 m depth by 1.0 m in height. Due to the location of some Solar PV Panels in Flood Zone 2 and Flood Zone 3, the maximum height of string inverters is currently expected to be up to 2 m AGL. String inverters would either be mounted parallel to the array or at the end of each frame.
	Transformers at Field Stations step up the voltage of the electricity generated across the Solar PV Site from low voltage (1.0 kV alternating current (AC) or 1.5 kV direct current (DC)) produced by the inverters to medium voltage (33 kV). These will be provided either within containerised Field Station Units or as separate standalone units.	
	Type	Transformers will either be provided containerised with other components in a Field Station Unit or supplied stand alone.

Scheme Component	Parameter Type	Applicable Design Parameter
	Indicative dimensions	If pre-assembled as part of Field Station Units – see dimensions above. If standalone, these will be external (not in cabins or enclosures). They will have a maximum footprint of up to 4.0 m by 4.0 m and a maximum height of 3.5 m. To comply with British Standard (BS) EN 62271-1:2017 (Ref. 2-3), standalone transformers will be surrounded by a secure wire mesh fence up to 2.4 m in height.
	Colour	Externally finished in keeping with the prevailing surrounding environment, often with a grey or green painted finish. External finish varies between manufacturers and colour would not be confirmed until detailed design.
	Switchgear – combination of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. Switchgear is used to protect and isolate/de-energise equipment to allow work to be conducted safely and to clear faults downstream.	
	Type	Switchgear will either be an individual standalone unit within its own enclosure or will be pre-assembled with other components in a Field Station Unit.
	Indicative dimensions	If pre-assembled as part of a Field Station Unit – see dimensions above. If standalone, these would be housed in a cabin with maximum dimensions of 6.0 m by 2.5 m in plan and up to 3.5 m in height.
	Colour	Externally finished in keeping with the prevailing surrounding environment, often with a green or grey painted finish.
Solar PV Site Perimeter Fencing	Type	Stock proof mesh-type security fence with wooden posts.
	Installation	Fence posts will be directly driven into the ground using a standard post driver. There will be no excavation of foundations or ‘concreting in’ of posts. The average/typical distance between fence posts will be 5 m but will vary between

Scheme Component	Parameter Type	Applicable Design Parameter
		3 m and 7 m to best avoid Root Protection Zones (RPZ) and fit the shape of the field.
	Height	Maximum height of 2.2 m.
Solar PV Site Internal Fencing (e.g. where required to create rotational grazing plots)	Type	Stock proof fence mesh-type security fence with wooden posts.
	Installation	Fence posts will be directly driven into the ground using a standard post driver. There will be no excavation of foundations or ‘concreting in’ of posts.
	Height	The internal fencing will be at a typical height of 1.0 m.
Security System	Type	Pole mounted internal facing closed circuit television (CCTV) systems would be deployed around the perimeter of the operational areas of the Solar PV Site. The CCTV cameras will have fixed, inward-facing viewsheds and will be aligned to capture only the perimeter fence and the area inside the fence, thereby not capturing publicly accessible areas. The CCTV will use thermal imaging and Infrared (IR) lighting to provide night vision functionality meaning that no visible lighting will be needed for security.
	Mounting	CCTV cameras will be mounted on wooden posts approximately 2.5 m high. The posts will be positioned at every change in direction to the fence, and the anticipated spacing is every 50 m along straight sections.
	Installation	The wooden mounting posts will be directly driven into the ground using a standard post driver. There will be no excavation of foundations or ‘concreting in’ of posts. The power supply and communication (fibre optic) cables to the cameras will be underground.

Scheme Component	Parameter Type	Applicable Design Parameter
On-Site Cables	Type	On-Site Cables would connect the Solar PV Panels to inverters and the inverters to the transformers. These low voltage cables are all less than 1.0 kV alternating current (AC) or 1.5 kV direct current (DC). Fibre optic and/or Cat 5/6 network data (communications), typically installed alongside electrical cables in order to allow for the monitoring during operation, such as the collection of solar data from pyranometers (specialist sensors which measure the level of solar irradiance).
	Placement	Cabling between Solar PV Panels and inverters is typically above ground level (along a row of racks fixed to the mounting structure or fixed to other parts of nearby components), and then underground if required (between racks and in the inverter's input). All other on-site electrical cabling will be underground.
	Indicative cable trench dimensions for On-site Cables	Up to 0.8 m in width and up to 1.4 m in depth.
Interconnecting Cables	Type	Medium Voltage (MV) 33 kV cables, which transfer electricity between the transformers/switchgears at the Field Stations or BESS and the On-Site Substation. Multiple Field Stations may be on one 33 kV cable circuit, daisy chained or looped. All Interconnecting Cables will be buried within underground trenches.
	Indicative cable trench dimensions for Interconnecting Cables	Between 0.6 m and 2.0 m in width and up to 1.4 m in depth. Trench depths would increase at crossings, for example at or on the approach to open trenched watercourse crossings, or if utilities or obstacles such as buried utilities are encountered in which case trenches would be deeper to avoid the obstacle by set clearance limits. Cables will be laid a minimum of 10 m from the façade of any residential dwelling.

Scheme Component	Parameter Type	Applicable Design Parameter
Battery Energy Storage System (BESS)	Type	Batteries would be contained in shipping-type containers, with a maximum footprint of up to 12.5 m by 2.5 m and a height of up to 3.5 m. Battery containers would have built-in fire detection and be supplied with an automatically operated fire extinguisher system.
	Colour	External finish varies between manufacturers and colour would be confirmed during detailed design.
	Location	BESS Battery Containers would be located at a centralised BESS Area within Field SW10 of the Solar PV Site (refer to **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**). The footprint of the BESS Area would be up to 250 m by 200 m. BESS Battery Containers would be located at least 500 m away from residential properties.
	Indicative foundations for BESS Battery Containers	Concrete foundations (blocks or plinths), although other types of foundations (for example ground screws, metal piles, or compacted stone/gravel) may be used depending on the local geology or land quality.
	Indicative number of BESS Battery Containers	Up to a maximum of 432.
	BESS inverters, transformers and switchgear	BESS inverters would be 3 m by 2 m and 2.2 m in height. Up to a maximum of 108. BESS transformers and switchgear would be provided in shipping-type containerised units, with a maximum footprint of up to 12.5 m by 2.5 m and a height of up to 3.5 m. Up to 54 containerised transformer/switchgear units, subject to detailed design. All units would be located within the BESS Area adjacent to the BESS Battery Containers.

Scheme Component	Parameter Type	Applicable Design Parameter
	BESS Control	Up to five shipping-type containers with maximum dimensions of each container: 12.5 m by 2.5 m and a height of up to 3.5 m.
	Fire water storage	Fire water supply will be provided at the Site. This is currently being assessed through the development of the Framework Battery Safety Management Plan (to be presented with the DCO Application). On-site fire water storage would take the form of above ground tanks.
	Fire water containment	Provision of impermeable water capture to prevent loss of potentially contaminated fire water to the surrounding environment is being investigated as part of the development of the Framework Battery Safety Management Plan – full details will be presented in the DCO Application.
	Fencing	The BESS Area would be fenced with galvanised palisade security fencing. Fence posts would be directly driven into the ground using a standard post driver. There would be no excavation of foundations or ‘concreting in’ of posts. The fencing will be up to a height of 2.5 m. The securely fenced BESS Area would be located inside Field SW10 which would also be fenced with Solar PV Site Perimeter Fencing (described above in this Table).
On-Site Substation	Description	The On-Site Substation would: a. Receive the electricity from Field Stations and BESS and step up the voltage from 33 kV to 400 kV ready to be exported to the Existing National Grid Thorpe Marsh Substation via the 400 kV Grid Connection Cables; b. Receive excess electricity generated by the Solar PV Panels and send it to BESS for storage; and c. Import excess electricity from the grid via the 400 kV Grid Connection Cables, step down the voltage from 400 kV to 33 kV and send it to BESS for storage.

Scheme Component	Parameter Type	Applicable Design Parameter
	Location	The On-Site Substation would be located within Field SW8 (refer to **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**). The On-Site Substation would be located at least 500 m away from residential properties.
	Electrical infrastructure	The electrical infrastructure comprising cable sealing ends (where the export cables would terminate into the infrastructure), busbars/conductors, isolator/disconnectors and circuit breakers (for electrical safety), voltage transformers (for measuring supply) and the transformer would be outside (i.e. not contained within a building) and would comprise separate infrastructure and conductors as illustrated in Plate 2-5**.**
	Indicative dimensions	The footprint of the On-Site Substation compound will be up to 100 m by 200 m based upon the maximum design parameters of similar facilities. The electrical infrastructure (transformer, lines, and structures) would be outside (i.e. not contained within a building) and would comprise separate infrastructure and lines. The maximum structure height would be 13.0 m, although the majority of the infrastructure and lines would be shorter. The feasibility of connecting the On-Site Substation via a Grid Connection Line Drop from existing overhead power lines running north south across the east of the Solar PV Site is currently being explored. The On-Site Substation would be at the same location and the same maximum footprint for either grid connection option.
	Fencing	The On-Site Substation would be securely fenced with barbed galvanised palisade security fencing likely green in colour, which may have additional barbed wire above and mandatory warning signage. A typical arrangement is shown in Plate 2-5. Fence posts will be directly driven into the ground using a standard post driver. There will be no excavation of foundations or ‘concreting in’ of posts. The fencing will be up to a height of 2.5 m.

Scheme Component	Parameter Type	Applicable Design Parameter
	Security	A Centrally located CCTV system mounted up to 5.0 m would likely be installed within the On-Site Substation covering a 360° view of the On-Site Substation. Alternatively, a pole mounted internal facing CCTV system may be deployed around the perimeter of the On-Site Substation. The perimeter CCTV cameras would have fixed, inward-facing viewsheds and would be aligned to capture only the perimeter fence and the area inside the fence. The CCTV would use thermal imaging and IR lighting to provide night vision functionality meaning that no visible lighting would be needed for security.
Control and Metering Buildings	Location	The control and metering building would have a footprint of 20 m by 20 m and be a maximum of 6.0 m in height.
Offices, welfare and storage	Location	An Operations and Maintenance Hub would be established by constructing a containerised welfare unit (maximum footprint up to 12.5 m by 2.5 m, up to 6.5 m in height) adjacent to an existing barn within Field NW08 of the Solar PV Site. This would provide welfare, office accommodation and facilities for maintenance throughout the operation and maintenance phase of the Scheme. The existing agricultural building would be used for storage and would not require modification. The construction of the containerised unit of offices and welfare facilities would be prioritised within the programme of works, commencing prior to or at the very start of main construction works, so that these facilities are available as soon as possible (likely during the construction phase of the Scheme). During the operation and maintenance phase, portable welfare facilities would be provided at the further reaching sites on an ad hoc basis (e.g. if required by maintenance crews). During construction, portable welfare facilities would be provided within the Solar PV Site.

Scheme Component	Parameter Type	Applicable Design Parameter
Grid Connection Cables	**Grid Connection Corridor** – the area in which the 400 kV Grid Connection Cables would be installed between the On-Site Substation and the Existing National Grid Thorpe Marsh Substation.	
	Cable Type	The On-Site Substation and the Existing National Grid Thorpe Marsh Substation would be connected via three 400 kV single core AC cables, as well as a bare copper Earth cable, fibre optic cable, and low voltage control cable.
	Indicative cable trench dimensions for Grid Connection Cables	The cable trench would be up to approximately 0.7 m wide. Grid Connection Cables will be installed to a minimum depth of 0.9 m (to top of cable). To accommodate this trench depth will be up to 1.4 m.
	Indicative working width for Grid Connection Cables	The Grid Connection Corridor allows for necessary spatial flexibility in the routing of the Grid Connection Cables. The working area for installation of the Grid Connection Cables is anticipated to be a 30 m wide corridor. This may be widened in places to accommodate required operations and narrowed in others, for example to minimise removal of hedgerows or at open cut watercourse crossings. The minimum width is anticipated to be 5.0 m. The working width includes the trench, soil and spoil storage, working area and haul road with passing places where required. As is typical for cable installation projects, the haul road will be up to a maximum of 5 m wide and will run directly on the subsoil surface with temporary track matting used where required; it will not be stoned.
	Fencing	The working width of the Grid Connection Corridor will be demarcated by temporary (Heras style) fencing where required.
	Grid Connection Line Drop – the grid connection currently being explored to connect the On-Site Substation to existing overhead power lines within the Solar PV Site.	
	Location	The potential for a line drop to the On-Site Substation within the Solar PV Site from existing overhead power lines is currently being explored. Should this option

Scheme Component	Parameter Type	Applicable Design Parameter
		be practicable, this could supersede the requirement for the Grid Connection Corridor. The Grid Connection Line Drop would comprise of below ground cables connecting the On-Site Substation to a new Cable Sealing End Compound at the base of an existing on-site 400 kV overhead line tower within Field SE2. The tower will likely require modification to allow the associated infrastructure to connect by this method.
	Indicative dimensions of the Cable Sealing End Compound	The footprint of the new Cable Sealing End Compound would be approximately 50 m by 85 m.
	Link boxes (underground pits and above ground covers) – inspection pits which are installed at points where different sections of the Grid Connection Cables or the Grid Connection Line Drop Cable are joined. The covers of the pits are the only above ground infrastructure.	
	Indicative dimensions	Maximum below ground dimensions for link boxes (inspection pits) are 2.0 m by 2.0 m and less than 2.0 m deep. Above ground features would comprise manhole covers (and marking post) measuring approximately 2.0 m by 2.0 m.
	Indicative location and distribution	Located on the edges of fields to minimise disruption to agriculture, link boxes will occur approximately every 500–600 m along the cable routing, including within the Solar PV Site. It is estimated that approximately 13 link boxes will be required for the Grid Connection Cables, or approximately 3 link boxes for the Grid Connection Line Drop.

Scheme Component	Parameter Type	Applicable Design Parameter
Existing National Grid Thorpe Marsh Substation	Point of connection	The Grid Connection Cables would connect to the national grid at the Existing National Grid Thorpe Marsh Substation. Modifications will be required at the Existing National Grid Thorpe Marsh Substation to accommodate the Scheme and will be carried out by National Grid under the terms of the Scheme's grid connection agreement. All work to modify the Existing National Grid Thorpe Marsh Substation would remain under National Grid's control and do not form part of the Scheme.

2.6 Components of the Scheme

2.6.1 Table 2-1 above describes the design parameters of the Scheme. Further detail of the role and function of the Scheme components are presented below. Plate 2-1 schematically presents the components of the Scheme and how they are interconnected.

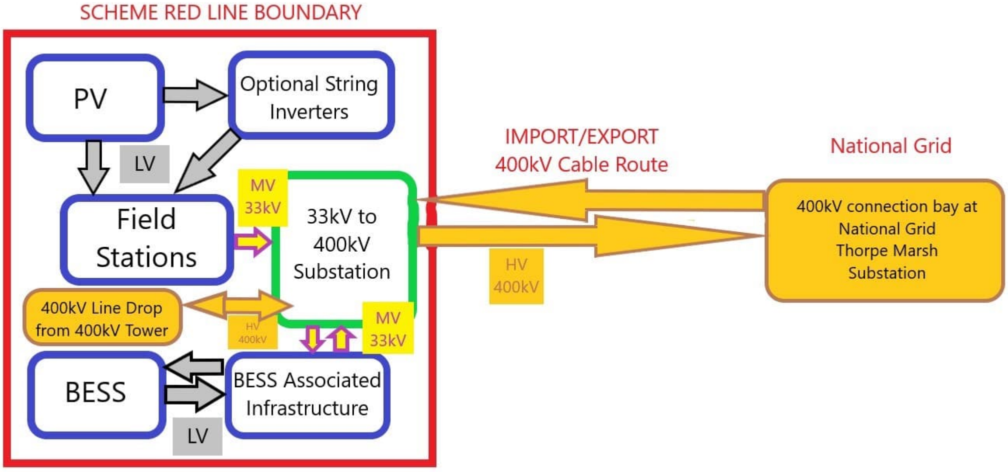

Plate 2-1: Scheme Overview

Solar PV Infrastructure

Solar PV Panels

2.6.2 Solar PV Panels convert sunlight into electrical current (as direct current, DC). Solar PV Panels can be monofacial and bifacial. Monofacial panels generate energy only from the top side facing the sun and have an opaque backing; this type is historically the most commonly installed in the UK. Bifacial panels are designed to let some sunlight through and have a transparent backing. The solar cells of bifacial panels are also able to absorb energy from the rear of the cell and any reflected light increasing the energy production compared to the monofacial type. The type of panels to be used for the Scheme will be selected closer to the construction phase, however, this will not affect the maximum parameters that are being assessed in the EIA. There are no atmospheric emissions from this infrastructure.

2.6.3 Various factors inform the number and arrangement of Solar PV Panels in each table, and it is likely some flexibility will be required to accommodate future technology developments at the detailed design stage, as referenced in Section 2.5.

2.6.4 The Applicant does not propose a limit on the generating capacity of the Scheme in the DCO Application as the environmental effects associated with the Scheme are determined by the relevant design parameters and not capacity.

Solar PV Mounting Structure

2.6.5 Each Solar PV Panel would be mounted on a metal rack, known as a Solar PV Mounting Structure. The piles and cross members of the mounting structures are typically made of galvanised steel. The most common installation solution on existing UK solar farms is to drive the piles directly into the ground without the need for the excavation for foundations and avoiding disturbance to the surrounding land surface (soils). This installation method is proposed to be used for the Scheme.

2.6.6 The Scheme would utilise fixed south facing system. Fixed south facing solar mounting structures are the most common approach for utility scale solar PV facilities in the UK to date (and therefore are the most commonly seen layout) and involve installing Solar PV Panels to fixed tables, arranged in rows facing south. An example of fixed south facing arrangement is presented in Plate 2-2.

Plate 2-2: Example South Facing Solar PV Panels

Supporting Infrastructure: Inverters, Transformers and Switchgear

2.6.7 The design parameters of Field Stations and supporting infrastructure are set out in Table 2-1. Indicative Field Station locations are shown on **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**. As the Scheme design develops at the detailed design stage, the configuration of the supporting infrastructure will be confirmed based upon environmental and technical factors.

2.6.8 Inverters convert DC electricity collected by the Solar PV Panels into alternating current (AC) electricity which can then be exported to the national grid. The size of inverters would be determined by the level of voltage and current which is output from the rows of Solar PV Panels. Plate 2-3 shows a typical arrangement for string inverters.

Plate 2-3: Typical String Inverter Installed Next to Solar PV Panels

2.6.9 Transformers step up the voltage of the electricity generated across the Solar PV Site from low voltage (less than 1.0 kV AC or 1.5 kV DC) produced by the inverters to medium voltage (33 kV) so that it can be transported (via the Interconnecting Cables) to the On-Site Substation.

2.6.10 Switchgears are the combination of electrical disconnect switches, fuses and circuit breakers used to control, protect and isolate electrical equipment. Switchgear is used to protect and isolate/de-energise equipment to allow work to be conducted safely and to clear faults downstream.

Field Station Units

2.6.11 Field Station Units are single enclosures that contain the central inverters, a transformer, and switchgear in a single containerised unit.

2.6.12 Within the Field Station Units, the DC electricity collected by the Solar PV Panels is converted into AC (inverters). The voltage is increased from low voltage (less than 1.0 kV AC) to 33 kV (transformers) and then exits through the switchgear into the Interconnecting Cables (33 kV) connecting to one of the On-Site Substation.

2.6.13 An illustrative example is shown in Plate 2-4 below.

Plate 2-4: Example of a Field Station Unit

Battery Energy Storage System Area

2.6.14 The Scheme would include an associated BESS Area within Field SW10. The BESS is designed to provide peak generation and grid balancing services to the national grid. It would do this by allowing electricity generated from the Solar PV Panels or excess energy in the grid to be stored in batteries and dispatched at strategic times of the day.

2.6.15 The BESS batteries would be housed within individual shipping-style BESS Battery Containers. The BESS Battery Containers would be mounted on concrete foundations, although other types of foundations such as compacted gravel, metal pile, or ground screw pile may be used depending on ground conditions.

2.6.16 The precise number of individual BESS Battery Containers is subject to further development, but it is currently expected that the Scheme would include up to 432 BESS Battery Containers. **PEIR Volume II Figure 2-3: Indicative Site Layout Plan** presents the current proposed location of the BESS Area, and a more detailed layout is shown within **PEIR Volume III Appendix 2-2: BESS and On-Site Substation**.

2.6.17 To ensure the efficiency of the batteries, each of the individual BESS Battery Container would have an integrated heating, ventilation and cooling (HVAC) system. This may involve a HVAC system that is external to the container, located either on the top of the unit or attached to the side of the unit. If this uses air to heat and cool the BESS Battery Containers, it would have a fan built into it that is powered by auxiliary power.

2.6.18 Similar to the Solar PV Panels, the BESS Battery Containers will be connected to inverters, and transformers and switchgear packaged into shipping-container type enclosures similar to BESS Battery Containers and located within the BESS Area. These units would convert the electricity between AC and DC, and would step the voltage up or down depending on the direction of the energy flow allowing the BESS Battery Containers to receive electricity from the On-Site Substation for storage, and to release the stored energy via the On-Site Substation into the national grid. A separate BESS Control Building would also be located within the BESS Area.

2.6.19 The individual BESS Battery Containers would have built-in fire detection and be fitted with an automatically operated fire extinguisher system (noting that this would not utilise chemical fire suppressant as this is no longer considered good practice due to environmental considerations). South Yorkshire Fire and Rescue Service has provided requirements regarding the Emergency Response Plan and guidance which would aid Operation Crews when tackling BESS fires. Fire water will be provided via on-site fire water storage in the form of above ground tanks as shown in **PEIR Volume III Appendix 2-2: BESS and On-Site Substation**. There will be a volume of 300 m^3 to provide a water supply which can deliver no less than 1,900 litres per minute for at least 2 hours.

2.6.20 Similarly, provision will be made for fire water containment (impermeable water capture to prevent used firewater reaching ground/the surrounding environment). More details on the preliminary firewater storage and containment proposals are provided in Section 9.4 of **PEIR Volume I Chapter 9: Water Environment**, and full details will be presented and assessed in the ES. A Framework Battery Safety Management Plan will also be presented with the DCO Application. Other fire safety measures include spacing requirements between the BESS Battery Containers and between the BESS Area and other infrastructure.

On-Site and Interconnecting Cables

2.6.21 On-Site low voltage cables would connect the Solar PV Panels and BESS Battery Containers to inverters, and the inverters to transformers at the Field Stations or within the BESS Area. Additional low voltage auxiliary cabling would supply the CCTV and monitoring equipment. This will be underground.

2.6.22 On-Site Cables between Solar PV Panels and the inverters would typically be above ground level (along a row of racks fixed to the mounting structure or fixed to other parts of nearby components) and then underground if required between racks and in the string inverter’s input. All other on-site cabling would be underground.

2.6.23 Medium voltage (33 kV) Interconnecting Cables then transfer electricity between Field Stations and the On-Site Substation, and between the BESS transformers and the On-Site Substation.

2.6.24 Fibre optic and/or Cat 5/6 data cables would also be installed, typically alongside electrical cables in order to allow for monitoring during the operation and maintenance phase of the Scheme, such as the collection of solar data from pyranometers (specialist sensors which measure the level of solar irradiance).

On-Site Substation

2.6.25 One 400 kV/33 kV On-Site Substation would be connected to the Field Stations and the BESS, and would step up the voltage from 33 kV to 400 kV ready for this to be exported to the Existing National Grid Thorpe Marsh Substation via the 400 kV Grid Connection Cables or Grid Connection Line

Drop, or step down the voltage from 400 kV to 33 kV to allow for the excess electricity in the grid to be stored within the BESS.

2.6.26 The On-Site Substation would be located within Field SW08. The proposed location of the On-Site Substation is presented in **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**. An indicative layout is shown within **PEIR Volume III Appendix 2-2: BESS and On-Site Substation**.

2.6.27 The On-Site Substation comprises a single transformer bay, associated electrical infrastructure including bus-bar, circuit breakers and isolators, car parking and control and metering buildings. The On-Site Substation will be equipped with a backup diesel generator. The purpose of the backup generator is to operate protection systems should this be required in the event of electrical failure and restart the systems if required. For the purposes of assessment it is assumed that the backup generator will operate for up to a maximum of eight hours in any one year.

2.6.28 The electrical infrastructure comprising cable sealing ends (where the export cables would terminate into the infrastructure), busbars/conductors, isolator/disconnectors and circuit breakers (for electrical safety), voltage transformers (for measuring supply), and the transformer would be outside (i.e. not contained within a building) and would comprise separate infrastructure and conductors. The On-Site Substation would have a separate Control Building (with welfare facilities) and may incorporate a metering room, though this may instead be a smaller separate structure.

2.6.29 The On-Site Substation would be securely fenced with galvanised palisade security fencing which may have additional barbed wire above and mandatory warning signage.

2.6.30 An example of an On-Site Substation is presented in Plate 2-5.

Plate 2-5: Example On-Site Substation showing Infrastructure and Fencing

Grid Connection Line Drop

2.6.31 The feasibility of connecting the On-Site Substation via a line drop from existing overhead power lines running north south across the east of the Solar PV Site is currently being explored. The On-Site Substation would be at the same location but would instead include a cable connection to the existing overhead lines. The Grid Connection Line Drop would comprise of below ground cables running approximately 1.5 km (refer to **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**) connecting the On-Site Substation to a new Cable Sealing End Compound at the base of an existing on-site 400 kV overhead line tower located within Field SE2. The tower will likely require modification to allow the associated infrastructure to connect by this method. The maximum footprint of the On-Site Substation would remain the same for either the Grid Connection Cables or Grid Connection Line Drop connection options. An example of a line drop grid connection compound is presented in Plate 2-6.

Plate 2-6: Example Line Drop On-Site Substation

Grid Connection Cables

2.6.32 If the grid connection at the Existing National Grid Thorpe Marsh Substation is taken forward, the high voltage (400 kV) Grid Connection Cables would start at the On-Site Substation, exit the Solar PV Site and follow the Grid Connection Corridor to the Existing National Grid Thorpe Marsh Substation.

2.6.33 Modifications would be undertaken at the Existing National Grid Thorpe Marsh Substation to accommodate the Scheme. All work to the Existing National Grid Thorpe Marsh Substation would be undertaken by National Grid under the terms of the Scheme's grid connection agreement and would remain under National Grid's control.

2.6.34 A Grid Connection Line Drop to the On-Site Substation within the Solar PV Site from existing overhead power lines is also currently being explored. Both grid connection options are assessed in this PEIR.

Operations and Maintenance Hub

2.6.35 An Operations and Maintenance Hub would be established through the construction of a containerised unit adjacent to an existing barn within Field NW08 of the Solar PV Site (up to 6.5 m in height). This would provide welfare, office accommodation and facilities for maintenance and storage throughout the operation and maintenance phase of the Scheme. The existing agricultural building would be used for storage and would not require modification. The location of the proposed Operations and Maintenance Hub is presented in **PEIR Volume II Figure 2-3: Indicative Site Layout Plan** and the existing structure is presented in Plate 2-7.

Plate 2-7: Existing Barn within Field NW08 of the Solar PV Site

2.7 Construction

Construction Programme

2.7.1 Subject to being granted development consent and following a final investment decision, the earliest construction could start is in 2028. Construction of the Solar PV Site and Grid Connection Cables would start in tandem. The Grid Connection Cables would require approximately 12 months, and the construction of the Solar PV Site would require an estimated 24 months, with the operation and maintenance phase anticipated to commence in 2030. The construction phase could be of longer duration however these timings have been used within the PEIR as a worst case assumption for the technical assessments presented in **PEIR Volume I Chapter 6** to **14**, for example to present the maximum predicted daily traffic flows and the amount of construction activity that could occur at any given time. The technical chapters each provide clarification on the assumptions used for the construction phase.

2.7.2 As noted in **PEIR Volume I Chapter 5: Environmental Impact Assessment Methodology**, the Applicant is in discussions with National Grid to bring forward the grid connection date and ensure that the renewable energy generated by the Scheme would be available to the National Grid as soon as possible, helping to meet net zero targets and contributing towards security of supply. The Scheme is expected to be operational from 2030.

Construction Activities

2.7.3 The types of construction activities that are likely to be required include (not necessarily in order):

a. Site preparation and civil engineering works to include:
   i. Installation of fencing;
   ii. Import of construction materials, plant and equipment;
   iii. The establishment of construction compounds (indicative locations are shown on **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**);
   iv. The establishment of the Operation and Maintenance Hub;
   v. Upgrading of existing Site tracks/access roads and construction of new tracks;
   vi. The upgrade or construction of crossing points (bridging structures) over drainage ditches. Where a new ditch crossing is required, both a new culvert and an open span bridge will be considered, with the type of crossing selected based on site-specific factors and in consultation with the relevant authority (generally the IDB/ lead local flood authority). Culverts/culvert extensions will be designed to maintain connectivity along watercourses for aquatic species and riparian mammals, where these are shown to be present. All culverts to convey watercourses will be set 150 mm below bed level to allow sedimentation and a naturalised bed to form, which will maintain longitudinal connectivity for aquatic fauna. Where new culverts are required, length-for-length watercourse enhancements are required in each case to mitigate the impacts and to ensure compliance against WFD objectives;
   vii. De-culverting of a section of Fleet Drain east of Fenwick Hall; and
   viii. Marking out the location of the infrastructure.

b. Solar PV Site construction to include:
   i. Import of components to Site;
   ii. Erection of Solar PV Mounting Structures;
   iii. Mounting of Solar PV Panels;
   iv. Installation of On-Site and Interconnecting cables;
   v. Installation of Field Stations;

vi. Installation of BESS structures and units;

vii. Construction of the On-Site Substation and Grid Connection Line Drop;

viii. Implementation of crossing methodologies for watercourses, infrastructure (including roads and rail) and sensitive habitats (e.g. HDD, cable bridging, etc.);

ix. Testing and commissioning;

x. Site reinstatement, including topsoil reinstatement and repair and reinstatement of existing field drainage; and

xi. Habitat creation/enhancement.

c. Grid Connection Cables installation to include:

i. The establishment of mobilisation areas;

ii. The establishment of temporary construction compounds for the Grid Connection Corridor (indicative locations are shown on **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**);

iii. Stripping of topsoil in sections;

iv. Trenching in sections;

v. Appropriate storage and capping of soil;

vi. Appropriate construction drainage with pumping where necessary;

vii. Sectionalised approach to duct installation;

viii. Excavation and installation of jointing and link box pits;

ix. Cable joint and link box installation;

x. Cable pulling;

xi. Implementation of crossing methodologies for watercourses, infrastructure (including roads and rail) and sensitive habitats (e.g. HDD, cable bridging, etc.);

xii. Testing and commissioning;

xiii. Site reinstatement, including topsoil reinstatement and repair and reinstatement of existing field drainage; and

xiv. Habitat creation.

2.7.4 It is anticipated that construction activities would be carried out in a sequential manner with construction teams responsible for specific type of works moving across the Solar PV Site. In this case, the works would start with fencing, followed by frame installation, Solar PV Panel installation, and cabling and connection. It may be possible to generate power from some areas of the Solar PV Site whilst other areas are still being built, providing the associated On-Site Substation and Grid Connection Cables or Grid Connection Line Drop are in place, and subject to testing and commissioning.

Site Preparation and Civil Engineering Works

Establishment of the Operation and Maintenance Hub

2.7.5 The construction of the containerised unit of offices and welfare facilities would be prioritised within the programme of works, commencing prior to or at the very start of main construction works, so that these facilities are available as soon as possible (likely during the construction phase of the Scheme).

Establishment of the Perimeter Fencing and Security

2.7.6 At the start of construction, the perimeter of the Solar PV Site would be demarcated with the installation of security fencing to enclose the operational area. The fence would be a stock proof mesh-type security fence with wooden posts, at a maximum height of 2.2 m, as illustrated in Plate 2-8.

2.7.7 Fence posts will be directly driven into the ground using a standard post installer machine as shown on Plate 2-11. The average/typical distance between fence posts will be 5 m but will vary between 3 m and 7 m to best avoid Root Protect Zones (RPZ) etc. and fit the shape of the field. There may be cases where the mesh of the fence over-sails an RPZ, but there is no direct/physical impact to the RPZ due to the positioning of the fenceposts.

2.7.8 The fencing will also be installed to observe the agreed buffer distances from ecological receptors (watercourses, trees, hedges etc.) as set out in **PEIR Volume I Chapter 8: Ecology**, and where these are not required the fence will be a minimum distance of 5 m from the field edge. There will be a further 5 m buffer from perimeter fence to the Solar PV Panels.

2.7.9 The gap at the base of the fencing and the size of the mesh would allow the passage of small mammals. Foxes and badgers typically dig under such fencing for free access, however larger gaps will be created beneath the fence at strategic locations to facilitate access. The perimeter fencing would exclude deer from operational areas, however, they would be able to freely move along the PRoW and areas outside the perimeter fencing.

2.7.10 Within the larger fields (within the perimeter fence) further mesh stock proof fencing (approximately 1.0 m high) may be installed in some areas to create rotational grazing plots. This is further discussed in Section 2.8 and illustrated in Plate 2-9. The fencing would not be a barrier to the passage of small mammals and badgers are expected to dig underneath these for free access.

2.7.11 PRoW that cross the Solar PV Site would be preserved with the fence installed on either side of them. Where PRoW cross or are adjacent to the Solar PV Site the fencing will be erected from the inside without impacting the PRoW or preventing its use. There would be a requirement for temporary and permanent diversions of PRoW within the Solar PV Site.

2.7.12 To comply with British Standard (BS) EN 62271-1:2017 (Ref. 2-3), if standalone transformers are used, they would be surrounded by a secure wire mesh fence. This fence is likely to be up to 2.5 m in height. Additionally, the On-Site Substation will be securely fenced with galvanised palisade security fencing, likely green in colour, which may have additional barbed wire above. A typical arrangement is shown on Plate 2-5.

2.7.13 Post mounted internal facing closed circuit television (CCTV) systems would be deployed around the perimeter of the operational areas of the Solar PV Site. As the cabling for the CCTV typically shares trenches with the On-site cabling, installation of the permanent CCTV will take place nearing completion of the works within each Solar PV Site. It is anticipated that the perimeter CCTV would be mounted on poles between 2.0 m and 3.0 m in height. These CCTV cameras would have fixed, inward-facing viewsheds and would be aligned to capture only the Scheme fence and the area inside the fence, thereby not capturing publicly accessible areas. The posts would be positioned at every change in direction to the fence and approximately every 50 m along straight sections. Additionally, ‘centrally located’ pole mounted CCTV of up to 5.0 m may be installed within the Solar PV Site by Field Stations and/or the On-Site Substation covering a 360-degree view of the Solar PV Panels, Field Stations and/or the On-Site Substation. The CCTV would use thermal imaging and/or Infrared (IR) lighting to provide night vision functionality meaning that no visible lighting would be needed for security.

2.7.14 Plate 2-8 shows a CCTV camera mounted to a metal post with foundations, although this design will not be used in the Scheme the image provides a good indication of the height of the post, location in relation to the fence and the size of camera.

2.7.15 Temporary CCTV would be installed at strategic locations during construction (until the permanent system is installed) – for example to monitor construction compounds and accesses into the Solar PV Site. The temporary system would be mounted at approximately 2.5 m height.

2.7.16 During construction there would be regular out of working hours checks of the Site by roving security guards who would undertake scheduled patrols of each area, as well as additional checks when an alarm is triggered.

Plate 2-8: Example of Perimeter Fencing

Plate 2-9: Example of Mesh Stockproof Fencing which may be Installed to Further Separate Areas within the Perimeter Fencing

Establishment of Construction Compounds

2.7.17 Temporary construction compounds comprising parking, storage, staff welfare and waste management would be located within the Site. In the Solar PV Site, these would include one main temporary construction compound located south of Haggs Lane and west of the BESS Area, and two satellite construction compounds located in the northwest and northeast, in fields NW07 and SE02, respectively.

2.7.18 Within the Solar PV Site, temporary construction compounds will be created and 'built-out' as the solar installation progresses. In addition to the main construction compound and the two satellite compounds, smaller short-term use construction compounds will be located across the Solar PV Site. The compounds will be approximately up to 150 m by 150 m and will contain a site office, mobile welfare units, generators, canteen facilities and a fenced area for storage and waste containers.

2.7.19 Two construction compounds would be located within the Grid Connection Corridor, one in a field east of the junction between Trumfleet Lane and Brick Kiln Lane and the other in the field northeast of Marsh Road adjacent to Engine Dike. The precise location and dimensions of the compounds are to be determined, and therefore for the purpose of assessment a wider area in which it could be located is considered. Indicative locations are shown in **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**. Appropriate buffers from watercourses and other sensitive features will be observed.

2.7.20 At a number of the grid connection access points there will be 50 m by 50 m compound and lay-down areas. The compound area footprint will take into consideration topography, drainage and heritage and environmental constraints. The compounds will allow construction vehicles to turn off the public highway and park safely. They will include parking bays, portacabins, unloading and storage areas and power generators. Upon completion of construction, the compound areas will be removed and the land reinstated.

2.7.21 To establish the compounds, topsoil in the compound footprint will be stripped and stored in line with the Soil Management Plan (SMP), based on the Framework SMP to be prepared and submitted with the DCO Application. The hardstanding would then be formed of compacted stone (Type 1 aggregate) over appropriate geotextile.

2.7.22 Construction compounds will be fenced with temporary (Heras style) fencing where required. Trees within compound locations will be fenced off and protected as exclusion zones.

2.7.23 During the construction phase additional infrared cameras and motion sensors will be installed at construction compounds. Lighting of compounds is discussed in Paragraphs 2.7.53–2.7.56.

Creation of Internal Access Tracks within the Solar PV Site

2.7.24 The Scheme will utilise existing hard-surfaced tracks within the Solar PV Site, where practicable, and construct additional access tracks where further connectivity is required. Where necessary, upgrades to existing tracks through widening and resurfacing will be undertaken.

2.7.25 Access tracks would typically be 4.0 m wide (8.0 m wide for BESS Area access tracks) compacted stone tracks (Type 1 aggregate) over appropriate geotextile with gradient slopes on either side with a typical depth of up to 300 mm, where required. An example access track within a solar PV facility during construction is shown on Plate 2-10.

2.7.26 Access tracks will be routed to avoid sensitive receptors and have been designed to minimise vegetation removal as far as practicable.

2.7.27 Where drainage is required, a ditch may be cut into the slope next to the road. Where a requirement for trenchless crossing has been identified no temporary track crossing would be installed over these features.

Plate 2-10: Typical crushed stone access track laid on hardcore and geotextile (photo during construction phase and prior to landscaping)

Construction of Electrical Infrastructure

Solar PV Construction

2.7.28 The following activities would be undertaken to install the Solar PV Panels:

a. Import of components to the Site;

b. Direct drive installation of piles and erection of Solar PV Mounting Structures (Plate 2-11);

c. Mounting of Solar PV Panels. This would be undertaken by hand (see Plate 2-12);

d. Trenching and installation of electric cabling; and

e. Installation of equipment at Field Stations (and string inverters if required). Cranes would be used to lift equipment into position where required.

Source: Image taken by Màrtainn MacDhòmhnaill (Ref. 2-4).

Plate 2-11: Tracked Post Driver to Illustrate Type of Plant Likely to be Used to Install Fence Posts and the Solar PV Mounting Structures

Source: MetroWest Daily News article on the Westborough Solar Array, Massachusetts (Ref. 2-5).

Plate 2-12: Construction Staff Mounting Solar PV Panels by Hand

Cable Installation

2.7.29 The design parameters for the installation of On-site, Interconnecting and Grid Connection Cables including but not limited to, working width, cable types and depth of trenching are presented in Table 2-1. Plate 2-13 illustrates cabling to a Field Station thereby representing the busiest trench on site with respect to the number/volume of cables being installed within it. The concrete block foundations of the Field Station Unit into which these cables are being routed is also shown in the plate.

2.7.30 The On-Site Cables and Interconnecting Cables would typically be installed using an open trench method, except in locations where design, engineering, or environmental constraints require a trenchless methodology to be employed. At this stage, trenchless methods have been identified to be required to cross Fenwick Common Drain, Fleet Drain, and associated waterways located within the Solar PV Site, although incorporation of crossings into culverts/span bridges are also being explored. It is acknowledged that as the electrical designs and environmental studies progress, other features also requiring trenchless crossing such as tree belts and hedgerows may be identified. However, this PEIR assumes that all other crossings would be open trenched with the cables either laid directly into trenches or into ducting (that would be installed into the trench with the cables pulled through later). Trenchless crossings would likely be undertaken using HDD, although other techniques such as micro-tunnelling and boring may also be used. This will be determined as the design progresses.

Plate 2-13: Example Underground Cable Installation Beneath a 33 kV Field Station Unit Awaiting Delivery

2.7.31 The Grid Connection Cables would be buried below ground and would typically be installed using an open trench method. At this stage, three locations along the Grid Connection Corridor have been identified as requiring trenchless methods of cable installation, most likely HDD. These are the crossings of Engine Dike, Thorpe Marsh Drain and the Carcroft Junction to Stainforth Junction Railway Line. The precise locations of the crossing points within the Site are to be determined, however, **PEIR Volume II Figure 2-3: Indicative Site Layout Plan** illustrates where the Site crosses these features. It is acknowledged that other features such as tree belts and hedgerows may also require trenchless crossing using HDD or other techniques such as micro-tunnelling and boring. However, at this stage of design this PEIR assumes all other crossings would be open trenched with the cables either laid directly into trenches or into ducting (that would be installed into the trench with the cables pulled through later).

2.7.32 A crossing schedule will be progressed for the ES as more data become available and further constraints requiring trenchless installation are identified.

Battery Energy Storage System Construction

2.7.33 The following activities would be undertaken to construct the BESS Area:

a. Installation of electric cabling;

b. Construction of foundations;

c. Import of components to Site;

d. Installation of BESS Battery Containers, transformers, inverters, and switchgear;

e. Installation of control building; and

f. Installation of fire water tanks fire water containment.

Testing and Commissioning

2.7.34 Commissioning of the Scheme would include testing and commissioning of the process equipment. Commissioning of the solar PV, BESS and associated infrastructure would involve mechanical and visual inspection, electrical and equipment testing, and commencement of electricity supply into the national grid. Individual sub-systems would be commissioned separately, with each having its own procedures and prerequisite lines, and it may be necessary to commission these elements separately or at the same time, depending on the end technology utilised at the time of construction.

2.7.35 This process would take place prior to the operation and maintenance phase of the Scheme.

Construction Staff

2.7.36 Based on the Applicant's experience of other similar sized solar projects, it is currently estimated that the Scheme would generate an average of 200 gross direct Full Time Equivalent (FTE) jobs on-site per day during the construction phase. The size of the workforce is based on the activities required and would fluctuate during the period, therefore, being both higher and lower than average at times.

2.7.37 The peak construction workforce (in 2028, when construction activities are likely to include construction of the On-Site Substation, Grid Connection Corridor or Line Drop, and solar PV infrastructure) is estimated to be 250 FTE staff per day. This may represent an overestimate of the maximum number of jobs during peak construction and has been accounted for in the technical assessments as relevant, such as in **PEIR Volume I Chapter 12: Socio-Economics and Land Use**.

Construction Hours of Work

2.7.38 The core construction working hours are defined as:

a. Monday to Friday from 07.00 to 19.00 (daylight hours permitting);

b. Saturday from 07.00 to 13.00 (daylight hours permitting); and

c. No Sunday or Bank Holiday working unless crucial to construction (for example for HDD which must be a continuous activity) or in an emergency.

2.7.39 Emergency working may extend beyond the timescales quoted above.

2.7.40 Working hours would be shortened if working would necessitate artificial lighting and, therefore, the working day would be shorter in the months with reduced daylight hours. It is not possible to avoid working over winter due to the length of the construction programme. However, cabling and groundworks would be prioritised during the drier summer months where practicable.

2.7.41 As an exceptional activity, HDD may require 24-hour working, for example to cross the Thorpe Marsh Drain flood defence crossing. 24-hour working is to be agreed in advance with the relevant Local Planning Authority (the City of Doncaster Council).

2.7.42 Noisy work near residential properties, such as use of power tools, would be limited to between 08.00 and 18.00 from Monday to Friday and 08.00 to 13.00 on Saturdays.

2.7.43 Additionally, quiet non-intrusive works using electric hand tools only, such as the installation of Solar PV Panels may take place over longer periods during the summer and other quiet non-intrusive works such as electrical testing, commissioning and inspection may take place over longer periods throughout the year.

Construction Traffic and Site Access

2.7.44 Construction traffic and Site access is further discussed in **PEIR Volume I Chapter 13: Transport and Access**.

2.7.45 An Access Strategy (the routes for all vehicles into the Site (Heavy Goods Vehicles (HGV), Abnormal Indivisible Loads (AIL), Light Goods Vehicles (LGV), and private vehicles) will be prepared to determine appropriate access during construction, operation and maintenance, and decommissioning phases – this will be presented in the ES. An initial assessment of accessibility has been undertaken and forms the first stage in defining routing to and from the Site. Swept Path Analysis (SPA) has been undertaken on identified pinch point locations on the road network to ascertain whether HGVs and other vehicles are able to safely access the Site. All construction accesses will be confirmed as the Scheme design progresses. The need for road upgrades, widening and new road construction, for example for abnormal loads or to ensure visibility splays at site access/egress points, is also being assessed and will be determined as the Scheme design develops.

2.7.46 Currently existing accesses are proposed for construction access to the Site where this is practicable. A new temporary construction access off Moss Road is also being considered to facilitate safe movement of construction vehicles. Accesses would be designed to ensure there are no impacts on veteran and mature trees as a result of vehicles movements, however, there may be localised removal of sections of hedgerows where required. **PEIR Volume II Figure 2-3: Indicative Site Layout Plan** illustrates the existing and proposed Site accesses.

2.7.47 At this stage, based on the preliminary construction material and equipment requirements, it is anticipated that as a worst case there could be up to a total of 18 HGV deliveries per day (including waste movements). This results in 36 HGV movements per day at peak construction.

2.7.48 It is anticipated that goods would be delivered to the main construction compound within the Solar PV Site and then distributed to the point of need within the Site using a lighter vehicle tractor and trailer as required.

2.7.49 There would be a maximum of five AIL movements for the delivery of the 400 kV/33 kV transformer to the On-Site Substation, which also considers the potential for transformer failure by the delivery of a spare phase that would be stored on site. Transformer failure is a very rare occurrence and therefore the AIL trip generation is considered to be a worst case.

2.7.50 The current estimate is that 250 FTE staff would be on site per day at the peak of construction and the assessment presented in **PEIR Volume I**

Chapter 13: Transport and Access considers that workers would travel in a private car or use shuttle minibus services which would be provided to transfer staff to/from key settlements where workers would be expected to originate. This would require a total of 32 minibus movements and 248 car movements per day for staff transportation at the peak of construction. Indicative information on the origins of construction worker traffic (i.e. where construction workers are likely to travel to and from) is also presented in **PEIR Volume I Chapter 13: Transport and Access**.

2.7.51 To prevent nuisance and potential obstruction/restriction of free traffic flows caused by vehicles parked around the Site, limited (but sufficient) on-site car parking to accommodate the expected parking demand of construction staff using private vehicles to travel to and from Site (commuting) would be provided within the Site. Parking on public roads within a defined radius of the Site would not be permitted. This will be further set out in the transport assessment presented in the ES.

2.7.52 A Framework Construction Traffic Management Plan (CTMP) will be developed and submitted with the DCO Application. This will define information such as the routes that construction traffic must take and any timing restrictions in relation to the use of certain routes (for example avoidance of routes close to or passing schools during drop off and pick up times). The CTMP will also encourage local construction staff to car share to reduce single occupancy car trips, by promoting the benefits of car sharing such as reduced fuel costs and by providing dedicated parking spaces for car sharing at or near Site compounds.

Plate 2-14: Typical Crushed Stone Access Track Laid on Hardcore and Geotextile (Photo during Construction Phase and Prior To Landscaping)

Lighting

2.7.53 The lighting strategy for the construction phase will be set out in the detailed Construction Environmental Management Plan (CEMP). **PEIR Volume III**

Appendix 2-1: Framework Construction Environmental Management Plan includes details of lighting design.

2.7.54 Lighting would be directional with care to minimise potential for light spillage beyond the Site, particularly towards houses, live traffic and habitats. Lighting will be designed with reference to the Institute of Lighting Professionals Guidance Notes (in particular GN-8: Bats and Artificial Lighting (Ref. 2-6) which was produced in collaboration with the Bat Conservation Trust, and GN-1: Reduction of Obtrusive Light (Ref. 2-7) in so far as it is reasonably practicable.

2.7.55 This includes the implementation of measures such as:

a. Lights installed would be of the minimum brightness and/or power rating capable of performing the desired function;

b. Light fittings would be used that reduce the amount of light emitted above the horizontal (reduce upward lighting);

c. Light fittings would be positioned correctly, inward facing and directed downwards;

d. The direction of lights would seek to avoid spillage onto neighbouring properties, habitats, highways or watercourses; and

e. Passive Infra-Red (PIR) controlled lights (motion sensors) would be used except where temporary focussed task specific lighting is required.

2.7.56 Construction works would generally be restricted to daylight hours only, with focussed task specific lighting provided where this is not practicable, for example HDD drilling operations requiring night-time working, unless directed by authorities or areas requiring road closures. Task specific and fixed 'general' lighting may be required in construction compounds in winter periods (early mornings and up to 19.00 for general workforce and potentially by the mobile security team during their rounds) to meet safety requirements. Outside of core working hours, PIR controlled lights (motion sensors) would be used. The CCTV would also use IR lighting to provide night vision functionality meaning that no visible lighting would be needed for the security system. Additionally, lighting would be used by the security teams during their regular checks and 'emergency' visits (if an alert is triggered).

Waste

2.7.57 Solid waste materials generated during construction would be segregated and stored on-site in containers prior to transport to approved, licensed third party waste management facilities. This would primarily comprise packaging associated with the electrical items. During construction, the removal of waste is estimated to require an average of one load per day which has been accounted for in the estimated 18 HGV deliveries a day (at peak construction).

Fuel

2.7.58 Fuel for machinery and generators would be delivered to Site by a fuel bowser as required and stored in integrally bunded above ground fuel storage tanks (cubes) which comply with the Oil Storage Regulations (Ref. 2-8). The fuel storage tanks would be sheltered, secured from unauthorised access, and equipped with integral bunding capable of holding 110% of the volume of the tank (i.e. it would have 10% more capacity than needed). Spill kits would be carried by all plant and would be available at the fuelling point and other strategic locations of the Site to allow for prompt clean up. All construction workers would be trained in pollution prevention and spill kit use. Oil storage areas would not be created in areas susceptible to flooding.

Water

2.7.59 An estimated 35,000 m^3 total of water would be required during construction to support welfare facilities on-site and other uses, or approximately 1,800 m^3 during peak months.

2.7.60 It is anticipated that the Scheme would obtain the water required for the Operations and Maintenance Hub and temporary facilities from a private water supply from the nearby farm with a separate meter installed. At the time of publication of this PEIR it is being confirmed if there is an existing water supply line to the Operations and Maintenance Hub area; a new water supply line would be installed if necessary. It is understood that foul water and grey water would be treated off-site. However, to present a worst case at construction it is assumed that this would not be available until the operation and maintenance phase of the Scheme and that all water would be imported. Water will be transported to Site by road from an existing nearby licenced water abstraction source and stored on site in Intermediate Bulk Containers (IBC), or similar.

2.7.61 During construction self-contained portable welfare units which store foul/wastewater for collection/emptying by specialist licenced contractors would be used.

Construction Environmental Management Plan

2.7.62 A Framework CEMP is presented at **PEIR Volume III Appendix 2-1: Framework Construction Environmental Management Plan**. This describes the framework of mitigation measures identified at this stage. This framework document will be expanded based upon further studies and presented to accompany the DCO Application. The Framework CEMP will be used as the basis for the contractor to prepare a detailed CEMP prior to construction and following the detailed design of the Scheme. The detailed CEMP would be a live document updated throughout the construction phase as required, for example, to reflect changes in legislation or contact details. The aim of the CEMP is to eliminate or reduce nuisance and environmental impacts from issues such as:

a. Use of land for temporary laydown areas, accommodation etc.;

b. Construction traffic (including parking and access requirements) and any changes to access and temporary road or footpath closure;

c. Noise and vibration;

d. Utilities diversion;

e. Dust generation;

f. Handling of soil resources;

g. Spillages of oil and other chemicals;

h. Run off and drainage; and

i. Waste generation.

2.7.63 The detailed CEMP would be produced by the appointed construction contractor and agreed with the relevant Local Planning Authority (the City of Doncaster Council) following the grant of the DCO and prior to the start of construction. It would identify the procedures to be adhered to and managed by the contractor throughout construction and would clearly define roles and responsibilities. Production of the detailed CEMP would be secured through a Requirement attached to the DCO.

2.7.64 Contracts with companies involved in the construction works would incorporate environmental control, health and safety regulations, and current guidance. This would ensure that construction activities are sustainable and that all contractors involved with the construction phase are committed to agreed good practice and meeting all relevant environmental legislation including:

a. COPA 1974 (Ref. 2-9);

b. Environment Act 2021 (Ref. 2-10);

c. Hazardous Waste (England and Wales) Regulations 2005 (as amended) (Ref. 2-11); and

d. Waste (England and Wales) Regulations 2011 (Ref. 2-12).

2.7.65 Records would be kept and updated regularly, ensuring that all waste transferred or disposed of has been appropriately processed with evidence of signed Waste Transfer Notes (WTNs) that would be kept on-site for inspection whenever requested. Furthermore, all construction works would adhere to the Construction (Design and Management) Regulations 2015 (CDM) (Ref. 2-13).

Site Reinstatement, Biodiversity and Landscaping

2.7.66 The working widths of the Grid Connection Cables, On-Site and Interconnecting Cables would be reinstated as soon as practicable following the completion of construction activities. Accesses into the Site installed during the construction phase (either new accesses or modified/extended existing accesses) will remain in place throughout the operation and maintenance phase, with the exception of the temporary access north of Moss Road which would be removed and reinstated. Accesses to the Grid Connection Corridor alone may be modified/reduced in footprint to suit the operation and maintenance phase, their layout will be developed in consultation with the relevant Highways Authority. Measures such as those outlined in Defra's 'Code of practice for the sustainable use of soils on construction sites' (Ref. 2-14) would ensure that the soils are appropriately managed allowing their quality and function to be retained upon reinstatement and that any agricultural land is restored to the same quality (ALC grade) as prior to construction.

2.7.67 Within the Solar PV Site, following construction, a programme of Site reinstatement and habitat creation and enhancement would take place. The Scheme is being designed to integrate with and enhance the local green infrastructure network, improving ecological and recreational connectivity across the Solar PV Site. Plate 2-15 shows an example of typical grassland planting in a solar farm site. The proposed planting design would respond to the local landscape by allowing views to remain open, where tall screening would not be appropriate. New planting would likely include, but may not be limited to:

a. New hedgerows/vegetated boundary;

b. 'Gapping up' of existing hedgerow/hedgerow trees, including some 'defunct' hedgerows for visual mitigation and enhanced ecological connections;

c. 'Gapping up' of existing hedgerow/hedgerow trees with wet-loving species;

d. New vegetation boundary using a mixed hierarchy of wet-loving trees and scrub; and

e. New species-rich native grassland.

Plate 2-15: Example Landscaped Solar PV Facility

2.7.68 The Scheme design would seek to retain/avoid most receptors to minimise the requirement for mitigation for biodiversity effects. However, the above new planting would be required to minimise landscape, visual and heritage impacts, and hedgerows, woodland, and tree belts would be embedded mitigation within the Scheme. New species rich grassland would be created and be functional in advance of construction, where practical, so that any displaced (bird) populations have alternative areas of habitats available during the construction phase. This may not be possible depending on the planned works areas but will be investigated at detailed design stage and taken forward where feasible. The areas of species rich grassland habitat are separate to the grassland areas under the panels – indicative areas are shown in **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**.

2.7.69 The options for landscaping, biodiversity and habitat management are currently being explored and full details will be presented in the Framework Landscape and Ecological Management Plan (LEMP) which will accompany the ES. Indicative locations for 'gapping up' of existing hedgerow and hedgerow trees, new hedgerow, new vegetation boundaries, species-rich native grassland, open areas, and scrub corner are identified on **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**.

2.7.70 Embedded mitigation measures for the construction phase are set out in the Framework CEMP (**PEIR Volume III Appendix 2-1: Framework Construction Environmental Management Plan**). This includes but is not limited to measures such as the use of construction and exclusion zones for retained vegetation, ensuring a tidy and neat working area, covering stockpiles, and storing topsoil in accordance with good practice measures.

2.7.71 The enhancements and planting would increase biodiversity throughout the landscape and contribute to the Scheme achieving BNG in line with the principles of the Environment Act 2021 (Ref. 2-10), NPS EN-1 (November 2023) (Ref. 2-15), the National Planning Policy Framework (NPPF) (Ref. 2-16), and local planning policy. The Scheme design aims to achieve BNG levels greater than 10%. BNG will be measured using Defra's Biodiversity Metric 4.0, or the most up to date metric at the time. As further discussed in **PEIR Volume I Chapter 8: Ecology**, the Biodiversity Metric 4.0, uses three different Biodiversity Units:

a. Area (habitat) units;

b. Hedgerow/line of tree units; and

c. Riverine habitat units.

2.7.72 Each Unit type is considered independently, and they are not interchangeable; meaning that the loss of one type cannot be addressed by providing habitat of a different type.

2.7.73 The land use within the Site is predominantly arable (some with semi-improved grassland margins), intersected by a network of drainage ditches, hedgerows, and tree lines. Other, less frequently recorded habitats within the Solar PV Site (recorded to date) include swamp, marshy grassland, tall ruderal, dense scrub, broadleaved woodland, scattered trees, reedbed, scattered treeline, ditches and hedgerows.

2.7.74 Recent research by Lancaster University has provided evidence that solar farms can enhance biodiversity on farmland through an increase in wildlife, especially pollinators, which has benefits for neighbouring land in arable production (Ref. 2-17).

Public Rights of Way

2.7.75 The PRoW within the Site and within a 500 m radius of the Site are shown in **PEIR Volume II Figure 2-2: Public Rights of Way**. There would be a requirement for permanent and temporary PRoW diversions within the Solar

PV Site. Where PRoW cross or are adjacent to the Site, fencing would be erected from the inside without impacting the PRoW or preventing its use. Fencing is the first stage of construction and with this in place construction activities can operate without impacts to PRoW. The PRoW would also be buffered from the perimeter fencing, with fencing being installed a minimum distance of 20 m either side of the centre of the PRoW where solar infrastructure lies to both sides (creating a 40 m wide corridor between the fence lines), or 15 m from the PRoW centreline if solar infrastructure is to one side only. There would be a further 5 m from the perimeter fence to the Solar PV Panels.

2.7.76 The routes of PRoW during the operation and maintenance phase of the Scheme are presented in **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**.

2.7.77 Impacts and mitigation options for the existing PRoW network has been discussed with the City of Doncaster Council. Further discussion regarding PRoW is contained in **PEIR Volume I Chapter 10: Landscape and Visual Amenity** and **PEIR Volume I Chapter 12: Socio-Economics and Land Use**.

2.8 Operation and Maintenance

Operation and Maintenance Activities

2.8.1 During operation, activity on the Solar PV Site would be restricted principally to vegetation management, equipment maintenance and servicing, ad hoc replacement of any components that fail or reach the end of their lifespan, periodic fence inspection, and monitoring to ensure the continued effective operation of the Scheme.

2.8.2 Along the route of the Grid Connection Cables, operational activity would consist of routine inspections and any reactive maintenance such as where a cable has been damaged.

2.8.3 A Framework OEMP will be prepared as part of the EIA and submitted with the DCO Application. This will set out the general environmental principles to be followed during the operation of the Scheme. The Framework OEMP will be used as the basis for a detailed OEMP to be prepared prior to commencement of operation.

Operational Staffing

2.8.4 It is anticipated there would be up to two permanent staff on-site at any one time during the operation and maintenance phase, based at the Operations and Maintenance Hub. Additional staffing/visitors, such as maintenance workers and deliveries, would be ad hoc as needed. It is assumed this would equate to an average of four additional workers per month.

Operational Traffic and Access

2.8.5 There should be no requirement for regular HGV movements during the operation and maintenance of the Scheme. AIL movements during the operation and maintenance phase are not anticipated due to the delivery of spare transformer phases during construction (see Paragraph 2.7.49).

2.8.6 A small number of private vehicles for up to two permanent staff and ad hoc maintenance workers and visitors would use the local road network along with light goods maintenance and delivery vehicles when required.

2.8.7 It is anticipated that any components which are removed (replaced) would be transported to the Scheme's storage facilities in the existing barn in Field NW08 (by transit van or similar LGV). Once a sufficient volume of waste has been accumulated to make a 'load' for transport offsite, it is anticipated that these movements would also be undertaken by LGV (not by HGV).

2.8.8 Currently existing Field accesses are proposed for the operational access where this is practicable and would reuse construction accesses (except for the temporary access off Moss Road which would have been removed and reinstated at the end of construction). Main operational access to the Solar PV Site will be via Fenwick Common Lane and Haggs Lane, with Lawn Lane also used as the main access point for the Operations and Maintenance Hub. **PEIR Volume II Figure 2-3: Indicative Site Layout Plan** illustrates the existing and proposed accesses.

Lighting

2.8.9 The lighting strategy for the operation and maintenance phase will be set out in the Framework OEMP, which will include details on lighting design and will be provided as part of the DCO Application. The lighting design requirements are the same as for the construction phase as set out in Paragraphs 2.7.54 and 2.7.55.

2.8.10 During operation and maintenance, the Scheme would not require artificial lighting other than during temporary periods of maintenance/repair. All routine maintenance activities, except panel cleaning, would be scheduled for daylight hours as far as is practicable, and therefore it is anticipated that focussed task specific lighting should only be required in the event of emergency works/equipment failure requiring night-time working or panel cleaning operations.

2.8.11 As further described in Paragraph 2.8.25, as a worst case, it is estimated that the Solar PV Panels would be cleaned every two years. The panels would be cleaned at night when they are cool. The current preferred solution for cleaning operations would be by tractor mounted lighting, which is akin to that used during night-time arable harvesting operations currently undertaken within the Site.

2.8.12 Task specific and fixed 'general' lighting will be installed at the On-Site Substation, BESS Area and at the Operations and Maintenance Hub during the winter months (in early mornings and evenings only) to maintain safe working conditions. There will be internal lighting within the control buildings for the On-Site Substation and the BESS Area, and at the Operations and Maintenance Hub. Light spillage from these would be minimal (through open doorway or windows only). Outside of core working hours, PIR controlled lights (motion sensors) would be used.

2.8.13 Containerised units at Field Stations and BESS Battery Containers may contain internal artificial lighting (to be manually activated when needed), however, light spillage would be minimal (for example through a doorway when open).

2.8.14 The lighting strategy for the Scheme will be set out in the detailed environmental plans prepared for each stage of the Scheme (the Construction Environmental Management Plan (CEMP), Operational Environmental Management Plan (OEMP), and Decommissioning Environmental Management Plan (DEMP)). A Framework CEMP (including details of lighting design) is included as **PEIR Volume III Appendix 2-1: Framework Construction Environmental Management Plan**. A Framework OEMP and Framework DEMP will be provided at the ES stage.

Waste

2.8.15 Solid waste materials generated during Scheme operation and maintenance would primarily be general (household type) waste from the offices. However, there would also be a limited volume of packaging waste associated with the delivery of spare components. All general and packaging type waste would be segregated and stored on-site in containers (bins or covered skips) prior to transport to an approved, licensed third party landfill and recycling facilities.

2.8.16 Additionally, any waste components (e.g. faulty or damaged Solar PV Panels, batteries, cables, connectors and mounting structures) would be securely stored at the Scheme’s storage facilities until such time as the volume of waste is sufficient to allow transport to an approved, licensed third party waste management facility.

2.8.17 **PEIR Volume I Chapter 14: Other Environmental Topics** summarises the anticipated design life and replacement frequency for the main elements of the Scheme (Solar PV Panels, BESS etc.), based on other similar solar Nationally Significant Infrastructure Project (NSIP) schemes.

Water

2.8.18 During operation and maintenance, self-contained portable welfare units which store foul/wastewater for collection/emptying by specialist licenced contractors would be deployed on an ad hoc basis (e.g. if required by maintenance crews) at the further reaching sites where the use of the Operations and Maintenance Hub is not feasible.

2.8.19 It is anticipated that the water supply for the Operations and Maintenance Hub would come from the private water supply of a nearby farm with a separate meter installed. Foul water and grey water would be treated off-site.

2.8.20 The volume of stored fire water (as described in Paragraph 2.6.19) will be maintained to ensure there is sufficient water for firefighting purposes. More details on fire water supply and storage will be provided within the Framework Battery Safety Management Plan (to be presented with the DCO Application).

Surface Water Drainage

2.8.21 The detailed operational drainage design would be carried out pre-construction with the objective of ensuring that drainage of the land to the present level is maintained. It would follow either the design of a new drainage system taking into account the proposed new infrastructure (access tracks, cable trenches and structure foundations) to be constructed or, if during the construction of any of the infrastructure there is any interruption to existing schemes of land drainage, new sections of drainage would be constructed.

2.8.22 The design of new drainage systems would be based on the FRA and hydrological assessment to be undertaken as part of the ES. Infiltration drainage design would be in accordance with Building Research Establishment (BRE) Digest 365: Soakaway Design and Sewers for Adoption (Ref. 2-18) and infrastructure would be placed at least 10 m away from watercourses, as shown on **PEIR Volume II Figure 2-3: Indicative Site Layout Plan**.

2.8.23 Management of fire water is further described in Section 9.4 of **PEIR Volume I Chapter 9: Water Environment**; further details regarding management of fire water will be outlined in the Drainage Strategy to be submitted with the DCO Application.

Cleaning of Panels

2.8.24 In the UK climate, Solar PV Panels are largely self-cleaning and deterioration in PV system output due to dust or dirt is generally low. The requirement for, and the frequency of, cleaning of the Solar PV Panels due to the build-up of dust and dirt varies depending upon site specific conditions. For example, the presence of fine dust emitters such as quarries, agricultural operations (harvesting), coastal salt water, and the volume and proximity of nearby woodland can all impact the level of dust deposition. However, the main factor influencing cleaning requirements in the UK is lichen growth which again is influenced by site specific and climatic factors.

2.8.25 As stated above, the deterioration in output due to dust or dirt is generally low and, therefore, the requirement for cleaning due to loss of output is balanced against cost of the cleaning operation. Some sites can operate without the need to be cleaned, whereas some sites require cleaning every two years (annual cleaning is considered not to be cost effective). The cleaning requirements for the Scheme can only be accurately determined once operational and, therefore, to present a worst case for the assessments presented in this PEIR, a two-year cleaning cycle is assumed.

2.8.26 Solar PV Panel cleaning technology is evolving. However, this PEIR assumes a tractor mounted system (currently the system typically used on UK solar farms) would be used. This also allows the water usage to be determined based on current schemes using this technology (see **PEIR Volume I Chapter 9: Water Environment**).

2.8.27 A tractor mounted cleaning system uses a rotating ‘car-wash’ type brush, as shown in Plate 2-16. It is anticipated that water would be transported to the Solar PV Site in 1 m^3 (one tonne/1,000 litres (l)) intermediate bulk containers (IBCs). Individual IBCs would be mounted on the rear of the tractor to provide water supply during cleaning. Based upon cleaning water usage on similar schemes it is estimated that the cleaning of each panel would require 250 millilitres (ml) of water and that, assuming cleaning of all panels is required, the total volume of cleaning water per cleaning cycle would be 250,000 litres (250 m^3).

2.8.28 Panels would be cleaned at night when the panels are cool, as applying cold water to warm panels can lead to thermal shock and the risk of micro-cracks to the panel surface. Cleaning operations would be lit by tractor mounted lighting which is akin to that used during night-time arable harvesting operations currently undertaken within the Solar PV Site. As the use of cleaning products (chemicals) can damage panels and void manufacturer's warranties, only water would be used with no cleaning products applied. If required, a water softener would be added to prevent wash-residue forming on the panels; this would be biodegradable and would have no impact on the environment.

2.8.29 Dry-cleaning would not be employed as the action of the dry brush and any dust present on the panel surface would likely result in the formation of micro-scratches. Such scratches would likely attract/harbour more dirt on the panel surface decreasing efficiency and potentially voiding manufacturer's warranties.

Plate 2-16: Tractor-Mounted Cleaning System

Grazing

2.8.30 For the purposes of assessment and reporting of effects, it is assumed that there will be no grazing at the Solar PV Site during the operation and maintenance phase.

2.8.31 However, should consent be granted, grazing by sheep will be explored, noting that there are no known landowner restrictive covenants or other reasons that would prevent such use.

2.9 Design Life and Decommissioning

2.9.1 The design life of the Scheme is 40 years with decommissioning to commence 40 years after final commissioning (currently anticipated to be 2030 to 2070). The technical assessments (**PEIR Volume I Chapters 6** to **14**) therefore assume a design life of 40 years.

2.9.2 It is expected that throughout this period faulty or damaged Solar PV Panels and other components would require replacement as part of normal maintenance operations on an ad hoc basis. There will be no ‘wholesale’ replacement of Solar PV Panels or other equipment.

2.9.3 When the operation and maintenance phase ends, the Solar PV Site would be decommissioned. All Solar PV Panels, mounting piles, cabling, inverters, transformers, switchgear, BESS and the containerised unit of the Operations and Maintenance Hub would be removed from the Solar PV Site and recycled or disposed of in accordance with good practice and market conditions at that time.

2.9.4 It is anticipated that some areas of habitat and biodiversity mitigation and enhancement within the Solar PV Site may be left in-situ given they could contain protected species and so relevant licences at the time would be obtained for any changes. However, the majority of the Solar PV Site would be available to be returned to its original use after decommissioning. This would include the removal of any hardstanding and reinstatement of the soil profile (using the stockpiled site won soils) in areas where top soils were removed. Application of measures set out in Defra’s ‘Code of practice for the sustainable use of soils on construction sites’ (Ref. 2-14) would ensure that the restored soils are appropriately managed allowing their quality and function to be retained upon reinstatement and that any agricultural land is restored to the same quality (ALC grade) as prior to construction. The undisturbed soils within the Solar PV Site would have been removed from intensive agriculture for a long period and are expected to have achieved improvements in soil structure and carbon sequestration over that time.

2.9.5 The future of the On-Site Substation, including associated control and metering buildings and 400 kV export cables (i.e. the Grid Connection Cables or Grid Connection Line Drop), would be agreed with National Grid Electricity Transmission (NGET) and/or the asset owners prior to the commencement of decommissioning. It is common practice for such infrastructure to be retained and used for another purpose after the development they were originally installed to support is decommissioned. Therefore, it is possible that the On-Site Substation and Grid Connection Cables may remain in place/operational after the decommissioning phase of the Scheme. This cannot be confirmed at this time and will depend upon demand closer to the decommissioning date. Where retention or decommissioning of this infrastructure is relevant, the technical assessments presented in **PEIR Volume I Chapters 6** to **14** have considered a worst case in respect to that technical topic.

2.9.6 All work to the Existing National Grid Thorpe Marsh Substation would remain under National Grid’s control.

2.9.7 Should the Grid Connection Cables be decommissioned, the mode of their decommissioning would be dependent upon government policy and good practice at that time. Currently, the most environmentally acceptable option is considered to be leaving the cables in situ, as this avoids disturbance to overlying land and habitats and to neighbouring communities. Alternatively, the cables can be removed by opening up the ground at regular intervals and pulling the cable through to the extraction point, avoiding the need to open up the entire length of the cable route. The impact assessment is based on the worst case parameters for each technical topic.

2.9.8 A Framework DEMP will be prepared as part of the EIA and submitted with the DCO Application. This will set out the general principles to be followed in the decommissioning phase of the Scheme. A detailed DEMP would be prepared and agreed with the relevant authorities at that time of decommissioning, in advance of the commencement of decommissioning works, and would include timescales and transportation methods. The detailed DEMP would ensure that decommissioning was undertaken safely and with regard to the environmental legislation at the time of decommissioning, including relevant waste legislation.

2.9.9 Decommissioning is expected to take between 12 and 24 months and would likely be undertaken sequentially.

2.9.10 The effects of decommissioning are usually similar to, or of a lesser magnitude, than construction effects and are considered in the relevant sections of the PEIR. The specific method of decommissioning the Scheme at the end of its design life is uncertain at present as the engineering approaches to decommissioning would evolve over the design life of the Scheme. Assumptions will therefore been made where appropriate.

Waste

2.9.11 The waste generated at decommissioning would primarily be from the Solar PV Site, including electrical components, the Solar PV Mounting Structures, and fencing. Waste would be managed in accordance with the relevant legislation and guidance at the time and in accordance with the DEMP. Wastes would be safely and securely stored. It is anticipated that waste would either be segregated and stored on-site in containers or would be stored within secure storage buildings prior to transport to an approved, licensed third party landfill and recycling facilities.

2.9.12 At this time, it is not possible to identify either the waste management routes or specific facilities that would be used, as these are liable to change over such a timescale. The waste types generated, and effects of decommissioning are likely to be similar to the construction effects.

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