FENWICK SOLAR FARM

Fenwick Solar Farm
EN010152

Environmental Statement

Volume I Chapter 2: The Scheme

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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 **Environmental Statement (ES) Volume I Chapter 6** to **Chapter 14 [EN010152/APP/6.1]**.

2.1.2 This chapter is supported by the following figures in **ES Volume II [EN010152/APP/6.2]**:

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

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

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

d. **Figure 2-4: Location of Temporary Construction Compounds and Indicative HDD Areas**.

2.1.3 This chapter is supported by the following appendices provided in **ES Volume III [EN010152/APP/6.3]**:

a. **Appendix 2-1: Grazing Feasibility Study**; and

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

2.2 The Order limits

2.2.1 The Order limits, shown on **ES Volume II Figure 1-2: Site Boundary Plan [EN010152/APP/6.2]**, identify the maximum extent of land anticipated to be acquired or used for the construction, operation and maintenance, and decommissioning phases.

2.2.2 In this chapter and throughout the ES, the following definitions are used to describe the key areas and elements of the Scheme. These are illustrated in **ES Volume II Figure 1-3: Elements of the Site [EN010152/APP/6.2]**:

a. The Site – the collective term for all land within the Order limits comprising the Solar PV Site, Grid Connection Corridor, and Existing National Grid Thorpe Marsh Substation;

b. 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 (BESS), On-Site Substation, and associated infrastructure;

c. 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); and

d. 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 National Electricity Transmission System (NETS).

2.2.3 The Order limits also include a section of highway at the junction of the A19 and Station Road in the town of Askern to allow for abnormal indivisible load (AIL) vehicle access and escort. This area is approximately 1 ha and is centred on the approximate National Grid Reference SE 56598 13647. At this location, the works are currently anticipated to be limited to temporary traffic signal and banksman control for the period of AIL delivery whilst it is escorted to site, as shown on the **Traffic Regulation Measures Plan [EN010152/APP/2.4]** and specified in the **Draft DCO [EN010152/APP/3.1]** Schedule 8. Based upon preliminary swept path analysis, it is not anticipated that any street furniture is required to be removed to facilitate the manoeuvre.

2.3 Site Description

2.3.1 In total, the Order limits comprises approximately 509 hectares (ha) of land.

2.3.2 The Solar PV Site area is approximately 407 ha comprised predominantly of agricultural fields. A naming system has been applied to fields within the Solar PV Site, as presented in **ES Volume II Figure 1-3: Elements of the Site [EN010152/APP/6.2]**: Fields were loosely grouped by ordinal directions – northeast (NE), southeast (SE), southwest (SW), and northwest (NW) – and then numbered within each group.

2.3.3 The Solar PV Site is approximately centred on National Grid Reference (NGR) SE 604 161 (**ES Volume II Figure 1-1: Scheme Location [EN010152/APP/6.2]**). The Order limits is located entirely within City of Doncaster Council's administrative area. The surrounding landscape largely comprises agricultural fields and small rural villages, including Fenwick, Moss, Sykehouse, and the hamlet of Topham.

2.3.4 At the closest point, the Solar PV Site 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 Order limits, 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 considerably greater, as shown in the indicative layout presented in **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**.

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

2.3.6 The Grid Connection Corridor has an average 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 narrows to avoid sensitive receptors such as habitat designations, residential and commercial properties, and cultural heritage assets. 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 **ES Volume II Figure 1-2: Site Boundary Plan [EN010152/APP/6.2]**. 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 Section 2.6), this would supersede the requirement for Grid Connection Cables exiting the Solar PV Site, 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 Order limits or Scheme.

2.4 Existing Conditions Within and Surrounding the Order limits

2.4.1 Key environmental planning constraints within and around the Order limits are shown on **ES Volume II Figure 2-1: Environmental and Planning Constraints Plan [EN010152/APP/6.2]**. Further detail regarding the Order limits and the surrounding areas is provided in the **ES Volume I Chapters 6** to **14 [EN010152/APP/6.1]**.

Landscape

2.4.2 The landscape features within the Order limits 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 **ES Volume I Chapters 6** to **14 [EN010152/APP/6.1]** present the location of existing baseline features in relation to the Order limits.

Ecology

2.4.3 The Order limits 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 southwest of the Solar PV Site.

2.4.4 There are four non-statutory Local Wildlife Sites (LWS) located wholly or partially within the Order limits, 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 Order limits.

2.4.5 There is one area of Ancient Woodland located adjacent to the Order limits, 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 Order limits are reported in **ES Volume I Chapter 8: Ecology [EN010152/APP/6.1]**.

Cultural Heritage

2.4.7 There are no World Heritage Sites, Registered Parks and Gardens, Registered Battlefields, or Protected Wrecks within the Order limits 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 Order limits, however, there are a number in close proximity to the Order limits. 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 Order limits. 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 Order limits.

2.4.8 Further information regarding cultural heritage and the heritage assets located within the Order limits and Cultural Heritage Study Areas is provided in **ES Volume I Chapter 7: Cultural Heritage [EN010152/APP/6.1]**. Areas of archaeological mitigation within the Order limits are defined within the **Draft Archaeological Mitigation Strategy [EN010152/APP/7.19]**.

Water Environment

2.4.9 From published Environment Agency flood mapping, the majority of the Solar PV Site is located within Flood Zone 1 (low risk of flooding) and Flood Zone 2 (medium risk of flooding) with some areas of Flood Zone 3 (high risk of flooding). Flood Zones 2 and 3 are predominantly located to the north and east of the Solar PV Site with west and southwestern areas falling in Flood Zone 1. 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 Order limits are illustrated in **ES Volume II Figure 9-4: Environment Agency Flood Map for Planning (Rivers and Seas) [EN010152/APP/6.2]**.

2.4.10 The watercourses within the Order limits are shown on **ES Volume II Figure 9-1: Surface Water Features and their Attributes [EN010152/APP/6.2]**. 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 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) (City of Doncaster Council and North Yorkshire Council) is included in **ES Volume I Chapter 9: Water Environment [EN010152/APP/6.1]**, **ES Volume III Appendix 9-3: Flood**

Risk Assessment [EN010152/APP/6.3] and **ES Volume III Appendix 9-4: Framework Drainage Strategy [EN010152/APP/6.3]**.

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 Sykehouse 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 **ES Volume II Figure 1-1: Scheme Location [EN010152/APP/6.2]**.

2.4.12 There is a network of Public Rights of Way (PRoW) that surround and cross the Order limits as shown on **ES Volume II Figure 2-2: Public Rights of Way [EN010152/APP/6.2].** There are no national trails or national cycle routes within the Solar PV Site; however, the Grid Connection Corridor intersects the Trans Pennine Trail. The PRoW network is mostly used by local residents for recreational purposes such as dog walking and guided walks by equestrians. Fir Tree Farm Equestrian Centre and the Orchard Equine College and Equestrian Centre lie close to the Order limits.

2.4.13 Green Belt extends westwards of the railway to the west of the Order limits (and broadly extends across the western half of City of Doncaster administrative area) as shown on **ES Volume II Figure 2-1: Environmental and Planning Constraints [EN010152/APP/6.2]**.

2.5 Description of the Scheme

Overview of the Scheme

2.5.1 The Scheme will comprise the construction, operation and maintenance, and decommissioning of a solar photovoltaic (PV) electricity generating facility with a total capacity exceeding 50 megawatts (MW) together with BESS with a connection to the NETS via the Existing National Grid Thorpe Marsh Substation or via the Grid Connection Line Drop.

2.5.2 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 Rochdale Envelope

2.5.3 The design of the Scheme has been an iterative process based on environmental assessments and consultation with statutory and non-statutory consultees, including the public. **ES Volume I Chapter 3: Alternatives and Design Evolution [EN010152/APP/6.1]** describes this process further, including options that have been considered and discounted or amendments made to the Scheme design to date.

2.5.4 The Environmental Impact Assessment (EIA) presented within this ES has been undertaken adopting the principles set out in the Planning Inspectorate's Advice Note Nine: Rochdale Envelope ('Advice Note Nine') (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).

2.5.5 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. A number of the design aspects and features of the Scheme cannot be confirmed until the tendering process for the detailed 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. Therefore, the ‘Rochdale Envelope’ approach is adopted in this ES.

2.5.6 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 connection to the NETS at the Existing National Grid Thorpe Marsh Substation via the Grid Connection Cables and the final routing of the Grid Connection Cables within the Grid Connection Corridor, or the connection to the NETS via a Grid Connection Line Drop at the cable sealing end compound.

2.5.7 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.

2.5.8 The technical assessments therefore assess an ‘envelope’ within which the works would take place. As such, the DCO Application and EIA have been based on maximum and, where relevant, minimum parameters. The parameters are set out below.

2.5.9 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.

Design Parameters

2.5.10 Table 2-1 sets out the design parameters that have been assessed within this ES. Each Scheme component is described in more detail in Section 2.6 below. Each technical chapter (**ES Volume I Chapters 6** to **14**

[EN010152/APP/6.1]) has assessed the design identified to be the likely worst-case scenario for that discipline in order to determine effect significance.

2.5.11 The **Outline Design Parameters [EN010152/APP/7.4]** document submitted as part of the DCO Application provides the principles and maximum parameters for the detailed design of the Scheme and is secured by a requirement in the **Draft DCO [EN010152/APP/3.1]**. When the detailed design for the Scheme is submitted for approval to the relevant planning authorities, those details must accord with the **Outline Design Parameters [EN010152/APP/7.4]**. This ensures confidence that the environmental effects (of the detailed design) would be the same as or no worse than those assessed and reported in the ES.

Table 2-1: Design Parameters

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 typically 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 typically 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	The typical installation would be pile driven directly into the ground with indicative installation depth of 1.8 m to 3.0 m depending upon ground conditions. In areas of archaeological mitigation where required – Solar PV Mounting Structures may be mounted on pre-cast concrete blocks. For the purposes of the assessment up to 4,000 1-tonne blocks measuring approximately 4 m by 0.5 m in footprint each have been assumed, although block size, number and weight will only be determined upon final detailed design. At the time of writing (DCO Application submission), the areas of archaeological mitigation have not been defined, but the potential to utilise pre-cast concrete blocks as a strategy for preservation in-situ is presented within the **Draft Archaeological Mitigation Strategy [EN010152/APP/7.19]**. The final mitigation areas and confirmation on whether this strategy is suitable for each mitigation area will be set out within the Final Archaeological Mitigation Strategy.
	The Solar PV Mounting Structures are arranged into Solar PV Tables.	

Scheme Component	Parameter Type	Applicable Design Parameter
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.
	Minimum height to the lower edge of the Solar PV Panel (AGL)	0.8 m, except in areas of Flood Zone 3 where this will be bespoke and set to ensure a 300 mm freeboard above 1-in-100 year plus climate change flood levels is maintained at all times. Where Solar PV Panels are located within the Credible Maximum Scenario flood extent, these will be raised 400 mm above the flood level associated with this event.
Solar PV Site	Indicative separation distance between rows of Solar PV Tables	The minimum spacing between rows (inner spacing) is 3 m.
Field Stations (including Field Station Units)	Type	Field Stations are areas of hardstanding up to 20 m by 20 m that would comprise 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.
	Flood risk	Field Stations will be located outside of Flood Zone 2 and Flood Zone 3. Where Field Stations are located within the Credible Maximum Scenario flood extent, these will be raised 300mm above the flood level associated with this event.
	Field Station Units – enclosures similar to a shipping-style container which houses a central inverter (if used instead of string inverters), a transformer and switchgear.	

Scheme Component	Parameter Type	Applicable Design Parameter
	Indicative number and dimensions	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.
	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. Another option is to use string inverters: 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.

Scheme Component	Parameter Type	Applicable Design Parameter
	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 standalone.
	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.
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

Scheme Component	Parameter Type	Applicable Design Parameter
		between fence posts will be 5 m but will vary between 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.
On-Site Cables	Type	On-Site Cables would connect the Solar PV Panels, inverters, transformers, switchgear, and BESS with the On-Site Substation. These cables may be low voltage (less than 1.0 kV alternating current (AC) or 1.5 kV direct current (DC)) or medium voltage (33 kV).

Scheme Component	Parameter Type	Applicable Design Parameter
		Fibre optic and/or Cat 5/6 network data (communications) would be 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 string 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) whilst central inverters would require underground cabling. All other on-site electrical cabling will be underground unless there are obstacles such as archaeology in which case an above ground method such as concrete trough or cable tray would be used in these limited scenarios.
	Indicative cable trench dimensions for On-Site Cables	Up to 2 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.
Battery Energy Storage System (BESS)	Type	Batteries would be housed within enclosures (BESS Containers), with a maximum footprint of up to 12.5 m by 2.5 m and a height of up to 3.5 m. 'BESS Container' refers to any battery storage system enclosure design that may be used for the Scheme, i.e. cabinet, unit, shipping container. BESS Containers would have built-in gas, heat and smoke detection and an explosion protection system.
	Colour	External finish varies between manufacturers and colour would be confirmed during detailed design.

Scheme Component	Parameter Type	Applicable Design Parameter
	Location	BESS Containers would be located at a centralised BESS Area within Field SW10 of the Solar PV Site (refer to **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**). The footprint of the BESS Area would be up to 250 m by 200 m. The BESS would be located at least 500 m away from residential properties.
	Flood risk	The BESS Area would be located within Flood Zone 1. The BESS Area is to be bunded to provide protection during the unlikely event of a breach of the flood defences. The height of this bund would be 300 mm above the maximum flood depths during the River Don breach scenario.
	Indicative foundations for BESS 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 Containers	Up to a maximum of 432.
	BESS inverters, transformers and switchgear	If BESS string inverters are utilised, they would be 1.5 m length by 0.5 m depth by 1.0 m in height. Up to a maximum of 1187 located at the end of the BESS Containers and would sit on a plinth of 1 m x 2 m housing 5 string inverters. These would then feed into a shipping-type containerised or open sided container up to a maximum footprint of 12.5 m x 2.5 m and a height of up to 3.5 m. This would house the switchgear and the transformer. Up to 64 containerised or open sided containerised units will be required subject to detailed design. If BESS Central Inverters are used, inverters, 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 64 containerised or open sided containerised units will be required subject to detailed design.

Scheme Component	Parameter Type	Applicable Design Parameter
		All units would be located within the BESS Area adjacent to the BESS Containers.
	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 BESS Area. On-site fire water storage would take the form of above ground tanks. Tanks will be supported on structural concrete slab foundations. Details are provided in the **Framework Battery Safety Management Plan (BSMP) [EN010152/APP/7.16]**.
	Fire water containment	Impermeable water capture with penstocks to hold any fire water to allow for it to be tested before release or, if necessary, removed by tanker and treated offsite (refer to **ES Volume III Appendix 9-4: Framework Drainage Strategy [EN010152/APP/6.3]**).
	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 until it is

Scheme Component	Parameter Type	Applicable Design Parameter
		exported at times of peak demand assisting in the balancing of the grid and wider NETS.
	Location	The On-Site Substation would be located within Field SW8 (refer to **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**). The On-Site Substation would be located at least 500 m away from residential properties.
	Flood risk	The On-Site Substation would be located within Flood Zone 1. The On-Site Substation would be bunded to provide protection during the unlikely event of a breach of the flood defences. The height of this bund would be 300 mm above the maximum flood depths during the River Don breach scenario.
	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, busbars, circuit breakers, isolators and associated equipment and structures) would be outside (i.e. not contained within a building) and would comprise of multiple components. The maximum structure height would be 13.0 m, although the majority of the infrastructure would be much 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 being explored and will be determined by National Grid after the DCO is granted. The On-Site Substation would be at the same location and the same maximum footprint for either grid connection option.

Scheme Component	Parameter Type	Applicable Design Parameter
	Fencing	The On-Site Substation would be securely fenced with galvanised palisade security fencing, with 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.
	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 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. During the operation and maintenance phase, portable welfare facilities would be provided elsewhere in the Order limits 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 or cables for the Grid Connection Line Drop	Location	**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. **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. This will be determined by National Grid after the DCO is granted. Should this option 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. All works to establish the cable sealing end compound, and works within the cable sealing end compound to modify the tower and connect the Scheme's cables to the NETS would remain under National Grid's control.
	Cable Type	The Grid Connection Cables or cables for the Grid Connection Line Drop would comprise 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 or cables for the Grid Connection Line Drop	The cable trench would be up to approximately 0.75 m wide. Grid Connection Cables or cables for the Grid Connection Line Drop will be installed to a minimum depth of 1.0 m (to top of cable duct). To accommodate this trench depth will be up to 1.5 m. Where HDD is used to install the Grid Connection Cables beneath watercourses, installation would be a minimum of 1.5 m below the bed of the watercourse, except for Mill Dike, Wrancarr Drain, Engine Dike and Thorpe Marsh Drain due to the connectivity to the River Don where the minimum installation depth would be 5.0 m below the lowest surveyed point of the watercourse.
	Indicative working width for Grid Connection Cables or	The working area for installation of the Grid Connection Cables or cables for the Grid Connection Line Drop 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

Scheme Component	Parameter Type	Applicable Design Parameter
	cables for the Grid Connection Line Drop	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. The Grid Connection Corridor allows for necessary spatial flexibility in the routing of the Grid Connection Cables.
	Fencing	The working width of the Grid Connection Corridor will be demarcated by temporary (Heras style) fencing where required.
	Indicative dimensions of the cable sealing end compound for the Grid Connection Line Drop	The footprint of the new cable sealing end compound would be approximately 50 m by 85 m, noting this would be delivered by National Grid.
	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 Cables 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 500–900 m along the cable routing, and could include within the Solar PV Site.

Scheme Component	Parameter Type	Applicable Design Parameter
		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.
Existing National Grid Thorpe Marsh Substation	Point of connection	The Grid Connection Cables would connect to the NETS 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 works to modify the Existing National Grid Thorpe Marsh Substation would remain under National Grid’s control.

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.

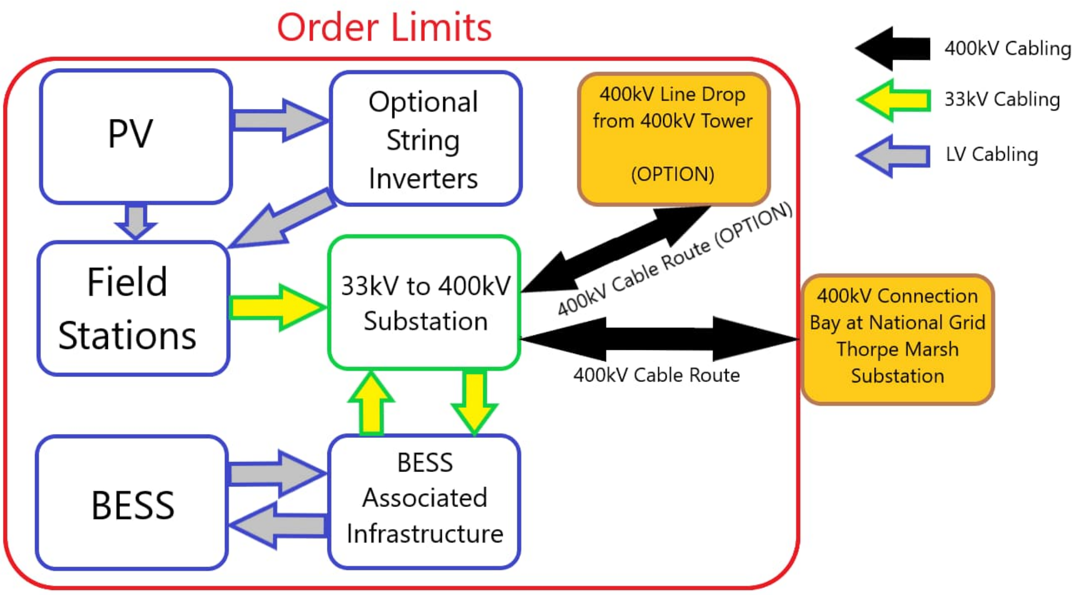

Plate 2-1: Scheme Overview

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.

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 The Scheme would utilise a 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 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

2.6.6 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 majority of the Solar PV Panels of the Scheme.

2.6.7 In areas of archaeological mitigation of the Solar PV Site (as defined within the **Draft Archaeological Mitigation Strategy [EN010152/APP/7.19]**) the Solar PV Mounting Structures may be fixed using pre-cast concrete blocks which avoids disturbance of any below ground features. The ground may need to be levelled for the installation of the concrete blocks, with any surface impacts no deeper than 100 mm. Ground conditions would be considered and mitigation measures put in place (such as bog matting) to limit ground disturbance and rutting during the installation of concrete blocks and solar PV panels in areas of archaeological mitigation. Confirmation of the use of this strategy will be set out in the Final Archaeological Mitigation Strategy.

Supporting Infrastructure: Inverters, Transformers and Switchgear

2.6.8 The design parameters of Field Stations and supporting infrastructure are set out in Table 2-1. Indicative Field Station locations are shown in **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**. 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.

2.6.9 Inverters convert DC electricity collected by the Solar PV Panels into alternating current (AC) electricity which can then be exported to the NETS. 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 (prior to reinstatement)

2.6.10 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 On-Site Cables) to the On-Site Substation.

2.6.11 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

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

2.6.13 Within the Field Station Units, the DC electricity collected by the Solar PV Panels is converted into AC (by an inverter). The voltage is increased from low voltage (less than 1.0 kV AC) to 33 kV (by a transformer) and then exits through the high voltage (HV) switchgear into the On-Site Cables (33 kV) connecting to the On-Site Substation.

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

Plate 2-4: Example of a Field Station Unit

Battery Energy Storage System Area

2.6.15 The Scheme would include an associated BESS Area within Field SW10. Within the BESS Area, this ES considers provision of the BESS infrastructure as described below as well as the provision of Solar PV Panels in the area in the event that not all of the BESS is built out, with each discipline assessing the worse case scenario. The BESS is designed to provide peak generation and grid balancing services to the NETS. 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 times of peak demand.

2.6.16 The BESS batteries would be housed within individual shipping-style containers. The BESS 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.

2.6.17 The precise number of individual BESS Containers is subject to further development, but it is currently expected that the Scheme would include up to 432 BESS Containers. **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]** presents the current proposed location of the BESS Area, and a more detailed layout is shown within **ES Volume III Appendix 2-2: BESS and On-Site Substation [EN010152/APP/6.3]**.

2.6.18 To ensure consistency of internal climate control, each of the individual BESS Containers 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 Containers, it will have a fan built into it that is powered by auxiliary power. Heating and cooling of the battery modules will be provided by an independent liquid cooling system which is separate to any HVAC system providing climate control for the BESS Container.

2.6.19 Similar to the Solar PV Panels, the BESS Containers will be connected to inverters, transformers and switchgear that will be packaged into shipping-container type containers and located within the BESS Area. If string inverters are used these will be housed separately from the transformers and switchgear. These units would convert the electricity between AC/DC or DC/AC, and would step the voltage up or down depending on the direction of the energy flow allowing the BESS Containers to receive electricity from the On-Site Substation for storage, and to release the stored energy via the On-Site Substation into the NETS. A separate BESS Control Building would also be located within the BESS Area.

2.6.20 The individual BESS Containers would have battery enclosures with built-in gas, heat and smoke detection and an explosion protection system. South Yorkshire Fire and Rescue Service have been consulted 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 **ES Volume III Appendix 2-2: BESS and On-Site Substation [EN010152/APP/6.3]**. The water tanks will be supported on structural concrete slab foundations and will have a storage capacity of up to a maximum volume of 300 cubic meters (m^3). The system will deliver a discharge rate of up to 1,900 litres per minute (L/min) for a minimum duration of 2 hours. The final storage volumes and discharge rates will be subject to approval and agreement with South Yorkshire Fire and Rescue Service and will align with the latest National Fire Chiefs Council (NFCC) guidance to ensure compliance with all applicable safety and operational requirements. This water will be supplied from the existing mains water supply.

2.6.21 Similarly, provision will be made for fire water containment (impermeable water capture with penstocks to prevent used firewater reaching ground/the surrounding environment). More details on the firewater storage and containment proposals are provided in Section 9.4 of **ES Volume I Chapter 9: Water Environment [EN010152/APP/6.1]**, **ES Volume III Appendix 9-4: Framework Drainage Strategy [EN010152/APP/6.3]** and the **Framework BSMP [EN010152/APP/7.16]**.

2.6.22 Other fire safety measures include (but are not limited to) spacing requirements between the BESS Containers and between the BESS Area and other infrastructure, as well as regular training and liaison with the local fire brigade, as described within the **Framework BSMP [EN010152/APP/7.16]**. Production of the detailed BSMP and its approval by the relevant planning authority is secured through a requirement attached to the DCO.

On-Site Cables

2.6.23 On-Site low voltage cables would connect the Solar PV Panels and BESS 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.

2.6.24 On-Site Cables between Solar PV Panels and string 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 unless there are obstacles such as archaeology in which case an above ground method such as concrete trough or cable tray would be used in these limited scenarios.

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

2.6.26 Fibre optic and/or Cat 5/6 data cables would also be installed, typically alongside electrical cables 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

2.6.27 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.

2.6.28 The On-Site Substation would be located within Field SW08. The location of the On-Site Substation is presented in **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**, and an indicative layout is shown within **ES Volume III Appendix 2-2: BESS and On-Site Substation [EN010152/APP/6.3]**. These layouts are indicative for the purposes of the ES. Final detailed design of the On-Site Substation will be developed prior to construction. The location and maximum footprint of the On-Site Substation (as well as all other key elements of the Scheme) are defined within the **Works Plan [EN010152/APP/2.2]** provided as part of the DCO Application.

2.6.29 The On-Site Substation comprises a single transformer bay, associated electrical infrastructure including busbar, 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 a grid connection failure (power cut/outage); it would also maintain communication and protection allowing a safe re-start of systems when available. 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.

2.6.30 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.

2.6.31 The On-Site Substation would be securely fenced with galvanised palisade security fencing with mandatory warning signage.

2.6.32 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 Cables

2.6.33 If the grid connection at the Existing National Grid Thorpe Marsh Substation is taken forward, the high voltage (400 kV) Grid Connection Cables, which will all be underground, 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.

2.6.34 The Grid Connection Corridor crosses the Network Rail freight line near the Existing National Grid Thorpe Marsh Substation. The cable will be installed under the railway using a trenchless technique (HDD) avoiding interruption to rail services (see **ES Volume II Figure 2-4: Location of Temporary Construction Compounds and Indicative HDD Areas [EN010152/APP/6.2]**).

2.6.35 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.

Grid Connection Line Drop

2.6.36 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 being explored. The determination of this option's viability by National Grid will only be possible after the DCO consent has been granted.

Until future discussions with National Grid conclude and the Line Drop is confirmed or no longer pursued, this connection method has been incorporated into the Scheme description as an alternative to the Grid Connection Corridor and is considered as part of the overall assessment.

2.6.37 If the Grid Connection Line Drop is used, the On-Site Substation would be at the same location but would instead connect to the existing overhead lines at one of the pylons within the PV site. The Grid Connection Line Drop would comprise of below ground cables running approximately 1.5 km (refer to **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**) 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. All works to establish the cable sealing end compound, and works within the cable sealing end compound to modify the tower and connect the Scheme's cables to the NETS would remain under National Grid's control.

2.6.38 There will be no noise emitting equipment associated with the Grid Connection Line Drop option.

2.6.39 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

Operations and Maintenance Hub

2.6.40 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 **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]** and the existing structure is presented in Plate 2-7.

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

Landscaping and Biodiversity

2.6.41 A **Framework Landscape and Ecological Management Plan (LEMP) [EN010152/APP/7.14]** has been prepared to support the DCO Application. This document sets out the principles for how the land within the Order limits will be reinstated and managed throughout the operation and maintenance phase following the completion of construction. A detailed LEMP would be produced by the appointed construction contractor and agreed with the relevant Local Planning Authority (City of Doncaster Council) following the grant of the DCO and prior to the start of construction. Production of the detailed LEMP is secured through a requirement attached to the DCO.

2.6.42 The proposed planting design (as outlined in the **Framework LEMP [EN010152/APP/7.14]**) has been developed to integrate the Scheme into its surrounding landscape; to avoid or minimise adverse landscape and visual effects as much as practicable; and to maximise opportunities for delivering net biodiversity gains. The proposed habitats, as shown on the Indicative Landscape Masterplan in Appendix A of the **Framework LEMP [EN010152/APP/7.14]**, comprise:

a. Native hedgerows with trees and hedgerow enhancement;

b. Native scrub;

c. Riparian edge trees and scrub;

d. Neutral grassland (moderate and good condition);

e. Modified grassland;

f. Wet grassland; and

g. Wetland scrapes.

2.6.43 The locations for 'gapping up' of existing hedgerows, new hedgerow and scrub, and grassland are identified on **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**.

2.6.44 The **Biodiversity Net Gain (BNG) Assessment [EN010152/APP/7.11]** quantifies the overall effect of the Scheme upon the Site's biodiversity value by comparing the Site's current (baseline) habitat value with that of the Scheme. Calculations consider the level of proposed habitat loss, retention, enhancement and/or creation delivered by the Scheme and are measured using DEFRA's Statutory Biodiversity Metric. Based on the current plans for the Order limits, the Scheme is predicted to result in a net gain of 36.46% for area-based habitat units, a net gain of 62.75% for hedgerow units, and a net gain of 24.97% for watercourse units (**BNG Assessment [EN010152/APP/7.11]**).

2.6.45 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).

Ecology Mitigation Area and Heritage Buffer Area

2.6.46 Ecology Mitigation Area will be provided along the River Went and the Fleet Drain, and Heritage Buffer Area will be provided along the Fleet Drain as shown on **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**. There will be no solar PV and associated infrastructure installed within these areas, and the land will be managed to create high quality habitat for priority bird species; provide setting buffer for the Scheduled Monument Fenwick Hall moated site; and preserve the ridge and furrow and preserve in situ areas of archaeological interest identified from the geophysical survey.

2.6.47 Where Heritage Buffer Area overlaps with Ecology Mitigation Area, there will be no below ground impacts that could result in impacts to archaeological remains.

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 is anticipated to 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 ES as a worst case assumption for the technical assessments presented in **ES Volume I Chapter 6** to **14 [EN010152/APP/6.1]**, 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 **ES Volume I Chapter 5: Environmental Impact Assessment Methodology [EN010152/APP/6.1]**, should the DCO be granted the Applicant will pursue discussions with National Grid to bring forward the grid connection date (set to April 2032 as of October 2024) and ensure that the renewable energy generated by the Scheme would be available to the NETS as soon as possible, helping to meet net zero targets and contributing towards security of supply. The Scheme could be operational from 2030 which has been assumed for the purposes of the assessment in this ES. The ES chapters each provide clarification of whether delaying or extending the construction phase (and knock-on changes to the decommissioning date) would lead to changes in the outcome of the assessment provided.

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 **ES Volume II Figure 2-4: Location of Temporary Construction Compounds and Indicative HDD Areas [EN010152/APP/6.2]**);
   iv. The establishment of the Operations 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, an open span bridge will be suggested, with the type of crossing selected based on site-specific factors and in consultation with the relevant authority (generally the Internal Drainage Board/lead local flood authority). Extensions or modifications of existing culverts 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.
   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 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 (if applicable);

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

ix. Testing and commissioning;

x. Site reinstatement, including topsoil reinstatement and repair of damaged field drainage where necessary to avoid negative impacts on the Order limits and its surroundings; 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 **ES Volume II Figure 2-4: Location of Temporary Construction Compounds and Indicative HDD Areas [EN010152/APP/6.2]**);

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 bays 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);

xii. Testing and commissioning; and

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

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 Solar PV Mounting Structure 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 Operations 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 **ES Volume I Chapter 8: Ecology [EN010152/APP/6.1]**, 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.

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. Further details on PRoW are provided in Paragraphs 2.7.68 to 2.7.71.

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. 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 approximately 2.5 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 by the On-Site Substation covering a 360-degree view of 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 5 m height.

2.7.16 During construction there would be regular out of working hours checks of the Order limits by roving security guards who would undertake scheduled patrols of each area, as well as additional attendance if 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

<u>Establishment of Construction Compounds</u>

2.7.17 Temporary construction compounds comprising parking, storage, staff welfare and waste management would be located within the Order limits. 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 could 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 **ES Volume II Figure 2-4: Location of Temporary Construction Compounds and Indicative HDD Areas [EN010152/APP/6.2]**. 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 roving compounds 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 (except for roving compounds), topsoil in the compound footprint will be stripped and stored in line with the Soils Resource Management Plan, based on the **Framework Soil Management Plan (SMP) [EN010152/APP/7.10]** submitted with the DCO Application. The hardstanding would then be formed of compacted stone (Type 1 aggregate) over appropriate geotextile. The temporary construction compounds including roving compounds may utilise track mats instead of compacted stone, given they will be utilised for shorter periods of time.

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

2.7.23 During the construction phase additional infrared cameras and motion sensors will be installed at construction compounds mounted at approximately 5 m height. Lighting of compounds is discussed in Paragraphs 2.7.51 to 2.7.54.

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 (up to 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 (swale) 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:

a. Import of components to the Order limits;

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

c. Mounting and connecting 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

<u>Cable Installation</u>

2.7.29 The design parameters for the installation of On-Site 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.

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

2.7.30 The On-Site Cables and Grid Connection 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. Trenchless crossings would likely be undertaken using HDD, although other techniques such as micro-tunnelling and boring may also be used.

2.7.31 Ten potential HDD locations have been identified. The precise locations of the HDD crossing points within the Order limits will be determined at detailed design stage post-consent, however indicative locations are illustrated on **ES Volume II Figure 2-4: Location of Temporary Construction Compounds and Indicative HDD Areas [EN010152/APP/6.2]** and described in Table 2-2 below.

Table 2-2: Potential HDD Crossings

HDD ID	Features being crossed
HDD.01	Existing high pressure fuel pipeline
HDD.02	Moss Road & London Hill Drain; Moss Road
HDD.03	Trumfleet Lane; Brick Kiln Lane; Moss Little Common Drain
HDD.04	Hawkehouse Green Dike
HDD.05	Mill Dike; PRoW Moss 20
HDD.06	Trumfleet Lane; PRoW Moss 21; Wrancarr Drain
HDD.07	Marsh Road; Engine Dike; PRoW Thorpe in Balne 6
HDD.08	Private field with tree and hedgerow boundary; PRoW Thorpe in Balne 7
HDD.09	Wilsick House Drain; unnamed watercourses; trees; Thorpe Lane; Marsh Lane; Thorpe Marsh Drain (River); PRoW Thorpe in Balne 8; PRoW Thorpe in Balne 11; PRoW Thorpe in Balne 13
HDD.10	Unnamed waterbodies; trees; Network Rail freight line

Battery Energy Storage System Construction

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

a. Installation of fencing, CCTV, roads, drainage;
b. Installation of electric cabling;
c. Construction of foundations;
d. Import of components to Site;
e. Installation of BESS Containers, transformers, inverters, and switchgear;
f. Installation of control building; and
g. Installation of fire water tanks, hydrants, fire water containment.

Testing and Commissioning

2.7.33 Commissioning of the Solar PV Panels, BESS and associated infrastructure would involve mechanical and visual inspection, electrical and equipment testing, and commencement of electricity supply into the NETS. Individual sub-systems would be tested and 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 and regulations utilised at the time of commissioning.

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

Construction Staff

2.7.35 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, assuming the worst case, two year construction timeline. 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.

2.7.36 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 **ES Volume I Chapter 12: Socio-Economics and Land Use [EN010152/APP/6.1]**.

Construction Hours of Work

2.7.37 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 another construction time cannot be practicably accommodated or in an emergency.

2.7.38 Emergency working may extend beyond the timescales quoted above. For these purposes, 'emergency' means a situation where, if the relevant action is not taken, there will be adverse health, safety, security or environmental consequences that in the reasonable opinion of the undertaker would outweigh the adverse effects to the public (whether individuals, classes or generally as the case may be) of taking that action.

2.7.39 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.

2.7.40 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 (City of Doncaster Council).

2.7.41 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.

2.7.42 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

2.7.43 Construction traffic and Site access is further discussed in **ES Volume I Chapter 13: Transport and Access [EN010152/APP/6.1]**.

2.7.44 A **Framework Construction Traffic Management Plan (CTMP) [EN010152/APP/7.17]** has been prepared as part of the DCO Application. This will be updated to a detailed CTMP which would be produced by the appointed construction contractor and agreed with the relevant Local Planning Authority (City of Doncaster Council) following the grant of the DCO and prior to the start of construction. Production of the detailed CTMP is secured through a requirement attached to the DCO. The aim of the CTMP is to minimise the impact of construction traffic on local communities by managing traffic using the local highway network, and where required/possible implementing mitigation. The **Framework CTMP [EN010152/APP/7.17]** defines information such as the routes that construction traffic must take, any timing restrictions in relation to the use of certain routes, and the penalties to contractors if the CTMP is not adhered to.

2.7.45 Currently existing accesses are proposed to be used for construction access to the Order limits where this is practicable. Accesses have been 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. **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]** illustrates the existing and proposed Site accesses. Detailed drawings of the Site accesses are provided within the **Framework CTMP [EN010152/APP/7.17]**. Sections of hedgerows to be removed are shown on Figure 8-5-2 within **ES Volume III Appendix 8-5: Hedgerow Report [EN010152/APP/6.3]**.

2.7.46 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 two-way movements (18 in and 18 out) per day at peak construction. This allows for the delivery of all components as defined within the design parameters summarised in Table 2-1, including the delivery of concrete blocks for the solar PV panels in areas of archaeological mitigation where required. All HGVs will enter the Solar PV Site via the main site access off Moss Road.

2.7.47 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 Order limits using a lighter vehicle tractor and trailer as required. To access the northern part of the Solar PV Site the tractor and trailer will be required to travel on a short section of Lawn Lane, using existing accesses. Appropriate traffic management measures will be in place on Lawn Lane to ensure the safety of road users.

2.7.48 There would be a maximum of five AIL deliveries (10 two-way 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.

2.7.49 The current estimate is that 250 FTE staff would be on site per day at the peak of construction and the assessment presented in **ES Volume I Chapter 13: Transport and Access [EN010152/APP/6.1]** 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 (two-way) – 8 arriving and 8 departing in the AM (16 two-way) and 8 arriving and 8 departing in the PM (16 two-way) per day, and 248 car movements (two-way) – 124 arriving in the AM and 124 departing in the PM per day for staff transportation at the peak of construction. The majority of construction workers will arrive to the Solar PV Site via Fenwick Common Lane/Haggs Lane and all will exit the Solar PV Site via the main construction access off Moss Road. 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 **ES Volume I Chapter 13: Transport and Access [EN010152/APP/6.1]**.

2.7.50 To prevent nuisance and potential obstruction/restriction of free traffic flows caused by vehicles parked around the Order limits, 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 Order limits. Parking on public roads within a defined radius of the Order limits would not be permitted. This has been further set out in **ES Volume III Appendix 13-4: Transport Assessment [EN010152/APP/6.3]**.

Lighting

2.7.51 The lighting strategy for the construction phase will be set out in the detailed Construction Environmental Management Plan (CEMP). The **Framework CEMP [EN010152/APP/7.7]** includes details of lighting design.

2.7.52 Lighting would be directional with care to minimise potential for light spillage beyond the Order limits, 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.

2.7.53 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.

2.7.54 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 early evenings 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

2.7.55 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

2.7.56 Fuel for machinery and generators would be delivered to Site by a fuel tanker 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). Bowsers will distribute the fuel to the construction plant. Spill kits would be available at the fuelling point and other strategic locations of the Order limits 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

2.7.57 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.

2.7.58 It is anticipated that the Scheme would obtain the water required for the Operations and Maintenance Hub and temporary facilities from an existing water supply from a nearby farm with a separate meter installed. 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.

2.7.59 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

2.7.60 A **Framework CEMP [EN010152/APP/7.7]** has been prepared as part of the DCO Application. This describes the framework of mitigation measures for construction identified from the ES assessments. The **Framework CEMP [EN010152/APP/7.7]** 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.

2.7.61 The detailed CEMP would be produced by the appointed construction contractor and agreed with the relevant Local Planning Authority (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 be managed by the contractor throughout construction and would clearly define roles and responsibilities. Production of the detailed CEMP is secured through a requirement attached to the DCO.

2.7.62 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);

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

e. Construction (Design and Management) Regulations 2015 (CDM) (Ref. 2-13).

2.7.63 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

2.7.64 The habitat and landscape restoration measures are described within the **Framework LEMP [EN010152/APP/7.14].**

2.7.65 The working widths of the Grid Connection Cables, On-Site Cables would be reinstated as soon as practicable following the completion of construction activities. Accesses into the Order limits installed during the construction phase (either new accesses or modified/extended existing accesses) will remain in place throughout the operation and maintenance phase. 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.

2.7.66 Within the Solar PV Site, following construction, a programme of Site reinstatement and habitat creation and enhancement would take place. The Scheme has been designed to integrate with and enhance the local green infrastructure network, improving ecological and recreational connectivity across the Solar PV Site. Plate 2-14 shows an example of typical grassland planting in a solar farm site.

2.7.67 Within the Ecology Mitigation Area along the River Went (refer to **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**) a network of linear foot drains (‘wetland scrapes’) will be created to maintain shallow water levels and maximise edge habitat. The specific locations of these features will be guided by the existing topography and any potential constraints, such as archaeological sites. The scrapes will be created with a gentle slope from shallow margins (3 cm to 5 cm deep) to a maximum depth of 40 cm to 50 cm at the centre.

Plate 2-14: Example Landscaped Solar PV Facility

Public Rights of Way

2.7.68 The PRoW within the Order limits and within a 500 m radius of the Order limits are shown in **ES Volume II Figure 2-2: Public Rights of Way [EN010152/APP/6.2]**. There would be a requirement for permanent and temporary PRoW diversions within the Solar PV Site. Where PRoW cross or are adjacent to the Order limits, 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.

2.7.69 The routes of PRoW during the operation and maintenance phase of the Scheme are presented in **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]**.

2.7.70 Impacts and mitigation options for the existing PRoW network has been discussed with City of Doncaster Council. Further discussion regarding PRoW is contained in **ES Volume I Chapter 10: Landscape and Visual Amenity [EN010152/APP/6.1]** and **ES Volume I Chapter 12: Socio-Economics and Land Use [EN010152/APP/6.1]**.

2.7.71 Management of PRoW is set out in the **Framework Public Rights of Way Management Plan (PRoWMP) [EN010152/APP/7.13]**. The detailed PRoWMP would be produced by the appointed construction contractor and agreed with the relevant Local Planning Authority (City of Doncaster Council) following the grant of the DCO and prior to the start of construction. Production of the detailed PRoWMP is secured through a requirement attached to the DCO.

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 (further described below), periodic fence inspection, and monitoring to ensure the continued effective operation of the Scheme. 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 faulted or been damaged.

2.8.2 Table 2-3 summarises the indicative design life of key components of the Scheme and their replacement requirements. Faulty solar PV panels will be replaced on an ad hoc basis. BESS batteries and inverters have been assumed to require replacement three times during the operation of the Scheme. The replacement of BESS batteries and inverters will be staggered, such that there is no wholesale replacement in a single construction period. For the purposes of the ES, it has been assumed that up to five batteries or inverters per day will be replaced over a period of several months, every 10 years.

2.8.3 Replacement of the following components is not anticipated during the Scheme operation and maintenance as their design life exceeds the operational life of the Scheme: solar PV panel mounting structures; On-Site and Grid Connection Cables; and the On-Site Substation.

Table 2-3: Indicative Design Life of the Key Components of the Scheme

Scheme Component	Indicative Design Life	Indicative Replacement Frequency
Solar PV panels	25–40 years	Faulty or damaged solar PV panels will be replaced as part of normal maintenance operations. There will be no wholesale replacement of solar PV panels. Spare solar PV panels will be delivered during construction and stored at the Operations and Maintenance Hub.
Inverters	10–15 years	To be replaced up to three times during the Scheme operation.
BESS batteries	10–15 years	To be replaced up to three times during the Scheme operation.

Scheme Component	Indicative Design Life	Indicative Replacement Frequency
Transformers	Over 20 years	Assumed design life of 20 years, although replacement will only be carried out if required for performance or health and safety reasons.
Switchgear	Over 20 years	Assumed design life of 20 years, although replacement will only be carried out if required for performance or health and safety reasons.

Operational Environmental Management Plan

2.8.4 A **Framework Operational Environmental Management Plan (OEMP) [EN010152/APP/7.8]** has been prepared as part of the DCO Application. This sets 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 produced by the appointed operation contractor and agreed with the relevant Local Planning Authority (City of Doncaster Council) following the grant of the DCO and prior to the final commissioning of any part of the Scheme. Production of the detailed CEMP is secured through a requirement attached to the DCO.

Operational Staffing

2.8.5 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

2.8.6 There should be no requirement for regular HGV movements during the operation and maintenance of the Scheme. Limited use of HGVs will be required for the replacement of batteries, inverters and transformers associated with the Field Stations and the BESS as explained in Paragraph 2.8.2. It has been assumed that during the replacement activity up to five pieces of equipment will be replaced per day (equating to 10 two-way HGV movements) over a period of several months, every ten years during operation.

2.8.7 AIL movements during the operation and maintenance phase are not anticipated due to the delivery of spare transformer phases during construction (see Paragraph 2.7.48).

2.8.8 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.

2.8.9 It is anticipated that any components which are removed (replaced), other than larger equipment such as batteries and inverters described above, 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).

2.8.10 Currently existing field accesses are proposed for the operational access where this is practicable and would reuse construction accesses. Main operational access to the Solar PV Site will be via Lawn Lane, while the access to the BESS Area and the On-Site Substation will be from Moss Road. Emergency access to the BESS Area and the On-Site Substation will be provided via Fenwick Common Lane/Haggs Lane and from Moss Road; at the Fenwick Common Lane/Haggs Lane access point emergency vehicles will be able to enter the Solar PV Site however all egress would be via Moss Road. Access to the Solar PV Site off West Lane will be for emergency use only. **ES Volume II Figure 2-3: Indicative Site Layout Plan [EN010152/APP/6.2]** illustrates the existing and proposed accesses.

Lighting

2.8.11 The lighting strategy for the operation and maintenance phase is set out in the **Framework OEMP [EN010152/APP/7.8]**, which includes details on lighting design. The lighting design requirements are also captured within the **Outline Design Parameters [EN010152/APP/7.4]** and are the same as for the construction phase as set out in Paragraphs 2.7.52 and 2.7.53.

2.8.12 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.

2.8.13 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 parts of the Solar PV Site.

2.8.14 Task specific and fixed 'general' lighting will be used 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.

2.8.15 Containerised units at Field Stations and BESS 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).

Waste

2.8.16 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.

2.8.17 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.

2.8.18 **ES Volume I Chapter 14: Other Environmental Topics [EN010152/APP/6.1]** 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

2.8.19 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.

2.8.20 It is anticipated that the water supply for the Operations and Maintenance Hub would come from an existing water supply of a nearby farm with a separate meter installed. Foul water and grey water would be treated off-site. Foul drainage from any permanent welfare facilities would be directed to an on-site cesspit for treatment prior to discharge. The tank would be emptied by road tanker as and when required. It is not proposed to have a permanent discharge to sewer.

2.8.21 Fire water will be stored at the volume outlined in Paragraph 2.6.20 to ensure there is sufficient water for firefighting purposes. More details on fire water supply and storage is provided within the **Framework BSMP [EN010152/APP/7.16]**.

Surface Water Drainage

2.8.22 **ES Volume III Appendix 9-4: Framework Drainage Strategy [EN010152/APP/6.3]** covers the BESS Area and the On-Site Substation. 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.

2.8.23 Management of fire water is further described in Section 9.4 of **ES Volume I Chapter 9: Water Environment [EN010152/APP/6.1]** and **ES Volume III Appendix 9-4: Framework Drainage Strategy [EN010152/APP/6.3]**.

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 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 ES, a two-year cleaning cycle is assumed.

2.8.26 Solar PV Panel cleaning technology is evolving. However, this ES 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 **ES Volume I Chapter 9: Water Environment [EN010152/APP/6.1]**).

2.8.27 A tractor mounted cleaning system uses a rotating 'car-wash' type brush, as shown in Plate 2-15. 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 approximately 138,000 litres (138 m^3). The cleaning water will be obtained from the existing water mains.

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 parts of 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.

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 2-15: 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 may be explored, noting that there are no known landowner restrictive covenants or other reasons that would prevent such use. **ES Volume III Appendix 2-1: Grazing Feasibility Report [EN010152/APP/6.3]** confirms that *“if managed correctly, by providing good fencing and water supplies and good sheep husbandry, then there is no reason why the land under the panels cannot successfully be grazed by sheep, as is common practice on other operational solar farms both within the UK and internationally.”*

2.8.32 Should grazing be implemented at the Solar PV Site, stock density and seasonality of grazing will be such as to maintain the post-development grassland status as presented within the **BNG Assessment [EN010152/APP/7.11].**

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 (**ES Volume I Chapters 6** to **14 [EN010152/APP/6.1]**) 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 and concrete blocks, 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. In areas of archaeological mitigation ground conditions would be considered and mitigation measures put in place (such as bog matting) to limit ground disturbance and rutting during decommissioning activities.

2.9.4 Upon decommissioning the Order limits will be returned to landowners, including the established habitats. Any impacts to important ecological features present at the time of decommissioning will be mitigated fully in line with relevant legislative and policy requirements. Decommissioning 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 drainage of the land within the Scheme will be checked after decommissioning. Should any agricultural drains be altered or removed, they will be restored or the land otherwise re-drained such that agricultural activities could continue after decommissioning of the Scheme.

2.9.6 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 **ES Volume I Chapters 6** to **14 [EN010152/APP/6.1]** have considered a worst case in respect to that technical topic.

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

2.9.8 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.

2.9.9 A **Framework Decommissioning Environmental Management Plan (DEMP) [EN010152/APP/7.9]** is included with the DCO Application. This sets 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 Local Planning Authority (City of Doncaster Council)at that time of decommissioning, in advance of the commencement of decommissioning works, and would include timescales and transportation methods. Production of the detailed DEMP is secured through a requirement attached to the DCO. 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.

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

2.9.11 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 ES. 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

2.9.12 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.

2.9.13 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. Recycling routes are generally available for materials at present, and it is likely that there will be even greater opportunities for recycling in the future, not least because the market will have expanded to meet demand as solar PV and BESS installations increase. The waste types generated, and effects of decommissioning are likely to be similar to the construction effects. Assessment of effects associated with materials and waste is provided in **ES Volume I Chapter 14: Other Environmental Topics [EN010152/APP/6.1]**.

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