East Anglia ONE
Offshore Windfarm

# East Anglia ONE Offshore Windfarm

## Substation Detailed Design (Work No 39)
## DCO Requirement 10
## Final for Approval

ID: EA1-CON-F-GBE-008553

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# REVISION CONTROL

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| | | | | | |

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# Abbreviations

**AC** – Alternating Current
**AOD** – Above Ordnance Datum
**BCT** – Bat Conservation Trust
**BDC** – Babergh District Council
**CfD** – Contracts for Difference
**CHP** – Combined Heat and Power
**DC** – Direct Current
**DCO** – Development Consent Order
**DECC** – Department for Energy and Climate Change
**EAOL** – East Anglia One Limited
**GIS** – Gas Insulated Switchgear
**HVAC** – High Voltage Alternating Current
**HVDC** – High Voltage Direct Current
**LED** – Light Emitting Diode
**LPA** – Local Planning Authority
**MSDC** – Mid Suffolk District Council
**MW** – Megawatts
**NG** – National Grid
**PIR** - Passive Infra Red
**SCC** – Suffolk County Council
**SPR** – ScottishPower Renewables
**STATCOM** – Static synchonous Compensator
**SuDS** – Sustainable Drainage Systems
**W** - Watts

# 1 Introduction

## 1.1 Project Overview

1. East Anglia ONE Limited (EAOL) was awarded Development Consent Order (DCO) by the Secretary of State Department of Energy and Climate Change (DECC) on June 17th 2014 for East Anglia ONE Offshore Wind Farm (EA ONE). The DCO granted consent for the development of a 1200MW offshore windfarm and associated infrastructure.

2. In February 2015 EAOL secured a Contract for Difference (CfD) award to build a 714MW project and ScottishPower Renewables announced its role in leading East Anglia ONE towards construction. In April 2015 EAOL submitted a non-material change application to DECC to amend the consent from direct current (DC) technology to alternating current (AC). In March 2016 DECC authorised the proposed change application and issued an Amendments Order.

3. The onshore construction works associated with EA ONE comprise of the following, which is based on the AC technology with an installed capacity of 714MW and transmission connection of 680MW;

- A landfall site at Bawdsey, Suffolk
- Up to six underground cables, approx. 37km in length
- Up to four cable ducts for future East Anglia Three project
- An onshore substation located at Bramford next to existing National Grid infrastructure

4. The scope of this document relates to the onshore substation located near Bramford, Suffolk referred to as Work No 39 in the DCO, to the north of the existing National Grid substation (Figure 1 Site Context Plan).

## 1.2 Purpose and Scope

5. This document sets out the details for the design of the EA ONE onshore substation, herein referred to as 'the substation', (Work No 39) as defined by the DCO. It explains how the design for the substation and associated landscaping has been developed so that it is sensitive to its location and minimises its potential visual impact as far as practical. This document has been produced to discharge DCO Requirement 10 parts (1) to (5) as proposed amended which states:

> ***10.—(****1) No part of Work No. 39 shall commence until details of the layout, scale and external appearance of the same, have been submitted to and approved in writing by the relevant planning authority. Work No. 39 must be carried out in accordance with the approved details.*
>
> *(2) Any details provided by the undertaker pursuant to sub-paragraph (1) must accord with the outline converter station design principles statement and be within the Order limits.*
>
> *(3) No building comprised in Work No. 39 shall exceed 79 metres AOD for the HVDC option and 75 metres AOD for the HVAC option and no external electrical equipment comprised in Work No. 39 shall exceed 64 metres AOD for the HVDC option and 69 metres AOD for the HVAC option.*
>
> *(4) The total footprint of the buildings housing the converters comprised in Work No. 39 must not exceed 130 metres in length and 85 metres in width for the HVDC option and for the HVAC option.*
>
> *(5) The fenced compound (excluding its accesses) comprised in Work No. 39 must not exceed 190 metres by 150 metres.*

6. In the case of Requirement 10 it is Mid Suffolk District Council (MSDC) who is the relevant planning authority. However EAOL has acknowledged from an early stage that Suffolk Council (SCC) and Babergh District Council (BDC) are important consultees in the process.

7. The purpose of this document is to detail the process that has been followed and demonstrate that consideration has been given to the design of the substation in accordance with the 'outline converter station design principles statement' as required by DCO Requirement 10.

8. There are other elements of the onshore construction works of EA ONE that are linked very closely to the substation design, including landscaping, which are the subject of DCO Requirements in their own right. Where such issues are relevant to the substation design information is presented within this document, however the detailed information necessary to discharge such individual DCO Requirements will be provided within independent documents.

### 1.3 Site location and Context

9. The existing landscape context around the substation site is illustrated in Figure 1. In general terms, the landscape around the substation is predominantly farmed agricultural land. Large open fields feature extensively around the site, which are mainly used for arable crops. Field boundaries are often hedgerows, hedgerow trees and intermittent woodlands or woodland shelterbelts.

10. The substation is situated within the Ancient Plateau Claylands LCT. This is described in the Suffolk Landscape Character Assessment as:

- Gently rolling heavy clay plateaux with ancient woodlands.
- Flat or gently rolling arable landscape of clay soils dissected by small river valleys.
- Field pattern of ancient enclosure – random patterns in the south but often co-axial in the north. Small patches of straight-edged fields associated with the late enclosure of woods and greens.
- Dispersed settlement pattern of loosely clustered villages, hamlets and isolated farmsteads of medieval origin.
- Villages often associated with medieval greens or tyes.
- Farmstead buildings are predominantly timber-framed, the houses colour-washed and the barns blackened with tar. Roofs are frequently tiled, though thatched houses can be locally significant.
- Scattered ancient woodland parcels containing a mix of oak, lime, cherry, hazel, hornbeam, ash and holly.
- Hedges of hawthorn and elm with oak, ash and field maple as hedgerow trees.
- Substantial open areas created for WWII airfields and by 20th century agricultural changes.
- Network of winding lanes and paths often associated with hedges create visual intimacy.

11. The landscape is predominantly agricultural (arable) in nature with the land use pattern relating to the topography. Many of the field boundaries are a mixture of intact areas of hedgerow with mature trees, areas with some gaps or occasional trees, and large sections with no hedgerow. There are large areas of mature vegetation surrounding the site – blocks of ancient and semi-natural woodland, tree belts and hedgerows, which provide good natural screening of the site. Communication links include the busy A14 to the east, the rail line through the Gipping valley and a network of minor roads, tracks and footpaths in the west of the area. Pylon lines form linear man-made features in the landscape and cross through the surrounding countryside, converging on the existing substation at Bramford, which is itself a prominent feature in the local landscape. The presence of the adjacent Bramford Substation provides screening to the south and, in association with the pylons, establishes energy infrastructure as heavily intruding on the landscape character.

12. The main settlement pattern in the area is of isolated farmsteads and small villages which are scattered throughout the landscape and often situated within the valleys. The local area is interspersed with farm buildings, barns and residential houses. To the east, lies the western edge of Ipswich which is visible in long views from elevated positions across the area. The settlements of Sproughton and Bramford extend the urban influence into the area. Views are extensive, particularly on higher ground and frequently open. Small woodland blocks and sections of hedgerow are seen in many views and can limit views in lower lying areas. Overhead transmission lines and pylons are seen on the skyline in most views within the area. Views into the site from immediate surrounding areas are generally restricted by existing vegetation. The plateau landform does provide a number of open distant views, but the network of winding lanes and tall hedges means that other areas can be much more intimate.

# 2 Design Principles and Parameters

13. DCO Requirement 10 parts (1) and (2) identifies details of the layout, scale and external appearance of Work No 39 that should be submitted to the relevant planning authority for written approval. The Requirement provides that such details must accord with the 'outline converter station design principles statement' and be within the Order limits. Parts (3) to (5) of DCO Requirement 10 set the parameters for the key elements of the onshore substation.

14. The Design Principles Statement[1] identifies the following eight key principles that should be addressed under Requirement 10 (not repeated in full):

(1) Engagement: with Parish Councils, local residents and relevant authorities (Mid Suffolk District Council (MSDC), Babergh District Council (BDC) and Suffolk County Council (SCC)) in respect of both Requirement 10 and 12;

(2) Design: sensitive to place, with visual impacts minimised as far as possible by the use of appropriate design, building materials, shape, layout, coloration and finishes;

(3) Height: substation building and ancillary equipment will be kept to a minimum and the slab level will be set at the lowest practical level;

(4) Landscaping: to minimise the visual intrusion, and respond to local landscape character and biodiversity; considered in the building design and layout of ancillary structures;

(5) Embedded ecological mitigation and enhancement: with particular attention to lighting, large areas of glass and baffling of noise sources;

(6) Sustainable Drainage (SuDS) strategy: to be developed in accordance with DCO Requirement 16 relating to a Surface Water and Drainage Management Plan (for Work 39);

(7) Engagement: Through development of the final design and landscaping proposals provide opportunity to engage with local communities who will be directly affected by the substation; and

(8) Design Review: The design should be subject to design review, in consultation with the relevant local authorities.

15. The key parameters set by Requirement 10 are as follows:

- No building shall exceed 75 metres AOD for the HVAC option;
- External electrical equipment shall not exceed 69 metres AOD for the HVAC option;
- The total footprint of the buildings housing the converters must not exceed 130 metres in length and 85 metres in width; and
- The fenced compound (excluding its accesses) must not exceed 190 metres by 150 metres.

16. This document considers each of the principles in turn and describes how each principle has been addressed.

[1] [Note that the references to converter station and associated terminology have been amended to suit the AC form which now comprises the DCO following amendment. This approach was agreed with the relevant authorities on 22nd April and 29th May 2015]

# 3 Matters for Approval

17. The following section presents the details of the design of the onshore substation and how each of the principles and parameters identified in Section 2 above have been addressed.

## 3.1 Engagement

18. EAOL has undertaken consultation with officers from BDC, MSDC and SCC in respect of the substation since the DCO was published. Consultation has also been undertaken with Burstal Parish Council. This has taken the form of meetings and presentations over an extended period. The way in which this consultation has been undertaken has been discussed and agreed with the planning authority.

### 3.1.1 Relevant Authorities

19. A number of Steering group meetings have been held with officers of MSDC, BDC and SCC. This has provided a forum for discussion on the substation. This has included steering group meetings on the 22nd April 2015, 29th May 2015, 25th September 2015 and 14th December 2015. During the course of these meetings the approach to the design of the substation was discussed. The involvement of the Design Council was discussed and the presentation to the Design Council was reviewed. Further information in respect of the role of the Design Council in the process is described in more detail in Section 3.7.

20. In addition to this, meetings were held with Councillors and officers of BDC and MSDC on 29th September 2015. A total of 20 officers and Councillors attended the meeting with BDC and 25 Councillors and officers attended the MSDC meeting. At these meetings the proposed design of the substation compound was presented to the attendees by EAOL.

### 3.1.2 Parish Councils and Local Residents

21. A meeting was held with Burstal Parish Council on 29th September 2015. A total of 10 people attended this meeting. At this meeting EAOL presented the proposed design of the substation to those present.

## 3.2 Design

22. EAOL is committed to good design and appointed Optimised Environments (OPEN), a landscape design and architectural practice, to consider the existing environment and develop a design approach for the substation that builds on the principles set out in Design Principles Statement (see section 2.0). The design approach ensures that the substation is sensitive to place, with visual impacts minimised as far as practical by the use of appropriate design, building materials, shape, layout, coloration and finishes, whilst considering the functional constraints of a substation. The design approach for the substation buildings is described in this section, together with details of the layout, scale and external appearance of the substation.

### 3.2.1 Layout and Scale

23. In the design of the substation there are a number of important technical constraints which are inherent to the design, particularly in respect to the location, form and appearance of the key electrical equipment. The layout is determined by the functional demands of the substation, practical restrictions and considerations, which results in a specific electrical layout model (presented in Figures 3 and 4 and Appendix 2). The design criteria for the substation layout are relatively rigid, in order to comply with Health and Safety obligations, Electrical Safety Regulations and electrical design specifications. However, around these constraints other elements including landscape design, have been used to ensure the substation responds as far as practical to a sense of place and visual impact.

24. Installations and equipment must be capable of withstanding electrical, mechanical, climatic and environmental influences anticipated on site. The design takes into account:

- the purpose of the installation;
- the users requirements such as power quality, reliability, availability, and ability of the electrical network to withstand the effects of transient conditions such as short power outages and re-energisation of the installation;
- the safety of the operators and the public;
- the environmental influence; and

- the maintenance.

25. Plant and equipment must satisfy their specified functional and performance requirements and must also operate safely and without any degradation in performance for the appropriate range of primary voltages. The plant and equipment has been designed and installed so that system and its components will be operated and maintained in accordance with the relevant statutory requirements, including:

- substation electrical clearances - minimum clearances from Phase to Earth and Phase to Phase;
- substation safety clearances - safety distance, design clearance for safety (vertical and horizontal) and insulation height for pedestrian access (versailing conductors shall be eliminated from the design as far as is reasonably practicable);
- clearance to roadways;
- maximum equipment heights;
- insulation levels;
- earthing system; and
- electromagnetic compatibility.

26. Further details on the electrical and safety clearance are presented in Appendix 1. The electrical layout for the substation is presented in Figures 3 and 4 and Appendix 2, which shows the layout of the main electrical elements of substation and identifies the dimensions of the compound. In accordance with the DCO Requirement 10 (5) the substation compound is 190 metres by 150 metres.

### 3.2.2 Fencing

27. A perimeter security fence shall be installed around the substation compound. The fencing must comply with “The Electricity safety, Quality and Continuity Regulations 2002” as a minimum standard and relevant British Standards (e.g. BS 1722). The function of the perimeter security fence is to provide a deterrent, physical barrier and potential alarm against intruders, and must be robust enough to delay entry into the substation for persons who are unauthorised.

28. The perimeter fence around the substation compound will consist of a 2.4m high fence, which is the minimum fence height required for safety and security purposes, which are paramount . The perimeter fencing system will be a mesh fence configuration Hi SEC Super 6 or similar solution. This solution provides a close mesh that is almost impossible to climb and very difficult to cut through with anything but power tools. The Hi Sec security system uses welded mesh to repel would be intruders. The perimeter fence will be screened by earthworks, which rise from the perimeter of the substation compound and hedgerow planting (Figures 14 and 15).

### 3.2.3 Substation Form

29. The design process for the substation has involved extensive engagement undertaken with the Design Council, LPAs and local communities (see Sections 3.1 Engagement and 3.7 Design Review for details). Detailed work was undertaken to develop substation buildings that respond successfully to the surrounding context, speak a confident architectural language and respond to views of the local community. In order to develop an appropriate design language for the substation buildings, an architect was engaged to develop an architectural vocabulary that can be applied to the substation buildings. An Architectural Report (EA1-CON-F-IBR-010113) has been prepared (provided under separate cover) and consultations held with all consultees in order to inform the design approach for the substation.

30. Several design approaches for the substation buildings were considered, building upon the outline design principles identified in the Design Principles Statement. Further consideration was given to both the local building vernacular and other substation building design precedents, in order to understand the most suitable appearance for the substation in its landscape context (Figure 5). The local vernacular includes agricultural buildings and existing substation buildings/ infrastructure. In the immediate area, the Bramford National Grid (NG) substation is the nearest building precedent and its appearance is a functional substation building with dark-grey steel vertical cladding. The local agricultural vernacular in the surrounding landscape has distinct style of wall treatments for barns, observed to be dark weatherboard cladding as stand-alone, or in combination with rendered or brick walls, together with contemporary barn buildings generally clad in metal (Figure 5). Examples of local modern industrial design were considered. The Great Blakenham Combined Heat and Power (CHP) plant is an example of a more expressive industrial building style in the local area, which uses changes in colour shade and materials to express its exterior building panels (Figure 5) however this building is located in an area with more urban

influences than the site for the substation. Other large scale farm buildings in the area utilise large roof areas for solar panel arrays.

31. Three potential design options for the substation buildings were identified - 'functional', 'vernacular' and 'expressive', based upon the outline design principles, the local building vernacular and the landscape context of the site. These options are described as follows and illustrated in Figure 7:

- **Expressive option** - An expressive building appearance that emphasises the substation. Panel and 'dazzle' patterns using shades of green or grey or colour graduation patterns (dark to light).
- **Vernacular option** - A vernacular building appearance that appears similar to local agricultural/farm buildings and barn conversions, with horizontal timber cladding, brick base course and muted/dark colours.
- **Functional option** - A functional 'electrical' building appearance, consisting vertical steel cladding with an engineering brick base course and muted colours. Appears functional as an electrical substation building.

32. These different design options were considered using façade rendered images and indicative photomontage visualisations to consider each option in relation to the baseline conditions at the site (Figure 8) and inform the most appropriate approach to the treatment of the substation buildings.

33. The expressive option emphasises the substation as a feature in the landscape, using panel and dazzle pattern and colour graduation (dark to light). There are a number of examples of large buildings that use changes in colour and pattern to express elements of the building (including the nearby Great Blakenham CHP plant), which can be quite effective, but it depends on context. The landscape context of the site is essentially agricultural, with electrical infrastructure influences. An expressive approach was considered more appropriate for urban fringe/urban areas, than the rural context of the site. Further patterns on the substation cladding is likely to increase complexity when viewed with external electrical infrastructure, although a dark to light colour gradation appears recessive. Expressive substation buildings which are effectively hidden by mitigation planting would be inconsistent. An expressive building appearance was ruled out in favour of a quieter, more subdued appearance.

34. A vernacular building appearance appears similar to local agricultural/farm buildings and barn conversions, consisting of either dark grey horizontal weatherboard cladding, with brick base course, or contemporary barn buildings generally clad in metal sheet. This option would combine a rural vernacular with electrical infrastructure, as it will be seen in the context of external electrical infrastructure within the substation site and the nearby Bramford NG substation. The use of an agricultural building style for the substation appears to be less appropriate in this context. The substation is located at relative distance from settlements/roads/paths, therefore if a vernacular style was used it would be unlikely to be acknowledged or recognised by people. Over time, woodland planting will effectively screen much of the substation buildings and electrical infrastructure. A vernacular substation building which is effectively hidden by mitigation planting would be inconsistent with the concept of expressing a vernacular building style. The precedent set by the dark grey colour of barns is considered appropriate to apply to the substation buildings.

35. A functional building appearance relates directly to the functional requirements of the substation, consisting of vertical cladding with muted colours, with engineering brick base course. The functional option is in keeping with the general substation typology and appears appropriate in the landscape context. Muted grey colours allow the substation buildings to recede against the backcloth views of woodland and sky. Vertical steel panel cladding allows for longevity and ease of maintenance. Functional substation buildings would be appropriate in the context of additional mitigation planting, which will effectively screen much of the buildings and electrical infrastructure over time. Simple, functional, crisply detailed substation buildings, forming a simple solution, appears to be most appropriate in the landscape context and was taken forward as the preferred substation design option (Figure 9), while also incorporating the dark grey colour precedent established in the local vernacular.

#### 3.2.3.1 Building Treatment

36. Although the basic overall form and size of the substation buildings is determined through its functional requirements, the precise roof shape, wall head and base details and articulation generally may be influenced by the chosen cladding materials. Design review of the overall form and cladding treatment was undertaken, in order to consider options to break down the form of the GIS/control building in a way that addresses its scale and presents the building as a more contemporary form.

37. Given the nature of the GIS/control building shape and scale, the most appropriate articulation of form in this case will be to visually split the building into two distinct elements: a lower element running the full length of the building, with an upper element housing the higher parts of the GIS building, as shown in Figure 9. This breaks the overall mass of the building down, creating a lower horizontal emphasis to 'ground' the building and offers opportunities to readily introduce more than one colour to further break down the form of the building.

38. In order to create the appearance of a flat roof, the wall-head heights of the GIS/control building will be marginally increased to a uniform level matching the highest point, just above the roof ridge. It is considered appropriate to hide the shallow pitched roof behind a horizontal upstand, to present a more contemporary form, as shown in Figure 9. The roof would still be to a shallow pitch behind wall-heads, but from all ground level vantage points will be invisible behind a uniform, horizontal wall parapet: a simple way of restricting the number of visible junction detail types, and an opportunity to present the building as a more crisp and contemporary form. This building form takes some cues from other local modern industrial designed buildings, such as the Great Blakenham Combined Heat and Power (CHP) plant (which utilises a flat roof to create a contemporary building form).

### 3.2.4 Colour Options

39. A colour comparison exercise was undertaken to inform the choice of colour for the substation buildings. A range of colours in the landscape were sampled and compared as potential colour options for the substation (Figure 6), using colours from the local landscape identified in the Kingspan sheet metal colour range. Indicative photomontage images of the substation were produced to compare each colour option in relation to the baseline conditions at the site and the prevailing summer, spring and winter colours in the landscape (Figure 6). The site layout, location and scale of these images are not representative of the final design solution, but were used for the purpose of colour comparison and choice.

40. The bolder/brighter colours tested were observed as being more expressive, tending to draw attention to the substation buildings and were not considered appropriate in this rural context. Comparison of the colour options illustrated in the visualisations confirmed that the substation should be 'quiet' in appearance, as far as possible, with the colour palette used to blend and integrate into the existing landscape context. Recessive mid to dark grey colours were selected as the most suitable to integrate the substation with the colour of the landscape across the seasons, particularly as the substation buildings will generally be seen in the context of, or is back-dropped by, large woodland blocks or sky. Mid to dark grey colours avoid strong contrast with the existing site conditions across the seasons and are appropriately 'conservative' with an appearance that is suitably recessive in colour. Mid to dark grey colours also appear most appropriate when seen alongside the existing electrical infrastructure and Bramford National Grid substation, which is dark grey in colour.

41. The articulation of this preferred mid to dark grey colour is considered further in relation to the materials for the cladding of the substation buildings in Section 3.2.5 and within the Architectural Report (EA1-CON-F-IBR-010113). The optimum colour solution for the substation is considered to be a dark grey / anthracite base element which will tend to recede visually rather than stand out, and a visually lighter/mid grey upper building element, which will tend to be least visible against sky.

### 3.2.5 Materials

42. Consideration of a range of substation cladding proposals and fundamental material options for the substation buildings has been undertaken, with key factors assessed including cost effectiveness, functionality, sustainability and aesthetics. The relative advantages and disadvantages of material options for the substation buildings are explored in full in the Architectural Report (EA1-CON-F-IBR-010113). Kingspan Trapezoidal steel cladding has been selected as the cladding material for the substation buildings, based on the form and articulation described above. Kingspan has been identified as also providing a system which can achieve the form and articulation of the substation buildings described above, while having a series of significant technical advantages in terms of being a large, lightweight and composite panel which provides safety benefits, short erection and installation programmes, reduced structural support requirements and minimises delivery vehicle movements.

43. The optimum Kingspan colour solution for the GIS/control building is considered to be a dark grey base element (e.g. Anthracite) which will tend to recede visually rather than stand out, and a visually lighter/mid grey upper building element (e.g. Merlin Grey), which will tend to be least visible against sky (Figure 9). The form of the GIS/control building will be visually split into two distinct elements, with the articulation of these colours on different parts of the building. A darker grey (e.g. Anthracite) lower element will run the full length of the GIS/control building, with a mid-grey (e.g. Merlin Grey) upper element housing the taller GIS building (Figure 9). This breaks the overall mass of the building down, creates a 'lower'

horizontal emphasis and offers opportunities to introduce more than one colour to the GIS/control building. Wall-head heights will have a uniform level to present the GIS/control building as a more crisp and contemporary form. Elevations, illustrative section drawings and photomontage visualisations showing the appearance of the substation are shown in Figures 9 and Figures 14 – 17.

### 3.3 Height and Key Parameters

44. The DCO Requirements 10 (3) to (5) sets the maximum dimensions with respect to the height and size of buildings, compound and other infrastructure within the substation. A plan showing the height and dimensions and the different elements of the substation is presented as Figure 3. Table 3-1 provides a summary of the height and dimensions of the substation and how they are in accordance with the key parameters stated within the DCO.

Table 3-1 Substation Dimensions

| DCO Requirement | Key Parameters | Substation Dimensions | |
|---|---|---|---|
| 10 (3) | No building comprised in Work No 39 shall exceed 75m AOD for the HVAC option | GIS Building<br>Control Building<br>STATCOM Building | 68m AOD<br>61m AOD<br>64m AOD |
| | No external equipment comprised in Work No 39 shall exceed 69m AOD for the HVAC option | Maximum height of outdoor electrical equipment | 68m AOD |
| 10 (4) | The total footprint of the buildings housing the converters comprised in Work No 39 must not exceed 130 metres in length and 85 metres in width | GIS & Control Building | 77.95m in length and 14.70m width |
| 10 (5) | The fenced compound (excluding its accesses) comprised in Work No 39 must not exceed 190 metres by 150 metres | Substation Compound | 190 metres by 150 metres |

45. The amendment from direct current (DC) technology to alternating current (AC) has resulted in a substantial reduction in the height of the substation buildings. This reduction in height notably reduces the potential visual effects of the substation and addresses potential for mitigation through its siting adjacent to large woodland blocks that provide visual screening.

46. The substation buildings have the following main features:

- GIS/control building with the overall length of the building (GIS/control building) being 77.95m, with the GIS hall being approx. 33.49m in length and the control building being approx. 44.46m.
- The GIS hall has a maximum height of 12m to the apex of the roof, with the control building being lower with a maximum height of 5m (Figure 3 and Appendix 2).
- The resulting appearance is of a relatively long substation building with a low elevation (Figure 4).
- Two Statcom buildings, being 22 m in length, with a maximum height of 8m.

47. The ground level for the substation compound has been lowered as far as practicable given the existing topographical elevations and construction required, in order to minimise the visual impacts of equipment and buildings and has been defined as 56 metres Above Ordnance Datum (m AOD).

## 3.4 Landscaping

### 3.4.1 Landscape Approach

48. Several landscape design approaches have been considered for the substation, building upon on the mitigation concept proposed in the Environmental Statement (Figure 2) and the Design Principles Statement. The landscape design focuses on the area immediately around the substation, where new planting and changes to the landform around the site have potential to assist with the integration of the substation into the landscape. A separate Landscape Management Plan (EA1-CON-F-GBE-008554) describes the landscape proposals and the general maintenance requirements for the landscape proposals for the substation to fulfil DCO Requirements 12 (1). The landscape design proposals are also described as follows since they will influence the appearance of the substation.

49. Implementation of the landscape scheme offers the opportunity to consider the landscape and visual impact of the EA ONE substation in addition with substations required for future phases of the East Anglia Offshore Wind Farm (proposed East Anglia THREE (EA THREE) and potential 'East Anglia Future Project (EAF)) which are herein collectively referred to as the 'East Anglia Bramford Connection Developments'. A Landscape Masterplan for the East Anglia Bramford Connection Developments has been produced to illustrate the general principles and coordinated phased development of the East Anglia Bramford Connection Developments, this is an independent documents provided under separate cover. The landscape masterplan has been used to guide and inform the landscape mitigation proposals for EA ONE substation.

50. Three potential landscape design options for the substation were identified - 'hidden', 'integrated' and 'exposed'. These options are described as follows and illustrated in Figure 10:

- **The 'hidden approach'** - focuses on reducing the impact of the substation on the existing space. The hidden approach has extensive landscape screening to hide the substation, which limits the recognisability of the function of the substation while pylons and power lines remain visible, and has a lower change on the rural character. However, the scale of the substation is often hard to completely hide, and power lines and pylons approaching the substation often remain clearly visible. The hidden approach can be achieved with vegetation/woodland planting all around the substation, or on the side of the main observers.
- **The 'integrated approach'** - focuses on reducing the impact of the substation on the existing space, without completely hiding the substation. The strength of this approach is to use the existing landscape structure to embed the substation, and still show the function of the substation as part of the electricity grid. The integrated approach has some landscape screening, but expands existing electrical characteristics, enabling the observer to understand the function of the substation, with a more moderate change to the rural character. The integrated approach can be achieved using woodland clumps/shelterbelts and/or hedgerows.
- **The 'exposed approach'** - focuses less on the spatial impact and more on the recognisability of the function. The functional relationship between substation and grid clearly shows the nature of the electricity grid. The exposed approach has limited/no landscape screening, with high recognisability of the function of the substation, but also a high change to the rural character. The 'exposed approach' concentrates on emphasizing the substation e.g. through new architectural elements/installations, combined with specifically coloured elements of the substation, or emphasis through planting and management of vegetation in a specific form.

### 3.4.2 Landscape Mitigation

#### 3.4.2.1 Summary

51. The landscape design approach selected for the substation combines the approaches of hiding and integrating the substation into the landscape (Figure 10) to meet the agreed mitigation requirements and also as a response to the local landscape character. This approach results in the substation having a relatively low landscape and visual impact (as opposed to an approach where the substation is even more emphasised). Specifically placed woodland blocks/shelterbelts and hedgerows are to hide and integrate the substation, reducing the visual impact in specific views towards the substation experienced by people from residential areas, roads and public rights of way, while allowing the function of the substation to be recognised when in closer proximity.

52. This approach acknowledges the key requirement for visual screening of the substation, which has been a clear preference expressed during public and stakeholder consultations. Due to technical constraints, it would be unrealistic to completely

screen the entirety of the substation, therefore some element of integration is required and is considered suitable to allow some recognisability of the function of the substation, when viewed in the context of the existing National Grid infrastructure nearby.

53. The landscape plan proposes both screening earthworks and woodland planting to address the main aim of providing visual screening of the substation. New hedgerows are also to be planted to supplement the woodland framework around the substation. The landscape plan also provides areas of species rich grassland and SuDS ponds, providing enhanced habitat benefits in their own right, while also providing further visual contrast with the 'technological' appearance of the substation. Arable farming fields that are retained for agricultural use will contribute to retaining the rural character in the area around the substation.

54. The landscape plan seeks to ensure early establishment of tree and hedgerow planting, in order to deliver mitigation as early as possible for the substation.

55. The Landscape General Arrangement drawings (Figures 11 - 13) show the landscape scheme for the substation. The landscape scheme includes the following key elements, which combine to hide and integrate the substation in the landscape:

- Hedgerows and woodland blocks to provide visual screening which relate to local landscape context.
- In order to integrate the new woodland blocks within the landscape, mixed native species will be used, with some areas defined to be 'core' or 'edge' woodland areas.
- Some areas of woodland will be planted with faster growing native and non-native woodland species (for quicker visual screening and to act as a "nursery" crop).
- The size and location of woodland blocks respond to technical constraints.
- New hedgerows will be planted to supplement the woodland framework around the substation.
- Earthworks bunding around the western and southern perimeter of the substation will have natural looking, gentle slopes where possible (1:5 to 1:20) when looking towards substation.
- Earthworks bund to the west of the substation will be planted with trees to provide additional screening.
- A concrete access road into the substation will be constructed and designed to meet the structural bearing capacity for the intended equipment.
- The access road is framed by hedges and woodland blocks to create visual separation from the existing bridleway and the access road into the National Grid substation.
- Species rich grassland areas will be established to provide a low maintenance ground cover which also enhances the local biodiversity in areas that are not to be returned to agricultural use or planted as woodland.
- Existing agricultural land use will be retained in other areas with arable fields, such as to the east between Bullenhall Farm and the Bramford NG substation.
- A SuDS attenuation basin with permanent pond and associated open swales where technical and visual mitigation constraints allow.
- Amenity grasses will be used immediately next to the access road and perimeter foot track around the substation.
- Additional ecological mitigation where deemed appropriate and necessary.

56. Further description of the details of the layout and external appearance of the substation landscape proposals are provided in the following sections as relevant to the earthworks, woodland planting, hedgerows and other habitats.

#### 3.4.2.2 Earthworks

57. The earthworks general arrangement drawing (Figure 13) shows the earthworks for the substation. The ground level for the substation compound has been lowered as far as practicable, to 56 m AOD, given the existing topographical elevations and construction required in order to minimise the visual impacts. The earthworks bunding rises from the perimeter of the substation compound to approximately 60m AOD on the western edge of the substation compound and 58m on the southern edge, allowing the substation compound to sit at the lowest possible elevation and reduce the perceived height and visibility of the electrical infrastructure and substation buildings in views. The section drawings in Figures 14 and 15 (particularly Section B extracts) illustrate how the slab level of the substation compound will be lowered relative to the surrounding landscape, with the earthworks bund rising from the perimeter of the substation to a boundary hedgerow and woodland planting on the upper part of the bund, before the contours blend gradually into the landform of the surrounding fields. The earthworks proposals, combined with the planting of a hedgerow and woodland at the top of the bund, as illustrated in the soft landscape plan (Figure 11), provide screening and mitigation of the visual effects of the substation.

#### 3.4.2.3 Woodland Planting

58. The soft landscape general arrangement drawing (Figure 11) shows the woodland planting for the substation. Woodland blocks will provide further visual screening, relate to local landscape context and extend the existing woodland 'groves' which are prevalent at the adjacent Fore Grove and Bushey Grove to the north of the site. The size and location of woodland blocks responds to key visual receptors/views and technical constraints, such as high-voltage overhead power lines. The woodland planting broadly uses a varied woodland species mix to create areas of locally characteristic lowland mixed deciduous woodland. The following planting is to be implemented, as summarised below and set out in full in the Landscape Management Plan (EA1-CON-F-GBE-008554):

- WM1 – Core Woodland mix, containing a diverse mix of native species, typical to the area that is intended to provide long-term screening as well as providing habitat and biodiversity. These are generally slower growing, taller species.
- WM2 – Woodland Edge mix, containing a diverse mix of species generally used around the edges of the woodland; it is intended to provide habitat variety and diversity but also is used where taller growing species would be inappropriate to plant (for example, adjacent to overhead powerlines).
- WM3 – Screening Woodland mix, using native and a limited number of non-native species. These are generally faster growing species and the intention is for this mix to provide earlier visual screening and also to act as a "nursery crop" for the WM1 and WM2 woodland species. It is anticipated that these trees will be heavily thinned out or removed in the medium to long term.
- WM4 – this is a wet woodland tree mix for the SuDs basin tree planting area.

59. The intention is to create a resilient soft landscape by increasing the species numbers used within woodland plant mixes. Therefore, where possible, the specification will include a variety of woodland to achieve, hopefully, a strong ecological resilience for the long term future of the woodlands. Details of the species mix are presented in the Landscape Management Plan (EA1-CON-F-GBE-008554).

60. Substantial areas of woodland will be planted to the immediate west of the substation (Area A) and south-west of the substation (Areas B and C), either side of the high-voltage overhead power line (allowing for a 20m offset from the overhead line). These areas of woodland will provide visual screening of the substation in views from the Burstall / Burstallhill area to the west and south-west, the public right of way to the west and provide a landscape setting to the SuDs basin.

61. Woodland planting will extend the existing Fore Grove and Bushey Grove woodlands to the immediate north of the substation, in order to reinforce (Area D) and extend (Area E) the visual screening provided by these existing woodlands in views from the north, such as Tye Lane and settlements beyond at Somersham and Little Blakenham.

62. Areas of woodland will also be located to the east of the substation, extending Gobert's Grove woodland (Area F)in the area between the existing high-voltage overhead power lines and the Bramford National Grid substation. Woodland planting will be located near the access road junction to Bullen Lane (Areas G and H), to extend woodland that is locally characteristic along Bullen Lane and provide a setting to the access road and its SuDs basin. These areas of woodland will provide visual screening of the substation in views from the east, such as the public right of way, Bullen Lane and Bramford.

63. Further smaller areas of woodland planting will supplement the areas of National Grid mitigation planting to the south-east of the substation (along the northern side of the NG substation) and provide visual separation between the access track to the substation and the existing access track along the northern edge of the NG substation.

64. Woodland planting will complement the existing mature planting which provides screening to the north-west, west and north-east of the substation. Planting will be established early in the construction of the substation, where possible, to allow trees and planting additional growth time and allow mitigation to occur at the earliest opportunity. Newly planted woodlands would not be sufficiently tall to screen the initial construction phase, but then would increasingly screen the substation during the operational phase.

65. As a result of the woodland planting, there will be an apparent increase in woodland cover in the landscape around the substation and an extension of the characteristic woodland groves of this landscape. The substation will increase the electrical infrastructure elements in the landscape, in close proximity to existing NG substation, but as a result of the woodland planting and existing woodland cover, which largely encloses the substation, the operational and visual changes

will be relatively small and localised. The woodland planting will minimise visual impacts and respond to local landscape character and biodiversity.

#### 3.4.2.4 Hedgerow Planting

66. The soft landscape general arrangement drawing (Figure 11) shows the hedgerow planting for the substation. Hedgerows will consist of mixed native species hedge (including hedges of hawthorn, elm with oak, ash and field maple as hedgerow trees), which will combine with the woodland planting areas to integrate the substation into the landscape, both in terms of providing screening of the infrastructure and as an extension of an element that is characteristic in the local landscape. The top of the earthwork bund around the perimeter of the substation will be planted with a hedgerow, in order to screen the substation and soften the perimeter fence and the species mix will include typical 'defensive' planting species such as Holly, Hawthorn and Blackthorn. Further hedgerow planting will be undertaken around the field edges to the south of the site and along either side of the access track, in order to integrate the access road into the rural landscape.

#### 3.4.2.5 Other Habitats

67. Areas of species rich grassland are to be established (G3 in Figure 11) to the south, south-west and east of the substation, to provide a low maintenance ground cover which also enhances the biodiversity in areas that are not to be returned to agricultural use or planted as woodland; and also provide further visual contrast with the 'technological' appearance of the substation. Amenity grasses will be used immediately next to the perimeter foot track and along access track verges, with a general purpose amenity grass mix.

68. Existing agricultural land use will be retained in the remaining areas to the east within the DCO boundary, between Bullenhall Farm and the Bramford NG substation, as shown in Figure 11, and managed in accordance with local farming practices. Arable farming fields that are retained for agricultural use will contribute to retaining the rural character.

#### 3.4.2.6 Hard Landscape

69. The hard landscape general arrangement drawing (Figure 12) shows the hard landscape materials within the substation and access road.

70. Concrete access roads will be constructed to provide access into and within the substation. A concrete external access road will lead into the substation. The access road will run parallel to Bullen Lane and the bridleway to the north of the Bramford NG substation in an east-west direction. The junction with the new access road and Bullen Lane will be located just west of the private track to Bullenhall Farm. This will be a 5m access road with two lay-by/waiting areas suitably sized to accommodate the large vehicles used for the construction and maintenance of the substation. A concrete internal access and service road and car parking area will be constructed within the substation. This is a 5m wide circulation road designed to meet the load bearing capacity of the vehicles delivering the electrical components. The appearance of the access road will be further integrated into the landscape by hedgerow planting on either side.

71. The majority of the ground within the substation compound will consist of permeable gravel groundcover, where possible consisting of a local aggregate. A grass-road maintenance track to allow access to the main SuDS attenuation basins is to be constructed using a plastic cellular grass-reinforced road system. A self-binding gravel footpath will follow the perimeter of the substation compound, consisting of natural gravel.

72. A perimeter fence around the substation compound will consist of a 2.4m high perimeter mesh security fence (Hi SEC Super 6 or similar solution). Deer proof protection fencing (with rabbit proof mesh) will be provided around areas of new woodland planting.

### 3.5 Embedded ecology mitigation and enhancement

73. In accordance with the fifth principle this section provides details of how the substation has been designed to provide ecological mitigation and enhancement.

### 3.5.1 Ecological Enhancement Measures

74. As part of habitat enhancement works associated with the substation, five log piles (refugia) and three hibernacula would be constructed around the substation to provide shelter for reptiles and great crested newt. It is anticipated these would be located to the north of the substation within Fore Grove due to the woodlands' connectivity with existing pond features (subject to landowner agreement), and also within enhanced grassland habitat areas to the south.

75. As part of further ecological enhancements, a Barn Owl box will be erected in the vicinity of the substation, the location of which is to be agreed with Natural England and Suffolk County Ecologist.

76. Bat species are sensitive to artificial light and this has been considered within the substation lighting design for operation to ensure that the impact to bats from artificial light is reduced. The lighting has been developed in accordance with the best practice guidance from the Bat Conservation Trust (BCT); 'Artificial lighting and wildlife, Interim Guidance: Recommendations to help minimise the impact artificial lighting' June 2014 and Bats and Lighting in the UK, Bats and the Built Environment Series, v3 May 2009. Further details on the lighting are presented in Section 3.5.2.

77. The surface water from the substation will be discharged to a 'wet woodland' area to the west of the substation platform via a network of sub-surface drainage pipes and swales. The drainage aspects of this woodland is discussed further in section 3.6 In an ecological context, wet woodlands typically comprise willow, alder and birch tree species due to their ability to thrive in areas with poor drainage or higher water tables. Wet woodlands provide an ideal habitat for a variety of species. They can support a diverse ground flora (including ferns, greater tussoch sedge and other common marsh species) in addition to a rich lichen flora. A wide range of invertebrates are attracted to this type of habitat including a large number of beetle and moth species. The invertebrate population would also attract breeding birds and bats to the area for feeding opportunities. Wet woodlands also provide shelter and potential breeding areas for mammals including otter and dormouse.

78. In order to further develop ecological enhancement in the area around the substation, it is proposed to introduce a number of bird and bat boxes to the planted areas on site as well as install both insect boxes and hedgehog hibernation boxes.

### 3.5.2 Lighting

79. The external lighting of the substation during the operational phase will be only required for the following purposes:

- access and egress;
- security lighting;
- car park lighting; and
- repair/maintenance.

80. At night substation lighting levels will be switched off as the substation will be unmanned. Lights will only be used during periods where work is to be carried out, (i.e. maintenance) and lights will be positioned to suit the work. For emergency works, or work requiring perception of the detail, portable luminaires to suit the work will be used. Luminaires selected will ensure reduction in spill light and glare and sky glow.

81. No additional lighting is proposed along Bullen Road or along the additional access roads within the substation compound.

82. Exterior lighting shall allow safe access and emergency egress for personnel (including from buildings) and safe operation of equipment, subject to the following minimum requirements:

- Maintained average illuminance 6 lux.
- Minimum maintained point illuminance 2.5 lux.

83. The lighting shall allow safe access and emergency egress for personnel (including from buildings) and safe operation of equipment, and manual control will be done with internal switch inside the buildings.

84. Luminaires selected will ensure reduction in spill light and glare and sky glow. Luminaires shall be Light Emitting Diode (LED) type with directable light output to minimise light pollution.

85. Exterior lighting to buildings will incorporate LED luminaires at the perimeters, and the ones located at the access doors will be connected to Passive Infra Red (PIR) detectors. An internal wall override switch shall be fitted adjacent to the entrance door to enable constant operation.

86. A summary of the number, height and type of luminaries that will be installed at the onshore substation is described below:

- 38 Floodlights 90W LED with floodlighting peak 45º from vertical
  - 34 Floodlighting located in 15 columns of 6m high
  - 4 wall mounted floodlights; 2 in the GIS room (6/7m high) and 2 in the control room (4.5m high)
- 99 wall mounted lights (COOPER 2 x 13W LED GLR-2L-CWPC) and emergency lights (EBGLR-2L-CWPC)

87. Further details on the lighting scheme will be provided in the External Lighting Control Plan (EA1-CON-F-GBE-008556) produced to discharge DCO Requirement 21 (3) provided under separate cover.

### 3.5.3 Areas of glass

88. To eliminate any potential ecological impacts the substation buildings have been designed with no areas of glass. The buildings (GIS, Control and STATCOM) will be structural steelwork, with concrete floors and roof and walls with profiled steel panels, all of them without exterior windows.

### 3.5.4 Noise Mitigation

89. The following noise mitigation measures will be in place at the substation and are based on the use of noise enclosures to attenuate the noise from the main noise sources and using low noise design for the equipment shall comply with to reduce the impact on any potential sensitive receptors:

- Transformers and shunt reactors contained within full noise enclosures, which comprise solid enclosures, usually of composite metal or masonry, around the transformer, avoiding the cooling systems and high voltage lines.
- All the components of the STATCOM (Static synchronous Compensator) located indoor, low noise designs requested to suppliers for outside equipment.
- All the components of the harmonic filters, low noise designs requested to suppliers.
- Other components or equipment will be located inside the main buildings:
  - GIS (Gas Insulated Switchgear).
  - Control, protection and telecoms.

## 3.6 Sustainable Drainage Strategy

### 3.6.1 Surface Water Strategy

90. The surface water from the substation will be discharged to a ‘wet woodland’ area to the south-west of the substation platform via a network of sub-surface drainage pipes. The side slopes of the ‘wet woodland’ will be shallow gradients which will provide a soft and natural appearance and provide a habitat for bird life. The ‘wet woodland’ will feature a permanently retained pool of water however storm run-off will also be retained for a period of time and released at a low rate to satisfy the long term storage requirements stipulated by the SuDS manual. This area can be landscaped by planting suitable tree and plant species which can tolerate the occasional inundation.

91. The surface water run-off from the internal access roads and platform will be drained via a free draining sub base within the substation to a system of filter trenches and drains. The western section of the main access road will be drained with surface water shedding toward the southern road verge with over edge flow into a piped filter drain. These will in turn be discharged to the ‘wet woodland’. The eastern section of the main access road will be constructed to channel run-off into a separate detention basin adjacent to the access road to the east.

### 3.6.1 Waste Water Strategy

92. Due to the unmanned nature of the substation buildings, it is anticipated that the welfare facilities will only be in use on an intermittent basis. The foul drainage shall therefore be conveyed to a sealed on-site storage tank for removal and treatment offsite.

93. Oil containing equipment and electro-mechanical plant shall be contained within a reinforced concrete bund. Run –off from the equipment bunds which has the potential to be contaminated by oil will be conveyed to an on-site class 1 full retention oil interceptor. The outfall from the oil interceptor will be discharged via a network of sub-surface drainage pipes to the wet woodland area for further treatment.

### 3.6.2 Sustainable Principles

94. The sixth principle of the Design Principles Statement is clear that the design of the substation incorporate a Sustainable Urban Drainage System (SuDS).

95. There are four key principles of SuDS that have been implemented in the planning and design for the drainage system of substation, these are:

- attenuation;
- infiltration;
- conveying; and
- filtering out of pollutants.

96. A brief description of each is provided below.

#### 3.6.2.1 Attenuation

97. Attenuation storage aims to control the run-off volume by limiting the peak rate of run-off from the substation into the receiving watercourse or drainage system. This is typically achieved through the use of a storage facility with restricted outlet. The twin pipe filter trenches, detention basin and wet woodland in this case will detain the run-off for a given return period, but will gradually allow the water to discharge to the receiving watercourse over an extended duration, to reduce the peak flow rate of the run-off to the equivalent greenfield run-off rate. Sufficient storage will be provided to also ensure that only the greenfield runoff volume is allowed to discharge at greenfield rates. These attenuation measures minimise the risk of increased flooding downstream in the receiving watercourse.

#### 3.6.2.2 Infiltration

98. Infiltration is the means of allowing water to soak into the ground through the natural hydrological process. This is normally the most desirable solution for rainfall and other precipitation as it does not create any additional run-off and allows recharge of the underlying groundwater profile. However in this case a ground investigation undertaken in early 2016, which included infiltration testing, has confirmed that the ground conditions comprise a stiff to very stiff glacial till of low permeability, which prevents disposal of surface water to the ground through soakaways or other engineered infiltration systems.

99. The substation platform has however been designed to be free-draining and impermeable areas limited as far as practical. Water percolating through the platform construction, although unable to permeate into the natural formation below, will be collected by a series of permeable pipe networks located below formation level and conducted by the surface water drainage system towards the end of line wet woodland SuDS facility. Thus the surface water will receive a first stage of attenuation and treatment by passage through the granular platform construction and a second stage of treatment and attenuation within the wet woodland facility.

#### 3.6.2.3 Conveying

100. Conveyance is the process of transferring surface run-off from one place to another to manage the flow and to link the various SuDS components together. Rainfall collected in impermeable areas such as the access roads, transformer bunds or on the GIS building roof will be carried via underground pipes within the drainage system to the various elements of the SuDS to allow treatment and attenuation to take place.

#### 3.6.2.4 Pollutant Removal

101. Pollutants within the substation will be removed or treated prior to discharge to ensure there is no wider adverse environmental impact.

102. During normal operation of the substation there will be insufficient foul water discharge from the on-site welfare facilities to sustain the biological treatment processes within normal waste water treatment plant such as septic tanks or Biodiscs. The

foul water from welfare facilities within the buildings will therefore be collected and conveyed to a sealed cess tank located within the platform. The cess tank will be situated adjacent to the access road and outside the secure compound for ease of periodic emptying and disposal of contents to a suitable off-site waste water treatment and disposal facility.

103. Surface water runoff collected from within the transformer bunds or other oil-filled plant has the potential to be contaminated with oil. Water from these areas will be discharged to the surface water drainage system via a Class 1 full retention oil interceptor with automatic closure devices which will shut off in the case of a sudden influx. The water will subsequently pass through a twin pipe filter trench providing an additional stage of treatment and attenuation, before being conducted through the platform surface water drainage system to the end of pipe wet woodland SuDS facility for further treatment and attenuation.

104. The following table shows the design solution for the different elements involved:

Table 3-2 Drainage for different elements of substation

| Sources of pollution | Level of treatment required | Treatment proposal |
|---|---|---|
| Roof runoff | Limited pollution, attenuation only | Attenuation and dispersal via wet woodland‘ area |
| Transformer Bund | Oily water treatment with no infiltration | Oily treatment via class 1 full retention oil interceptor. Attenuation and dispersal via wet woodland area. |
| Shunt Reactor | Oily water treatment with no infiltration | Oily treatment via class 1 full retention oil interceptor. Attenuation and dispersal via wet woodland area |
| Car park runoff | Light vehicular traffic only, low frequency of movement. Slight risk of vehicular spills. Oily water treatment with no infiltration | Oily treatment via class 1 full retention oil interceptor. Attenuation and dispersal via wet woodland area. |
| Welfare services at building | Foul water treatment. | On site storage and off-site treatment |
| Internal road runoff | Limited pollution, attenuation only | Filter trenches and attenuation via main detention basin |

### 3.7 Design Review

105. The eighth principle of the Design Principles Statement is clear that the design of the substation should be the subject of a review, in consultation with the relevant local authorities. This could have included the Design Council or Shape East. If appropriate the outcome of this review process should form part of the procurement process.

106. It was agreed that a review of the substation design should be the subject of a review by the Design Council. The Design Council were contacted and agreed to undertake a review. Terms of Reference for the Design Council review were agreed between MSDC, BDC, SCC and EAOL. A Memorandum of Understanding of the process was also agreed between MSDC, BDC, SCC and EAOL.

107. An initial meeting with the Design Council, attended by representatives of MSDC, BDC and SCC, took place on 7th July 2015. At this meeting the background to the application and the substation was presented and the process of the Design Council review was explained. Information was provided, by way of a standard form, to the Design Council on the history of the project and the principles of the substation design on 28th September 2015.

108. A presentation to the Design Council was prepared in discussion with SCDC, BDC and SCC. This presentation comprised a power point presentation and a number of boards. A site visit itinerary, including view point locations, was discussed and agreed between MSDC.

109. The Design Council visited the site in the morning of 21st October 2015. They then listed to the presentation before providing feedback. Formal feedback from the Design Council was provided on 4th November 2015. The feedback provided by the Design Council has been considered by EAOL and EAOL have responded to the points raised in the Design Council document to MSDC, BDC and SCC. Where appropriate the recommendations of the Design Council have been progressed as part of the design for the substation.

110. The Design Council's recommendation to engage an architect in the substation design has been undertaken and is reflected in the design solutions described in this substation design document and the Architectural Report (EA1-CON-F-IBR-010113). Consultations with MSDC and SCC on the architectural aspects of the substation design, has confirmed that the rationale for the design solution is comprehensively explained and it was agreed that the use of uniform wall-head heights achieved the crisp detailing advocated by the Design Council and the colour and form of the substation building achieved an appropriate level of visual integration into the surrounding landscape.

# Appendix 1 Electrical and Safety Clearance Details

# Electrical and Safety Clearance Details

Plant and equipment shall satisfy their specified functional and performance requirements and shall also operate safely and without any degradation in performance for the appropriate range of primary voltages given in tables below.

## System Voltages

| ***Nominal System Voltage*** | 400 kV | 220 kV | 34,5 kV |
|---|---|---|---|
| Rated Voltage of Primary Equipment | 420 kV | 245 kV | 36 kV |

## Substation Electrical Clearances

| ***Nominal System Voltage (kV)*** | ***BIL,SIL kVp*** | ***Basic Electrical Clearance (Phase to Earth) (m)*** | ***Phase to Phase Clearance (m)*** |
|---|---|---|---|
| 34,5 | 170 | 0.5 | 0.5 |
| 220 | 1050 | 2.1 | 2.4 |
| 400 | 1425/1050-1575 | 2.8 | 3.6 |

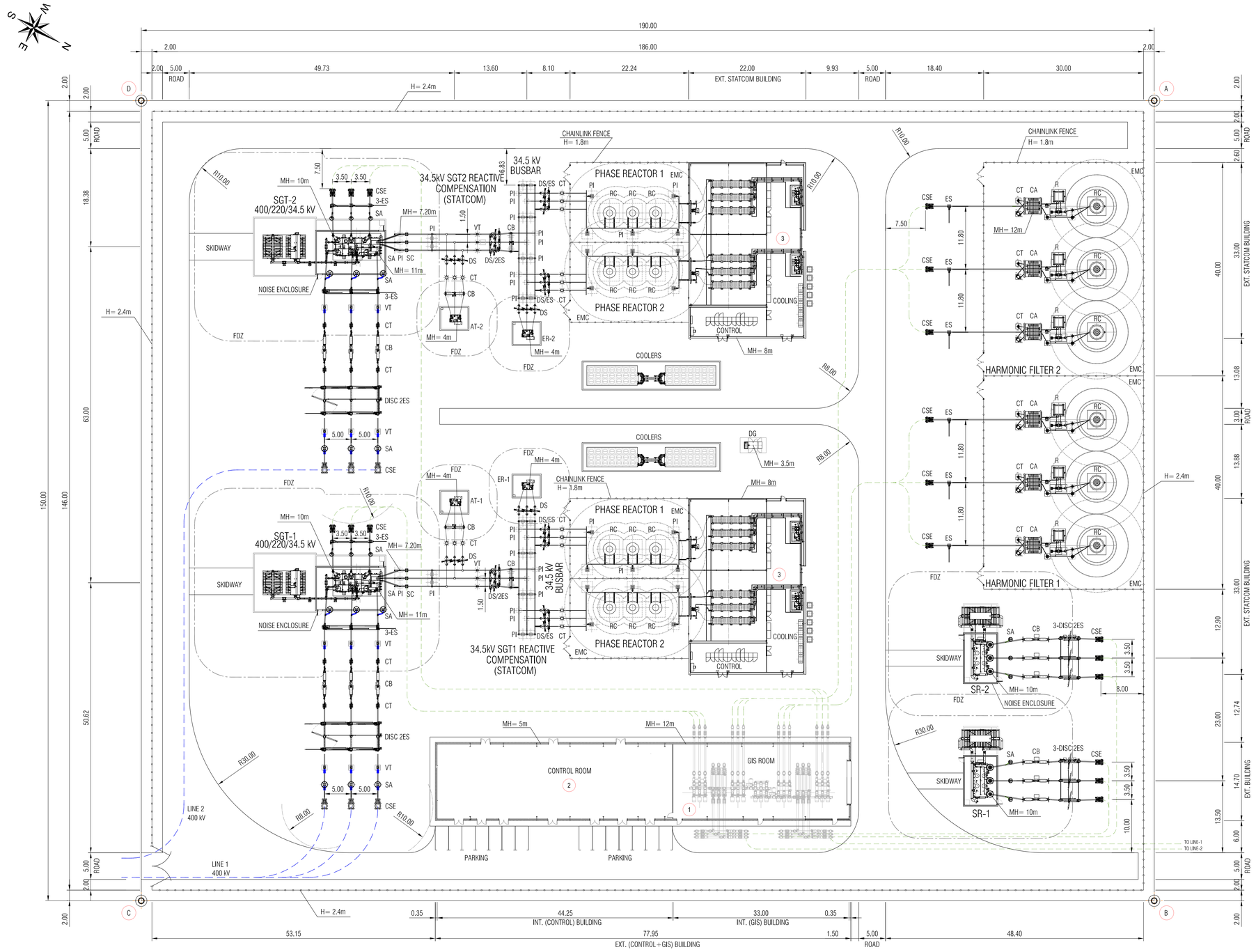
## Substation Safety Clearances

| ***Nominal System Voltage (kV)*** | ***Safety Distance (m)*** | ***Design Clearance for Safety (vertical) $D_S$ (m)*** | ***Insulation Height (pedestrian access) (m)*** |
|---|---|---|---|
| 34,5 | 0.8 | 3.2 | 2.4 |
| 220 | 2.4 | 4.8 | 2.4 |
| 400 | 3.1 | 5.5 | 2.4 |

## Clearance to Roadways

| ***Nominal System Voltage (kV)*** | ***Minimum Clearance to Roadways (m)*** |
|---|---|
| 34,5 | 5.6 |
| 220 | 7.2 |
| 400 | 7.9 |

# Appendix 2 Electrical Layout and Elevations




| 400KV SYSTEM | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| SGT | SUPER GRID TRANSFORMER 400/220/34.5 kV | 11 / 10 | 67 / 66 |
| CSE | CABLE SEALING END | 10 | 66 |
| SA | SURGE ARRESTER | 8.50 / 10 | 64.50 / 66 |
| CT | CURRENT TRANSFORMER | 6.50 | 62.50 |
| DISC 2ES | DISCONNECTOR WITH 2 EARTHING SWITCHES | 7.35 | 63.35 |
| VT | VOLTAGE TRANSFORMER | 6.50 | 62.50 |
| 3-ES | 3 POLES EARTH SWITCHES | 11 | 67 |
| CB | CIRCUIT BREAKER | 7.20 | 63.20 |

| 220KV SYSTEM | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| GIS | GAS-INSULATED SWITCHGEAR (GIS) | 9 | 65 |
| SR | SHUNT REACTOR | 10 | 66 |
| CSE | CABLE SEALING END | 7 | 63 |
| 3-ES | 3 POLES EARTH SWITCHES | 8 | 64 |
| 3-DISC 2ES | 3 POLES DISCONNECTOR WITH 2 EARTHING SWITCHES | 10 | 66 |
| SA | SURGE ARRESTER | 7.50 | 63.50 |
| CB | CIRCUIT BREAKER | 6 | 62 |

| HARMONIC FILTER SYSTEM | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| CA | CAPACITOR | 12 | 68 |
| RC | REACTOR | 6 | 62 |
| R | RESISTOR | 5 | 61 |
| CT | CURRENT TRANSFORMER | 6 | 62 |
| ES | POLE EARTH SWITCH | 7 | 63 |
| CSE | CABLE SEALING END | 7 | 63 |

| 34.5 kV REACTIVE COMPENSATION (STATCOM) | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| CB | CIRCUIT BREAKER | 5.60 | 61.60 |
| DS | DISCONNECTOR WITHOUT EARTHING SWITCH | 3.70 | 59.70 |
| DS/ES | DISCONNECTOR WITH EARTHING SWITCH | 4.30 | 60.30 |
| DS/2ES | DISCONNECTOR WITH TWO EARTHING SWITCHES | 5.10 | 61.10 |
| CT | CURRENT TRANSFORMER | 4.20 | 60.20 |
| VT | VOLTAGE TRANSFORMER | 5.50 | 61.50 |
| SA | SURGE ARRESTER | 5.10 | 61.10 |
| SC | SURGE CAPACITOR | 5.50 | 61.50 |
| PI | POST INSULATOR | 7.20 / 6.30 / 5.10 | 63.20 / 62.30 / 61.10 |
| RC | REACTOR | 4.70 | 60.70 |
| AT | AUXILIARY TRANSFORMER | 4 | 60 |
| ER | EARTHING REACTOR | 4 | 60 |

| AUXILIARY EQUIPMENT SCHEDULE | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| DG | DIESEL GENERATOR | 3.50 | 59.50 |

| BUILDINGS | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| 1 | GIS SYSTEM BUILDING | 12 | 68 |
| 2 | CONTROL BUILDING | 5 | 61 |
| 3 | STATCOM BUILDING | 8 | 64 |

| COORDINATES | | |
|---|---|---|
| | X | Y |
| A | 609,462.9487 | 246,181.2672 |
| B | 609,593.6073 | 246,254.9445 |
| C | 609,687.0325 | 246,089.4728 |
| D | 609,556.3739 | 246,015.7955 |

ASSOCIATED DRAWING:

ELECTRICAL PRELIMINARY LAYOUT ELEVATIONS - EAST ANGLIA (ONSHORE) SHEET 2

| *NOMINAL SYSTEM VOLTAGE* | 400kV | 220kV | 34.5kV |
|---|---|---|---|
| RATED VOLTAGE (kV) | 420 | 245 | 52 |
| RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE (kV) | 1425 | 1050 | 250 |
| MINIMUM PHASE-TO-EARTH CLEARANCE (m) - **E** | 2.80 | 2.10 | 0.50 |
| MINIMUM PHASE-TO-PHASE CLEARANCE (m) - **PH** | 3.60 | 2.40 | 0.50 |
| ELECTRICAL SAFETY DISTANCE (m) - **SD** | 3.10 | 2.40 | 0.80 |
| DESIGN CLEARANCE FOR SAFETY-VERTICAL (m) - **DS** | 5.50 | 4.80 | 3.20 |
| DESIGN CLEARANCE FOR SAFETY-HORIZONTAL (m) - **DSh** | 4.60 | 3.90 | 2.30 |
| MINIMUM INSULATION HEIGHT-PEDESTRIAN ACCESS (m) | 2.40 | 2.40 | 2.40 |
| MINIMUM CLEARANCE TO ROADWAYS (m) | 7.90 | 7.20 | 5.60 |

NOTES:

1.- ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2.- THE OVERALL SITE LAYOUT, ITS ASSOCIATED SWITCHGEAR AND SIZES ARE INDICATIVE AND MAY VARY DURING DETAILED DESIGN STAGE.
3.- THE GATE TO THE FILTER AND STATCOM COMPOUND IS INTERLOCKED WITH THE EARTHSWITCH OF THE CORRESPONDING FILTER.
4.- THE WHOLE SUBSTATION SHALL HAVE A COMMON COMPOUND FINISH LEVEL (CFL= +56.00 m).

LEGEND:

- 400 kV CABLE
- 220 kV CABLE
- FENCE (H= 2.4m, 1.8m)
- FIRE DAMAGE ZONE (FDZ)
- ELECTROMAGNETIC CONTOUR (EMC)

| REV. | DATE | Drawn | Prep. | Checked | Approv. | REASON, STATUS OF REVISION |
|---|---|---|---|---|---|---|
| 6 | 24-06-2016 | MZA | FAA | FAA | MVFL | BOUNDARY ROOF PARAPET IN THE GIS BUILDING |
| 5 | 16-06-2016 | MZA | FAA | FAA | MVFL | UPDATE ACCORDING TO:EA1-GRD-MEC-007885 REV 0 ONSS CONSIDERATIONS FOR LPA LAYOUT. |
| 4 | 24-05-2016 | AFSE | FAA | FAA | MVFL/MOVIEDO | ASSESSMENT OF FIRST ROUND OF SYSTEM STUDIES |
| 3 | 18-01-2016 | AFSE | FAA | FAA | MVFL/MOVIEDO | UPDATED (X,Y) COORDINATES ACCORDING TO EA1-GRD-DGI-EC-007563 RevOE (EA1 SUBSTATION FOOTPRINT) |
| 2 | 18-12-2015 | AFSE | FAA | FAA | MVFL/MOVIEDO | ADDED 400kV CV AND CT |
| 1 | 10-12-2015 | AFSE | FAA/LSLA | FAA/LSLA | MVFL/MOVIEDO | 220kV CABLES AFFECTED AREA |
| 0 | 09-09-2015 | AFSE | FAA/LSLA | FAA/LSLA | MVFL/MOVIEDO | FIRST ISSUE |

Client : SCOTTISHPOWER RENEWABLES

Client drawing nº :

Other ref. of client :

General Contractor / Engineering : IBERDROLA Ingeniería y Construcción

QUALITY LIST: YES ☐ NO ☒
DESIGN VERIFICATIONS: LEVEL 1 ☐ LEVEL 2 ☐ NOT APPL. ☒

Approval / Release for Construction : According stamps on drawing

Author :

Project : OSS EAST ANGLIA ONE

Classification : GENERAL INFORMATION

Titles : GRID TRANSMISSION SYSTEM ONSHORE SUBSTATION 400/220/34.5 kV ELECTRICAL PRELIMINARY LAYOUT PLAN

Type of Document : PROJECT

Sheet: 01 Next Sh: 02

First Issue : 09-09-15 INITIAL ISSUE

| Sign: | Drawn | Prep. | Check. | App. |
|---|---|---|---|---|
| Acron: | AFSE | FAA | FAA/LSLA | MVFL/NOVIEDO |

Draw. nº : EA1-ELE-D-IEC-000900

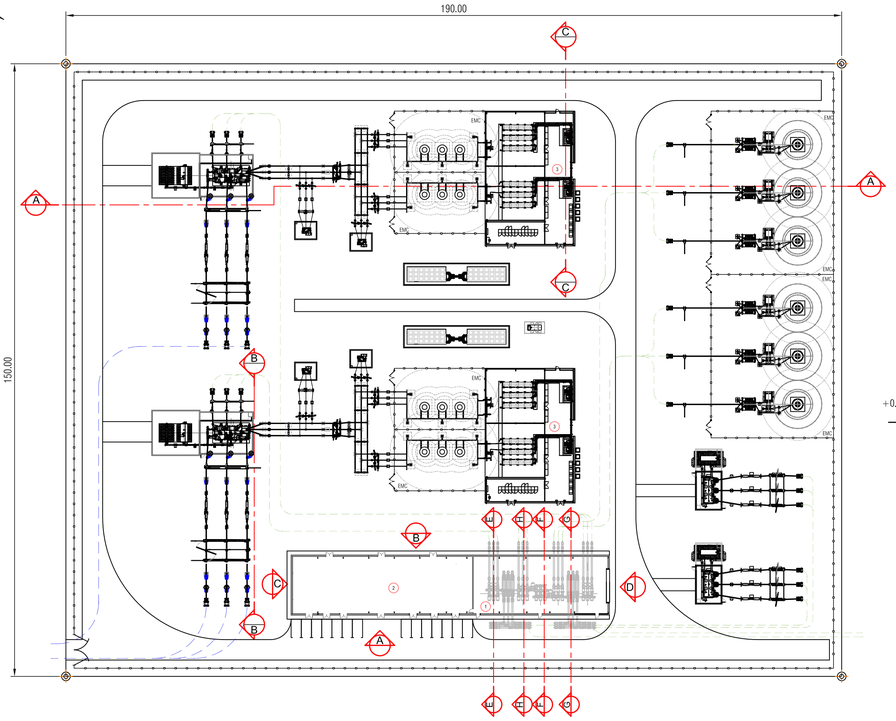
Rev : 6

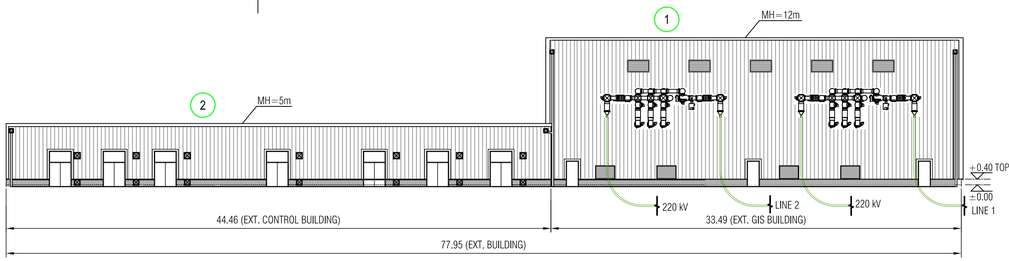
Replaces : -

SCALE : 1:400

SIZE: A1

LAYOUT PLAN
SCALE 1:750




VIEW -A-
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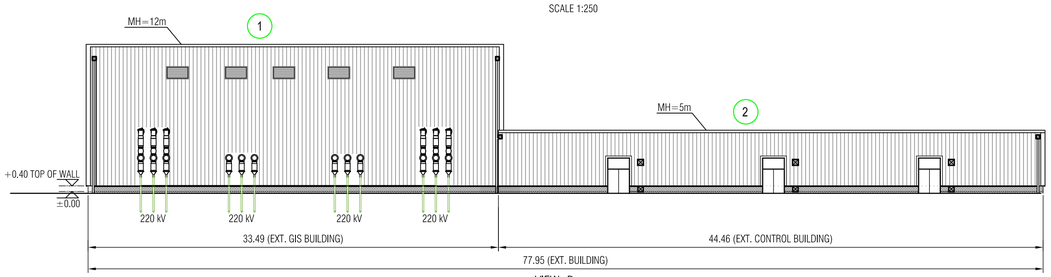
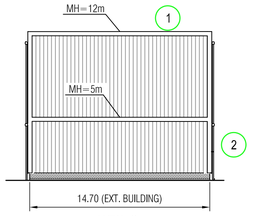



VIEW -B-
SCALE 1:250




VIEW -C-
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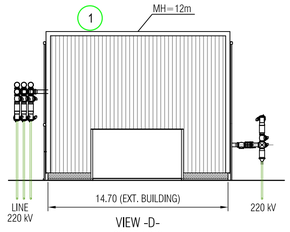


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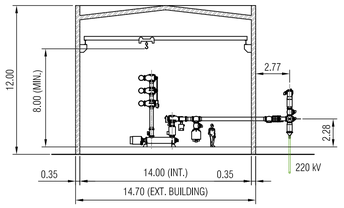


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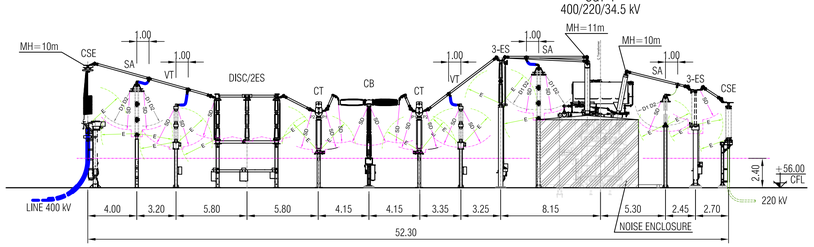


B-B SECTION
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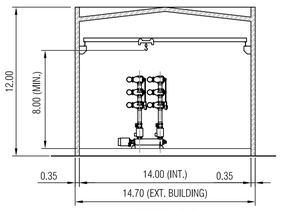


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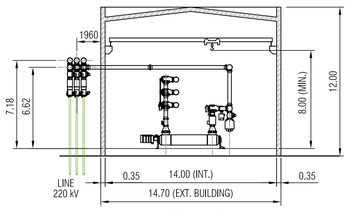
SCALE 1:250

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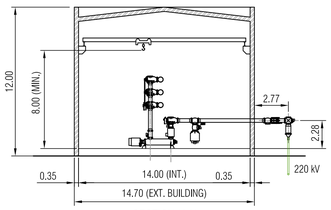
SCALE 1:250

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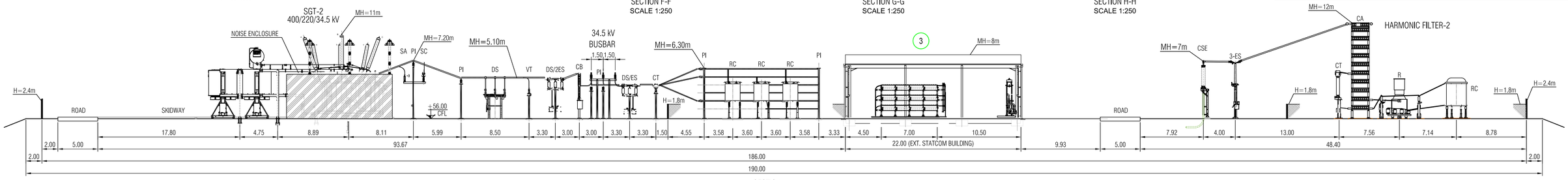
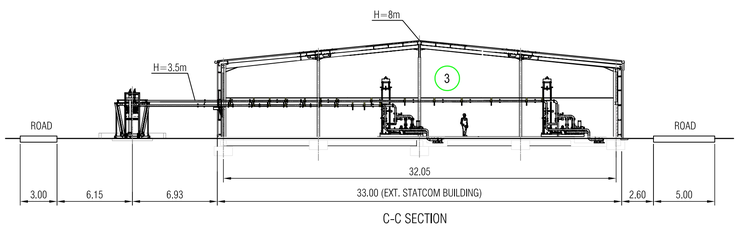
SCALE 1:250




A-A SECTION
SCALE 1:250




C-C SECTION
SCALE 1:250

| NOMINAL SYSTEM VOLTAGE | 400kV | 220kV | 34.5kV |
|---|---|---|---|
| RATED VOLTAGE (kV) | 420 | 245 | 52 |
| RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE (kV) | 1425 | 1050 | 250 |
| MINIMUM PHASE-TO-EARTH CLEARANCE (m) - E | 2.80 | 2.10 | 0.50 |
| MINIMUM PHASE-TO-PHASE CLEARANCE (m) - PH | 3.60 | 2.40 | 0.50 |
| ELECTRICAL SAFETY DISTANCE (m) - SD | 3.10 | 2.40 | 0.80 |
| DESIGN CLEARANCE FOR SAFETY-VERTICAL (m) - DS | 5.50 | 4.80 | 3.20 |
| DESIGN CLEARANCE FOR SAFETY-HORIZONTAL (m) - DSh | 4.60 | 3.90 | 2.30 |
| MINIMUM INSULATION HEIGHT-PEDESTRIAN ACCESS (m) | 2.40 | 2.40 | 2.40 |
| MINIMUM CLEARANCE TO ROADWAYS (m) | 7.90 | 7.20 | 5.60 |

| NOMINAL SYSTEM VOLTAGE | 400kV | 220kV |
|---|---|---|
| SURGE ARRESTER CLEARANCE TO LIVE METAL OF SAME PHASE (m) - D1 | 2.80 | 2.10 |
| SURGE ARRESTER CLEARANCE TO EARTH (m) - D2 | 2.80 | 2.10 |

NOTES:

1.- ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
2.- THE OVERALL SITE LAYOUT, ITS ASSOCIATED SWITCHGEAR AND SIZES ARE INDICATIVE AND MAY VARY DURING DETAILED DESIGN STAGE.
3.- THE GATE TO THE FILTER AND STATCOM COMPOUND IS INTERLOCKED WITH THE EARTHSWITCH OF THE CORRESPONDING FILTER.
4.- THE WHOLE SUBSTATION SHALL HAVE A COMMON COMPOUND FINISH LEVEL (CFL= +56.00 m).

ASSOCIATED DRAWING:

ELECTRICAL PRELIMINARY LAYOUT PLAN - EAST ANGLIA (ONSHORE) SHEET 1

| 400KV SYSTEM | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| SGT | SUPER GRID TRANSFORMER 400/220/34.5 kV | 11 / 10 | 67 / 66 |
| CSE | CABLE SEALING END | 10 | 66 |
| SA | SURGE ARRESTER | 8.50 / 10 | 64.50 / 66 |
| CT | CURRENT TRANSFORMER | 6.50 | 62.50 |
| DISC 2ES | DISCONNECTOR WITH 2 EARTHING SWITCHES | 7.35 | 63.35 |
| VT | VOLTAGE TRANSFORMER | 6.50 | 62.50 |
| 3-ES | 3 POLES EARTH SWITCHES | 11 | 67 |
| CB | CIRCUIT BREAKER | 7.20 | 63.20 |

| 220KV SYSTEM | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| GIS | GAS-INSULATED SWITCHGEAR (GIS) | 9 | 65 |
| SR | SHUNT REACTOR | 10 | 66 |
| CSE | CABLE SEALING END | 7 | 63 |
| 3-ES | 3 POLES EARTH SWITCHES | 8 | 64 |
| 3-DISC 2ES | 3 POLES DISCONNECTOR WITH 2 EARTHING SWITCHES | 10 | 66 |
| SA | SURGE ARRESTER | 7.50 | 63.50 |
| CB | CIRCUIT BREAKER | 6 | 62 |

| HARMONIC FILTER SYSTEM | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| CA | CAPACITOR | 12 | 68 |
| RC | REACTOR | 6 | 62 |
| R | RESISTOR | 5 | 61 |
| CT | CURRENT TRANSFORMER | 6 | 62 |
| ES | POLE EARTH SWITCH | 7 | 63 |
| CSE | CABLE SEALING END | 7 | 63 |

| 34.5 kV REACTIVE COMPENSATION (STATCOM) | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| CB | CIRCUIT BREAKER | 5.60 | 61.60 |
| DS | DISCONNECTOR WITHOUT EARTHING SWITCH | 3.70 | 59.70 |
| DS/ES | DISCONNECTOR WITH EARTHING SWITCH | 4.30 | 60.30 |
| DS/2ES | DISCONNECTOR WITH TWO EARTHING SWITCHES | 5.10 | 61.10 |
| CT | CURRENT TRANSFORMER | 4.20 | 60.20 |
| VT | VOLTAGE TRANSFORMER | 5.50 | 61.50 |
| SA | SURGE ARRESTER | 5.10 | 61.10 |
| SC | SURGE CAPACITOR | 5.50 | 61.50 |
| PI | POST INSULATOR | 7.20 / 6.30 / 5.10 | 63.20 / 62.30 / 61.10 |
| RC | REACTOR | 4.70 | 60.70 |
| AT | AUXILIARY TRANSFORMER | 4 | 60 |
| ER | EARTHING REACTOR | 4 | 60 |

| AUXILIARY EQUIPMENT SCHEDULE | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| DG | DIESEL GENERATOR | 3.50 | 59.50 |

| BUILDINGS | | | |
|---|---|---|---|
| LEGEND | DESCRIPTION | MAXIMUM HEIGHT (m) | AOD (m) |
| 1 | GIS SYSTEM BUILDING | 12 | 68 |
| 2 | CONTROL BUILDING | 5 | 61 |
| 3 | STATCOM BUILDING | 8 | 64 |

| REV. | DATE | Drawn | Prep. | Checked | Approv. | REASON. STATUS OF REVISION |
|---|---|---|---|---|---|---|
| 6 | 24-06-2016 | MZA | FAA | FAA | MVFL | BOUNDARY ROOF PARAPET IN THE GIS BUILDING |
| 5 | 16-06-2016 | MZA | FAA | FAA | MVFL | UPDATE ACCORDING TO: EA1-GRD-A-IEC-007885 REV 0 ONSS CONSIDERATIONS FOR LPA LAYOUT. |
| 4 | 24-05-2016 | AFSE | FAA | FAA | MVFL/MOVIEDO | ASSESSMENT OF FIRST ROUND OF SYSTEM STUDIES |
| 3 | 18-01-2016 | AFSE | FAA | FAA | MVFL/MOVIEDO | UPDATED (X,Y) COORDINATES ACCORDING TO EA1-GRD-DG-IEC-007563 RevOE (EA1 SUBSTATION FOOTPRINT) |
| 2 | 18-12-2015 | AFSE | FAA | FAA | MVFL/MOVIEDO | ADDED 400kV CV AND CT |
| 1 | 10-12-2015 | AFSE | FAA/LSLA | FAA/LSLA | MVFL/MOVIEDO | 220kV CABLES AFFECTED AREA |
| 0 | 09-09-2015 | AFSE | FAA/LSLA | FAA/LSLA | MVFL/MOVIEDO | FIRST ISSUE |

Client : SCOTTISHPOWER RENEWABLES

Client drawing nº :

Other ref. of client :

General Contractor / Engineering : IBERDROLA Ingeniería y Construcción

QUALITY LIST: YES ☐ NO ☒
DESIGN VERIFICATIONS:
LEVEL 1 ☐ LEVEL 2 ☐ NOT APPL. ☒

Approval / Release for Construction : According stamps on drawing

Author :

Project : OSS EAST ANGLIA ONE

Classification : GENERAL INFORMATION

Titles : GRID TRANSMISSION SYSTEM
ONSHORE SUBSTATION 400/220/34.5 kV
ELECTRICAL PRELIMINARY LAYOUT ELEVATIONS

Type of Document : PROJECT

Sheet: 02 | Next Sh: -

First Issue : 09-09-15 INITIAL ISSUE

| Sign: | Drawn | Prep. | Check. | App. |
|---|---|---|---|---|
| Acron: | AFSE | FAA | FAA/LSLA | MVFL/NOVIEDO |

Drawn. nº : EA1-ELE-D-IEC-000900

Rev : 6

Replaces : -

SCALE :

SIZE: A1

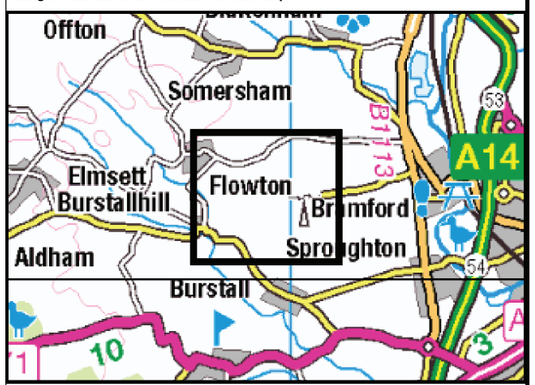
# Figures


SCOTTISHPOWER RENEWABLES

## LEGEND

- EA ONE DCO Boundary
- Substation Compound

**Note:**
**This map has been produced to the latest known information at the time of issue. Please consult with the GIS team to ensure the content is still current before using the information contained on this map.**




| | |
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| DRAWING NUMBER | *1* |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 |
| PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* |
| SCALE | 1:8,000 (0 50 100 m) |
| ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* |
| DRAWING TITLE | *SITE CONTEXT* |
| DRAWING ID | **1** |
| DRAWING PREPARED BY: | LA |



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609200 609400 609600 609800 610000 610200

246600 246400 246200 246000 245800 245600

Bushey Grove

Gobert's Grove

Bullen Green

Fore Grove

54 55 57 57

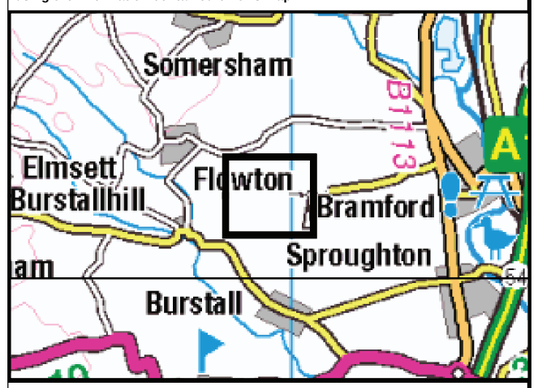
N

SCOTTISHPOWER RENEWABLES

## LEGEND

- EA ONE DCO Boundary
- Substation Compound
- ES Proposed Mitigation Woodland
- ES Proposed Mitigation Landform

**Note:**
**This map has been produced to the latest known information at the time of issue. Please consult with the GIS team to ensure the content is still current before using the information contained on this map.**




| | | | |
|---|---|---|---|
| DRAWING NUMBER | 2 | | |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 | PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | 1:4,000 (0 50 100 m) | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *ENVIRONMENTAL STATEMENT MITIGATION* | | |
| DRAWING ID | **2** | DRAWING PREPARED BY: | LA |



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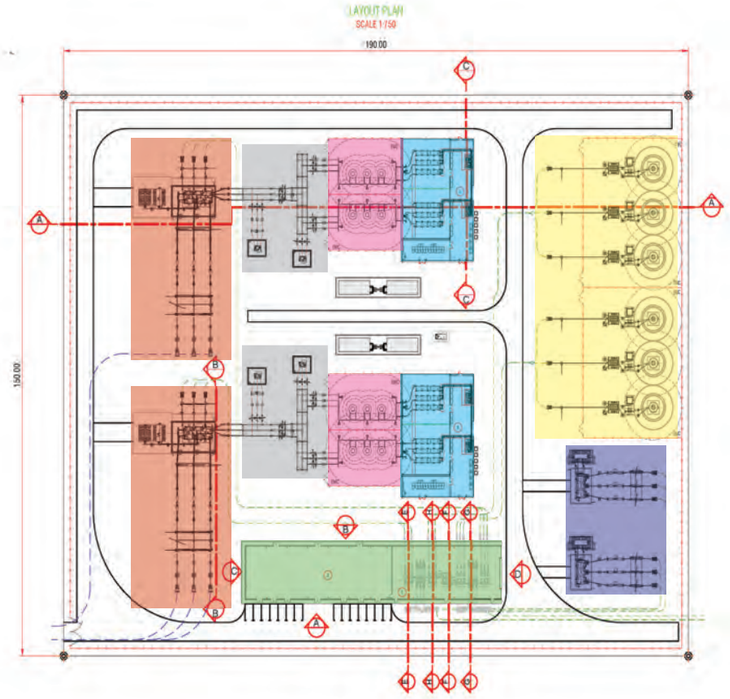


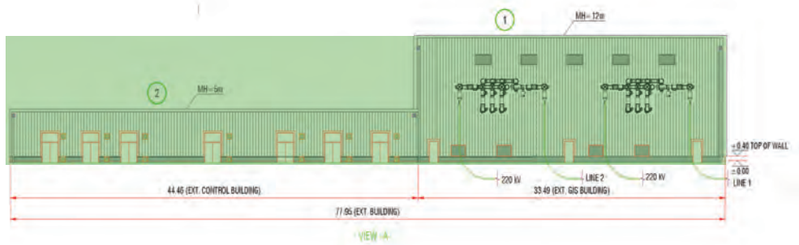



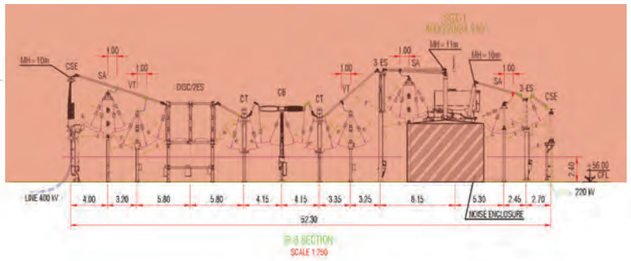


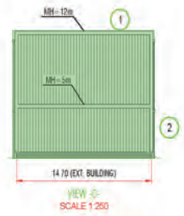


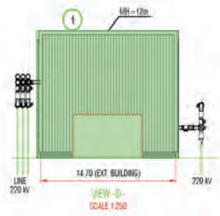


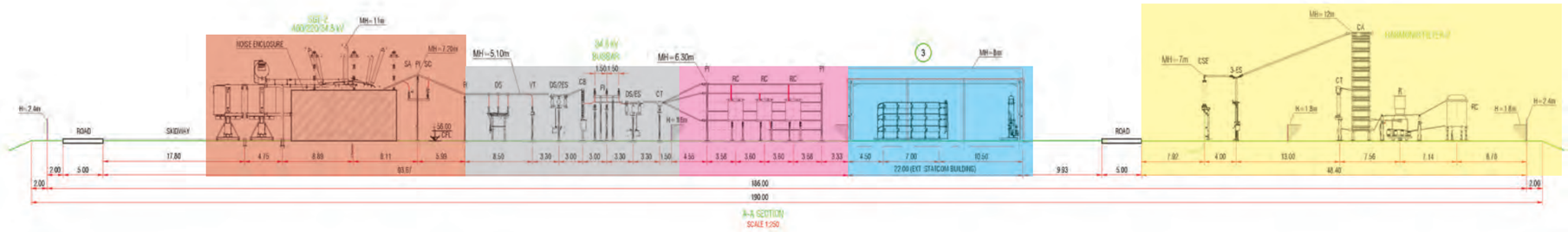


SCOTTISHPOWER RENEWABLES

**Note:**
**This map has been produced to the latest known information at the time of issue. Please consult with the GIS team to ensure the content is still current before using the information contained on this map.**

| | | | |
|---|---|---|---|
| DRAWING NUMBER | 3 | | |
| COORDINATE SYSTEM / DATUM | BNG OSGB 1936 | PROJECTION / UNITS | TRANSVERSE MERCATOR METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *KEY SUBSTATION COMPONENTS* | | |
| DRAWING ID | **3** | DRAWING PREPARED BY: | LA |



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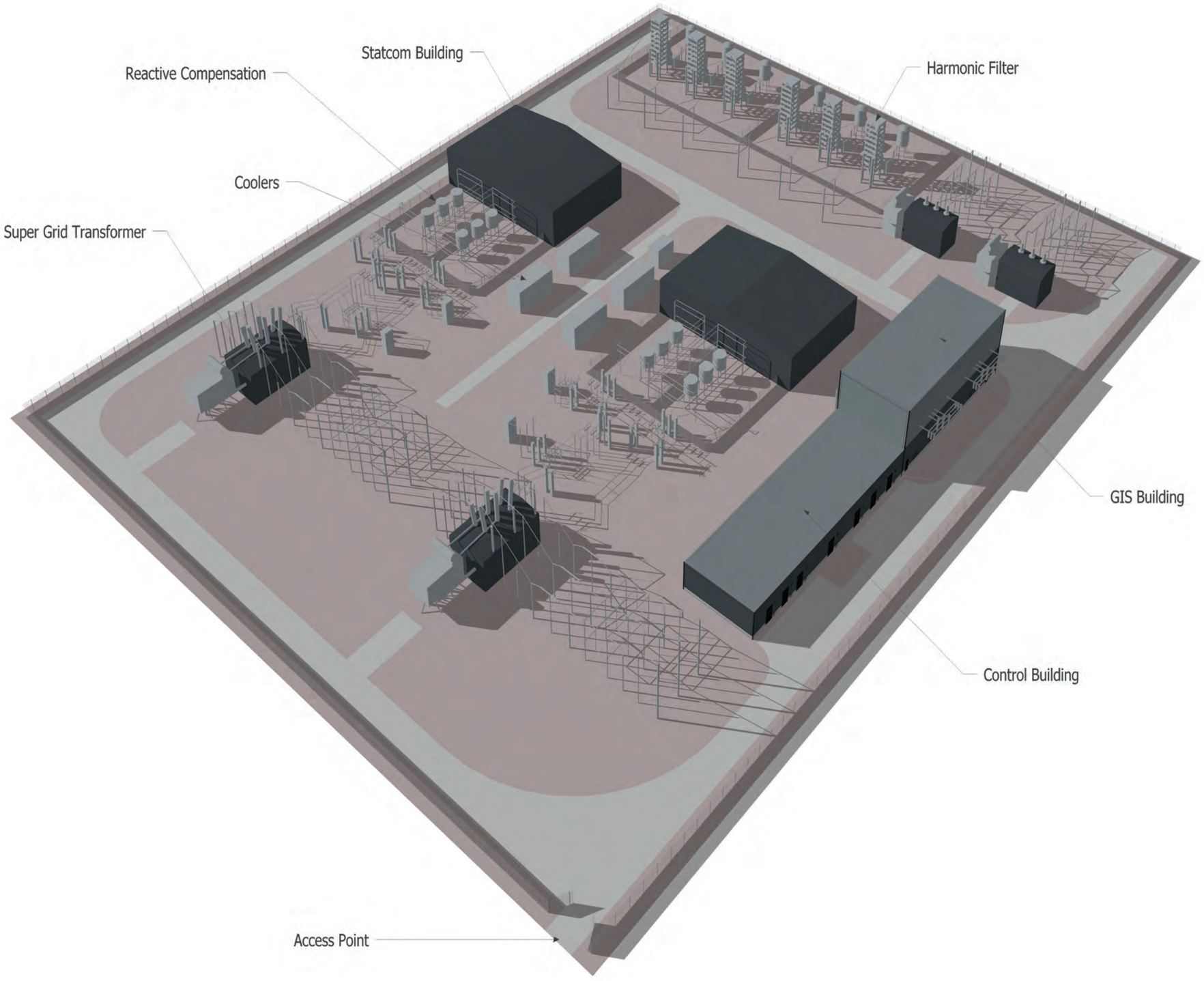


SCOTTISHPOWER RENEWABLES

**Note:**
**This map has been produced to the latest known information at the time of issue. Please consult with the GIS team to ensure the content is still current before using the information contained on this map.**

| | |
|---|---|
| DRAWING NUMBER | 4 |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 |
| PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* |
| SCALE | NOT TO SCALE |
| ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* |
| DRAWING TITLE | *SUBSTATION 3D MODEL* |
| DRAWING ID | **4** |
| DRAWING PREPARED BY: | LA |



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Great Blakenham Combined Heat and Power (CHP) Plant - an example of a high profile enegy building

Typical style timber weatherboard agricultural building

Contemporary barn buildings generally clad in steel

Bramford National Grid Substation

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SCOTTISHPOWER RENEWABLES

**Note:**
**This map has been produced to the latest known information at the time of issue. Please consult with the GIS team to ensure the content is still current before using the information contained on this map.**

| | |
|---|---|
| DRAWING NUMBER | 5 |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 |
| PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* |
| SCALE | NOT TO SCALE |
| ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* |
| DRAWING TITLE | *EXAMPLES OF LOCAL BUILDINGS* |
| DRAWING ID | **5** |
| DRAWING PREPARED BY: | LA |

## COLOUR OPTIONS

Various colour options were considered; using colours from the landscape or available as standard building cladding. Simple models were used to create seasonal examples.

## Sample Colours

**Colours on Site:**

1 — Fence R94 G85 B77

4 — Sky R72 G85 B109

2 — Woodland R47 G53 B41

5 — Hedge R82 G93 B59

3 — Pylon R68 G68 B68

6 — Shed R63 G66 B73

**Kingspan Colours:**

7 — Camouflage R123 G132 B114

8 — Mushroom R182 G168 B151

9 — Lolite R36 G44 B66

10 — Olive Green R77 G74 B41

11 — Wedgewood Blue R87 G128 B136

12 — Bottle Green R51 G58 B40













SCOTTISHPOWER RENEWABLES

**Please note that these visualisations were created for colour comparison / illustrative purposes only and do not show the final layout and appearance of the substation.**

**Note:**
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| | | | |
|---|---|---|---|
| DRAWING NUMBER | 6 | | |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 | PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *SUBSTATION COLOUR OPTIONS* | | |
| DRAWING ID | **6** | DRAWING PREPARED BY: | LA |



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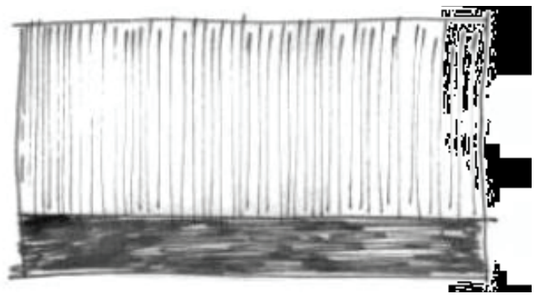
## BUILDING DESIGN APPROACH

### FUNCTIONAL



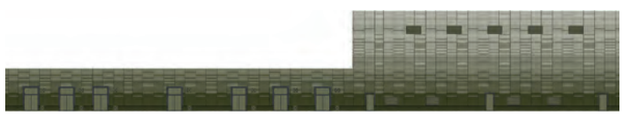
- Electrical appearance
- Vertical cladding muted colours
- Engineering brick base
- Course
- Typical substation building

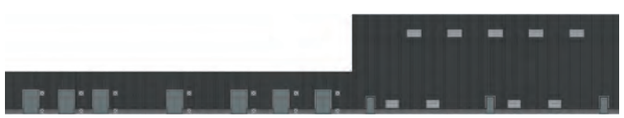
### VERNACULAR

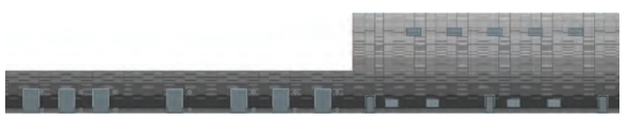
- Farm buildings & barn conversions
- Muted colours
- Brick base course
- Horizontal weather board/ timber cladding


### EXPRESSIVE

- Emphasis on substation Panel and ‘dazzle’ patterns
- Using shades of green or grey or colour graduation patterns (dark to light)







The above approaches were explored using the standard building design suplied by Scottish Power Renewables

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SCOTTISHPOWER RENEWABLES

**Note:**
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| | | | |
|---|---|---|---|
| DRAWING NUMBER | 7 | | |
| COORDINATE SYSTEM / DATUM | BNG OSGB 1936 | PROJECTION / UNITS | TRANSVERSE MERCATOR METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *DESIGN APPROACH: SUBSTATION BUILDING* | | |
| DRAWING ID | **7** | DRAWING PREPARED BY: | LA |

FUNCTIONAL (Juniper Green)

EXPRESSIVE

FUNCTIONAL (Dark Grey)

VERNACULAR (Timber)

SCOTTISHPOWER RENEWABLES

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| | |
|---|---|
| DRAWING NUMBER | 8 |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 |
| PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* |
| SCALE | NOT TO SCALE |
| ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* |
| DRAWING TITLE | *SUBSTATION DESIGN OPTIONS* |
| DRAWING ID | **8** |
| DRAWING PREPARED BY: | LA |



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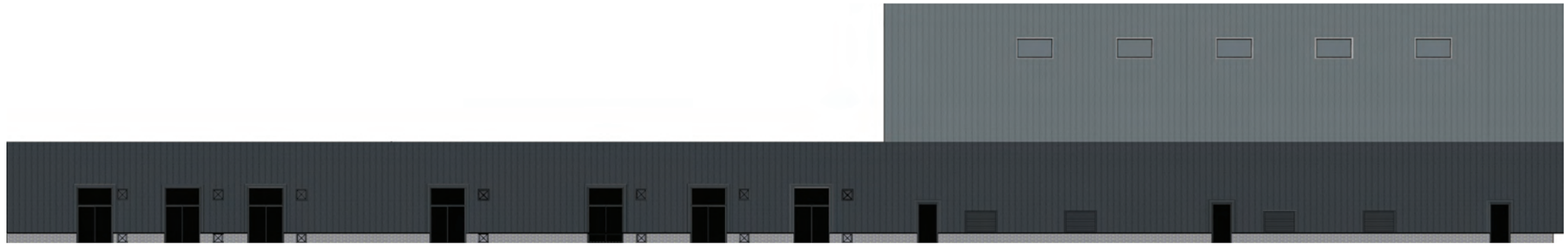
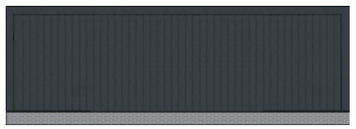


Eastern Elevation

Western Elevation

Northern Elevation

Southern Elevation



Southern Elevation

## Kingspan Trapezoidal Wall Panels
## Anthracite Base, Merlin Grey Upper

**Goosewing Grey**
RAL 080 70 05 BS 10A05

**Merlin Grey**
RAL 180 40 05 BS 18B25

**Anthracite**
RAL 7016

Colour palette and gradation
(dark to light with building height)

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SCOTTISHPOWER RENEWABLES

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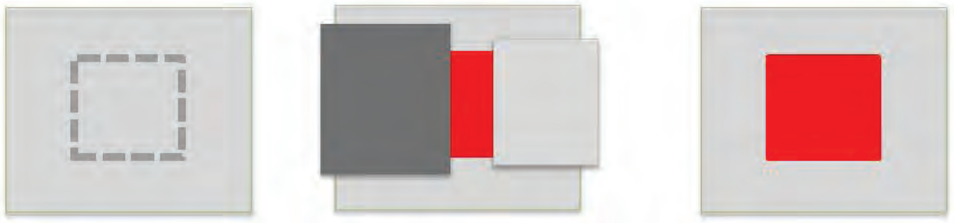
| | |
|---|---|
| DRAWING NUMBER | 9 |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 |
| PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* |
| SCALE | NOT TO SCALE |
| ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* |
| DRAWING TITLE | *SUBSTATION BUILDING APPEARANCE* |
| DRAWING ID | **9** |
| DRAWING PREPARED BY: | LA |

# LANDSCAPE DESIGN APPROACH



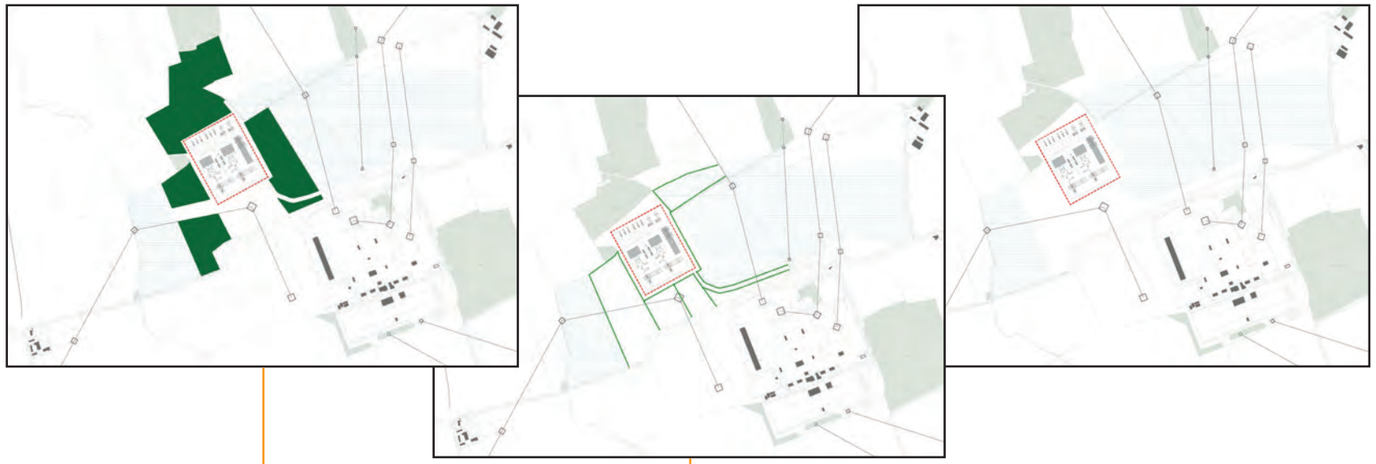
**Hidden**
Hide the substation from the surrounding landscape. Deny it is there.

**Integrated**
Adapt and relate the substation to the existing landscape.
Allow views to the substation.

**Exposed**
The substation is an integral part of the landscape equal to other elements. Not screened.

**Visual Impact**

Low — High



The landscape concept is a combination of hidden and intergrated to meet the agreed mitigation requirements and also as a response to the local landscape character.

SCOTTISHPOWER RENEWABLES

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| | | | |
|---|---|---|---|
| DRAWING NUMBER | 10 | | |
| COORDINATE SYSTEM<br>DATUM | BNG<br>OSGB 1936 | PROJECTION<br>UNITS | TRANSVERSE MERCATOR<br>METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *DESIGN APPROACH: LANDSCAPE* | | |
| DRAWING ID | **10** | DRAWING PREPARED BY: | LA |



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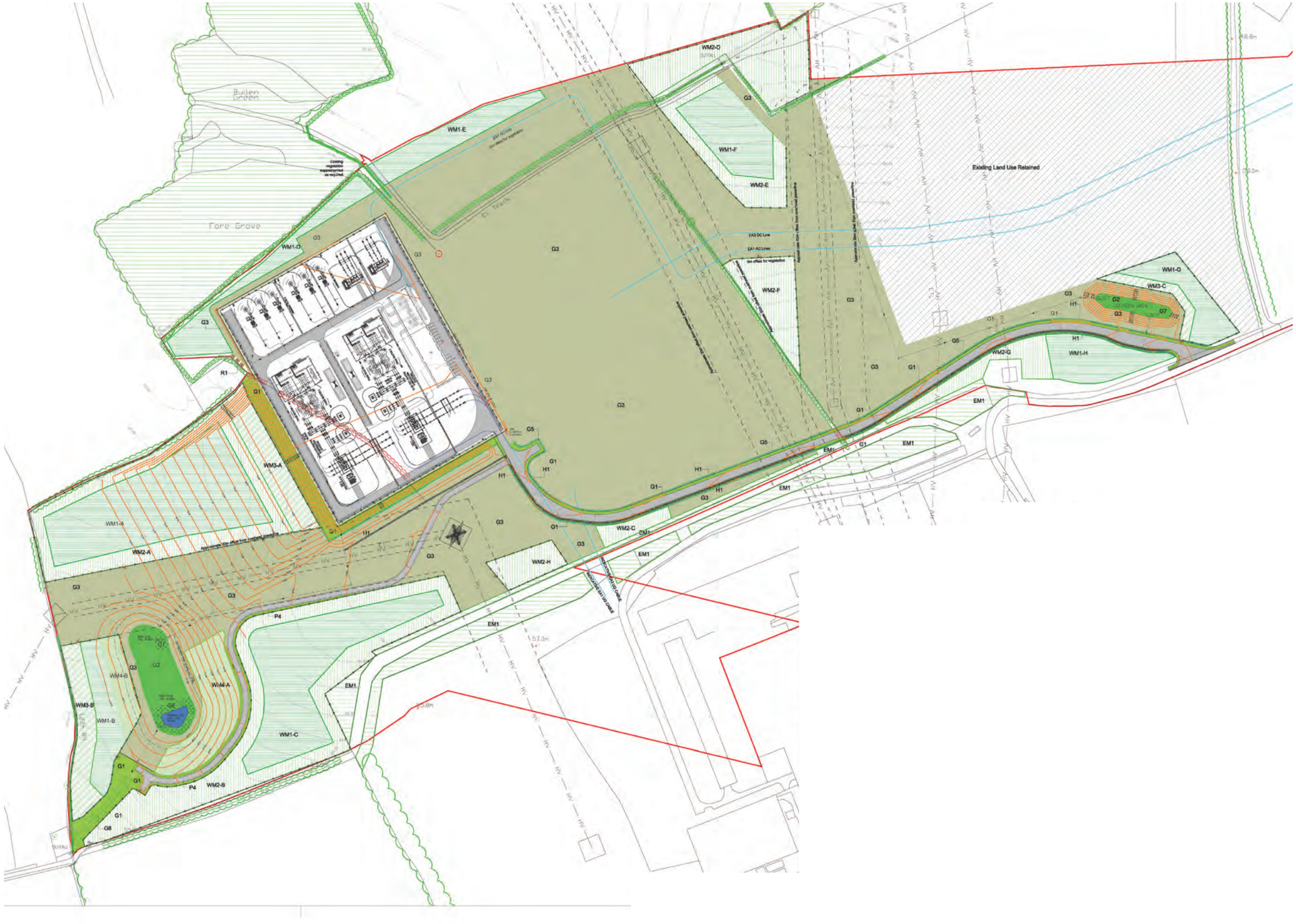
# SOFT LANDSCAPE general arrangement drawing showing key elements of structural woodland planting, containing belts of faster growing species for visual screening.




SCOTTISHPOWER RENEWABLES

## LEGEND

- EA ONE DCO Boundary
- Existing Contours
- Proposed Contours
- Existing Vegetation to be retained
- Existing Vegetation to be removed
- Indicative areas of existing mature woodland
- Pylon
- Overhead powerlines
- Approximate underground cable alignment

**Proposed Planting**

- **H1** Mixed native species hedge. See plant schedules for details.
- **WM1** Core Woodland comprising generally slower growing mixed broadleaf species such as oak (See plant schedules for details)
- **WM2** Edge woodland comprising generally lower growing mixed broadleaf species such as Rowan (See plant schedules for details)
- **WM3** Screening woodland edge comprising generally faster growing mixed broadleaf species to provide visual screening and shelter for the slower growing WM1. Species include Birch, Poplar (See plant schedules for details)
- **WM4** Wet woodland planting mix appropriate for SUDs detention basin area. (See plant schedules for details)
- **R1** Supplementary / infill planting for gaps in existing hedgerows using WM2 tree/shrub mix or H1 hedgerow mix as specified
- **G1** Amenity grass seed mix for embankments, verges and swale sides
- **G2** Wetland areas grassland seed mix areas.
- **G3** Species rich grassland seed mix areas.
- **G6** Marginal aquatic planting for the margins around the permanent pond.
- **G7** Marginal aquatics for the SUDs basin forebay areas
- **G8** Marginal aquatics for the base of the open swale with the SUD scheme
- Filter drain with grass cover and manhole access (Refer to engineers specification)
- Filter drain with exposed aggregate and manhole access (Refer to engineers specification)
- Filter drain within substation compound (Refer to engineers specification)
- **P4: Reinforced grass road surface**
  Description: Golpla pre-grown reinforced grass road from Geosynthetics Ltd.

**FOR INFORMATION ONLY:**

- **EM1** Indicative areas of existing National Grid mitigation planting and earthworks. For information only.
- Existing land use to be retained and managed as agricultural use in accordance with local landowners recommendations and guidance

**Note:**
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| | | | |
|---|---|---|---|
| DRAWING NUMBER | 11 | | |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 | PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *SOFT LANDSCAPE: GENERAL ARRANGEMENT* | | |
| DRAWING ID | **11** | DRAWING PREPARED BY: | LA |



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# HARD LANDSCAPE


## LEGEND

- EA ONE DCO Boundary
- Existing Contours
- Proposed Contours
- Pylon
- Overhead powerlines
- Approximate underground cable alignment

Proposed Hardworks

- **P1: Concrete road**
  Description: Rural road without kerb edging to Engineers specification.
- **P2: Permeable gravel groundcover within substation**
  Description: Local flint aggregate subject to conduction testing
- **P3: Self binding gravel footpath**
  Description: Natural gravel self-binding foothpath.
- **P4: Reinforced grass road surface**
  Description: Golpla pre-grown reinforced grass road from Geosynthetics Ltd.
- **F1: Fence**
  Description: 2.4m high galvanised steel mesh fencing.
- **F1a: Gate**
  Description: 2.4m high galvanised steel entrance gate.
- **F2: Fence**
  Description: Rabbit / deer protection fencing for new woodland.
- **F3: Maintenance access gate**
  Description: 2m wide maintenance gate / height dependent upon adjacent fencing.
- Filter drain with grass cover and manhole access
  (Refer to engineers specification)
- Filter drain with exposed aggregate and manhole access
  (Refer to engineers specification)
- Filter drain within substation compound
  (Refer to engineers specification)
- Field drain and manhole access
  (Refer to engineers specification)

**Note:**
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| | | | |
|---|---|---|---|
| DRAWING NUMBER | 12 | | |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 | PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *HARD LANDSCAPE: GENERAL ARRANGEMENT* | | |
| DRAWING ID | **12** | DRAWING PREPARED BY: | LA |



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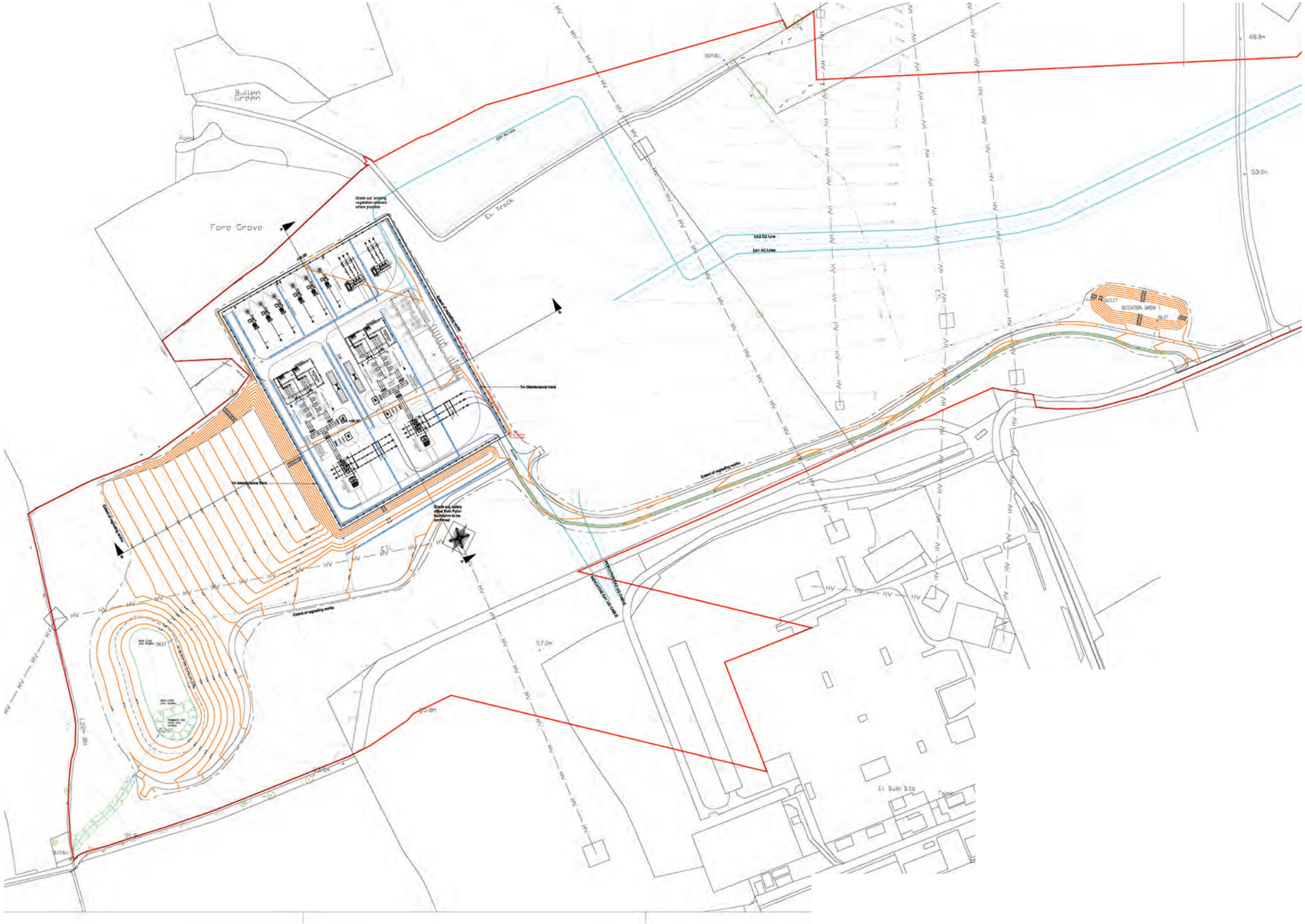
# EARTHWORKS




SCOTTISHPOWER RENEWABLES

## LEGEND

- EA ONE DCO Boundary
- +54.00 Existing Contours
- +54.00 Proposed Contours
- Pylon
- Overhead powerlines
- Approximate underground cable alignment

**Note:**
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| | |
|---|---|
| DRAWING NUMBER | 13 |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 |
| PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* |
| SCALE | NOT TO SCALE |
| ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* |
| DRAWING TITLE | *EARTHWORKS: GENERAL ARRANGEMENT* |
| DRAWING ID | **13** |
| DRAWING PREPARED BY: | LA |



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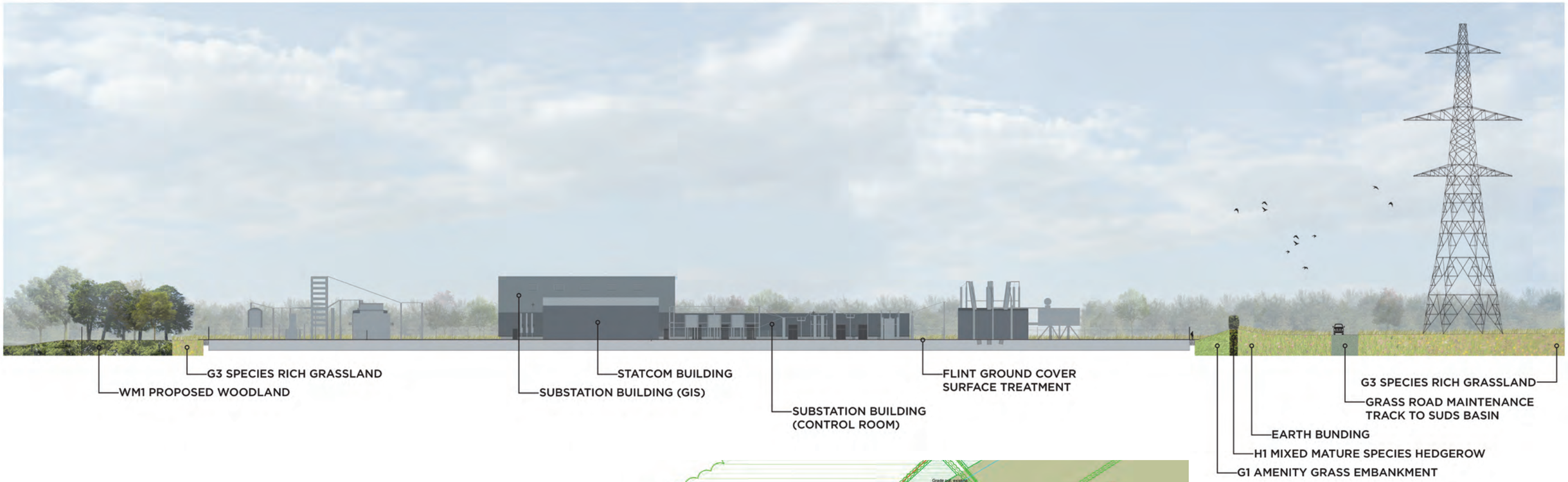
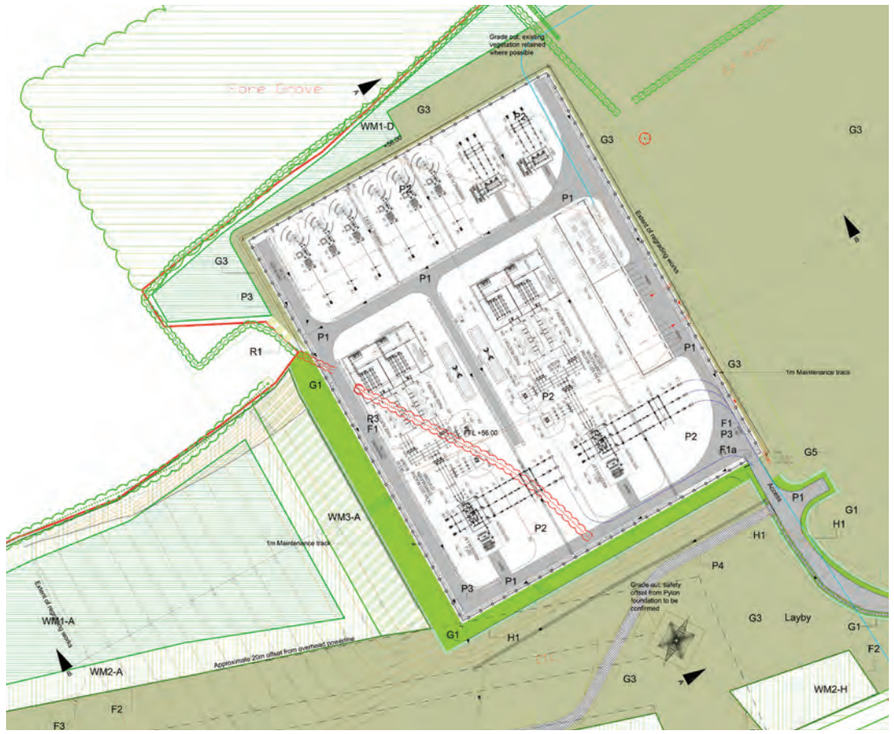
# KEY SECTION through the site with details showing relationship between fence, perimeter boundary and hedging.

SCOTTISHPOWER RENEWABLES

## SECTION AA

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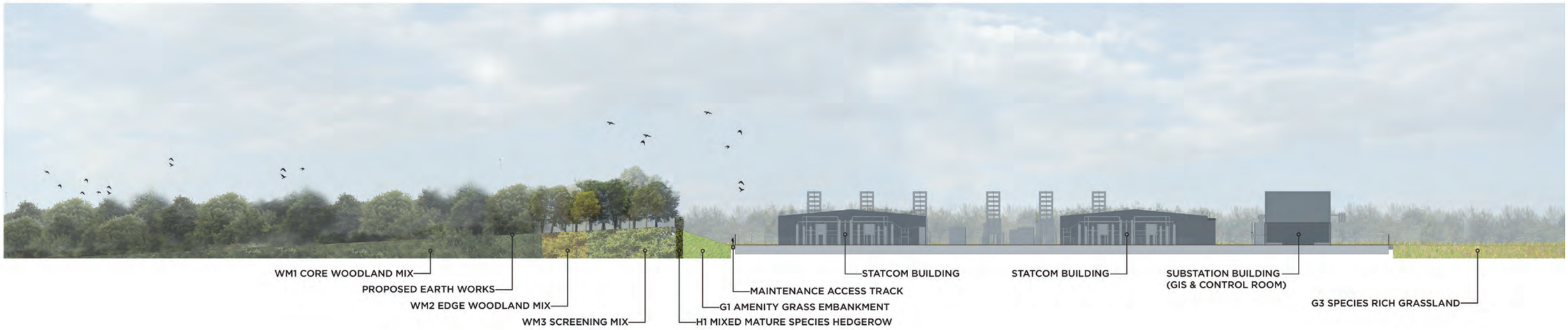
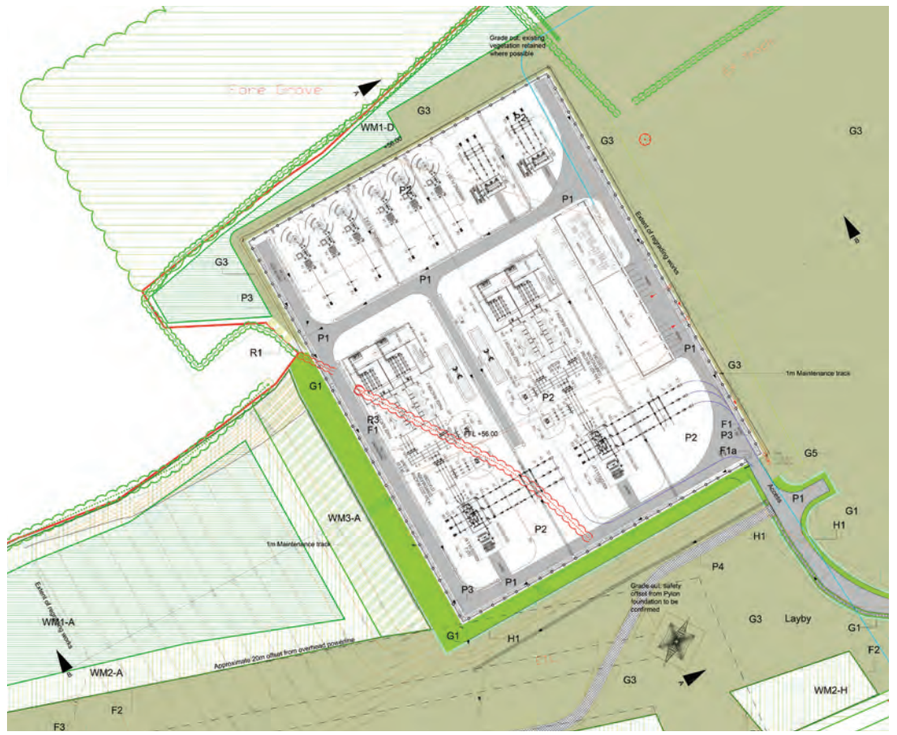
| | |
|---|---|
| DRAWING NUMBER | 14 |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 |
| PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* |
| SCALE | NOT TO SCALE |
| ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* |
| DRAWING TITLE | *ILLUSTRATIVE CROSS SECTION A-A* |
| DRAWING ID | **14** |
| DRAWING PREPARED BY: | LA |

# KEY SECTION through the site with details showing relationship between fence, perimeter boundary and hedging.

SCOTTISHPOWER RENEWABLES

**SECTION BB**

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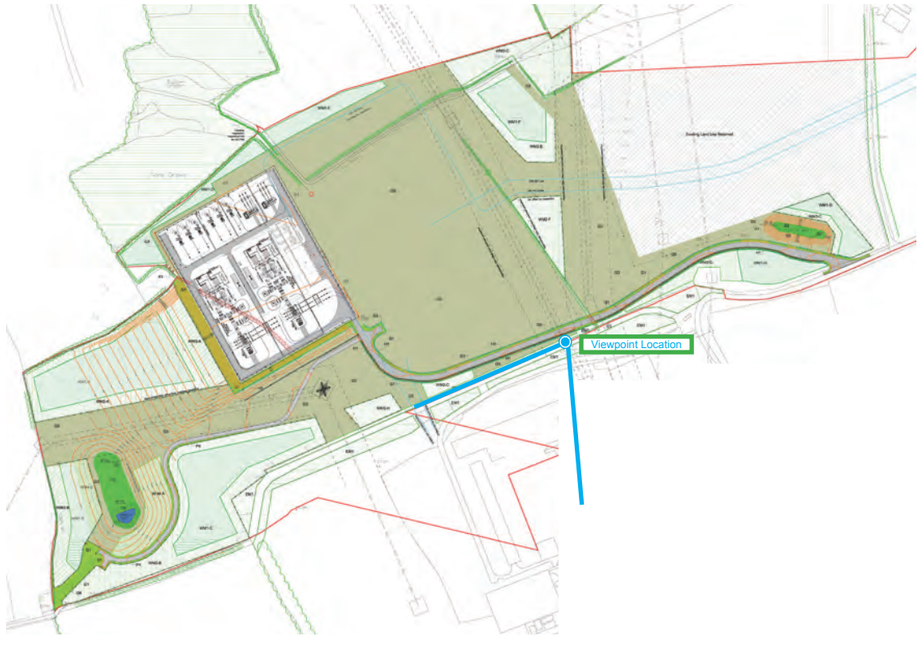
| | | | |
|---|---|---|---|
| DRAWING NUMBER | 15 | | |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 | PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *ILLUSTRATIVE CROSS SECTION B-B* | | |
| DRAWING ID | **15** | DRAWING PREPARED BY: | LA |

Photomontage visual representation of the substation.

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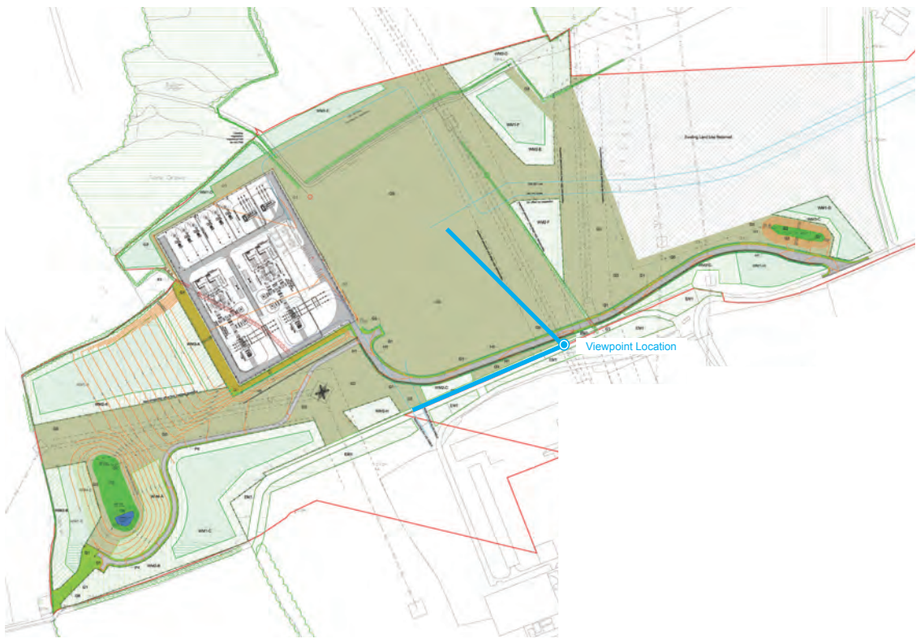
| | | | |
|---|---|---|---|
| DRAWING NUMBER | 16a | | |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 | PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *VISUAL REPRESENTATION: VIEWPOINT 1* | | |
| DRAWING ID | **16a** | DRAWING PREPARED BY: | LA |

SCOTTISHPOWER RENEWABLES




**Note:**
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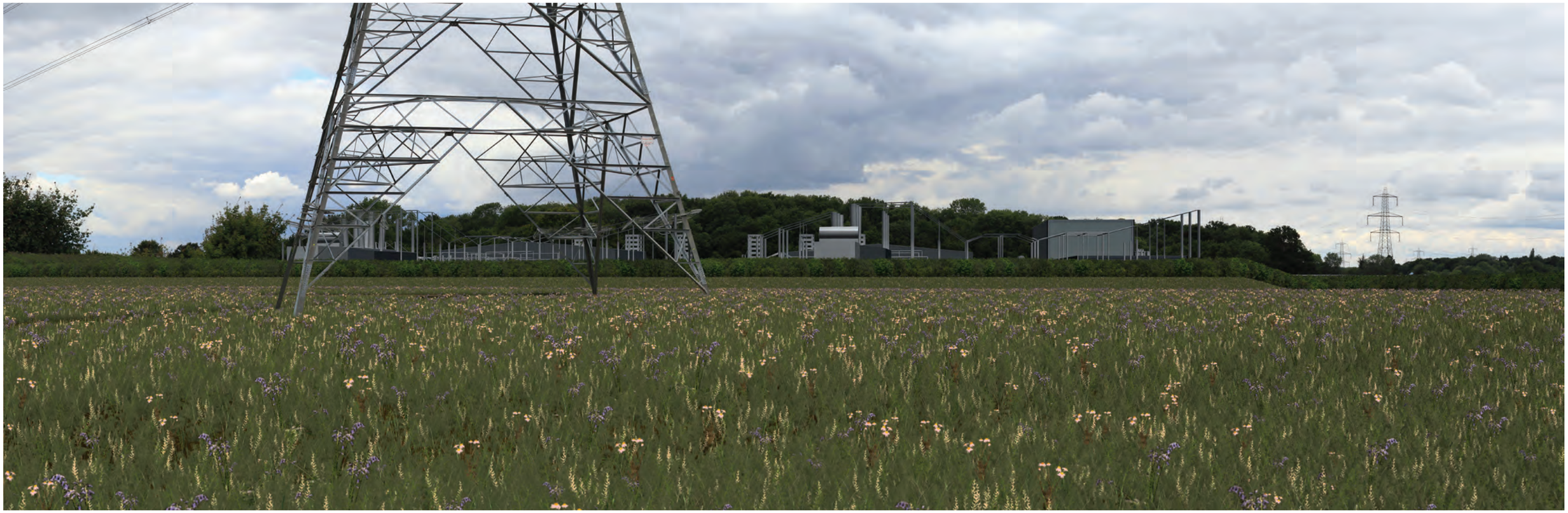
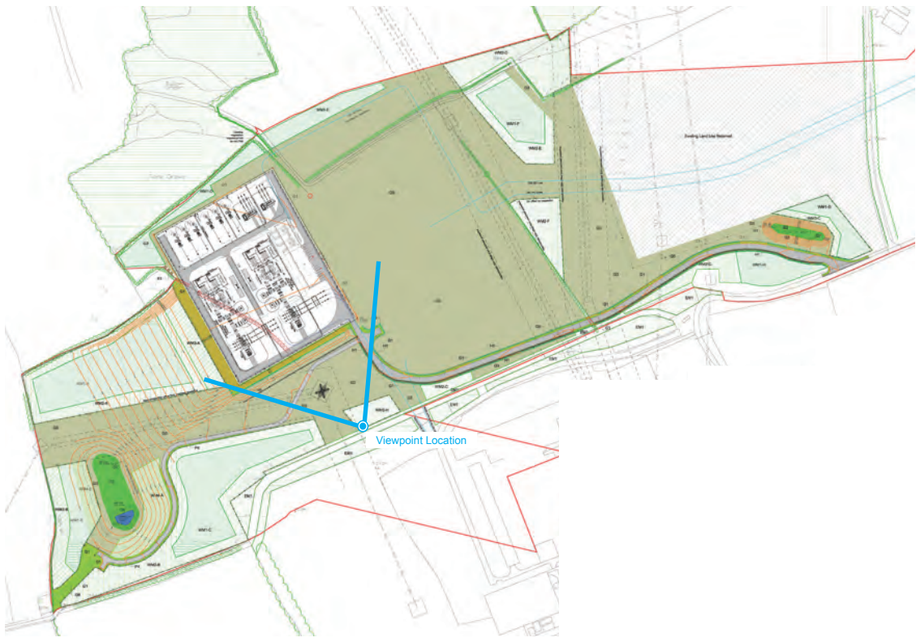
| | | | |
|---|---|---|---|
| DRAWING NUMBER | 16b | | |
| COORDINATE SYSTEM<br>DATUM | BNG<br>OSGB 1936 | PROJECTION<br>UNITS | TRANSVERSE MERCATOR<br>METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *VISUAL REPRESENTATION: VIEWPOINT 1* | | |
| DRAWING ID | **16b** | DRAWING PREPARED BY: | LA |



Photomontage visual representation of the substation. *Please note that the woodland block WM2-H has been omitted from the visualisation to create this view.*




**Note:**
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| | | | |
|---|---|---|---|
| DRAWING NUMBER | 17 | | |
| COORDINATE SYSTEM / DATUM | BNG / OSGB 1936 | PROJECTION / UNITS | TRANSVERSE MERCATOR / METRE |
| PURPOSE | *FINAL FOR DISCHARGE* | | |
| SCALE | NOT TO SCALE | ORIGINAL PLOT SIZE | A3 |
| PROJECT TITLE | *East Anglia ONE Wind Farm (EA ONE)* | | |
| DRAWING TITLE | *VISUAL REPRESENTATION: VIEWPOINT 2* | | |
| DRAWING ID | **17** | DRAWING PREPARED BY: | LA |