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Contents

Executive Summary

The primary purpose of the Design Approach for Site Specific Infrastructure (DASSI) is to outline the design guidance that will be taken forward into the detailed design. It sets out an approach to the design of site-specific infrastructure of non-linear works, this includes the proposed substations, works to substations and Cable Sealing End (CSE) compounds as shown in Figure 4.2: Proposed Project Design – Permanent Features (document reference 6.4.F2).

The DASSI supplements the Norwich to Tilbury Design and Access Statement (document reference 7.15) and Design Development Report (document reference 5.15).

The DASSI provides information on the site location, context and relevant site-specific information for the permanent infrastructure. Examples of existing infrastructure provides images showing existing substations and CSE compounds to highlight variation in design.

The report sets out an explanation of the components of the permanent infrastructure and their operational purpose. The design principles and scope for variation sets out where there is scope for flexibility in detailed design and elements of scope where there is not. National Grid has reviewed the proposed colour palette for the Gas Insulated Switchgear (GIS) building at Tilbury North Substation and landscaping at the CSE compounds and new substations / substation extension, as there is scope to vary these design details.

The report concludes with setting out the DCO requirements and approval process, and details of how the submission made by National Grid's final design must have regard to the DASSI.

This report provides design principles that should be applied to and details having regard to the DASSI, including all permanent buildings, unless otherwise agreed with the relevant planning authority. This is secured through compliancy Requirement 12. There is also Requirement 11 to agree the final colour of the GIS and gas insulated hall annex with the Local Planning Authority colour of buildings at Tilbury North Substation, which must be submitted for approval to the relevant Local Planning Authority (refer to Schedule 3 of the draft DCO (document reference 3.1) for more information), should the Secretary of State be minded to approve the DCO that grants the development consent.

1. Introduction

1.1 Purpose of this DASSI

1.1.1 This Design Approach for Site Specific Infrastructure (DASSI) document has been prepared in support of the application for development consent for the Norwich to Tilbury project (referred to as 'the Project'). It sets out the approach to the design of site-specific infrastructure of non-linear works; this includes the proposed substations, works to substations and Cable Sealing End (CSE) compounds as shown in Figure 4.2: Proposed Project Design – Permanent Features (document reference 6.4.F2).

1.1.2 This document supplements the Design and Access Statement (DAS) (document reference 7.15) and Design Development Report (DDR) (document reference 5.15).

1.1.3 The DAS (document reference 7.15) explains the legislative, policy and physical context within which the design proposals have evolved and the way in which that context has influenced the final proposals. The DAS sets out the design principles applied by National Grid and summarises the approach to good design and describes how the proposals have been influenced by consultation and informed by the design principles.

1.1.4 The DAS and the 2023 DDR (National Grid, 2023), 2024 DDR (National Grid, 2024) and 2025 DDR (document reference 5.15) are the primary documents referred to for information on the Project's approach to good design and provides an explanation of the main changes in the route alignment, infrastructure siting and technology incorporated into the Project following review and consideration of feedback received since the 2022 and 2023 non statutory consultations and statutory consultation in 2024. The document also addresses some of the main changes requested and those changes raised by a large number of respondents which may have led to a change of the Project design.

1.1.5 The DASSI document focuses on the design principles that led to the development of the layout of the non-linear permanent infrastructure on specific named sites within the geographical areas that the Project has been divided into. These areas are set out below.

1.1.6 The Project has been broken down into eight sections based largely on Local Authority boundaries. The eight sections are described below and presented within the Environmental Statement Figure 1.1: Site Location Plan and Project Sections (document reference 6.1.F1).

- Section A – South Norfolk Council
- Section B – Mid-Suffolk District Council
- Section C – Babergh District Council, Colchester City Council and Tendring District Council
- Section D – Colchester City Council
- Section E – Braintree District Council

- Section F – Chelmsford City Council and Brentwood Borough Council
- Section G – Basildon Borough Council and Brentwood Borough Council (and part of Chelmsford City Council)
- Section H – Thurrock Council.

1.1.7 The permanent site-specific infrastructure of non-linear works included in the Project have been listed below, including which section of the Project they are located within:

- Seven new CSE compounds (each with a permanent access) to connect the overhead lines to the underground cables and visa versa:
  - Wenham Grove (Section C)
  - Great Horkesley (East Anglia Connection Node (EACN) Side) and Great Horkesley (Tilbury Side) (Section D)
  - Fairstead (EACN Side) and Fairstead (Tilbury Side) (Section E)
  - Tilbury North (Tilbury Side) and Tilbury North (Warley Side) (Section H)
- A new 400 kilovolt (kV) substation on the Tendring Peninsula, referred to as the EACN Substation (with a new permanent access) (Section C). This is proposed to be an Air Insulated Switchgear (AIS) substation.
- A new 400 kV substation to the south of Orsett Golf Course in Essex, referred to as the Tilbury North Substation (with a new permanent access) (Section H). This is proposed to be a Gas Insulated Switchgear (GIS) substation.
- Additional interfaces including:
  - Connection works into the existing Norwich Main Substation (Section A)[1]
  - Substation extension at the existing Bramford Substation (Section B). The works comprise the installation of 400 kV Full Line Tension (FLT) gantries up to 15 m in height and associated connection/ancillary works within the substation boundary.

1.1.8 This document outlines the design principles that can be taken forward into the detailed design, sets out the approach to the design of site-specific infrastructure of non-linear works, and details those elements of the design which have some flexibility in their appearance and those that do not. The document sets out the approach to which the detailed design will have regard to this and secured through requirements.

1.2 Structure of the DASSI

1.2.1 The DASSI document has been structured to include the following chapters:

- Chapter 1: Introduction – Outlines the purpose of this document, provides background information and design context for the permanent site-specific infrastructure of non-linear works

[1] An extension to Norwich Main substation was approved by South Norfolk Council in September 2024 (Planning reference 2024/1336) to accommodate new infrastructure and additional customer bays.

- Chapter 2: Site Location and Context – Images and descriptions of the sites involved in the Project and relevant site-specific information
- Chapter 3: Examples of Existing Infrastructure – Images showing existing substations and CSE compounds to highlight variation in design
- Chapter 4: DCO Design and Operational Function – Explanation of the components included in the design and their operational purpose
- Chapter 5 – Design Principles and Scope for Variation in Developing the Detailed Design – Design principles and elements of scope that are flexible and those that are not
- Section 6: DCO Requirements and Approval Process – Details of how the final design must have regard to the DASSI

1.2.2 When the different types of permanent infrastructure are discussed, the report has been structured to group these together rather than run geographically along the route. This results in all the CSE compounds, substations and then substation works being discussed in turn.

1.3 Background to the Project

1.3.1 The Project is a proposal by National Grid to upgrade the electricity transmission system in East Anglia between Norwich and Tilbury, comprising:

- A new 400 kV electricity transmission connection of approximately 180 km overall length from Norwich Main Substation to Tilbury Substation via Bramford Substation, a new EACN Substation and a new Tilbury North Substation, including:
  - Approximately 159 km of new overhead line supported on approximately 509 pylons, either standard steel lattice pylons (approximately 50 m in height) or low height steel lattice pylons (approximately 40 m in height) and some of which would be gantries (typically up to 15 m in height) within proposed CSE compounds or existing or proposed substations
  - Approximately 21 km of 400 kV underground cabling, some of which would be located through the Dedham Vale National Landscape (an Area of Outstanding Natural Beauty (AONB[2])
- Up to seven new CSE compounds (with permanent access) to connect the overhead lines to the underground cables
- Modification works to connect into the existing Norwich Main Substation and a substation extension at the existing Bramford Substation
- A new 400 kV substation on the Tendring Peninsula, referred to as the EACN Substation (with a new permanent access). This is proposed to be an AIS substation

[2] National Landscape is the rebranded name of an Area of Outstanding Natural Beauty (AONB) from 22 November 2023

- A new 400 kV substation to the south of Orsett Golf Course in Essex, referred to as the Tilbury North Substation (with a new permanent access). This is proposed to be a GIS substation
- Modifications to the existing National Grid Electricity Transmission overhead lines to facilitate the connection of the existing network into the new Tilbury North Substation to provide connection to the Tilbury Substation
- Ancillary and/or temporary works associated with the construction of the Project.

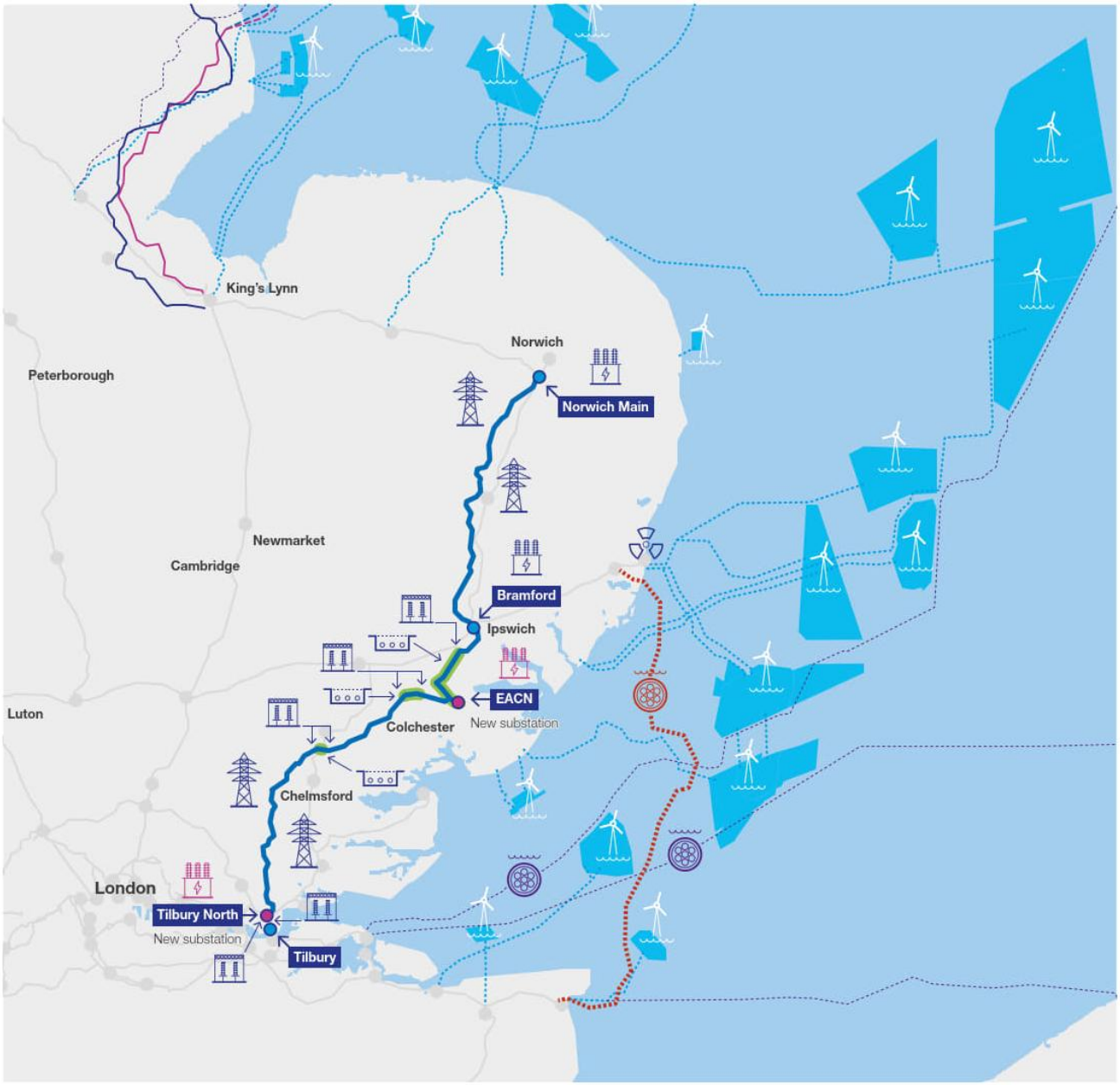
1.3.2 In addition, third party utilities diversions and/or modifications would be required to facilitate the construction of the Project. There would also be land required for environmental mitigation and Biodiversity Net Gain (BNG).

1.3.3 As well as the permanent infrastructure, land would also be required temporarily for construction activities including, for example, working areas for construction equipment and machinery, site offices, welfare, storage and temporary construction access.

1.3.4 The Project would be designed, constructed and operated in accordance with applicable health and safety legislation. The Project will need to comply with design safety standards including the Security and Quality of Supply Standard (SQSS), which sets out the criteria and methodology for planning and operating the National Electricity Transmission System (NETS). This informs a suite of National Grid policies and processes, which contain details on design standards required to be met when designing, constructing and operating assets such as those proposed for the Project.

1.3.5 Image 1.1 shows the locations of the substations, CSEs and overhead lines proposed for the project.

Image 1.1 Geographical Context- Schematic Map



Overview of the Operational Requirements for CSE Compounds

1.3.6 The Project will consist of up to seven CSE compounds, the individual site contexts for each are described in more detail below. CSE compounds are areas accommodating equipment required to allow for the transition from overhead lines to underground cables. They are needed where a section of underground cable carrying electricity ends and the circuit continues onto an overhead line (or visa versa). The CSE compounds typically occupy a footprint of approximately 64 m x 90 m for a 400 kV double circuit. Each CSE compound would have two gantries which are supporting structures (typically 26 m wide with a maximum height of 15 m, with an upward vertical limit of deviation (LoD) of 10%) which connect to the CSE compound via high voltage busbars and other high voltage electrical equipment.

1.3.7 In addition, a small portable relay room (PRR) may be required[3] in each compound, this houses the electrical protection and control equipment if needed. The proposed footprint allows sufficient land to accommodate one PRR per compound. The size of the PRR is the standard National Grid 9 m x 4 m facility.

1.3.8 The CSE compounds have a 15 m maximum height and an upward vertical LoD of 10%. There is no defined downwards vertical LoD for the works to CSE compounds. The lateral and longitudinal LoD are generally 50 m on all sides of the proposed location but vary locally depending on features (hedgerows, watercourses).

1.3.9 The CSE compounds will consist of two circuits with the below equipment:

- 400 kV CSEs (three cables per phase configuration)
- 400 kV surge arresters
- 400 kV earth switches
- Landing FLT Gantry/Low Duty Gantry – 26 m wide
- Post insulators
- PRR (if required)
- Category 3 fence

1.3.10 An electricity supply from a Local Distribution Network Operator (DNO) is not usually required to conventional CSE compounds, especially because such compounds are usually sited in remote areas. No supply is envisaged to be required for any of the CSE compounds proposed as part of this Project. Should a power source be required in the future solar power would be the preferred source.

Fencing

1.3.11 Each compound would be surrounded by security fencing, typically 4 m high, to protect the equipment. No specific requirements are needed for the security fencing around the new CSE compounds, therefore fencing has been designed as Category 3. Category 3 security fencing refers to perimeter security fencing used where full security fencing is not deemed to be required (for example, full security fencing is required at substations) while still meeting the required safety and security requirements.

1.3.12 There would be a minimum 2 m clearance zone around the internal side of the security fence to allow maintenance and access. Some equipment within the

[3] Currently there is no locally placed Protection and Control equipment however should this be required the design makes provision for a local PRR.

compound will require a greater separation distance from the fencing, for example the gantry must have at least a 3.1 m clearance distance.

Lighting

1.3.13 Operational lighting is not required for the CSE compounds; however, task lighting may be required when undertaking specific maintenance activities.

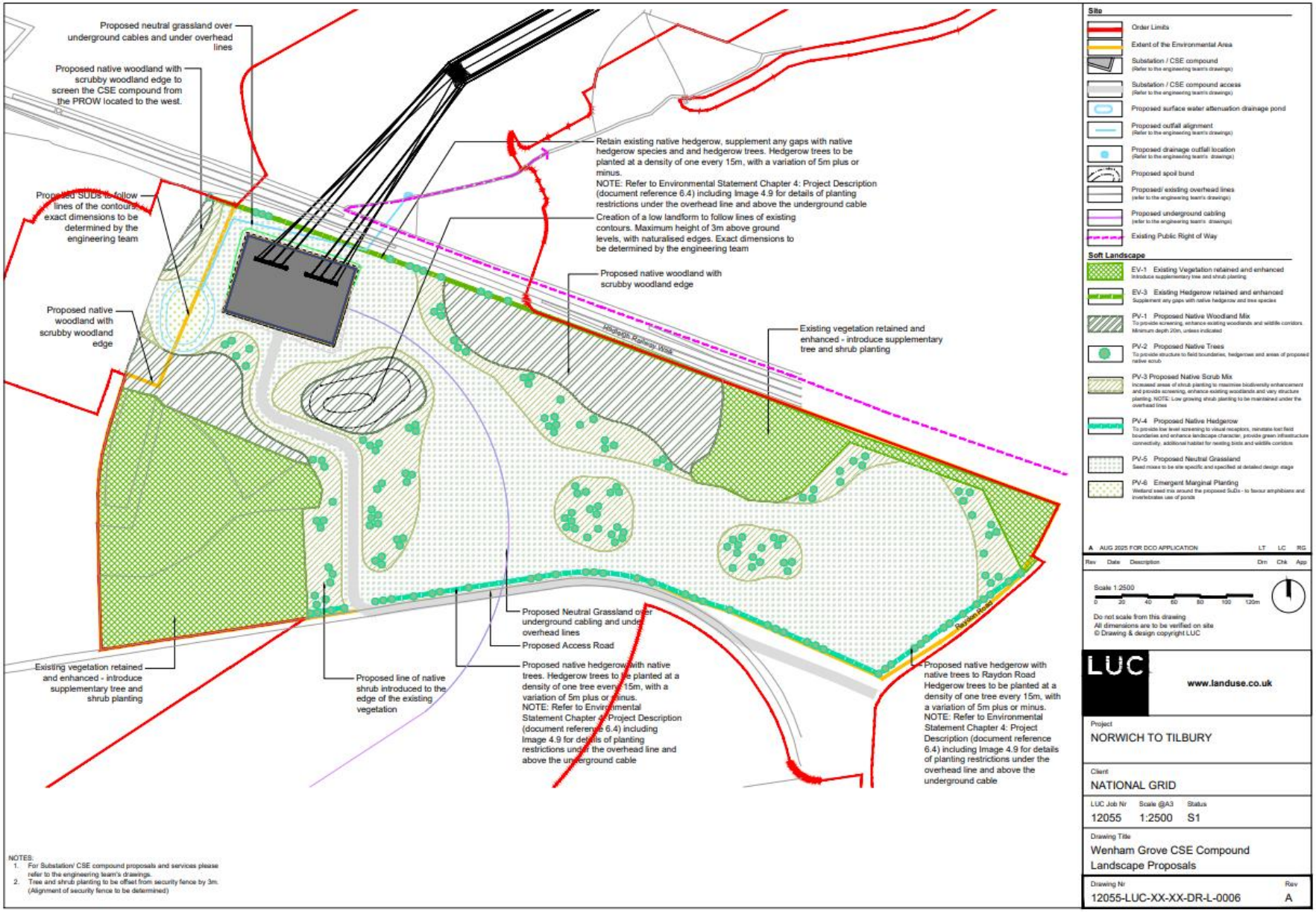
Access

1.3.14 There would be dedicated temporary access for the construction works. A separate permanent access road will be installed to connect each CSE compound to the local road network providing access for operation and maintenance activities. It is assumed these would be constructed using a bound solution (asphalt or concrete pavement); however, this would be determined at the detailed design stage. Access would be typically made to the CSE compounds and substations by foot, using 4 x 4 vehicle, or tractor and trailer.

Wenham Grove CSE Compound

1.3.15 A CSE compound is required to the north of the Dedham Vale National Landscape at Little Wenham to enable the transition from overhead line to underground cable. Drawing 13 of the Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (document reference 2.6.1) shows the indicative layout of the proposed CSE compound. There will be 'Environmental Areas' located around the new/ extended National Grid permanent assets (i.e. CSE compounds and substations) shown in images 1.2-1.9 below. An indicative landscape design has been created for these areas (Appendix D: Outline Landscape Proposals in document reference 7.4). The proposed Environmental Area is shown on Image 1.2 (Appendix D of the Outline Landscape and Ecological Mitigation Plan (LEMP) (document reference 7.4)). A permanent maintenance access is proposed from the east; the LoDs allow for access via a new bellmouth or the upgrading of the existing bellmouth. The design of this will be agreed in consultation with the relevant highway authority as part of an application for formal approval of highway works, in accordance with Schedule 15 (Protective Provisions - Local Highway Authorities) to the DCO (document reference 3.1). The Order Limits also allow for the removal and reinstatement of the unused existing access road and bellmouth, if not used for permanent maintenance access, following completion of the works.

Image 1.2 Wenham Grove CSE Compound (Source: Appendix D of the Outline LEMP (document reference 7.4))



Great Horkesley (EACN Side) and Great Horkesley (Tilbury Side) CSE Compounds

1.3.16 There has been careful siting of the CSE compounds which are proposed within areas of close proximity to the Dedham Vale National Landscape. These components have been carefully sited taking into consideration Horlock Rules including the potential for landscape and visual effects, and in the setting of the Dedham Vale National Landscape. A CSE compound (Great Horkesley (EACN Side) is required to the east of Great Horkesley to enable the transition from overhead line to underground cable. A permanent maintenance access is proposed from Boxted Road to the north to serve the Great Horkesley (EACN Side) CSE compound.

1.3.17 A second CSE compound Great Horkesley (Tilbury Side) is required to the west of Great Horkesley to enable the transition from underground cable back to overhead line towards Tilbury (see Image 1.4). A permanent maintenance access is proposed from Crabtree Lane to the east to serve the Great Horkesley (Tilbury Side) CSE compound; the temporary construction bellmouth on Crabtree Lane will be retained and modified for permanent operational usage.

1.3.18 Drawings 16 and 17 of the Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (document reference 2.6.1) show the indicative layout of the proposed CSE compounds. The proposed Environmental Areas are shown on Image 1.3 and Image 1.4 (Appendix D of the Outline LEMP (document reference = 7.4)).

Image 1.3 Great Horkesley (ECAN Side) Compound (Source: Appendix D of the Outline LEMP (document reference 7.4))

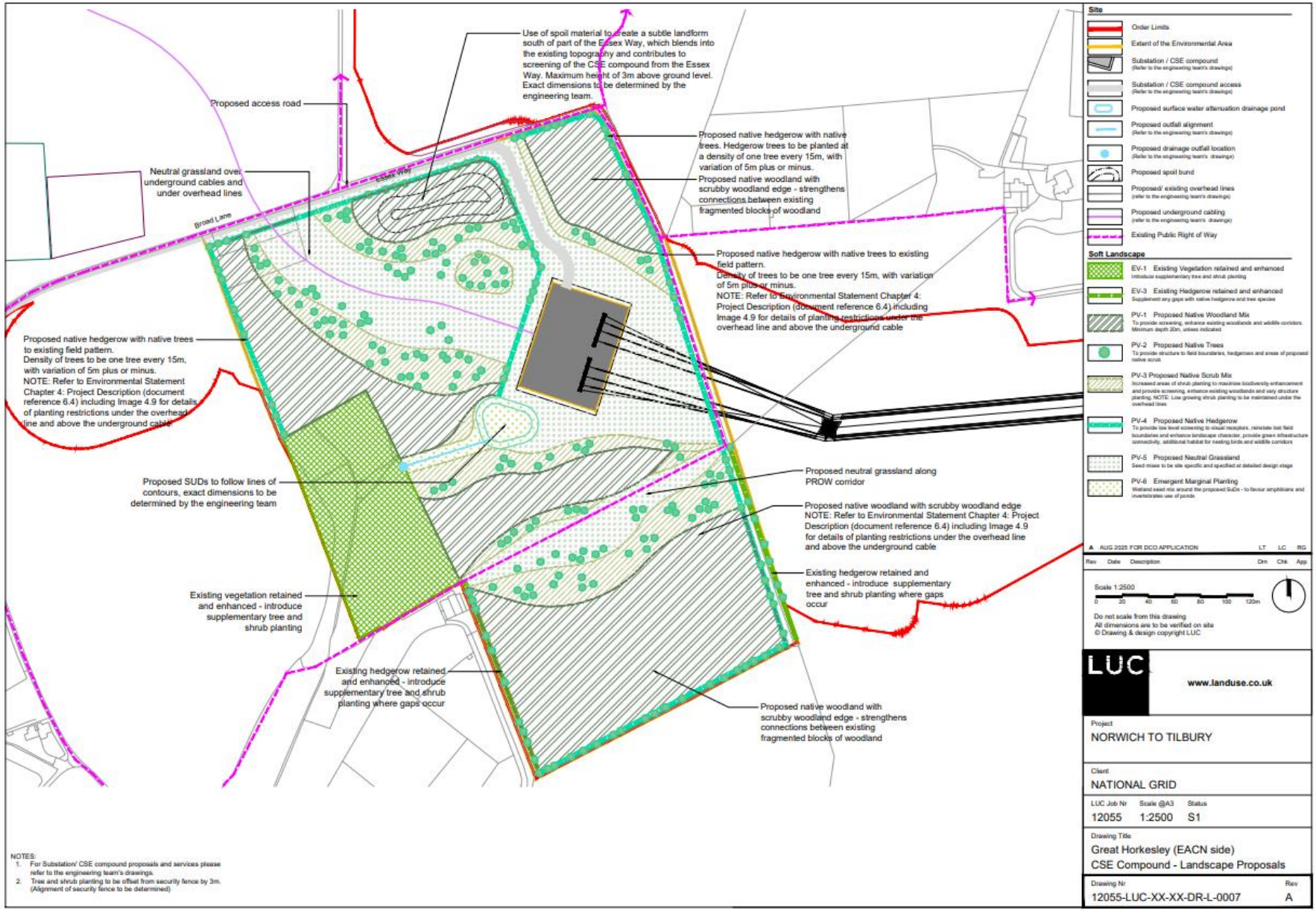
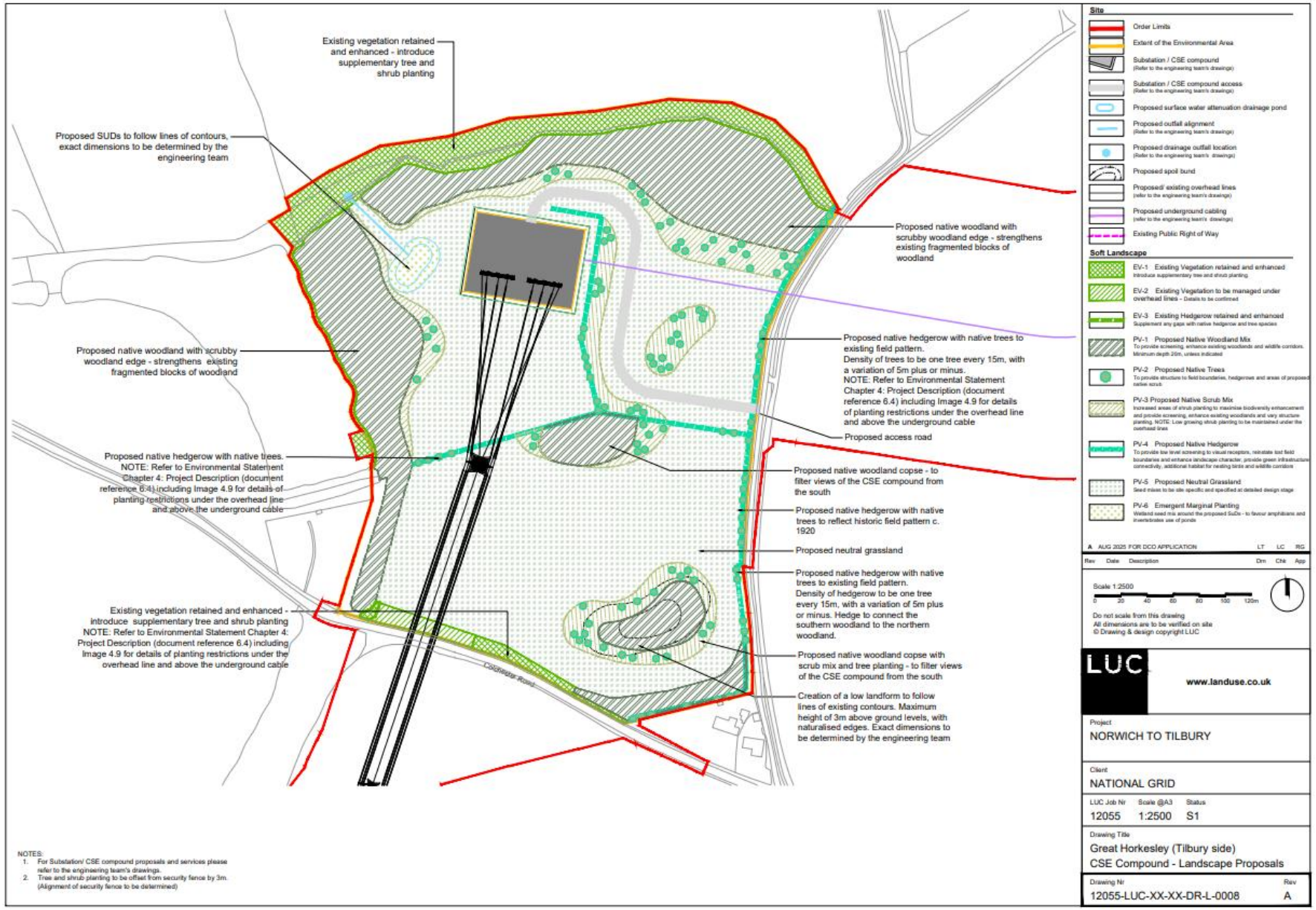


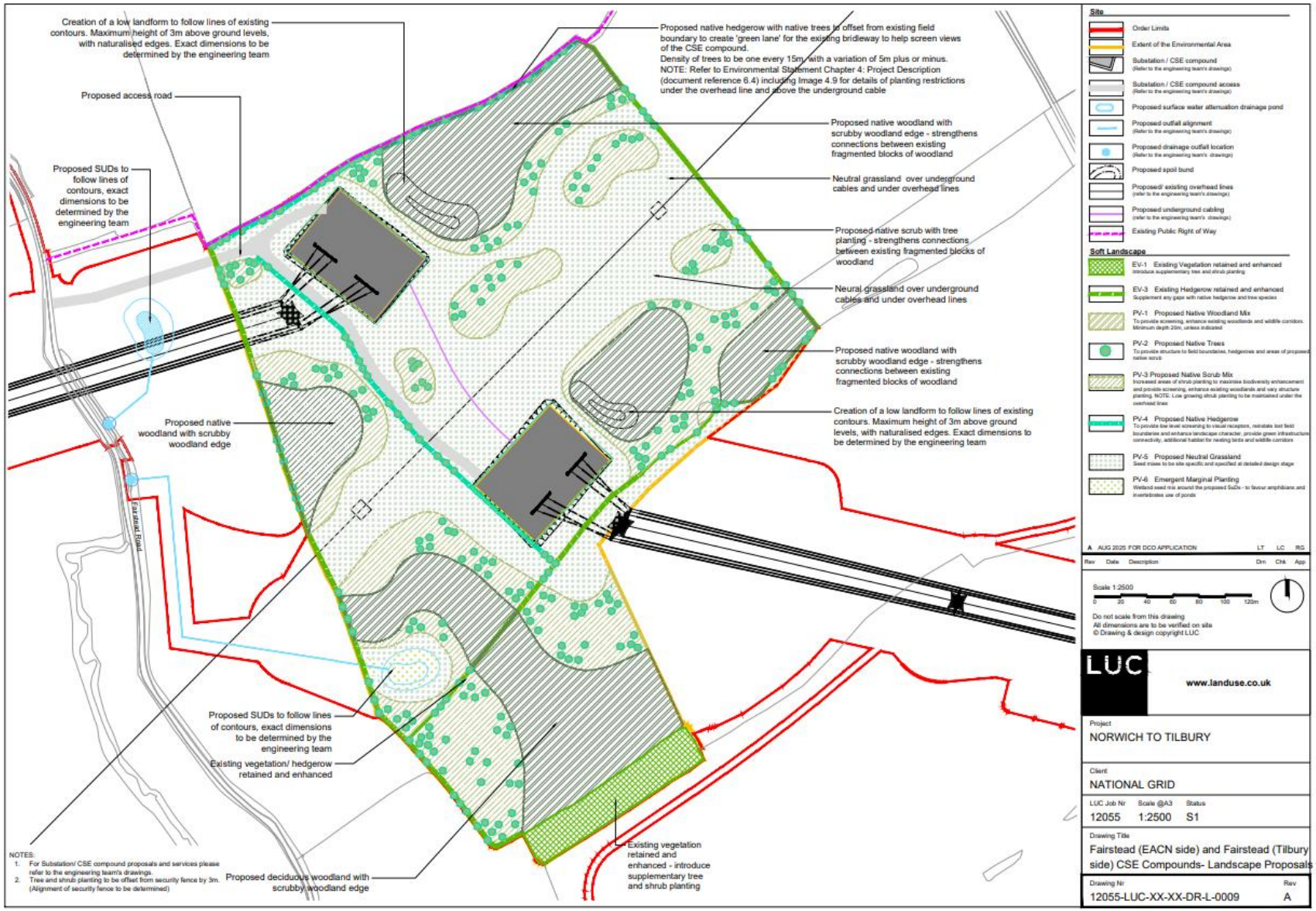
Image 1.4 Great Horkesley (Tilbury Side) Compound (Source: Appendix D of the Outline LEMP (document reference 7.4))



Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds

1.3.19 A short section of the proposed route requires undergrounding beneath an existing 400 kV overhead line in the vicinity of Fairstead, between pylons TB115 and TB110. Drawings 18 and 19 of the Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (document reference 2.6.1) show the indicative layout of the proposed CSE compounds. The proposed Environmental Area is shown on Image 1.5 (Appendix D of the Outline LEMP (document reference 7.4)). Two CSE compounds are required to facilitate the transition of this short section of cable from overhead line to underground cable back to overhead line. A permanent maintenance access is proposed from the west of the compounds, off Fairstead Road. A permanent access road will link the two CSE compounds.

Image 1.5 Fairstead (EACN Side) and Fairstead (Tilbury Side) Compounds (Source: Appendix D of the Outline LEMP (document reference 7.4))



Tilbury North (Tilbury Side) and Tilbury North (Warley Side) CSE Compounds

1.3.20 To enable integration of the new Tilbury North Substation into the existing transmission network, modifications are required to parts of the local overhead line infrastructure. Drawings 16 and 17 of the Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (document reference 2.6.1) show the indicative layout of the proposed Tilbury North substation. The proposed Environmental Area is shown in Image 1.6 and Image 1.7 (Appendix D of the Outline LEMP (document reference 7.4)). Image 1.6 shows the Environmental Area if Lower Thames Crossing (LTC) is not constructed. If LTC is constructed the landscape around the substation and CSE compounds would change to include the road and associated earthworks, infrastructure and LTC mitigation shown in Image 1.7.

1.3.21 Image 1.6 and Image 1.7 show the area south of the proposed new Tilbury North Substation, alterations to the existing ZB route that comprise amended pylon locations, two proposed new CSE compounds and a section of underground cable between the CSE compounds. In addition, the existing YYJ route is shown with alterations to the locations of existing pylons and new pylons to facilitate a connection into Tilbury North Substation and exiting the new substation to provide the onward connection to the existing Tilbury connection.

1.3.22 The LoDs in this location around the underground cable, existing and proposed new locations of YYJ and ZB pylons and the two CSE compounds has been widened to allow flexibility to allow for design refinements due to uncertainties regarding other projects (including the LTC project, housing developments and aggregate facilities). There are different forms that this could take with overhead line or cable configurations for the turn in and out of the new Tilbury North Substation with variable positioning of necessary CSE compounds - for example changes may include a double CSE compound arrangement and undergrounding of the YYJ route into the proposed new Tilbury North Substation as an alternative to the undergrounding of the ZB route as described in paragraph 1.3.21 above.

1.3.23 The different positioning and configuration of modifications to the existing overhead line transmission infrastructure as well as in the technology adopted (overhead line or underground cable) all present different combinations of implications for the Project, third party projects and in respect of National Grid’s duties. Given this uncertainty and pending the conclusion of ongoing discussions with landowners and developers (to be captured within Statements of Common Ground), flexibility in the proposals is being retained.

1.3.24 Plans showing the Environmental Areas for the alternative connection scenario both with and without the LTC project involving a double CSE compound arrangement and the replacement of a section of the YYJ with underground cable have not been provided within this document or the Outline LEMP (document reference 7.4). Given the ongoing discussions which are taking place as detailed in the DDR (document reference 5.15) which will have an influence of the final detail of the design solution.

Image 1.6 Tilbury North (Tilbury Side), Tilbury North (Warley Side) CSE Compounds and Tilbury North Substation without Lower Thames Crossing (Source: Appendix D of the Outline LEMP (document reference 7.4))

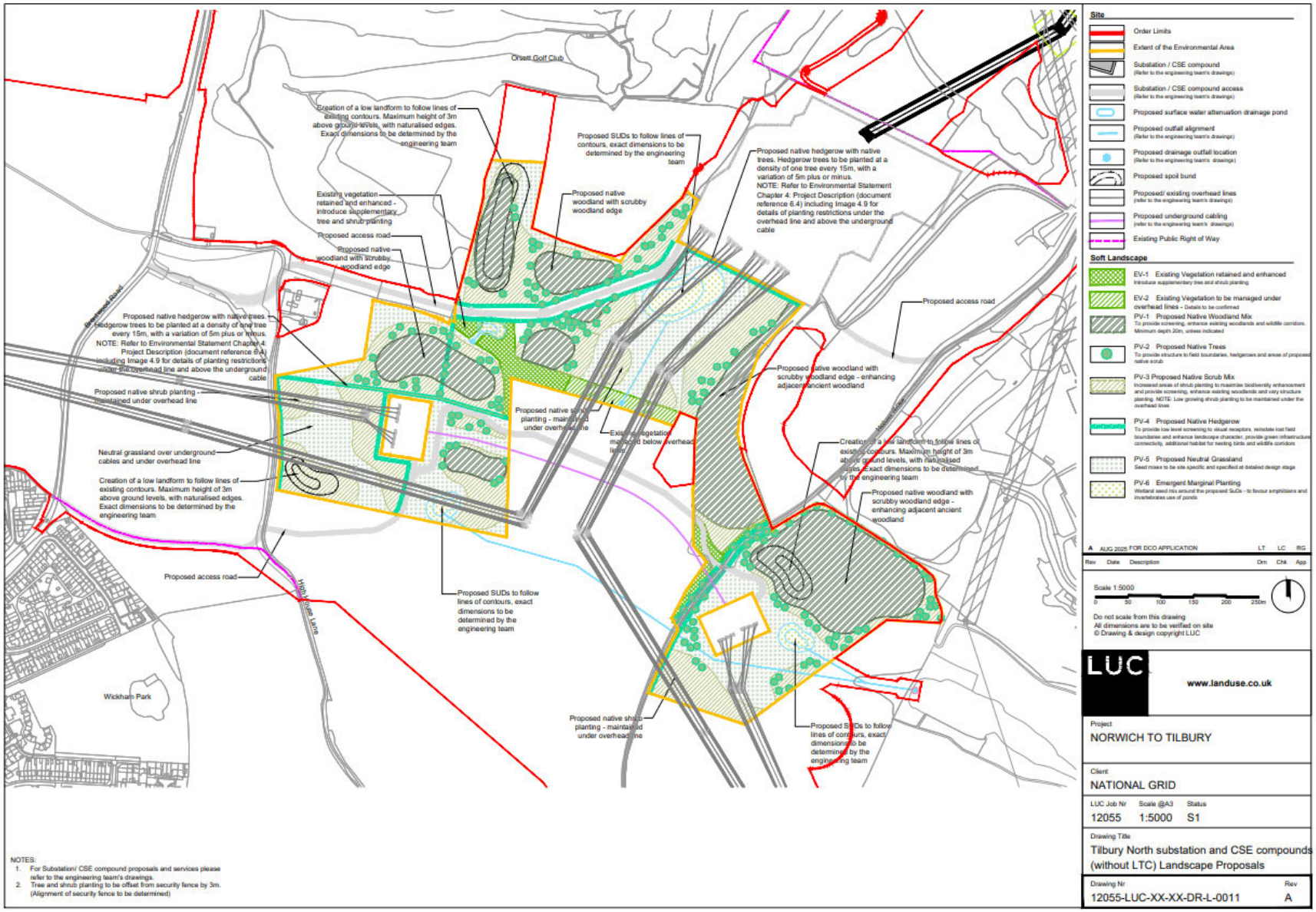
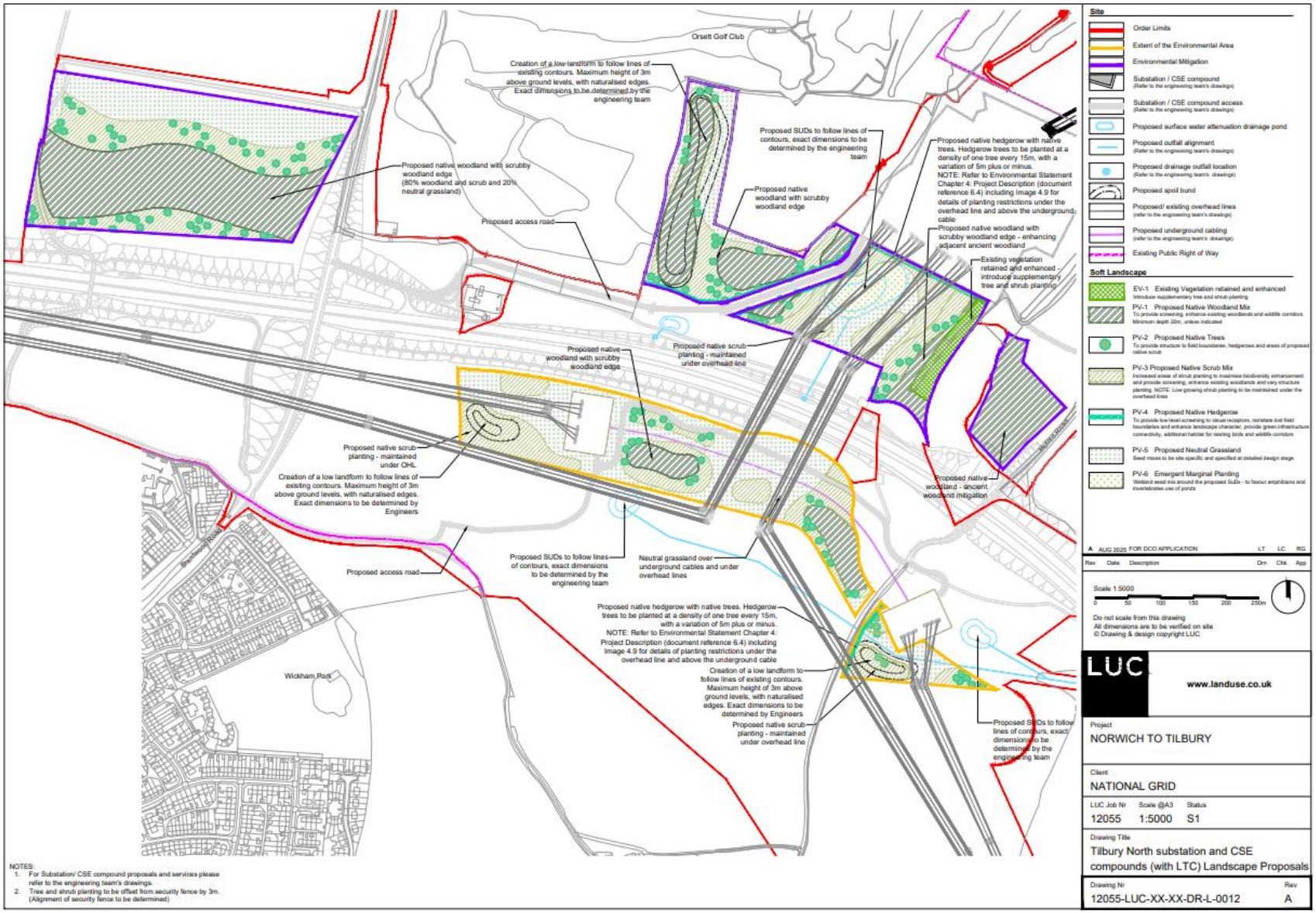


Image 1.7 Tilbury North (Tilbury Side), Tilbury North (Warley Side) CSE Compounds and Tilbury North Substation with Lower Thames Crossing mitigation (Source: Appendix D of the Outline LEMP (document reference 7.4))



EACN Substation

1.3.25 The EACN Substation is a new 400 kV substation that will be built on the Tendring Peninsula near Ardleigh between the existing Bramford Substation and the proposed Tilbury North Substation. The site is adjacent to the existing UK Power Networks Lawford 132 kV substation. Drawings 14 and 15 of the Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (document reference 2.6.1) show the indicative layout of the proposed substation. The proposed Environmental Area is shown in Image 1.8 (Appendix D of the Outline LEMP (document reference 7.4)). The EACN Substation comprises AIS equipment.

1.3.26 The EACN Substation facilitates the contracted Essex Coast Generation Group including Tarchon Energy Limited Interconnector, and North Falls and Five Estuary offshore wind generation projects by providing a point of connection to the National Grid. The customers have connection agreements that National Grid are required to comply with. These projects are anticipated to make landfall within East Anglia and connect via the eastern side of the substation within their allocated connection bays.

1.3.27 The substation would have an operational footprint of approximately 550 m x 230 m, excluding any requirement for landscaping and cable/overhead line connections. It is assumed that both the substation equipment and gantries would be up to a maximum height of 15 m above the finished ground level and an upward vertical LoD of 10%. The vertical limits (in relation to height) are defined in Article 5 of the DCO and presented in Parameter Tables within the Works Plans (document reference 2.3).

1.3.28 The connection from Bramford Substation to the EACN Substation would enter the EACN Substation via double circuit 400 kV underground cables and would exit the EACN Substation towards the Tilbury North Substation via 400 kV double circuit overhead lines.

1.3.29 The substation will be constructed to National Grid's design standards and will include a number of shunt reactors, AIS equipment, a new central control building, a PRR and other necessary equipment. In addition, several small buildings would be constructed to house electrical equipment, battery storage and workshops, together with suitably sized office/amenity buildings. There is also an area around the EACN proposed for an Environmental Area which will include landscaping and BNG.

Fencing

1.3.30 National Grid technical specification states external substation perimeter fencing must be a minimum of Category 2 fence system. Category 2 includes a fence with an overall height of up to 4 m from base level designed to BS 1722-12:2016 with an electrical pulse fence system installed to the rear (internal) face of the security fence.

Access

1.3.31 A permanent access road between Bentley Road and Ardleigh Road across agricultural land would be constructed to provide access for Abnormal Indivisible Loads required to deliver electrical equipment and to support ongoing operations and maintenance throughout the asset lifetime.

1.3.32 The substation design will include a dedicated car parking area to accommodate staff, visitors, and maintenance personnel. The parking design ensures safe and convenient access to the control building and other key facilities. In line with modern

sustainability practices, the parking area will also be equipped with Electric Vehicle (EV) charging points to support the use of low-emission transport by employees and visitors. The substation would be unmanned on a permanent basis with regular maintenance visits to the substation.

Lighting

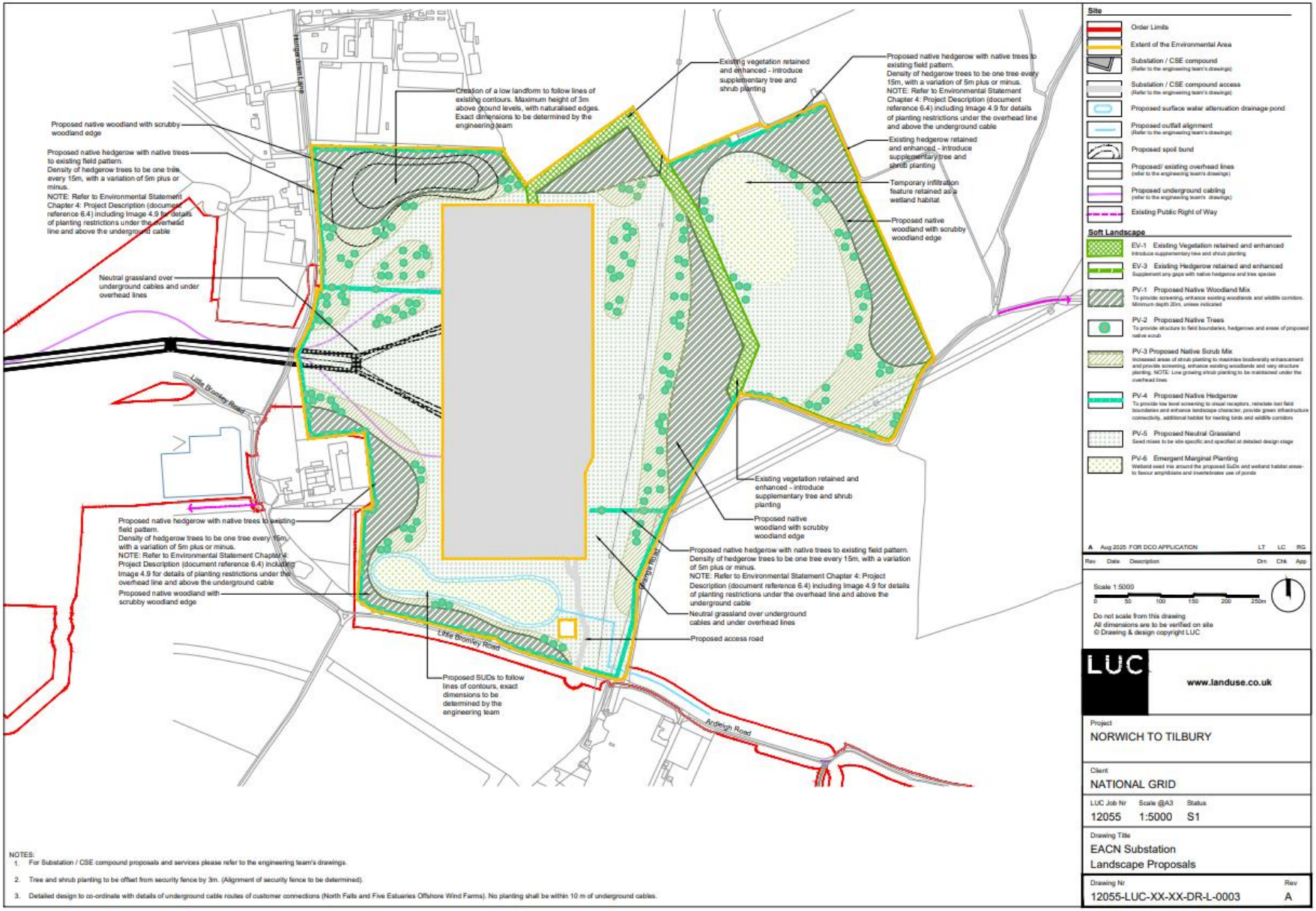
1.3.33 Exterior and interior lighting[4] would be provided at the site to allow for safe movement and the operation (and maintenance) of equipment. Lighting columns would typically be 12.5 m tall. All lighting would be designed in accordance with the appropriate design standards. The position of lighting columns would be subject to detailed design and would be determined by safety and operational requirements. Lighting would be directional and is intended to support safe movement of pedestrians and vehicles around the site (and minimise light spill to the local environment). The lighting would therefore not be on by default, and only whilst there are activities happening at the site as dictated by operational requirements. Additional task lighting may be required when undertaking specific maintenance activities.

1.3.34 Light spillage will be managed by minimising the provision of lighting: keeping to where it is required for tasks, specifying fittings that avoid light spillage, and using controls such that it only comes on when required. This will follow the dark skies strategy: to cut light pollution, its impact on wildlife, prevent wasting electricity, and mitigating visual impact at night. Windows will be fitted with blinds to control light spill if the facility is occupied after dark.

1.3.35 Indicative lux plot plans for the EACN Substation have been provided in Appendix B. The plan provided shows that the 1 lux light spill is a maximum of 19m outside the boundary fenceline.

[4] The maximum illuminance would be approximately 20 lux within the fence line with an approximate maximum illuminance of 10 lux around the perimeter fence line. The minimum average illuminance would be approximately 6 lux, using LED lighting.

Image 1.8 EACN Substation (Source: Appendix D of the Outline LEMP (document reference 7.4)



Tilbury North Substation and Modifications to Overhead Lines

1.3.36 A new 400 kV substation, referred to as the Tilbury North Substation, will be constructed and connected to the existing Tilbury Substation via a modification to the existing 400 kV YYJ overhead line. There are different forms that this could take with overhead line or cable configurations for the turn in and out of the new Tilbury North Substation, with variable positioning of necessary CSE compound arrangement for undergrounding the existing ZB route to enable the YYJ line to connect into and out of the substation or an alternative double CSE compound configuration to underground the YYJ route into and out the proposed new Tilbury North Substation under the ZB line that would be retained as an overhead line. The final configuration of CSE compounds and undergrounding is controlled by Requirement 14. This is sited adjacent to Orsett Golf Course and Rainbow Wood Ancient Woodland.

1.3.37 These alternative connection solutions have been developed in response to technical and stakeholder feedback received during the statutory consultation process, and forms part of the Project. Drawings 20 and 21 of the Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (document reference 2.6.1) show the indicative layout of the proposed substation. The proposed Environmental Area is shown in Image 1.6 and Image 1.7 (Appendix D of the Outline LEMP (document reference 7.4)) As stated above, Image 1.6 and Image 1.7 only show the Environmental Area with and without the LTC project with an overhead line configuration for the turn in and out of the new Tilbury North Substation. The underground cable configuration for the existing YYJ overhead line is not shown on the images within this document.

1.3.38 The decision to construct Tilbury North Substation, as opposed to installing underground cables directly into the existing Tilbury Substation (at the 2024 Statutory Consultation), follows extensive review of technical, environmental, and economic factors. The previously proposed 4.5 km underground cable route running south of Orsett Golf Course to Tilbury Substation was found to present a number of challenges, including potential conflicts with land within the designated Thames Freeport development zone, uncertainty over future land use, the likely requirement to restrict future development over the cable corridor, and associated impacts on economic growth. The site was also extremely congested from other services that connected into Tilbury Substation and presented several challenges with finding a suitable route on the approach into the substation, refer to the DDR (document reference 5.15) for more information.

1.3.39 To avoid these constraints and address consultation feedback, the proposed design eliminates the need for the underground cable section and associated restrictions within the Freeport zone. It also avoids the significantly increased cost, complexity, and land use impacts of constructing a tunnelled connection. The new substation connection via the YYJ overhead line provides the same system reinforcement benefits as a direct connection into the existing Tilbury Substation, with additional system performance benefits under certain demand conditions. Feedback was sought on the siting of Tilbury North Substation with the proposed site being preferred for the reasons set out in the DDR (document reference 5.15).

1.3.40 The Tilbury North Substation will be located 5 km to the north of existing Tilbury Substation close to Orsett. The operational footprint of the new GIS Tilbury North Substation is proposed to be approximately 340 m x 530 m. The substations have 15 m maximum height and an upward vertical LoD of 10%, excluding any

requirement for landscaping and cable/overhead line connections. The vertical limits (in relation to height) are defined in Article 5 of the DCO and presented in Parameter Tables within the Works Plans (document reference 2.3).

1.3.41 It will be constructed to National Grid's design standards and will include a number of shunt reactors, GIS, GIS building, annex building and other necessary equipment. The substation will connect into the existing YYJ 400 kV circuit via overhead lines or cables from the south and to the new EACN Substation via overhead lines from the north. There are different forms that this could take with overhead line or cable configurations for the turn in and out of the new Tilbury North Substation with variable positioning of necessary CSE compounds.

1.3.42 The substation would be unmanned on a permanent basis but with regular maintenance visits. Exterior and interior lighting would be the same as the proposed new EACN Substation. Indicative lux plot plans for the Tilbury North Substation have been provided in Appendix B. The plan provided shows that the 1 lux light spill is a maximum of 16m outside the boundary fenceline.

Fencing

1.3.43 National Grid technical specification states external substation perimeter fencing must be a minimum of Category 2 fence system. Category 2 includes a fence with an overall height of up to 4 m from base level designed to BS 1722-12:2016 with an electrical pulse fence system installed to the rear (internal) face of the security fence.

Access

1.3.44 There are two proposed access options into the new Tilbury North Substation during operation (and maintenance), each of the two access options have two alternatives due to the interaction with third parties. The chosen option will provide both construction and access maintenance. The access options comprise:

- A Primary Access Route (PAR) via Stanford Road (east of the Orsett Cock junction), Buckingham Hill Road and Hoford Road leading to a new access road with two alternative alignments through the aggregate yard so that an appropriate route can be agreed with Clearserve. The alternative routes are:
  - Alignment running mainly along or alongside Hoford Road before crossing the south-western part of the Clearserve site, or
  - Alignment running mainly through the Clearserve site from north-east to south-west.
- A PAR via Brentwood Road leading to a new access road with two alternative alignments which comprise alternatives with and without LTC in place:
  - Without LTC: east to west between Brook Farm and Orsett Golf Club using the existing access to the south of High House Lane, or
  - With LTC: initially a temporary access road to the west of Brentwood Road, crossing Brentwood Road and then running east to west between Brook Farm and Orsett Golf Club. On completion of the LTC Brentwood Road Bridge embankment works and new junction arrangements with High House Lane, access to the substation would be via Brentwood Road and the new junction with High House Lane and then east between Brook Farm and Orsett Golf Club.

1.3.45 Details of the final arrangements in relation to access to the highway will need to be submitted to and approved by the relevant highway authority in accordance with Schedule 15 (Protective Provisions - Local Highway Authorities).

1.3.46 In addition, several small buildings would be constructed to house electrical equipment, battery storage and workshops, together with suitably sized office/amenity buildings.

1.3.47 The substation design will include a dedicated car parking area to accommodate staff, visitors, and maintenance personnel. The parking design ensures safe and convenient access to the control building and other key facilities. In line with modern sustainability practices, the parking area will also be equipped with EV charging points to support the use of low-emission transport by employees and visitors.

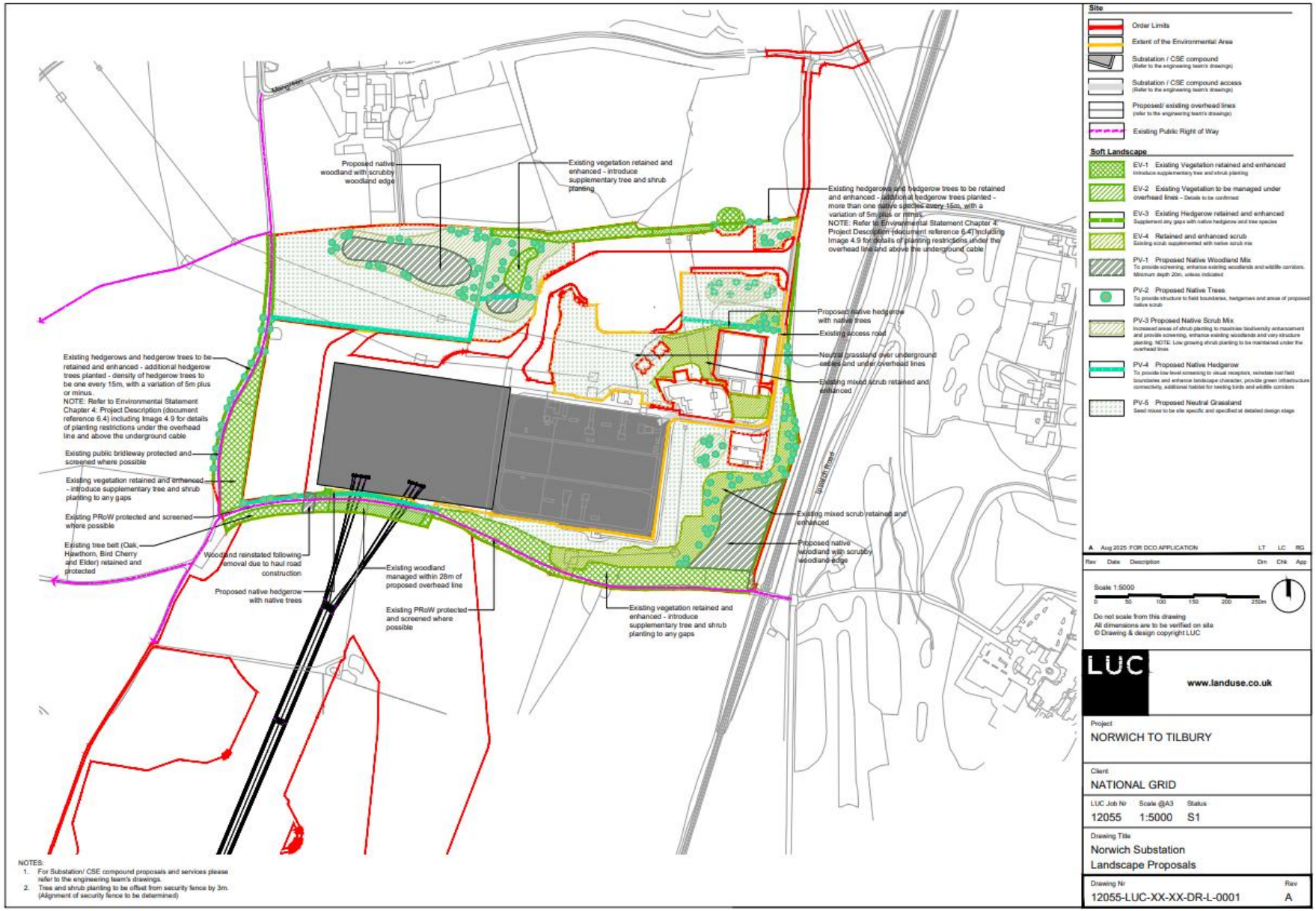
Connection Works at Norwich Main Substation

1.3.48 The Project starts at the existing Norwich Main Substation. Modification works are required to connect into the substation. Figure 4.1: Proposed Project Design (document reference 6.4.F1) and Figure 4.2: Proposed Project Design – Permanent Features (document reference 6.4.F2) show an overhead line alignment exiting the Norwich Main Substation between pylons RG1 and RG7, which are also shown in Image 1.9. The connection works required at Norwich Main Substation would comprise:

- Two new 400 kV FLT gantries (up to 15 m in height) within Norwich Main Substation
- Installation of new, and modifications to existing, apparatus within the footprint of Norwich Main Substation.

1.3.49 A battery storage development is proposed immediately to the south of Norwich Main Substation. The Project alignment was repositioned to the West of Sprow's Pits Woodland with the introduction of an additional pylon to accommodate the battery storage development. The LoD and Order Limits in this location have been widened to the east to allow flexibility to change the alignment should planning consent not be granted for a battery storage facility to the south of the substation.

Image 1.9 Connection works at Norwich Main (Source: Appendix D of the Outline LEMP (document reference 7.4))



Extension to Bramford Substation

1.3.50 This comprises an extension of the existing site compound with use of the existing site access arrangements. The works at the existing 400 kV Bramford Substation consist of overhead line gantries at the north (entry) and south (exit) of the existing site extension where the new double circuit overhead line enters the operational compound, between pylons RG120 and JC1. The extension would be approximately 5550 m^2 in total. This will connect to bays of AIS and then transition through Gas to Air Bushings (from one technology to another) onto runs of Gas Insulated Busbar (GIB). These busbars traverse the site around other existing infrastructure from north to south. The circuits have been designed to incorporate shunt reactors into the network which will be located in the middle of the existing high voltage compound. The equipment required for this will be non sulphur hexafluoride (SF6). SF6 is a synthetic gap that insulates and switches electrical current in switchgear, but it has a high global warming potential. The GIS will be built within the building extensions with only GIB connections visible from outside the building. In addition to the high voltage equipment there will be the inclusion of some amenity buildings to house the additional ancillary equipment associated with the new plant and equipment.

1.3.51 The equipment will be up to a maximum height of 15 m and the proposal would be approximately 300 m x 600 m for the extension works needed at Bramford Substation (including the footprint of the existing substation).

1.3.52 Drawings 11 and 12 of the Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (document reference 2.6.1) show the indicative layout of the proposed substation extension.

1.3.53 The extension to Bramford Substation is not an area identified for mitigation planting over and above reinstatement planting due to the physical limitations around this existing substation after existing development and other planned development. Therefore there is no Environmental Area proposed.

1.3.54 Exterior and interior lighting would allow for safe movement and the operation (and maintenance) of equipment. Lighting would be designed in accordance with the appropriate design standards. Additional task lighting may be required when undertaking specific maintenance activities. Indicative lux plot plans for the extension to Bramford Substation have been provided in Appendix B. The plan provided shows that the 1 lux light spill is a maximum of 24m outside the boundary fenceline.

Drainage

1.3.55 Surface water runoff from all the Permanent Features would be managed using Sustainable Drainage Systems (SuDS) techniques appropriate to local conditions, to meet with the relevant Local Lead Flood Authority discharge requirements. Further detail can be found in the Environmental Statement (ES) Chapter 12 (reference 6.12) and within the Flood Risk Assessment (document reference 7.9).

1.3.56 Measures to mitigate any impacts from construction are included within the Outline Code of Construction Impact (CoCP) (document reference 7.2).

1.4 Design Context

1.4.1 National Grid has published a suite of documents which detail how the design has been developed (based on environmental and engineering assessments, and a wide range of stakeholder feedback) in addition to showing the method used to evaluate National Grid's strategic choices, backcheck and review of these methods and how stakeholder feedback has been considered. A number of potential design changes have been identified and have been carefully considered in the context of environmental and socio-economic constraints and opportunities, engineering feasibility and cost, and planning considerations.

1.4.2 The design development process and decisions that were made are explained in the DDRs (National Grid 2023, 2024 and 2025 (see document reference 5.15)) and Consultation Report (document reference 5.1).

1.4.3 The relationship between the DASSI, DAS and DDR in respect of 'Good Design' is set out in Appendix A. Guide to the Approach on Design that form the Project's design approach.

1.4.4 As detailed in the DAS (document reference 7.15) and DDR (document reference 5.15) the development of the Project design is based on the following national policy context and National Grid's design principles which include the Holford Rules and Horlock Rules to ensure 'good design' throughout the iterative design process. Refer to the DAS (document reference 7.15) for detailed policy analysis.

1.4.5 Paragraph 2.9.16 of EN-5 states that the Holford Rules *'should be embodied in the applicants' proposals for new overhead lines'*. The Holford Rules were first set out in 1959, and subsequently reviewed by National Grid in 1992. They have become accepted within the electricity transmission industry as the basis for defining overhead transmission line routeing. National Grid employs the Holford Rules to inform the design and routeing of all new overhead line projects, including the Project. Paragraph 2.9.18 of EN-5 states that the Horlock Rules *'guidelines for the design and siting of substations…should be embodied in the applicants' proposals for the infrastructure associated with new overhead lines'*. The Horlock Rules were established in 2009 by National Grid in pursuance of its duties under Schedule 9 of the Electricity Act.

1.4.6 National Grid devised the Horlock Rules (National Grid, 2009) in 2003 and updated them in 2009 in pursuance of the duties under Schedule 9 of the Electricity Act 1989. The Horlock Rules provide guidelines for the siting and design of new substations, or substation extensions, to avoid or reduce the environmental effects of such developments. They also concern the siting of CSE compounds. They facilitate the consideration of environmental factors and amenity within the design and siting of new substations and CSE compound infrastructure. Some of the key guidelines have been summarised below:

- In the development of system options including new substations, consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements against the consequential environmental effects, in order to avoid as far as possible adverse effects
- Siting of substations, CSE Compounds and line entries should seek to avoid areas of the highest amenity, cultural or scientific value by the overall planning of the system connections

- Areas of local amenity value, important existing habitats and landscape features should be protected as far as reasonably practicable
- Siting of substations, extensions and associated proposals should take advantage of the screening provided by landform and existing features and the potential use of site layout and levels
- Proposals should keep visual, noise and other environmental effects to a reasonably practical minimum
- Land use effects of the proposal should be considered when planning the siting of substations or extensions
- In the design of new substations or line entries, early consideration should be given to the options available for terminal pylons, equipment, buildings and ancillary development appropriate to individual locations
- Space should be used effectively to limit the area required for development consistent with appropriate mitigation measures and to minimise the adverse effects on existing land use and rights of way, while also having regard to future extension of the substation
- Design of access roads, perimeter fencing, earth shaping, planting and ancillary development should form an integral part of the site layout and design to fit in with the surroundings
- In open landscape especially, high voltage line entries should be kept, as far as possible, visually separate from low voltage lines and other overhead lines so as to avoid a confusing appearance
- The inter-relationship between pylons and substation structures and background and foreground features should be studied to reduce the prominence of structures from main viewpoints. Where practicable, the exposure of terminal pylons on prominent ridges should be minimised by siting pylons against a background of trees rather than open skylines.

EACN Substation

1.4.7 The evolution of the selection of the site of the EACN was described in the Preliminary Routeing and Siting Study Report (2022) and balances factors relating to substation aspects (Horlock Rules) with factors relating to the electrical connections to them (for overhead lines this is the Holford Rules) as well as planning policy and National Grids various duties. This was developed and considered further in the DDRS (National Grid 2023, 2024 and 2025). In summary terms, a more inland location was favoured because of the effects that would have arisen from the two overhead lines down the Tendring peninsula that would have been most likely to make the necessary two points of connection (as the area is not a nationally designated landscape the use of underground cable is not likely).

1.4.8 The specific siting of the EACN within the preferred area was then informed by consideration of the Horlock Rules and in particular the selection of a site benefitting from the presence of some existing screening vegetation. In response to feedback we have also considered locations further inland including to the west of the A12. As already described, decision making is informed by changes in the 400 kV connection as well as changes required to the customer connections to reach a balanced decision. Various constraints to routeing, as explained in subsequent paragraphs of

the 2025 DDR (document reference 5.1), require additional corridors through the National Landscape to be used to extend to a more inland location. Whilst this reduces some effects to some receptors, on balance we do not consider these justify the additional effects on the National Landscape nor restrictions on future system flexibility. For further details refer to the 2025 DDR (document reference 5.1).

Tilbury North Substation

1.4.9 The evolution of the site selection for Tilbury North Substation was described in the DDR Addendum for Proposed Changes at Tilbury Connection. The Horlock Rules requires consideration to be given to the land use effects of the proposal when planning the siting of substations or extensions. In March 2023 the Thames Freeport received final government approval including up to £25 million seed funding from the government and potentially hundreds of millions in locally retained business rates to drive growth in the UK's advanced manufacturing, biomanufacturing, logistics, and low carbon industries. Whilst National Grid had originally considered that opportunities for co-existence with the Freeport, it became apparent following the formal feedback received on the 2024 statutory consultation, that the land use restrictions and technical challenges presented at the Freeport site, an alternative means of connecting into Tilbury would be preferred. A site selection and comparative appraisal was undertaken for alternative sites, informed by technical, environmental, socio-economic, programme and cost factors and evaluated in the context of guidance from the Holford and Horlock Rules. This resulted is the chosen option for Tilbury North Substation as detailed in the 2025 DDR (document reference 5.15).

AIS and GIS design

1.4.10 Both AIS and GIS substations contain the same compartments and components as each other; the main difference lies with the means of insulation. An AIS system (such as is proposed at the EACN Substation) is the normal starting position (on the basis of lower cost and relatively greater flexibility for future expansion of sites) and largely uses air as an insulator between electrical conductors and earth. GIS substations (such as is proposed at Tilbury North) are self-contained systems that largely use a gas with much better insulating properties than air as an insulator. This is particularly beneficial in locations where risk of contamination and its effects on maintenance are better managed with GIS solutions. The use of GIS solutions also allows the high voltage equipment to be much closer together, as it is not reliant on just air for insulation, enabling the substation to have a much smaller footprint than an AIS solution, which may be beneficial where land use pressures and land costs are high.

1.4.11 Key design features of GIS substations are the compact design, higher reliability, greater resilience and minimal maintenance. AIS substations provide a lower cost option with more flexibility to future and additional system requirements; the design however has a much greater land requirement. There are benefits and disbenefits of both technology solutions, for example although GIS substations have a smaller footprint, they are not always the most appropriate design solution in the context of individual landscapes. GIS substations are in large industrial looking buildings that may be more difficult to screen within the landscape. The design merits for each option have been assessed and taken into account in the design process for the EACN and Tilbury North Substations. Further details are provided in the DDR (document reference 5.15) and Chapter 5 below.

Limits of Deviation

1.4.12 The Order Limits include LoDs which represent the maximum deviation for permanent infrastructure, such as the CSE compounds, and new substations and substation extensions. This allows for adjustment to the final positioning of Project features to avoid localised constraints or unknown or unforeseeable issues that may arise.

1.4.13 As recognised in guidance provided by the Planning Inspectorate (Advice Note Nine using the Rochdale Envelope), a necessary and proportionate degree of flexibility often needs to be incorporated into the design of proposed development so that unforeseen issues that are encountered after a development has been consented can be dealt with. For example, previously unidentified poor ground conditions may require development to be re-sited for geotechnical reasons.

1.4.14 Therefore, to allow for this, new infrastructure would be constructed within specified LoDs which identify a maximum distance or measurement of variation within which the works must be constructed. These comprise lateral and longitudinal LoD (i.e., on the ground) as shown on the Works Plans (document reference 2.3) and vertical limits (in relation to height) as defined in Article 5 of the DCO and presented in Parameter Tables within the Works Plans (document reference 2.3). The location and orientation of the permanent infrastructure of this Project could be located anywhere within the LoDs, as defined on the Works Plans (document reference 2.3) (unless a commitment has been made to restrict the LoDs, – details of which are outlined within the Outline Code of Construction Practice (CoCP) (document reference 7.2)).

1.4.15 The location and orientation of the CSE compounds, new EACN Substation and new Tilbury North Substation may change within the LoDs.

1.4.16 The proposed LoDs for the Project are shown on the Works Plans (document reference 2.3), Figure 4.1: Proposed Project Design (document reference 6.4.F1) and Figure 4.2: Proposed Project Design – Permanent Features (document reference 6.4.F2), and are required for the following non-linear works (permanent infrastructure) of relevance to this document.

CSE Compounds

1.4.17 The Order Limits include approximately 64 m x 90 m for the CSE compounds (site only), plus the LoDs either side as defined below:

- There is no definitive vertical (downwards) LoDs for the works within the CSE compounds – the depth must be no more than is necessary as per the Order. Non-linear infrastructure located within cable sealing end compounds have a 15.0 m maximum height and an upward vertical limit of deviation of 10% of that height, excluding rooftop equipment, such as but not limited to lightning protection, aerials, fall arrest systems, and handrails
- The lateral and longitudinal LoD are generally 50 m on all sides of the proposed compounds but vary locally depending on existing features (e.g. hedgerows, watercourses).

Substations

1.4.18 The Order Limits include approximately:

- EACN Substation - 640 m x 740 m (including spacing for the associated Environmental Area). The operational footprint of the new EACN Substation is proposed to be approximately 550 m x 230 m
- Tilbury North Substation- 340 m x 530 m. The operational footprint of the new Tilbury North Substation is proposed to be approximately 340 m x 300 m
- Bramford Substation extension works - 300 m x 600 m for the extension works (including the footprint of the existing substation)
- 'Environmental Areas' are shown on Figure 4.1: Proposed Project Design (document reference 6.4.F1) and Figure 4.2: Proposed Project Design - Permanent Features (document reference 6.4.F2)
- There is no definitive vertical (downwards) LoD for the works within the substations. Non-linear infrastructure located within substations have a 15.0 m maximum height and an upward vertical limit of deviation of 10% of that height, excluding rooftop equipment, such as but not limited to, lightning protection, aerials, fall arrest systems, and handrails
- The LoD for the substation works are as shown on the Works Plans (document reference 2.3), including space for the substations, drainage, accesses, construction compounds and soil storage.

Landscape, visual and ecological mitigation

1.4.19 Landscape and visual mitigation is proposed at Norwich Main, EACN and Tilbury North Substations and the seven CSE compounds, proposed as 'Environmental Areas'. These multi-functional areas have been prioritised, to provide mitigation or enhancements for different environmental aspects i.e. sites where landscape and visual mitigation and biodiversity gains could be achieved together. An indicative landscape design has been created for these areas as detailed within Appendix D of the Outline Landscape and Ecological Management Plan (LEMP) (document reference 7.4). The Outline LEMP provides the site context for each of the Permanent Features and identifies the individual landscape mitigation proposals for the Environmental Areas (document reference 7.4) and shown in Image 1.2 through Image 1.9.

1.4.20 National Grid has committed to deliver at least 10% BNG with wider environmental and societal benefits The Outline LEMP (document reference 7.4) refers to the retention, replacement planting and onsite habitat creation and enhancement of habitats in line with the BNG Report (document reference 7.1). Where created or enhanced, habitats within these Environmental Area will be counted within the BNG assessment (onsite mitigation). The Environmental Areas are located on land to be acquired by National Grid and any habitats included within the BNG onsite mitigation, will be monitored and managed by National Grid for 30 years in line with commitments made within the BNG Report (document reference 7.1). Regular site visits will be undertaken by experienced ecologists, to ensure the habitat type and condition meet that prescribed within the BNG Report. Beyond the 30-year period it is expected that ongoing management will be undertaken by National Grid in line with standard practices around permanent assets.

1.4.21 There is flexibility for minor variations as part of the detailed design process once the engineering scheme has been fixed. It is important that any changes to the landscape proposals still align with the local landscape character. Habitat management and monitoring plans for each Environmental Area will be developed following detailed landscape design (post consent) and included within the Final LEMP, and secured through Requirement 4 (see Schedule 3 of the draft DCO (document reference 3.1)). The specific design objectives of the landscape and visual mitigation for the substations and the CSE compounds are set out in the Outline LEMP (document reference 7.4) and also in Chapter 5 of this document.

Sustainability

1.4.22 National Grid is committed to embedding a sustainable approach in the design of the Project, which is discussed in more detail in the DAS (document reference 7.15).

1.4.23 National Grid's Environmental Action Plan for RIIO-T2 (2021-2026) (2024) focuses on four priority areas:

- ***'Net zero carbon emissions:*** *Climate change is the greatest challenge of our generation, and the next 10 years will be crucial to addressing it. We will reduce our direct emissions in line with science-based targets and deliver carbon neutral construction.'.*
- ***Minimise waste and sustainable use of materials:*** *Waste is choking our oceans, spoiling our landscapes, as well as contributing to landfill and greenhouse gas emissions. … We will achieve zero waste to landfill across key areas of waste and use circular economy principles to make the most out of natural resources and our assets.*
- ***Caring for the natural environment:*** *One of the most important challenges facing humanity, alongside the climate emergency, is the global biodiversity crisis. … We will value nature and will protect and enhance it where possible using 'natural capital' and 'net gain' principles.*
- ***Leading the way:*** *Businesses have a duty to lead the way and deliver change across industry. We will be leaders in our industry to advance environmental good practice.*

1.4.24 On this Project, this will involve reducing, where possible, material use in construction especially away from high carbon materials such as concrete and cement and reducing waste. Buildings both temporary and permanent should be energy and resource efficient. Wildlife should be preserved, with habitats enhanced where possible. The Project has committed to delivering at least 10% Biodiversity Net Gain (BNG) with wider environmental and societal benefits; further details can be found in the BNG Report (document reference 7.1).

2. Site Location and Context

2.1 Baseline Landscape Context

2.1.1 The landscape context of the proposed CSE compounds, the EACN Substation and Tilbury North Substation, is set out below with reference to Section 6.6 of ES Chapter 13: Landscape and Visual (Document 6.13) the Outline LEMP (document reference 7.4).

2.1.2 Landscape character within the Project Study Area is described at the national, regional and local scales, in a series of Landscape Character Assessment publications. The following section describes the landscape character in which the fixed infrastructure is located within, which has been assessed as part of the design of the infrastructure and Environmental Areas (see Appendix D of the Outline LEMP document reference 7.4).

2.1.3 The landscape context of sites for the permanent infrastructure was taken into consideration during the siting and routeing studies. The outline landscape mitigation proposals have been developed for the areas around the CSE compounds and new substations and extensions, taking landscape context into account to create an outline design that complements the existing landscape character.

Wenham Grove CSE Compound

2.1.4 At a national level the proposed infrastructure is located in National Character Area 86: South Suffolk and North Essex Clayland. The Statements of Environmental Opportunity are published by Natural England in relation to each national character area, The statements most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include the planting of new woodlands on former woodland sites or extending and linking existing woodland using local native species. This will enhance ecological connectivity and benefit the traditional wooded appearance and character of the landscape. Other relevant opportunities are stated to include conserving, managing and replanting hedgerows and planting new hedgerow trees (notably new oak). It is noted that it is important to ensure new hedgerow planting on the plateau does not block important views and overly enclose the landscape. Planting characteristic species mixes will support biodiversity and landscape character and should include hawthorn, blackthorn, hazel, field maple, dogwood, spindle and small-leaved lime.

2.1.5 At a local level Wenham Grove CSE Compound is located within the Ancient Estate Claylands Landscape Character Type and is approximately 2 km to the north-east of Dedham Vale National Landscape at its closest point. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Dissected Boulder Clay plateau;
- Organic pattern of field enclosures;
- Straight boundaries where influence of privately owned estates is strongest;
- Enclosed former greens and commons; and
- Parklands.

2.1.6 Suffolk County Council Guidance Note for Ancient Estate Claylands states 'New planting should be designed to integrate the development into the character of this landscape, and may consist of both backdrop and screening planting. Although there should be a preference for native tree species other options should not be overlooked, especially if they can act as nurse trees, or are likely to prove successful in difficult conditions.'[5] The following guidelines are also relevant:

- Reinforce the historic pattern of sinuous field boundaries;
- Recognise localised areas of late enclosure hedges when restoring and planting hedgerows;
- Maintain and increase the stock of hedgerow trees;
- Maintain the extent, and improve the condition, of woodland cover with effective management; and
- Maintain and restore the stock of moats and ponds in this landscape.

2.1.7 The siting area for Wenham Grove CSE Compound is to the north of the former Royal Air Force Raydon Airfield. The ground levels are relatively flat, typically varying between 45 m and 50 m Above Ordnance Datum (AOD). The area is dominated by medium to large scale arable fields interspersed with blocks of deciduous woodland which are more frequent to the north of the area. A notable amount of woodland is found at Raydon Great Wood being approximately 700 m to the north-west. A mature deciduous tree belt runs along the former railway line to the north, connecting into Raydon Great Wood and beyond. Field boundaries vary with some being open and others defined by gappy hedgerows with few hedgerow trees.

Great Horkesley (EACN Side) CSE Compound

2.1.8 At a national level the proposed infrastructure is located in National Character Area 111: Northern Thames Basin. The Statements of Environmental Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include: promoting the establishment of a coherent and resilient network of treescapes (native woodland, wood pasture, parkland, coppice, scrub, field trees and hedgerows) through expanding and linking existing woodland with areas of new planting; incorporating woodland rides and paths within woodlands to allow for public access and create a variety of habitats within the woodlands which will increase biodiversity; and maintaining the diverse appearance of the landscape and shielding developments and infrastructure from the wider landscape.

2.1.9 At a local level Great Horkesley (EACN Side) CSE compound is located within the Great Horkesley Farmland Plateau Landscape Character Area (LCA) and is approximately 1.3 km to the south of Dedham Vale National Landscape at its closest point. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Small to medium scale arable fields with concentrations of mature trees at field boundaries;
- Interesting field pattern consisting of small, regular fields to the south of Boxted and to the east of Great Horkesley;

[5] https://suffolklandscape.org.uk/landscapes/ancient-estate-claylands/

- Orchards near Great Horkesley;
- A network of narrow lanes (sometimes sunken), which are lined by trees and hedges; and
- Hedgerows are diverse and well managed/ clipped in most places.

2.1.10 Great Horkesley (EACN Side) CSE Compound is sited within an area of medium scale arable fields on a flat plateau landscape around 50 m AOD. Small blocks of woodland and trees are frequent and typically associated with settlement pattern. The boundaries of the arable field within which the CSE compound is sited vary in nature. To the south-west is a well treed field boundary and small block of deciduous woodland associated with a drain or tributary that connects into Black Brook further south. To the north-east is an overgrown hedgerow with hedgerow trees and a block of mixed woodland. Small scale fields and paddocks and scattered properties are also present adjacent to these woodlands. Arable fields lie to the north-west and south-east and boundaries between them are more open. One Public Right of Way (PRoW) (Great Horkesley FP 30) crosses the area to the south of the CSE compound and ties into another (Great Horkesley FP 29) which runs to the east of the CSE compound. The Essex Way runs along Borad Lane, immediately north of the field.

Great Horkesley (Tilbury Side) CSE Compound

2.1.11 At a national level the proposed infrastructure is located in National Character Area 111: Northern Thames Basin. The Statements of Environment Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include: promoting the establishment of a coherent and resilient network of treescapes (native woodland, wood pasture, parkland, coppice, scrub, field trees and hedgerows) through expanding and linking existing woodland with areas of new planting; incorporating woodland rides and paths within woodlands to allow for public access and create a variety of habitats within the woodlands which will increase biodiversity; and maintaining the diverse appearance of the landscape and shielding developments and infrastructure from the wider landscape.

2.1.12 At a local level Great Horkesley (Tilbury Side) CSE Compound is located within the Rochfords Farmland Plateau LCA and is approximately 1.3 km to the south of Dedham Vale National Landscape at its closest point. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Mixture of medium and large rolling arable fields interspersed with small woodland patches;
- Fields enclosed by gappy hedges, with occasional mature trees within field boundaries; and
- Landscape feels more open and exposed in places than the adjacent Great Horkesley farmland plateau to the west.

2.1.13 The siting area for Great Horkesley (Tilbury Side) CSE Compound falls within an area dominated by medium to large arable fields. The siting area itself lies within a sloping arable field with ground levels varying from 40m AOD in the west up to 50 m AOD in the east. A reservoir and watercourse associated with the head of a tributary valley of the River Colne is in lower lying ground to the west. The B1508 Colchester Road is to the south and is lined with robust hedgerows. Crabtree Lane is to the east. Hedgerows along Crabtree Lane are gappy, though some hedgerow trees are

present. To the north is a well vegetated drainage channel that ties into the reservoir. Tree cover is concentrated around the few scattered properties and in association with the shallow head of the River Colne tributary valley.

Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds

2.1.14 At a national level the proposed infrastructure is located in National Character Area 86: South Suffolk and North Essex Clayland. The Statements of Environment Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include the planting of new woodlands on former woodland sites or extending and linking existing woodland using local native species. This will enhance ecological connectivity and benefit the traditional wooded appearance and character of the landscape. Other relevant opportunities are stated to include conserving, managing and replanting hedgerows and planting new hedgerow trees (notably new oak). It is noted that it is important to ensure new hedgerow planting on the plateau does not block important views and overly enclose the landscape. Planting characteristic species mixes will support biodiversity and landscape character and should include hawthorn, blackthorn, hazel, field maple, dogwood, spindle and small-leaved lime.

2.1.15 At a local level Fairstead CSE compounds are located within the Central Essex Farmland LCA. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Irregular field pattern of mainly medium size arable fields, marked by sinuous hedgerows and ditches;
- Many small woods and copses provide structure and edges in the landscape;
- Scattered settlement pattern, with frequent small hamlets, typically with greens and ponds; and
- Network of narrow, winding lanes.

2.1.16 The Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds are sited within a gently undulating landscape with medium scale arable fields. The fields are often irregular and frequently bounded by hedgerows. Many of the hedgerows are overgrown and include mature hedgerow trees. There are also small copses of trees, shelterbelts and blocks of woodland and field trees present in this landscape. The siting area itself lies within a medium scale arable field which slopes gently from around 60 m AOD in the north-east to around 55 m in the south-west. The field is bound by a combination of ditches and hedgerows with frequent trees. The east corner of the field ties into the end of a linear shelterbelt. Fairstead Road (Protected Lane) is a narrow sunken lane located one field away to the west. This lane partially follows a tributary to the River Ter to the south. Distinctive cricket bat willow (Salix alba) plantations and other vegetation are associated with the shallow valley and the tributary. An existing 400 kV overhead line runs through the field and area in a north-east to south-west orientation.

Tilbury North Substation and Tilbury North (Tilbury Side) and Tilbury North (Warley Side) CSE Compounds (with LTC)

2.1.17 At a national level the proposed infrastructure is located in National Character Area 111: Northern Thames Basin. The Statements of Environmental Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include: promoting the establishment of a coherent and resilient network of treescapes (native woodland, wood pasture, parkland, coppice, scrub, field trees and hedgerows) through expanding and linking existing woodland with areas of new planting; incorporating woodland rides and paths within woodlands to allow for public access and create a variety of habitats within the woodlands which will increase biodiversity; and maintaining the diverse appearance of the landscape and shielding developments and infrastructure from the wider landscape.

2.1.18 At a local level Tilbury North Substation and Tilbury North (Tilbury Side) and Tilbury North (Warley Side) CSE compounds are all located within the East and West Tilbury Open Undulating Farmland LCA. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Undulating landform, characterised by an underlying geology of sands, silts and clays, dropping in elevation to the south and east, and with a noticeable ‘scarp’ slope to the south. Productive agricultural land (arable and pasture) with occasional small copses (hawthorn, elm, field maple and ash) as a result of the generally well drained, coarse and loamy soils over gravel
- Semi-rural and open character, as a result of regular to large sized agricultural fields bounded by gappy hedgerows and relatively few trees (much was lost post 1950, including due to Dutch Elm disease). The landscape provides a rural setting to Chadwell St Mary and Stanford-le-Hope as well as a rural backdrop to the adjacent marshes
- Remnants of a historic settlement pattern of villages linked by a network of minor roads and lanes lined by hedgerows
- Remnant Thames Terrace grasslands (semi-natural or unimproved grassland sites, now a scarce habitat but would formerly have spread along the ridge of sand and gravel from Grays eastwards through Chadwell St Mary and then upwards towards the Langdon Hills)
- Occasional areas of historic field patterns, common land, historic lanes and tracks (e.g. Hornsby Lane between Orsett Heath and Orsett) and medieval earthworks, provide time depth to the landscape
- Noticeable urban influences such as pylons, gravel extraction operations, industrial development and modern residential development (in this and adjacent character areas).

2.1.19 Within the Order Limits around the substation is a golf course and arable fields, often enclosed by hedgerows, scrubby vegetation and woodland with some mature hedgerow trees. The landscape around the two CSE compounds is open arable farmland. Based on an assumption that LTC is constructed, the landscape around the substation and CSE compounds would change to include the road and associated earthworks, infrastructure and LTC mitigation including species rich grassland, scrub woodland and native woodland and wetland habitats. In addition there is a proposed housing allocation at Chadwell St Mary to the south of Tilbury North substation.

EACN Substation

2.1.20 At a national level the proposed infrastructure is located in National Character Area 111: Northern Thames Basin. The Statements of Environmental Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include: promoting the establishment of a coherent and resilient network of treescapes (native woodland, wood pasture, parkland, coppice, scrub, field trees and hedgerows) through expanding and linking existing woodland with areas of new planting; incorporating woodland rides and paths within woodlands to allow for public access and create a variety of habitats within the woodlands which will increase biodiversity; and maintaining the diverse appearance of the landscape and shielding developments and infrastructure from the wider landscape. Other opportunities are stated to safeguard wetlands and create new wetland habitats.

2.1.21 At a local level the new EACN Substation is located within the Bromley Heaths LCA, and the Order Limits around the EACN Substation are approximately 1.2 km to the south of Dedham Vale National Landscape. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Exposed and windswept plateau corresponding to the highest part of the district
- Deep, coarse, loamy, and often stoneless brown soils which support a high-grade agricultural land
- Large scale productive arable fields divided by low, gappy hedgerows where hedgerow oaks stand out as silhouettes against the skyline
- Apple orchards around Ardleigh, Elmstead and Frating are sheltered by belts of poplar or fast growing Leylandii
- Former heaths largely converted to smallholdings or regenerating as woodland. Small areas of remnant heath survive
- Neglected oak/sweet chestnut coppice with ground flora typical of acidic woodland soils
- Network of narrow lanes connects the scattered farms and villages, and roadside verges often contain gorse and bracken
- Dramatic, dominating skyscape.

2.1.22 Within the Order Limits around the EACN Substation there are large arable fields, enclosed by mature shelterbelts and hedgerows with some hedgerow trees. Existing overhead lines cross the Order Limits, connecting to the existing Lawford Substation to the south.

Connection Works at Norwich Main Substation

2.1.23 At a national level the proposed infrastructure is located in National Character Area 84: Mid Norfolk. The Statements of Environmental Opportunity most relevant to the Project, identify opportunities to enhance landscape character. These include the management and strengthening of the characteristic hedgerow network by protecting, managing and reinstating hedgerows and hedgerow trees and the planting of new hedgerow trees. Other opportunities are stated to include planting new areas of broadleaved woodland; minimising the effects of new development by incorporating green infrastructure and woodland buffer; and maintaining and

enhancing the floristic diversity of lowland meadow to increase the area of habitat suitable for pollinators.

2.1.24 At a local level the substation is located within the Tas Tributary Farmland LCA. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Open, gently undulating to flat and sloping landscape incised by shallow tributary valleys, the tributary streams of which are not prominent landscape features
- Large open arable fields of cereal, sugar beet and occasionally sweetcorn
- Framed open views across the countryside and into adjacent character areas
- Small blocks of deciduous woodland of high ecological and visual quality. These create wooded horizons which add variety to and create intimacy within the landscape
- Damp grasslands of ecological importance located within the tributary valleys
- Scattered remnant hedgerow trees, particularly oak, sometimes including intact avenues lining the roads or marking former, denuded, field boundaries
- Network of recreational footpaths.

2.1.25 Within the Order Limits around the substation there are large arable fields and mature belts of deciduous woodland, which provide some visual containment to the existing substation. There are existing overhead lines and underground cables which converge at the substation.

3. Examples of Existing Infrastructure

3.1 Existing Substations[6]

3.1.1 This Chapter of the DASSI document provides examples and images of existing electrical infrastructure, which whilst provided for illustrative purposes only, provides an indication of the design and appearance of similar types of infrastructure as that proposed by the Project.

3.1.2 In appearance HIS equipment is comparable to AIS as the equipment is all outdoors. The EACN Substation is proposed to be an AIS Grid Supply Point substation and Tilbury North Substation is proposed to be GIS.

3.1.3 The following images have been chosen for illustrative purposes only, they are representative of the AIS substation proposed at the EACN Substation site.

Image 3.1 Existing Norwich Main Substation 400 kV (Source: Norwich Main Site Visit)

[6] Substation sizes and/or layouts, within the Project may differ from that presented in these images.

Image 3.2 Existing Bicker Fen 400 kV Substation (Source: National Grid)

3.1.4 The following images have been chosen for illustrative purposes only, they are representative of different colours and materials of GIS substations.

Image 3.3 Existing Connah's Quay 400 kV Substation in colour cladding (Source: National Grid)

Image 3.4 Existing Connah's Quay 400 kV Substation in colour cladding (Source: National Grid)

Image 3.5 Existing Middleton 400 kV Substation (Source: National Grid)

Image 3.6 and 3.7 National Grid Deeside Centre for Innovation 400 kV Substation (Source: National Grid)

Image 3.8 Existing National Grid 400 kV Substation at Yaxley (Source: National Grid)

3.2 Existing Cable Sealing Ends

3.2.1 The following image has been chosen as it is representative of a CSE with FLT gantries[7]. The new gantry structures would generally be erected onto the prepared foundations. The conductors from the incoming overhead line circuits would be connected to the gantries via insulators and the rigid conductors on the other side, would be assembled across the new high voltage equipment.

Image 3.9 Existing CSE compound with gantries (Source: ES Chapter 4: Project Description (document reference 6.4))

3.3 Fencing

3.3.1 National Grid propose the acceptable and fit for purpose specification of a hot-dipped galvanized steel palisade fence. This product is contained within National Grid's policy due to its durability over the required design life, as well as its availability on the market as a product which can be relied upon to perform under the anticipated loading and external conditions. National Grid are aware of no other products on the market that meet the requirements of the high security specifications, upon which HV substations are built, to the level achieved by the hot-dipped galvanized fence.

3.3.2 National Grid Policy is to specify an 85-micron thick hot dip galvanized security fence on all sites, noting this provides the most reliable and evenly distributed form of corrosion protection to meet the 50-year design life requirements for National Grid infrastructure as per the Galvanizers Association.

[7] Gantries, and compound sizes and/or layouts, within the Project may differ from that presented in these images.

3.3.3 Visibility of fencing would be further reduced following the growth of mitigation planting in the Environmental Areas. In most locations it is the steel pylons and gantries that will be the most visible structures and where fencing is fleetingly visible it will be seen in the context of these larger metal structures.

3.3.4 Whilst a powder coated finish can be applied to an already galvanized steel element to provide a colour finish, this finish cannot match the durability of the galvanized alternative. A powder coated finish would be suitable for lifespans of up to 20 years and, if exposed to prolonged periods of UV, the product could deteriorate quicker than this. Whilst a powder coated fence would still have the basic corrosion protection of the galvanized steel fence, ensuring the National Grid design life, the product would become unsightly and require re–coating to maintain its “as installed” appearance.

3.3.5 Based on a best-case scenario of 20 years to replace, this would mean reapplying the powder coated finish 3 times within the 50-year design life. The process for applying powder coating is not something that can be done on site and requires factory conditions to ensure adequacy. This would mean removing fencing whilst the National Grid HV substation is in operation, jeopardising the security and safety of the site, which is not feasible for such assets. Based on the above information, the cost, programme, and security implications of providing a powder coated finish are demonstrably greater than the standard galvanised option and it is therefore National Grid’s proposal to proceed with galvanised only fencing for all sites. Should a powder coated application be specified, the implications of programme, cost and security will demand further cost on the project that would ultimately be borne by the end user. Further implications arising from operational safety would be introduced by the need to remove and repaint an existing fence of an operational HV substation. This would not be acceptable, even if the increased costs could be accommodated, and any maintenance would likely require bespoke and complex mitigations in place to ensure security and safety throughout.

3.3.6 The following image shows security fencing that has been used at an existing National Grid substation.

Image 3.10 Existing substation - Norwich Main 400 kV (Source: National Grid)

3.4 Colours and Materials

3.4.1 The following images are for illustrative purposes only, they show the types of building and fencing finishes and colours that have been used on National Grid infrastructure.

Image 3.11 Example of finishes, colours and surfacing.

Image 3.12 Examples of colour samples for consideration

4. DCO Design and Operational Function

4.1 Cable Sealing End Compounds

4.1.1 An illustrative design of an overall size CSE compound is presented in the diagrammatic illustration in Image 4.1. The illustration explains the function of the various elements required.

Key

A. CSE (400 kV): interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 2 x 1.5 x 8 m (LxWxH) per individual unit

B. Surge arrestor (400 kV): safeguard electrical equipment from overvoltages caused by lightning or switching events diverting the excess voltage to the ground, preventing it from damaging the equipment. Approximate dimensions: 1 x 1.5 x 6.5 m (LxWxH) per individual unit

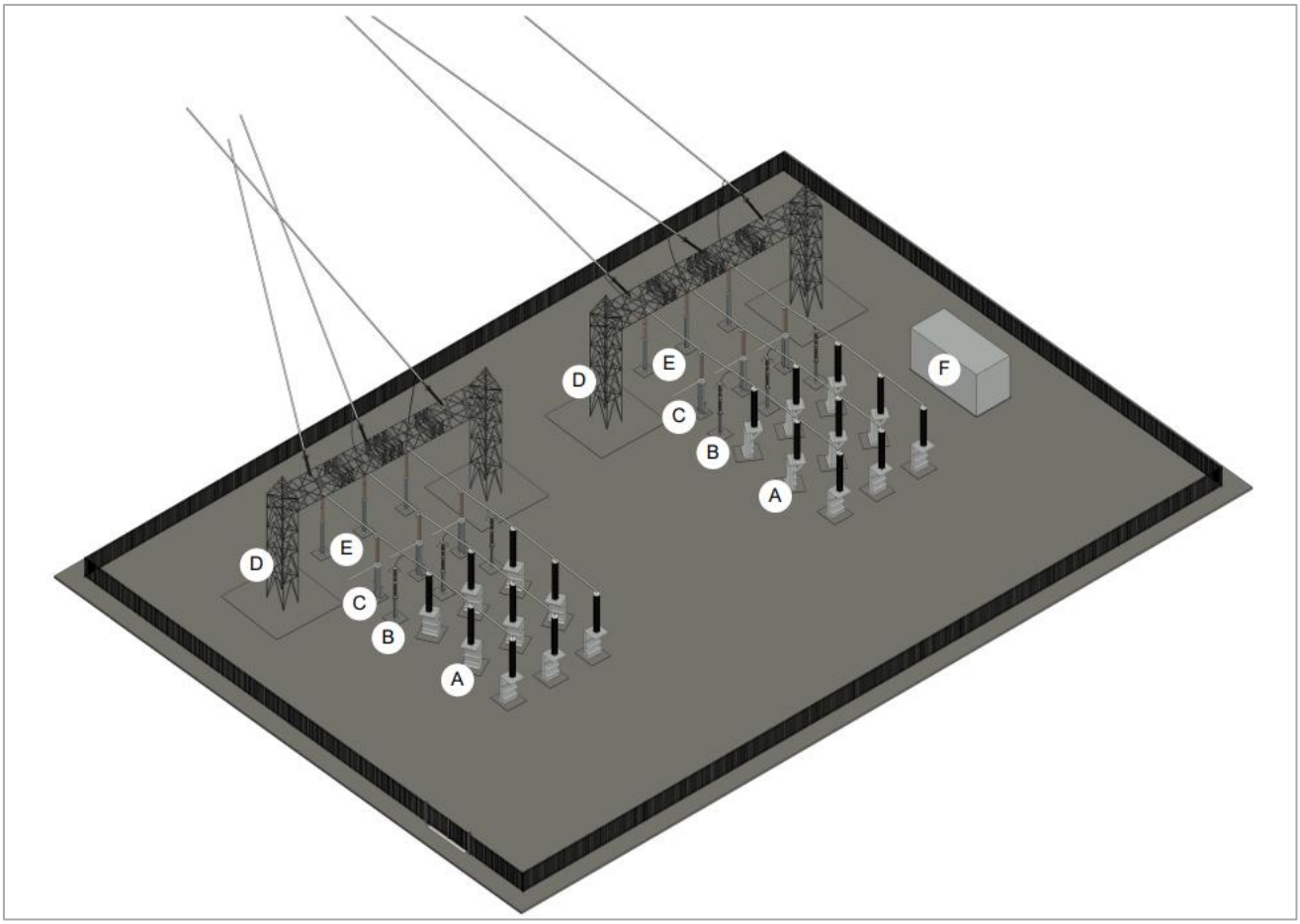
C. Earth switch (400 kV): discharge any residual voltage trapped in the circuit, ensuring the safety of personnel during maintenance or repair work. Typically installed alongside isolators in high-voltage switchgear systems. Approximate dimensions: 1 x 1 x 7.5 m (LxWxH) per individual unit

D. Overhead line gantry (400 kV): transfers high voltage conductors from an overhead line pylon. Approximate dimensions: 26 x 2.5 x 15 m (LxWxH)

E. Post insulators: Support high voltage conductors to keep them away from earth. Typically, porcelain insulators above a steel structure. The height of this equipment would be approximately 7.5 m (400 kV)

F. PRR is a fully integrated portable building designed to house protection and control equipment for power systems. They typically include custom-designed protection and control equipment, Supervisory Control and Data Acquisition system remote terminal unit (SCADA RTU) for remote monitoring and control, and environmental controls such as heating, lighting, power supply, and air-conditioning etc. Constructed from materials like Glass Reinforced Plastic (GRP) or stainless steel. Approximate dimensions: 10 x 5 x 6 m (LxWxH). The PRR will be provided if required.

Image 4.1 Illustrative example of CSE compound



4.2 Substations

EACN Substation

4.2.1 An illustrative design of the EACN Substation is presented in the diagrammatic illustration below. The illustration explains the function of the various elements required.

Key

A. Super Grid Transformers: Step down the voltage and regulate power flow with a cooler bank attached to each side. Approximate dimensions: 15 x 25 x 11 m (LxWxH)

B. Shunt Reactors: Stabilise voltage during load changes and to compensate for reactive power. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 10 x 18 x 11 m (LxWxH)

C. Overhead Line Gantry (400 kV): Transfers high voltage conductors from an overhead line pylon to substation equipment. Approximate dimensions: 25 x 2.5 x 15 m (LxWxH)

D. Diesel generator: Provides backup power, approximate dimensions: 9 x 5 x 5 m (LxWxH)

E. DNO building: Houses the 11 kV/415 V transformer for site supplies. Modular steel prefabricated building. Approximate dimensions: 7 x 15 x 3.5m (LxWxH)

F. Post Insulators: Support high voltage conductors to keep them away from earth. Typically, porcelain/polymeric insulators above a steel structure. The height of this equipment including the structure would be approximately 8 m (400 kV)

G. Earth switch/disconnector (400 kV): The disconnector isolates a circuit, while the earth switch then grounds it to ground potential, effectively eliminating any residual voltage. This combination is crucial for preventing electrical shock and ensuring the safety of personnel working on the equipment. Approximate dimensions: 10 x 4 x 8 m (LxWxH) per individual unit

H. PRR: A fully integrated portable building designed to house protection and control equipment for power systems. They typically include custom-designed protection and control equipment, SCADA RTU for remote monitoring and control, and environmental controls such as heating, lighting, power supply, and air-conditioning etc. Constructed from materials like GRP or stainless steel. Approximate dimensions: 10 x 5 x 6 m (LxWxH)

I. CSEs (400 kV): Interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1.5 x 2 x 8.5 m (LxWxH) per individual unit

J. National Grid control and amenity building: Control building houses protection equipment, control equipment, Low Voltage Alternating Current (LVAC) distribution board, battery systems, telecommunications and control/permit room. Amenity building houses rooms such as meeting room, mess room, archive, general office, shower, changing/locker room, etc. Modular construction, prefabricated steel unit which can be road transportable. Approximate control building dimensions: 35 x 15 x 5 m (LxWxH) and amenity building dimension: 25 x 15 x 5 m (LxWxH)

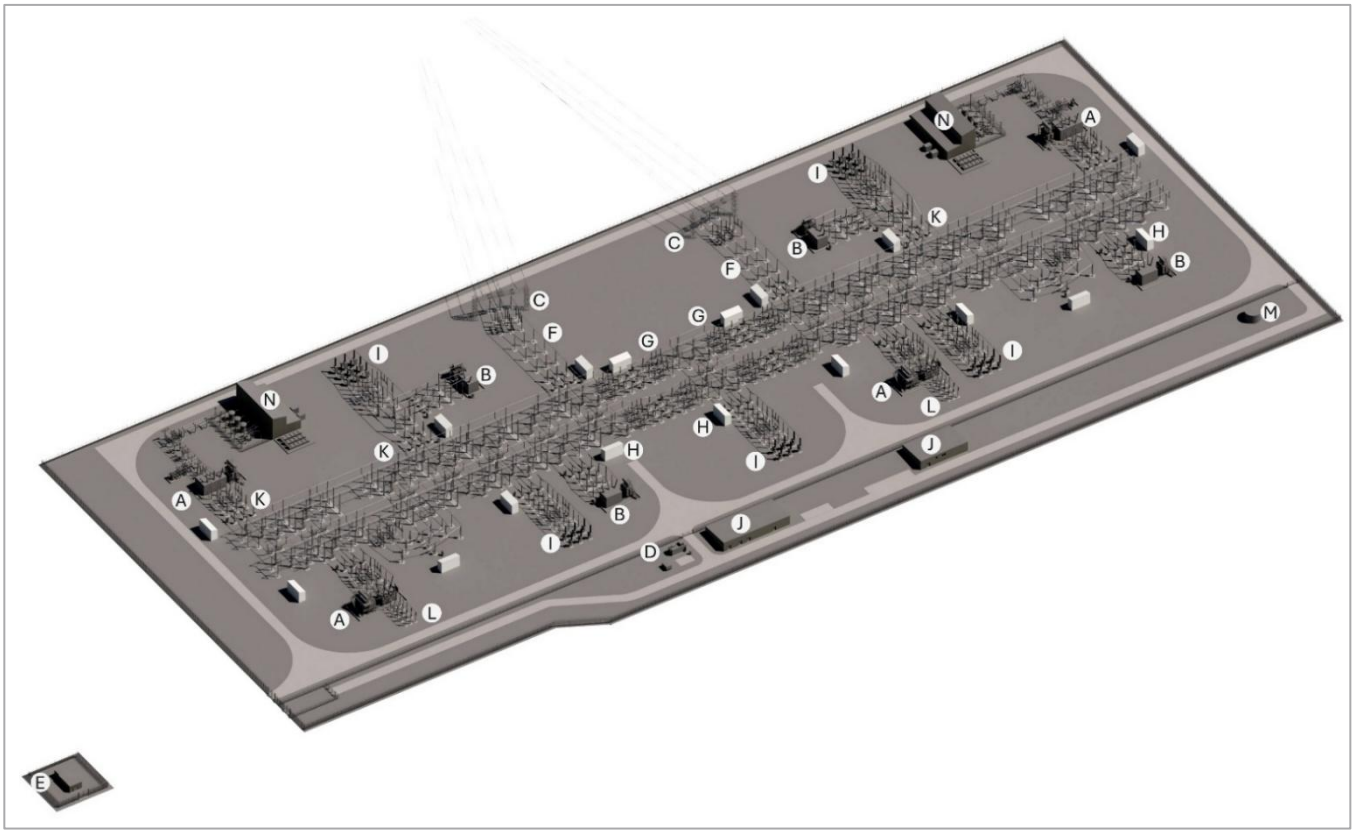
K. Circuit Breaker (400 kV): Interrupts power flow. Materials: mixture of metal body and silicone/porcelain insulators. Approximate dimensions: 5 x 1 x 7.4 m (LxWxH)

L. CSE (132 kV): Interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1.5 x 1.5 x 6 m (LxWxH) per individual unit

M. Water tank: Firefighting requirement to provide 120 l/s for 1 hour. Glass fused to steel construction with a galvanised steel frame. Approximate dimensions: 7 m diameter and 4 m height

N. Dynamic Reactive Compensator (DRC) building: DRC technology is crucial for enhancing the stability and reliability of high voltage substations. It is often integrated with Static Synchronous Compensator systems to provide reactive power compensation and voltage stability. Approximate building dimension: 30 x 15 x 12 m

Image 4.2 Illustrative example of EACN Substation



Tilbury North Substation

4.2.2 An illustrative design of Tilbury North Substation is presented in the diagrammatic illustration below. The illustration explains the function of the various elements required.

Key

A. Gas insulated busduct: Electrical busbar system where the conductor is insulated by gas within a metal enclosure

B. Shunt reactors: Stabilise voltage during load changes and to compensate for reactive power. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 10 x 18 x 11 m (LxWxH)

C. Overhead line gantry (400 kV): transfers high voltage conductors from an overhead line pylon to substation equipment. Approximate dimensions: 25 x 2.5 x 15 m (LxWxH)

D. Diesel generator: provides backup power, approximate dimensions: 9 x 5 x 5 m (LxWxH)

E. DNO building: houses the 11 kV/415 V transformer for site supplies. Modular steel prefabricated building. Approximate dimensions: 7 x 15 x 3.5 m (LxWxH)

F. Post insulators: Support high voltage conductors to keep them away from earth. Typically, porcelain/polymeric insulators above a steel structure. The height of this equipment including the structure would be approximately 8 m (400 kV)

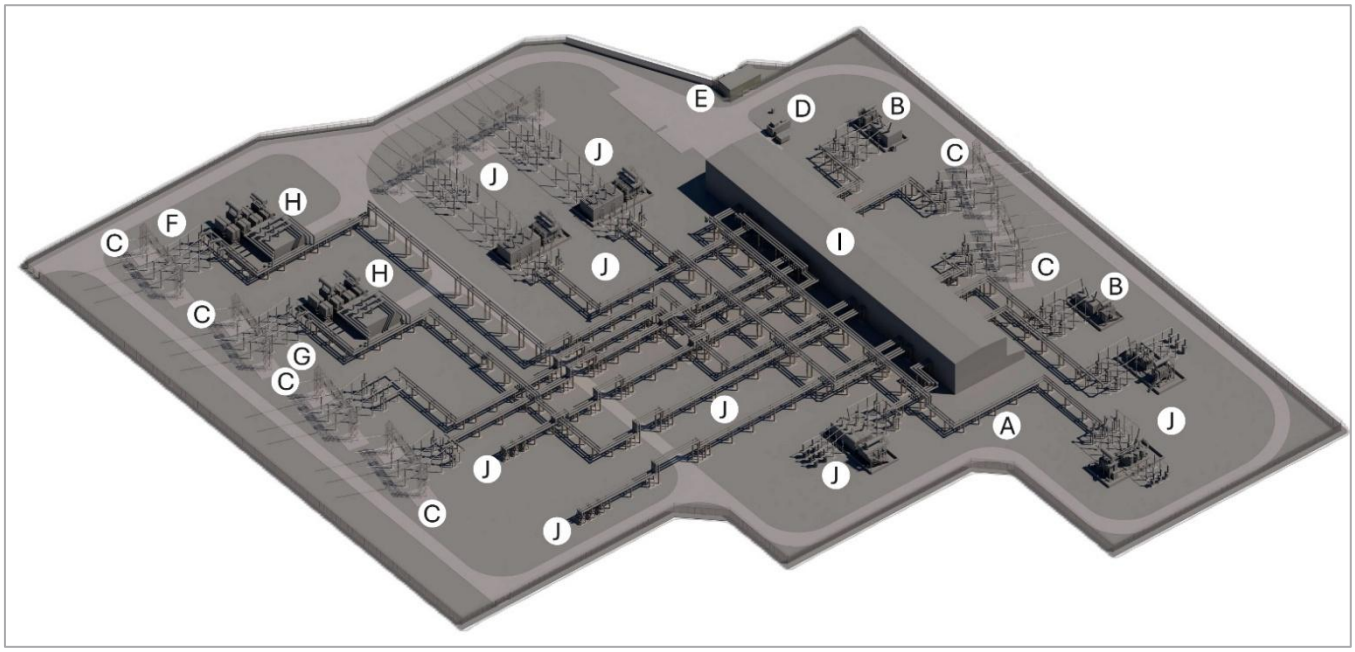
G. Earth switch/disconnector (400 kV): The disconnector isolates a circuit, while the earth switch then grounds it to ground potential, effectively eliminating any residual voltage. This combination is crucial for preventing electrical shock and ensuring the safety of personnel working on the equipment. Approximate dimensions: 10 x 4 x 8 m (LxWxH) per individual unit

H. Quadrature booster: helps manage power flow, prevent overloads, and improve the stability and efficiency of the power grid. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 25 x 30 x 11 m (LxWxH)

I. National Grid GIS building: Houses GIS panels, protection equipment, control equipment, LVAC distribution board, battery systems, telecommunications and control/permit room. Modular construction, prefabricated steel unit which can be road transportable. Approximate dimensions: 135 x 30 x 15 m (LxWxH).

J. Future equipment: Denotes area reserved for future equipment requirements

Image 4.3 Illustrative example of Tilbury North Substation



Extension to Bramford Substation

4.2.3 An illustrative design of the extension to Bramford Substation is presented in the diagrammatic illustration below. The illustration explains the function of the various elements required.

Key

A. Shunt Reactors: Stabilise voltage during load changes and to compensate for reactive power. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 10 x 18 x 11 m (LxWxH)

B. Overhead line gantry (400 kV): transfers high voltage conductors from an overhead line pylon to substation equipment. Approximate dimensions: 25 x 2.5 x 15 m (LxWxH)

C. Circuit breaker (400 kV): interrupts power flow. Materials: mixture of metal body and silicone/porcelain insulators. Approximate dimensions: 5 x 1 x 7.4 m (LxWxH)

D. Post insulators: Support high voltage conductors to keep them away from earth. Typically, porcelain insulators above a steel structure. The height of this equipment would be approximately 8 m (400 kV)

E. Earth switch/disconnector (400 kV): The disconnector isolates a circuit, while the earth switch then grounds it to ground potential, effectively eliminating any residual voltage. This combination is crucial for preventing electrical shock and ensuring the safety of personnel working on the equipment. Approximate dimensions: 10 x 5.6 x 8.6 m (LxWxH) per individual unit

F. National Grid existing GIS building: Houses GIS panels and local control cubicle. Modular construction, prefabricated steel unit which can be road transportable. Approximate dimensions: 155 x 17.6 x 14.5 m (LxWxH)

G. National Grid new GIS building: Houses GIS panels and local control cubicle. Modular construction, prefabricated steel unit which can be road transportable. Approximate dimensions: 32 x 17.6 x 15 m (LxWxH)

H. Gas insulated busduct: Electrical busbar system where the conductor is insulated by a gas, within a metal enclosure

I. PRR: A fully integrated portable building designed to house protection and control equipment for power systems. They typically include custom-designed protection and control equipment, SCADA RTU for remote monitoring and control, and environmental controls such as heating, lighting, power supply, and air-conditioning etc. Constructed from materials like GRP or stainless steel. Approximate dimensions: 10 x 5 x 6 m (LxWxH)

J. Lighting pole: The lighting pole is designed to provide adequate illumination for the substation area, ensuring safety and visibility during night-time operations. It is equipped with energy-efficient fixtures. The pole is strategically placed to cover key areas, including pathways, equipment zones, and control rooms

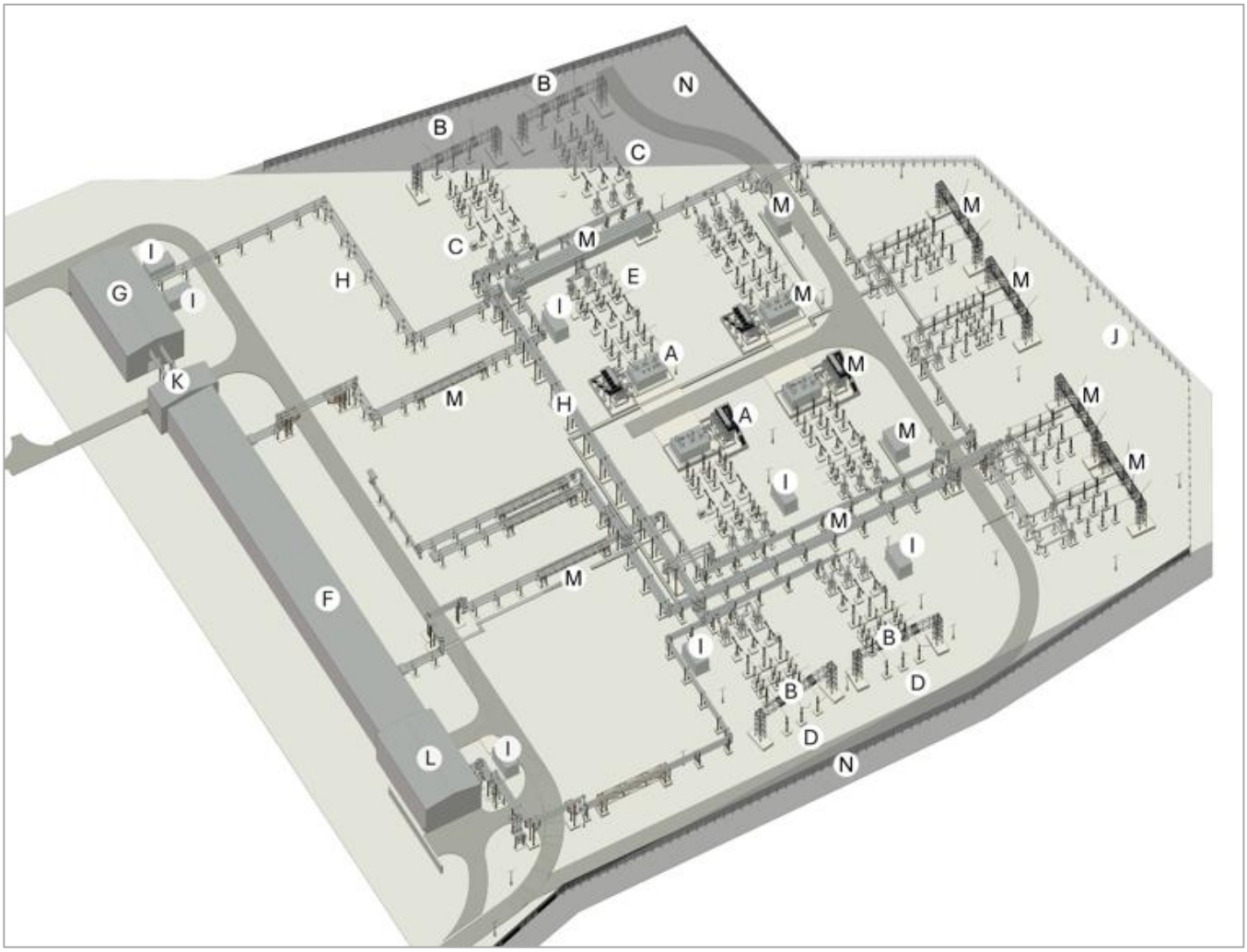
K. Southern side extension of National Grid existing GIS building: The extension will house additional GIS panels and local control cubicles. It will be constructed using modular, prefabricated steel units, designed for easy road transportation and integration with the existing building. Approximate dimensions: 7.5 x 17.6 x 15 m (LxWxH)

L. Northern side extension of National Grid existing GIS Building: The extension will house additional GIS panels and local control cubicles. It will be constructed using modular, prefabricated steel units, designed for easy road transportation and integration with the existing building. Approximate dimensions: 28 x 17.6 x 15 m (LxWxH)

M. Future equipment: Denotes area reserved for future equipment that is not needed as part of this Project but required for future connections and built on a phased basis

N. Substation Platform Extension: Denotes the area of the substation platform to be extended.

Image 4.4 Illustrative example of extension to Bramford Substation (extension shown in grey)



5. Design Principles and Scope for Variation in Developing the Detailed Design

5.1 CSE Compound Design Principles and Scope for Variation

5.1.1 This section sets out the design principles that led to the development of the CSE compound layouts, and explains where there is and is not scope for variation within the design and how elements for the CSE compound will look. There are some areas where there is no scope for variation, this is due to specific equipment being required to meet technical and safety standards, and therefore cannot be altered.

Electrical Equipment

5.1.2 The electrical equipment required within the CSE compounds is governed by standards and type tests which confirm a product meets strength and capability requirements.

5.1.3 There is no scope to vary the colour and finish of the electrical equipment needed. Typically, busbars and clamps are manufactured from aluminium (dull silver grey). Insulators are either porcelain (usually reddish brown or grey) or silicone (usually grey) and the manufacturers of equipment vary in their preference. Steel support structures within the compound would be left in a galvanised finish (dull silver grey) to avoid maintenance requirements in close proximity to 'live' equipment.

Size and Layout of CSE Compounds and Separation between Electrical Equipment

5.1.4 These design requirements and the dimensions of the electrical equipment and supporting infrastructure determine the overall size of the CSE compound and therefore there is very limited scope to vary the size and layout. Overarching National Policy Statement for Energy (EN-1) and the National Policy Statement for Electricity Networks Infrastructure (EN-5) recognise that there is very limited scope to alter the design and physical appearance of the linear and non-linear works, key elements such as substations and CSE compounds are fixed by their functional needs. See DAS (document reference 7.15) for more information.

5.1.5 The requirements National Grid adheres to sets out the basic separation and safe working distances that have to be maintained between equipment and between live equipment and the ground or any ancillary structures, buildings, masts, roads and fences. Live equipment is any equipment that is energised or electrically 'turned on'. The safe working distance for 400 kV equipment is 3.1 m.

5.1.6 Without adequate clearance between items of electrical equipment and vehicles requiring access into the CSE compound, more than one part of the CSE compound may need to be turned off, which may compromise the integrity of the system and supply to local users. For these reasons National Grid designs its system so that no

more than one part of the system needs to be switched off for any work to be carried out on it.

5.1.7 The overall size of the CSE compound has to provide space for the temporary accommodation of CSE testing equipment which is mounted in a lorry. Due to the technical requirements there is no scope to vary the separation between the electrical equipment.

Arrangement of the CSE Compounds' Electrical Equipment

5.1.8 The orientation and arrangement of the overhead line entry into the CSE compounds has influenced the orientation and layout of the CSE compounds. The compounds are orientated to be perpendicular to the incoming overhead line to simplify the arrangement of electrical equipment and minimise the overall footprint. There is no scope to vary the arrangement of the electrical equipment within the CSE Compounds as it would result in a less efficient layout.

CSE Compound Boundaries (Fences, Walls and Gates)

5.1.9 Regarding the materials/finishes used for the fencing, all fencing at the CSE compounds will have a standardised galvanised finish, up to 4 m in height. The fencing cannot be painted due to future maintenance issues as discussed in detail above. There is therefore no scope to vary the material or finishes or the boundary fences, walls or gates.

5.1.10 The Environmental Areas (Appendix D of the Outline LEMP (document reference 7.4) proposed around the CSE Compounds seek to reduce landscape and visual impacts through appropriate landscaping mitigation, that would help to screen the Permanent Infrastructure including the fencing.

5.1.11 The vehicle gates to the CSE compound will match the heights and specification of the boundary treatments.

CSE Compound Roads, Footpaths and Other Surfacing

5.1.12 To ensure the proper functioning and safety of electrical equipment, the surfacing beneath and between the equipment must be made of clean, 75 mm graded stone aggregate that is free-draining, interlocking, non-degrading, and has excellent electrical resistance.

5.1.13 During the operation of the substation, permanent vehicle access is necessary, and parking spaces should be available. The drawings included in the DCO application (Figure 4.2: Proposed Project Design – Permanent Features (document reference 6.4.F2)) include parking spaces. The number of spaces is judged on a site-by-site basis. Further detail on access is provided in the DAS (document reference 7.15).

5.1.14 For the external access roads, they would be constructed using an impermeable surface such as asphalt or concrete respectively. The requirement for substation surfacing is that it should need little to no maintenance (for up to 40 years), be load bearing and protected from spillages (fuel/oil). Given these requirements, it precludes the use of unbound material so there is no scope for variation in the surfacing of the access roads.

5.1.15 Where the permanent accesses are impermeable SuDS will be installed to collect, treat, attenuate and discharge the runoff from the access road. SuDS best practice

shall be used including the prioritisation of infiltration techniques close to the source where possible.

Finished Site Level

5.1.16 The site finish levels for the CSE compounds are shown in the Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (document reference 2.6.1). Non-linear infrastructure located within the CSE compounds have a 15 m maximum height and an upward vertical LoD of 10%. The site finish level for the permanent infrastructure is approximately indicated **2.6.1 Errata Design and Layout Plans - Subs and Cables [REP1-004]**, and secured in Schedule 19 of the dDCO as identified below:

- Wenham Grove CSE Compound
  - The site finish level is shown as approximately +47.866 m AOD on AENC-MMAC-ENG-DWG-0085-13 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1).
- Great Horkesley (EACN Side) and Great Horkesley (Tilbury Side)
  - The site finish level at Great Horkesley (EACN Side) is shown as approximately +50.500 m AOD on AENC-MMAC-ENG-DWG-0085-16 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1).
  - The site finish level at Great Horkesley (Tilbury Side) is shown as approximately +47.000 m AOD on the AENC-MMAC-ENG-DWG-0085-17 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1).
- Fairstead (EACN Side) and Fairstead (Tilbury Side)
  - The site finish level at Fairstead (EACN Side) is shown as approximately +58.300 m AOD on AENC-MMAC-ENG-DWG-0085-18 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1).
  - The site finish level at Fairstead (Tilbury Side) is shown as approximately +60.300 m AOD on AENC-MMAC-ENG-DWG-0085-19 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1).
- Tilbury North (Tilbury Side) and Tilbury North (Warley Side)
  - The site finish level at Tilbury North (Warley Side) is shown as approximately +21.800 m AOD on AENC-MMAC-ENG-DWG-0085-22 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1).
  - The site finish level at Tilbury North (Tilbury Side) is shown as approximately +11.000 m AOD on AENC-MMAC-ENG-DWG-0085-23 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1).

Summary

5.1.17 In summary the areas where there is scope for variation at the CSE Compounds are:

- Location based on the LoD (details can be found in Section 1.4 above) and
- The landscape mitigation proposals.

5.2 Substations

5.2.1 This section sets out the design principles that led to the development of the substation layouts, and explains where there is and no scope for variation within the design and how elements for the substations will look. The areas where there is no scope for variation are due to specific equipment required to meet technical and safety standards and therefore cannot be altered.

Substation Compound Design Principles

General Requirements and Design Principles

5.2.2 The necessary lifespan of various components in the infrastructure of a particular site varies based on whether maintenance can be performed while high voltage equipment is in use. National Grid's assets have a minimum life span of 50 years, although they are expected to have a life span of at least 80 years. The substation buildings (until their first maintenance) typically have a 15-year design life. Any deviations from standard design or materials needs to be carefully evaluated with this factor in mind, as alternatives could result in interruptions to energy flows and undermine National Grid's ability to fulfil its obligations. This limits the extent to which deviations to the standard design are possible.

5.2.3 National Grid designs its substations according to a set of safety instructions, policies, standards and guidance notes based on international standards. A substation layout is designed to protect staff working within, the wider public, local community and environment, protect the equipment in the substation and allow safe access to install, maintain, or remove all or part of the substation.

5.2.4 In general, there is a minimum size for substations, the buildings and infrastructure are positioned to avoid clashes with utilities, to manage site topography, and to minimise visual and environmental impact. Once this is fixed there is very little variation to amend the design of the substations.

Separation Between Electrical Equipment

5.2.5 The requirements National Grid adheres to set out the basic dimensions that must be maintained between equipment and between live equipment and the ground or any ancillary structures, buildings, masts, roads and fences. Without adequate clearance between items of electrical equipment and vehicles requiring access into the substation, more than one part of the substation may need to be turned off, which may compromise the integrity of the system and supply to local users. For these reasons, National Grid designs its systems so that no more than one part of the system needs to be switched off for any work to be done on it. Generally, the distance required between equipment, and between live equipment and other structures depends on the system voltage and the size of any vehicles or working platforms required to access equipment which is not at ground level. The safe working distance for 400 kV is 3.1 m. This limits the opportunity to minimise the scale, but the proposed design is as small as possible to ensure efficiency.

5.2.6 Equipment containing oil (such as the transformers) require a bund surrounding them to contain any spillage. The equipment and their bunds then need adequate separation so that if there is a fire it does not cause damage to other critical items of

equipment. The transformers also have an acoustic enclosure surrounding them to limit noise emitted, but this does not add to the space required.

Boundaries (Fences, Walls and Gates)

5.2.7 Regarding the materials/finishes used for the fencing, all fencing at the substations will have a standardised galvanised finish. The fencing cannot be painted due to future maintenance issues, see information as detailed above, so there is no scope for variation.

5.2.8 The vehicle gates to the substation compound will match the heights and specification of the boundary treatments.

Substation Roads, Footpaths and Other Surfacing

5.2.9 To ensure proper functioning and safety of electrical equipment, the surfacing beneath and between the equipment must be made of clean, 75 mm graded stone aggregate that is free-draining, interlocking, non-degrading, and has excellent electrical resistance.

5.2.10 During the operation of the substation, permanent vehicle access is necessary, and parking spaces should be available. The drawings included in the DCO application (Figure 4.2: Proposed Project Design – Permanent Features (document reference 6.4.F2)) include parking spaces. The number of spaces is judged on a site-by-site basis. Further detail on access is provided in the DAS (document reference 7.15).

5.2.11 For the external access roads, they would be constructed using an impermeable surface such as asphalt or concrete respectively. The requirement for substation surfacing is that it should need little to no maintenance (for up to 40 years), be load bearing and protected from spillages (fuel/oil). Given these requirements, it precludes the use of unbound material so there is no scope for variation in the surfacing of the access roads.

5.2.12 Where the permanent accesses are impermeable SuDS will be installed to collect, treat, attenuate and discharge the runoff from the road. SuDS best practice shall be used including the prioritisation of infiltration techniques close to the source where possible.

Tilbury North Substation

Size and Layout of Substation Compound

5.2.13 While AIS technology is a mature and proven approach, its deployment in this location is significantly prevented by land availability, environmental considerations, and limited scalability. In contrast, the preferred GIS solution presents a more robust and future-proof option. It avoids conflicts with statutory land-use stakeholders, and simplifies construction by reducing site footprint and complexity.

5.2.14 The GIS technology proposed at Tilbury North Substation allows electrical equipment to be placed closer together compared with conventional AIS, due to its use of insulating gas. As a result, the overall footprint of the substation is reduced, albeit the need for the required separation distances still limits the flexibility in terms of reducing the footprint further. Equipment such as transformers and shunt reactors will require adequate clearances and bunding (where applicable) to prevent fire spread

and environmental contamination. An acoustic enclosure may also be provided for noise attenuation, although this does not significantly alter the spatial requirements. A noise survey is required to determine if the equipment (shunt reactor) requires an acoustic enclosure and this would be carried out at the detailed design stage.

5.2.15 AIS has much greater land requirements and would encroach substantially onto adjacent land uses. Depending on the orientation, affected land uses would include, a working aggregates/closed landfill site, Orsett Golf Course, areas of woodland including ancient woodland (an irreplaceable habitat), replacement ancient woodland mitigation areas associated with the LTC proposals, and a local wildlife site. It is also possible that Special Parliamentary Procedures would be required for some areas (leading to a potential delay of up to two years) to secure the necessary land rights.

5.2.16 While some aspects of the potential effects may be capable of being addressed through compensation, it is recognised that the closure of a high-profile golf course would have a substantial community effect and is not considered acceptable in this case when an alternative technology is available. The GIS substation minimises these interactions and is proposed as the preferred technology.

5.2.17 These advantages in combination with the disadvantages of using AIS collectively make GIS the most practical and resilient choice to support long-term system reinforcement and network reliability.

5.2.18 Further details on the design considerations are provided in the DDR (document reference 5.15).

Arrangement of the Substation

5.2.19 As shown in image 6 and 7, the proposed Tilbury North Substation will be located on a greenfield site approximately 5 km north of the existing Tilbury Substation, in Tilbury Essex.

5.2.20 The layout of the substation has been influenced by site-specific factors including proximity to existing utilities, environmental constraints such as the adjacent Orsett Golf Course, and the need to connect to multiple new and existing overhead line routes. A dry valley runs along the eastern edge of the site, with a surface water flood path indicated. The site has been selected through an optioneering process to minimise impacts on these constraints while providing optimal connectivity into the existing 400 kV network and EACN Substation. Further details are provided in the DDR (document reference 5.15).

Electrical Equipment

5.2.21 There is no scope to vary the colour and finish of the electrical equipment inside the GIS hall. Modular steel fabricated building and cladding for the buildings are typically specified in standard industrial finishes (such as metal sheeting), which are selected to minimise maintenance and withstand environmental exposure. External steel support structures and enclosures would be finished in galvanised steel or appropriate protective coatings.

Finished Site Level

5.2.22 The existing site at Tilbury North slopes from north to south, ranging from approximately 28 m AOD at the northern edge to approximately 16 m AOD at the southern edge. The extent of the substation boundary is constrained along the

northern and western edges by Orsett Golf Course, a working aggregates processing/closed landfill site and an area of environmental importance.

5.2.23 The site finish level at Tilbury North Substation is shown as approximately +21.150 m AOD on AENC-MMAC-ENG-DWG-0085-21 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1).

5.2.24 Non-linear infrastructure located within the substation have a 15 m maximum height and an upward vertical LoD of 10%. The vertical limits (in relation to height) are defined in Article 5 of the DCO and presented in Parameter Tables within the Works Plans (document reference 2.3).

5.2.25 To mitigate flood risk and create a level working platform, the substation platform will be raised above existing ground levels and significant earthworks, including retaining structures, will be undertaken

5.2.26 The finished platform level will form the basis for determining the height parameters for structures and buildings. The platform design must ensure effective drainage and compatibility with overhead line gantry levels, particularly due to the elevation difference with the adjacent Orsett Golf Course. This would be determined at the detailed design stage.

Substation Buildings

5.2.27 For the GIS control buildings, there is scope for variation in the external finishes. Buildings must be located with due consideration for access, maintenance, and operational clearance. These buildings are expected to be modular steel-fabricated with metal sheet cladding for the GIS hall but may allow variations in colour to suit the surrounding landscape.

5.2.28 The GIS building will have maximum dimensions of approximately 135 m x 30 m x 15 m (length x width x height) and will house all high-voltage equipment. An associated annex building (approximately 135 m x 12 m x 15 m) will contain auxiliary equipment and welfare facilities. Prefabrication may be considered where appropriate to reduce on-site construction time and improve safety.

5.2.29 Smaller prefabricated buildings, fibreglass or steel containers or enclosures may be required for specific systems, such as protection or communication equipment. These may be fibreglass or metal containers/structures. The approach to the detailed design of Tilbury North Substation involves using a combination of cladding and modular steel frame for the GIS hall and annex buildings.

5.2.30 There are existing buildings to the north of Orsett Golf Course that have a ribbed metal cladding roofs and horizontal clad walls so the materials would reflect the local vernacular of similar large scale functional buildings, seen in image 326 This is likely to involve the use muted, ribbed metal cladding similar to Yaxley Substation.

Images 5.1 Example of a building to the north of Orsett Golf Course (Source: Google Streetview 2025)

5.2.31 For the GIS substation building it is recommended to have muted and matt colours such as RAL 110 30 10 Dark Olive Green or similar to those identified in the colour palette in image 21.

5.2.32 For any reused and/or relocated buildings, any cladding material proposed shall either be of identical specification to that of the existing cladding or, if a proposed change is requested by the relevant Local Authority, it must be compatible with the structure of the existing building. If no compatible alternative is available, the existing cladding material shall be reused on any relocated building, if practicable.

Summary

5.2.33 In summary the areas where there is scope for variation at North Tilbury Substation are:

- Location based on the LoD (details can be found in Section 1.4 above)
- Details of the external colour of the GIS building; and
- The landscape mitigation proposals.

EACN Substation

Size and Layout of Substation Compound

5.2.34 The preferred design solution for the EACN building was AIS, as it was considered that despite a larger footprint, it would fit better into the surrounding landscape and would be easier to visually screen compared to GIS technology, as there would be less massing to screen than if a building was used. It has reduced visual effect by virtue of generally lower height equipment. As there are no large-scale buildings in this area, the visibility of structures is likely to be reduced and mitigation is likely to be more effective in screening views towards the substation, when compared to GIS technology.

5.2.35 In this case there was sufficient land available to accommodate this design. Further details are provided in the DDR (document reference 5.15).

Arrangement of the Substation

5.2.36 As shown in the image 23, the EACN Substation consists of a single electrical compound containing the 400 kV equipment. Within the overall compound, a control building is separately fenced off to prevent unauthorised access to the main electrical high voltage compound. The compound consists of a security fence, control buildings and vehicle access, including for large vehicles such as cranes, heavy goods vehicles and abnormal loads to deliver and remove the transformers and reactors if required.

5.2.37 At the EACN Substation, the proposed 400 kV underground cable approaches from the west from Bramford Substation. The 400 kV overhead line also exits the substation from the west towards Tilbury North Substation.

5.2.38 The substation has been located with both local constraints and the contracted connecting customers in mind. The EACN Substation is located to the east of a network rail owned railway track which the Project's overhead line and underground cable then must cross. By doing so it avoids causing multiple additional track crossings stemming from the corridors that would be required to accommodate North Falls offshore wind farm and Five Estuaries offshore wind farm and Tarchon Energy Limited Interconnector when connecting to the EACN Substation. See DDR for more information (document reference 5.15).

Electrical Equipment

5.2.39 There is no scope to vary the colour and finish of the electrical equipment needed. Typically, busbars and clamps are manufactured from aluminium (dull silver grey). Insulators are either porcelain (usually reddish brown/grey) or silicone (usually grey) and the manufacturers of equipment vary in their preference. Steel support structures within the compound would be left in a galvanised finish (dull silver grey) to avoid maintenance requirements in close proximity to 'live' equipment.

Finished Site Level

5.2.40 The proposed substation has been located out of all flood zones and therefore does not pose a flood risk as per national planning requirements. However, for National Grid policy, a 1:1,000 year + climate change flood resilience level is required. The site finish level is shown as approximately +36.25 m AOD on the Substation Elevation drawing AENC-MMAC-ENG-DWG-0085-15 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1). The finished site level is the baseline from which the maximum height parameters are to be assessed against, and the maximum height of the non-linear infrastructure located within the substation would be 15 m with an upward vertical LoD of 10%. The vertical limits (in relation to height) are defined in Article 5 of the DCO and presented in Parameter Tables within the Works Plans (document reference 2.3).

5.2.41 The substation platform has been designed to be outside of the 1% Annual Exceedance Probability (AEP) +30% climate change flood extent so that there is no requirement to provide compensatory flood storage. Site access and egress is entirely via Flood Zone 1.

Substation Buildings

5.2.42 Smaller prefabricated buildings, fibreglass or steel containers or enclosures may be required for specific systems, such as protection or communication equipment. These may be fibreglass or metal containers/structures.

5.2.43 Buildings must be located with due consideration for access, maintenance, and operational clearance.

Summary

5.2.44 In summary the areas where there is scope for variation at the EACN substation are:

- Location based on the LoD; and
- The landscape mitigation proposals. See Chapter 6 below for further details.

Connection Works at Norwich Main Substation

5.2.45 Given the nature of the connection works at Norwich Main Substation there is limited scope to vary the size and arrangement of equipment or the colour and finish of materials.

5.2.46 The Project connection at Norwich Main Substation is being connected into the approved extension which is currently being constructed and does not form part of the scope of this Project. This was approved by South Norfolk Council in September 2024 (planning reference 2024/1336). Therefore, the extent of the Project's works within the Norwich Main Substation are limited to the population of two feeder bays. These are made up of 400 kV AIS equipment and are to be provided within the live electrical compound being established by third parties, therefore there is no scope to alter the size and layout of this equipment.

Extension to Bramford Substation

Size and Layout of the Connection Works

5.2.47 The Project connection at Bramford Substation is being connected into a new extension of the main 400 kV GIS substation. The Project has a direct interface on site with the Bramford to Twinstead Network Optimisation scheme as both projects traverse the same areas of site and are required to integrate together. It is for this reason GIS equipment has been selected for installation as it allows circuits to be built closer together and minimises the land take requirements. There are minor amendments required to the north and south of site to accommodate new line entry gantries which will require the existing fencing to be reconfigured; however, these changes are limited. Given this is an existing site, the plan is to match the design and colour schemes already implemented on site to aid in blending the new equipment into the surroundings. Due to the limitations of existing development around Bramford Substation no landscaping has been proposed.

Finished Site Level

5.2.48 The proposed connection works have been located out of all flood zones and therefore do not pose a flood risk as per national planning requirements. However, for National Grid policy, a 1:1,000 year + climate change flood resilience level is required. The site finish level is shown as approximately +56.250 m AOD on AENC-

MMAC-ENG-DWG-0085-12 within the Design and Layout Plans – Subs and Cables (document reference 2.6.1). The finished site level is the baseline from which the maximum height parameters are to be assessed against, and the maximum height of the non-linear infrastructure located within the substation would be 15 m with an upward vertical LoD of 10%. The vertical limits (in relation to height) are defined in Article 5 of the DCO and presented in Parameter Tables within the Works Plans (document reference 2.3).

5.2.49 The substation platform has been designed to be outside of the 1% AEP +30% climate change flood extent so that there is no requirement to provide compensatory flood storage. Site access and egress is entirely via Flood Zone 1.

5.2.50 Given the majority of the site is existing National Grid infrastructure, the works will be constructed to the same established site levels for ease of construction.

Substation Buildings

5.2.51 The main site is to be extended and the new buildings will match the existing substation buildings in terms of design, materials and finishes.

Summary

5.2.52 In summary the areas where there is scope for variation at Bramford Substation are:

- Location based on the LoD.

5.3 Landscape and Visual Mitigation

Design Principles

5.3.1 Environmental appraisal has been an integral part of the Project design from the outset, which has meant that the Project has been able to avoid environmentally sensitive features as far as reasonably practicable.

5.3.2 National Grid has also embedded mitigation into the design of the Project to avoid or reduce significant effects that may otherwise be experienced during construction and operation (and maintenance) of the Project.

5.3.3 Embedded mitigation measures are those that are intrinsic to and built into the design of the Project. These are presented in Table 4.2 of Chapter 4: Project Description (document reference 6.4). Those relevant to Landscape and Visual Amenity and the DASSI document include:

- Sensitive siting of the CSE compounds and substations and Order Limits - as far as practicable effects on identified environmental (including landscape and visual, ecology and heritage assets) and socio-economics receptors have been avoided and reduced
- The Project allows for landscape planting around CSE compounds, the new EACN Substation, south of the new Tilbury North Substation and the existing Norwich Main Substation and its extension. These are shown as 'Environmental Areas' on Figure 4.1: Proposed Project Design (document reference 6.4.F1) and Figure 4.2: Proposed Project Design – Permanent Features (document reference 6.4.F2). The Outline LEMP (document reference 7.4) has been produced to detail the environmental measures that would be implemented to avoid, minimise,

mitigate and compensate the landscape and visual and ecological features likely to be impacted during construction and operation. These are shown in image 2 to 9 above.

- New planting is illustrated on the indicative landscape proposals, within Appendix D of the Outline LEMP, including planting schedules, (document reference 7.4), will also contribute to BNG.

5.3.4 The Environmental Areas compromise of the following:

- Land around Norwich Main Substation (areas not included in the Norwich Main Substation Extension Planning application)
- Land around EACN Substation
- Land around Tilbury North Substation and Tilbury North (Warley Side) and Tilbury North (Tilbury Side) CSE Compounds (with LTC)
- Land around Tilbury North Substation and Tilbury North (Warley Side) and Tilbury North (Tilbury Side) CSE Compounds (without LTC)
- Land around Wenham Grove CSE Compound
- Land around Great Horkesley (EACN Side) CSE Compound
- Land around Great Horkesley (Tilbury Side) CSE Compound
- Land around Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds.

5.3.5 The extension to Bramford Substation is not an area identified for mitigation planting over and above reinstatement planting, as there is not sufficient space due to other planned developments. Reinstatement planting is secured under Requirement 9 in the form of the scheme for replacement planting in the draft DCO (refer to Schedule 3 of the draft DCO (document reference 3.1)) and details would be provided upon completion of the detailed engineering design to avoid abortive design work.

5.3.6 The principal objective of the mitigation within the Environmental Areas is to filter and screen views of the infrastructure from people living and moving around the landscape, whilst also aiming to integrate the infrastructure into the landscape in a way that respects and enhances landscape character. The overarching design principles for the landscape and visual mitigation of the CSE compounds and substations are secured via the outline LEMP, with the final LEMPs to be submitted under Requirement 4 (refer to Schedule 3 of the draft DCO (document reference 3.1), and have been outlined below:

- Develop proposals taking into consideration the baseline landscape context as outlined in Chapter 2
- Retain existing trees, woodland and hedgerows where practicable. A site survey of all hedgerows and trees to be retained would be carried out to establish up to date requirements for reinforcement, including any incidence of ash dieback. The survey would also identify potential locations of new tree planting taking into account more detailed information on constraints such as services. The detailed landscape mitigation design would also need to reflect the final locations of permanent visibility splays and other technical constraints. Reinforce existing field boundary hedgerows and restore historic hedgerows where possible through additional native shrub and tree planting to strengthen landscape character.

Maximise green infrastructure links and biodiversity and filter and screen views of new infrastructure

- Replacement planting would be undertaken at the earliest opportunity within the appropriate planting season to mitigate, where practicable, vegetation removed during construction
- New planting to reflect the overall pattern and composition of woodland blocks and belts in the vicinity of the substations and CSE compound sites, noting the greater quantum of existing woodland cover in the vicinity of the Tilbury North Substation in particular
- Adoption of permanent, subtle earth mounding generated from construction phase excavation with appropriate heights and slope profiles and native scrub and woodland planting to minimise adverse landscape and visual effects and achieve a cut and fill balance of material at each substation and CSE compound site

5.3.7 Drainage would also be required and would comprise attenuation ponds (or alternative feature) and outfalls as presented on ES Figure 4.2: Proposed Project Design – Permanent Features (document reference 6.4.F2). The detailed landscape mitigation proposals would reflect the indicative landscape proposals and would be developed from the fixed engineering design. Regard would be had to nearby developments, in particular to the substations and associated cables for the North Falls and Five Estuaries offshore wind farm projects which have been assessed in Chapter 17 Cumulative Effects Assessment of the ES (document reference 6.17). The proposals for the Environmental Areas are secured via the outline LEMP with detailed proposals being provided in the LEMP to be submitted under Requirement 4 (refer to Schedule 3 of the draft DCO (document reference 3.1).

5.3.8 There would be opportunities for the relevant Local Planning Authorities to suggest minor changes to the planting palette and/or request minor changes to the earthworks and extent of planting, subject to these changes being non-material, in general accordance with the outline LEMP and compatible with the detailed design of underground services and drainage and above ground easements related to infrastructure.

5.3.9 The following images show the Environmental Areas around the CSE compounds and substations, illustrated with planting at year 15. Whilst they are based Environmental Areas they are for illustrative purposes only (including access surfacing). They have been verified by the landscape specialists in the LUC team and the reader should defer to the detail shown in the Environmental Areas provided in the Outline LEMP (document reference 7.4) for specific landscaping details and proposed management and Image 1.2 through Image 1.9 detailed above.

Image 5.2 Wenham Grove CSE Compound illustrated with planting at year 15

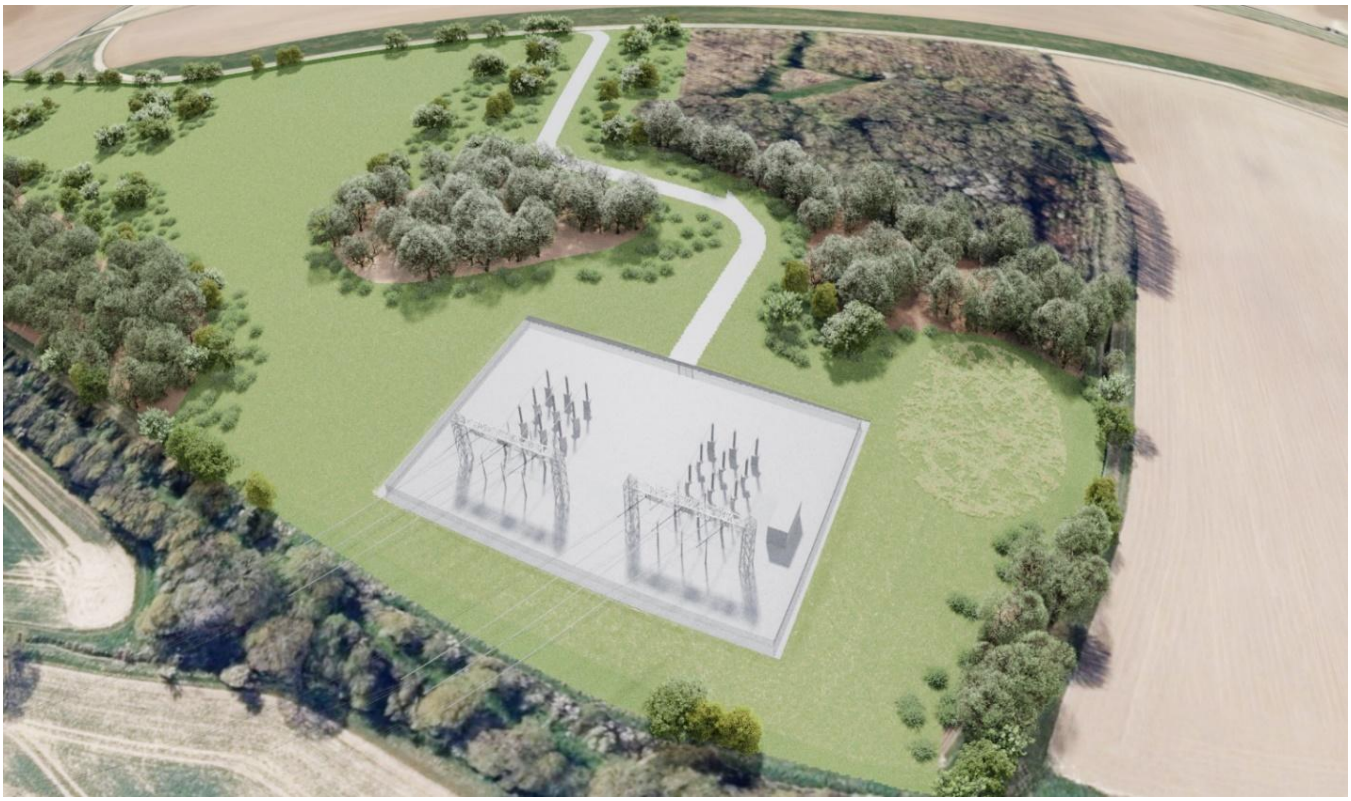


Image 5.3 Great Horkesley (EACN Side) CSE Compound illustrated with planting at year 15

Image 5.4 Great Horkesley (Tilbury Side) CSE Compound illustrated with planting at year 15

Image 5.5 Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds illustrated with planting at year 15

Image 5.6 Tilbury North (Tilbury Side) and Tilbury North (Warley Side) CSE Compounds illustrated with planting at year 15

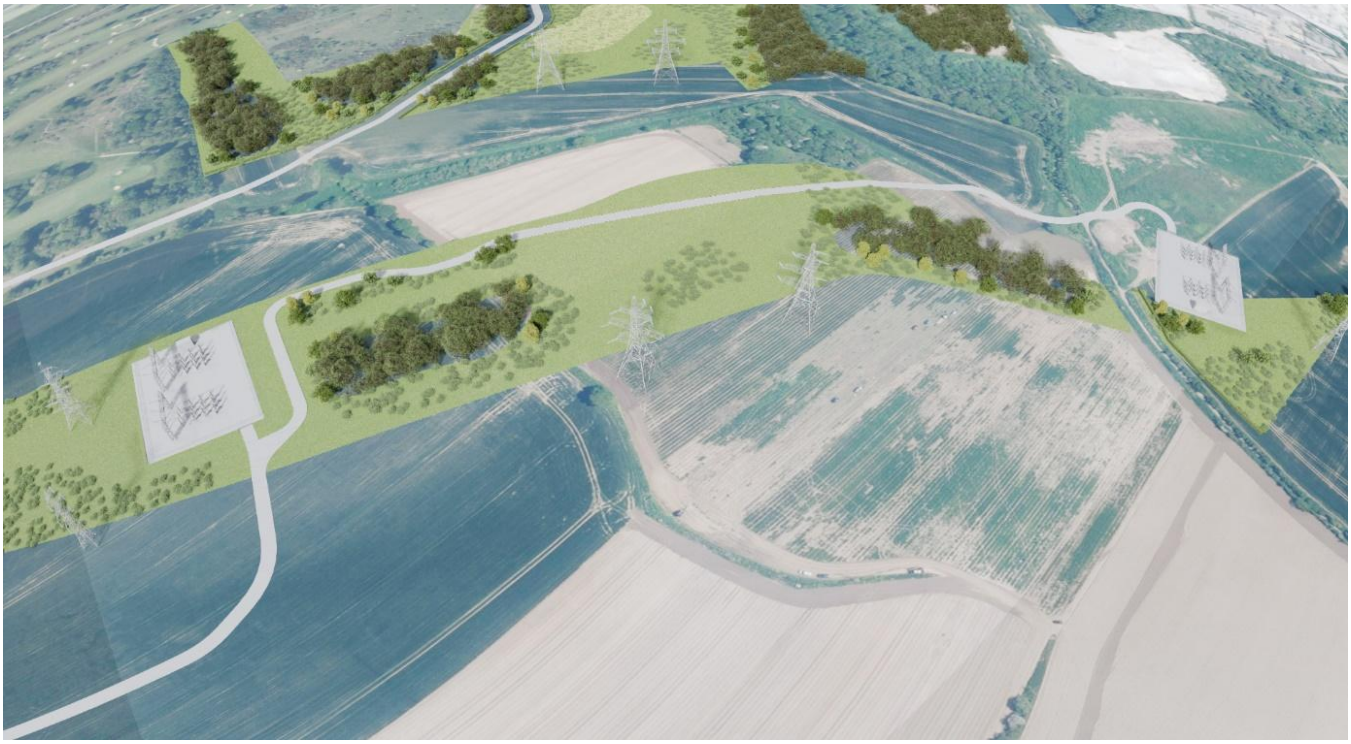


Image 5.7 Tilbury North Substation illustrated with planting at year 15

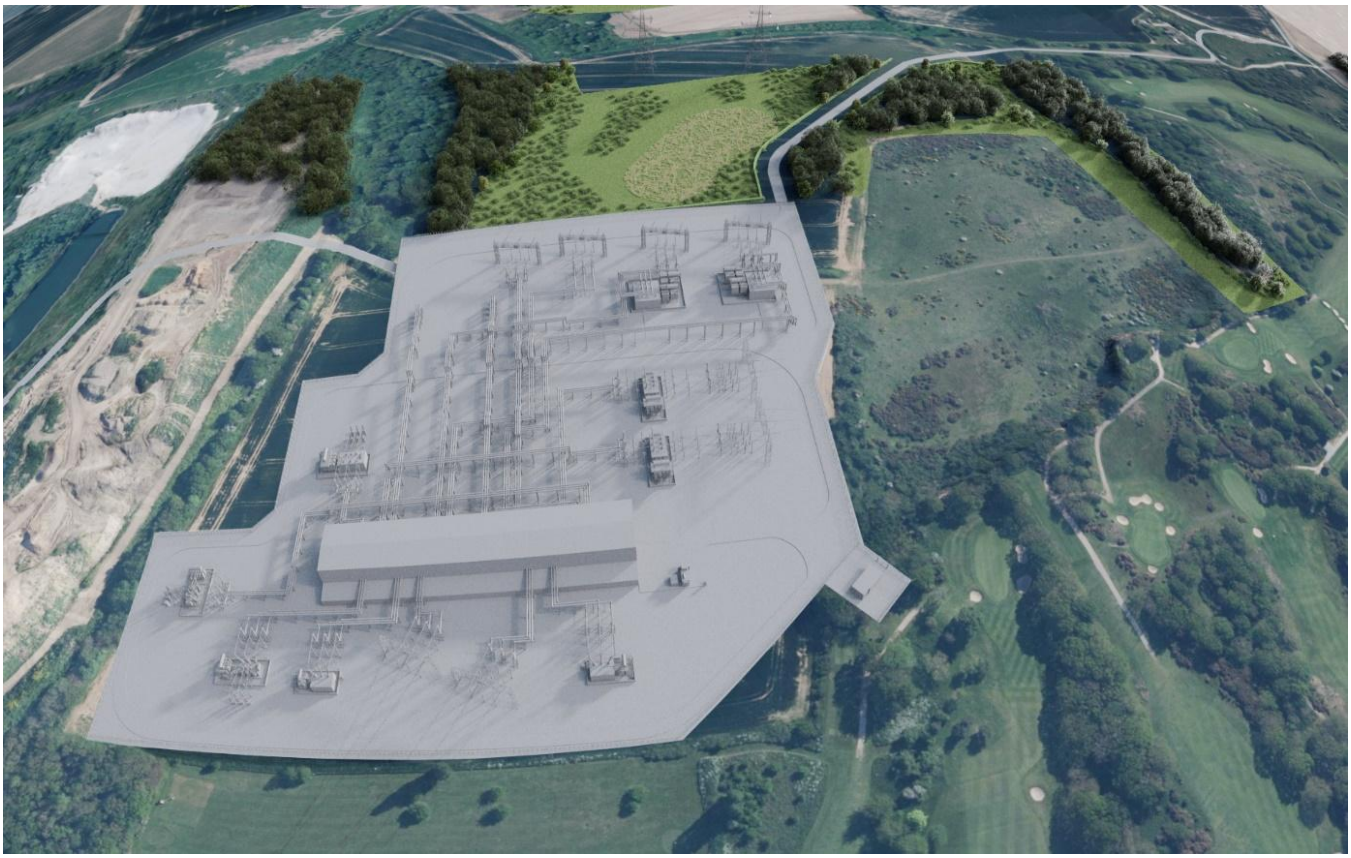


Image 5.8 EACN Substation illustrated with planting at year 15

Scope for Variation

5.3.10 A range of technical constraints reduce the scope for variation in the design of landscape mitigation including the following:

- Tree planting must be located outside the easements of overhead lines and the downleads in the vicinity of the substations and CSE compounds. A current indicative offset of 28 m from the centre line of the overhead lines with final offset distances to be confirmed at detailed design stage
- Clear space is required beneath the downleads from the overhead line to maintain safety clearances, which restricts both tree planting and earth mounding
- A minimum offset of 3 m is required for tree planting from the security fencing associated with the substations and CSE compounds
- There is a requirement for an offset both sides of the outer cable swathe to avoid impacts on the cables. The current indicative offset is 10 m from the outer extents with final offset distances to be confirmed at detailed design stage
- Tree planting must also be located outside the easements of pre-existing services such as gas and water pipes in accordance with relevant guidelines
- There are restrictions to planting related to permanent visibility splays required for permanent access to substations and CSE compounds.

5.3.11 Whilst there is some scope to vary the mitigation proposals within the Environmental Areas in terms of detailed layouts and types of proposed planting; at the detailed design stage there is no scope to vary the size or locations of the proposed Environmental Areas within the Order Limits. These Environmental Areas have been developed in consultation with relevant Local Planning Authorities and Natural England. These will be subject to design details to be secured via the LEMPs to be submitted under Requirement 4 (refer to Schedule 3 of the draft DCO (document reference 3.1).

6. Approach to Detailed Design and Approval Process

6.1 Detailed Design

6.1.1 Section 5.2 identified that in relation to the new substations proposed, there was scope for variation in the external colour of the GIS building within the Tilbury North Substation. This Chapter provides details of the approach to the materials to be used on the building, suggested approach for the external colour and how it will be secured. It is considered the proposed colour palette for Tilbury North Substation should be sensitive to the environment it is located in, where practicable. Tilbury North and EACN Substations and CSE Compounds

6.1.2 As stated in Section 5.2 in addition to the external colour of the GIS building at the Tilbury North Substation and the landscaping details can be influenced during the detailed design stage for the new substations (Tilbury North and EACN Substations) and the CSE compound sites.

6.2 Approval Process

6.2.1 The DASSI document has been prepared as part of the development consent application submission. It will be shared with the relevant Local Planning Authorities for discussion and reviewed as part of the Statements of Common Ground (SoCGs). The DASSI document is intended to be a live and working document that will be updated as the examination progresses, as appropriate. The final SoCGs will be prepared ahead of the close of the DCO Examination and further comments on the DASSI will be addressed and updated accordingly.

6.2.2 The draft Development Consent Order (DCO) (document reference 3.1) is a critical mechanism for ensuring that good design is secured. It ensures that the design retains flexibility to respond to site conditions, innovation, and stakeholder feedback whilst embedding enforceable design commitments that provide clarity, certainty, and accountability. This section explains how the DCO ensures that the final built outcome secures the design aspirations assessed during examination and meets the expectations of stakeholders and the public.

6.2.3 Should the application for development consent be approved by the Secretary of State, Article 3 will give the legal authorisation for the development. Schedule 1 of the DCO will define the authorised development - the specific works and infrastructure that are granted development consent under the DCO. Schedule 1 lists individual work numbers which describe the key elements of the project, such as overhead transmission electric line and underground transmission electric line.

6.2.4 Whilst Schedule 1 defines the works, the Works Plans (document reference 2.3) show the spatial location of those works and identify the limits of deviation of each work number listed in Schedule 1. The scope of the limits of deviation are defined in writing in article 5 of the DCO (limits of deviation). The Works Plans also include the table of parameters which state the maximum height and upward extent of vertical limits of deviation for permanent infrastructure.

6.2.5 Schedule 19 (certified plans) lists all the documents that are formally “certified” and become the definitive version of what the National Grid must follow. Other parts of the DCO, especially Schedule 3 (requirements), will refer to specific certified documents.

6.2.6 Schedule 3 of the DCO (Requirements) controls how the Project is built by securing conditional control relating to design. The requirements secure mitigation commitments from the ES, provide the mechanism for agreeing detailed design where necessary, provide legal certainty and compliance controls and provide practical controls for the construction and operation phase.

Requirement 4

6.2.7 Requirement 4 of the draft DCO relates to the construction management plans and requires the submission, approval and implementation of a suite of construction management plans. As part of this suite, some plans have already been developed into an outline format to deliver commitments made within the ES into a practical set of controls and procedures that the contactor must follow. The outline management plans already drafted are to be certified as part of the application and listed in Schedule 18 and final versions must be substantially in accordance with the outline.

6.2.8 The Outline LEMP is secured under Requirement 4, the final LEMPs must be substantially in accordance with the Outline LEMP and no stage of the authorised development may commence until, for that stage, the final LEMP has been submitted to and approved by the relevant planning authority, in consultation with National England.

Schedule 19 and Requirement 6

6.2.9 Requirement 6 set out that the authorised development will be carried out in general accordance with the levels shown on the Design and Layout Plans (Elevations) (document reference 2.6.1). The following plans relate to the indicative Design and Layout Plans (Elevations) (document reference 2.6.1) of the permanent infrastructure discussed within this document and will be identified within Schedule 19 within the draft DCO (document reference 3.1) and certified:

- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Bramford Substation Layout Regulation 5(2)(o) Section B, sheet 1 of 1 Mid Suffolk District Council - AENC-MMAC-ENG-DWG-0085-11
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Bramford Substation Elevations Regulation 5(2)(o) Section B, sheet 1 of 2 Mid Suffolk District Council - AENC-MMAC-ENG-DWG-0085-12
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Bramford Substation Elevations Regulation 5(2)(o) Section B, sheet 2 of 2 Mid Suffolk District Council - AENC-MMAC-ENG-DWG-0085-12
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Cable Sealing End Compound Layout and Elevations Wenham Grove Regulation 5(2)(o) Section C, sheet 1 of 1 Babergh District Council - AENC-MMAC-ENG-DWG-0085-13

- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative EACN Substation Layout Regulation 5(2)(o) Section C, sheet 1 of 1 Tendring District Council - AENC-MMAC-ENG-DWG-0085-14
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative EACN Substation Elevations Regulation 5(2)(o) Section C, sheet 1 of 2 Tendring District Council - AENC-MMAC-ENG-DWG-0085-15
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative EACN Substation Elevations Regulation 5(2)(o) Section C, sheet 2 of 2 Tendring District Council - AENC-MMAC-ENG-DWG-0085-15
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Cable Sealing End Compound Layout and Elevations Great Horkesley – EACN Side Regulation 5(2)(o) Section D, sheet 1 of 1 Colchester City Council - AENC-MMAC-ENG-DWG-0085-16
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Cable Sealing End Compound Layout and Elevations Great Horkesley – Tilbury Side Regulation 5(2)(o) Section D, sheet 1 of 1 Colchester City Council - AENC-MMAC-ENG-DWG-0085-17
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Cable Sealing End Compound Layout and Elevations Fairstead – EACN Side Regulation 5(2)(o) Section E, sheet 1 of 1 Braintree City Council - AENC-MMAC-ENG-DWG-0085-18
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Cable Sealing End Compound Layout and Elevations Fairstead – Tilbury Side Regulation 5(2)(o) Section E, sheet 1 of 1 Braintree City Council - AENC-MMAC-ENG-DWG-0085-19
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Tilbury North Substation Layout Regulation 5(2)(o) Section H, sheet 1 of 1 Thurrock Council - AENC-MMAC-ENG-DWG-0085-20
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Tilbury North Substation Elevations Regulation 5(2)(o) Section H, sheet 1 of 1 Thurrock Council - AENC-MMAC-ENG-DWG-0085-21
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Cable Sealing End Compound Layout and Elevations ZB – Warley Side Regulation 5(2)(o) Section H, sheet 1 of 1 Thurrock Council - AENC-MMAC-ENG-DWG-0085-22
- The National Grid (Norwich to Tilbury) Order Design and Layout Plans Indicative Cable Sealing End Compound Layout and Elevations ZB – Tilbury Side Regulation 5(2)(o) Section H, sheet 1 of 1 Thurrock Council - AENC-MMAC-ENG-DWG-0085-23

6.2.10 These plans present an indicative representation of CSE compounds and substations based upon the Project Description as set out in Chapter 4 of the ES.

6.2.11 Requirement 6 requires the authorised development to be carried out in general accordance with the Design and Layout Plans (elevations) that have been certified under Schedule 19 of the draft DCO. This includes the levels shown on the plans. The authorised development will be in general accordance with the design and layout

plans to the extent that any departure from the design and layout drawings shall not give rise to any materially new or materially different environmental effects from those assessed in the ES.

Requirement 11

6.2.12 The requirement recognises that whilst there is generally very limited flexibility regarding scale, layout and appearance of substations and CSE compounds given their technical restrictions, as set out in this document, the proposed Tilbury North GIS substation does offer more flexibility regarding the final colour finish than other substation sites.

6.2.13 This requirement requires the relevant local planning authority to agree the final colour of the GIS building and gas insulated hall annex, at the Tilbury North Substation site to ensure visual cohesion.

Requirement 12

6.2.14 This requirement ensures that the final appearance of permanent buildings is consistent with the approved design principles in this document, which will be certified under Schedule 18. It provides a mechanism for enforceable design-led detailing post consent, ensuring matters agreed during examination are delivered throughout construction whilst still allowing flexibility for innovation at detailed design stage.

6.2.15 The other relevant requirements within the draft DCO (document reference 3.1) are:

- Requirement 8 - Retention and removal of trees, woodland and hedgerows. This requirement ensures that the detailed design phase of the project reflects the certified “trees and hedgerows to be removed or managed” plans (reference 2.16), maintaining alignment with what was assessed in the ES. This requirement prevents the premature or excessive clearance of trees, woodland and hedgerows by requiring submission of these finalised plans prior to commencement of development. This requirement also ensures that the removal of trees, woodland and hedgerows is carried out in accordance with measures captured within the Landscape and Ecological Management Plan (LEMP), a final version of which will be agreed prior to commencement of development under requirement 4 (construction management plans).
- Requirement 9 – Reinstatement planting plans - This requirement ensures that the reinstatement planting design following construction activities includes appropriate restoration of temporarily disturbed areas in a way that is consistent with the approved LEMP.
- Requirement 14 specifies which set of works can be built for the Tilbury North turn in scenarios, ZB undergrounding or the YYJ undergrounding. The requirement secure works that are an ‘ether/ or’ so they would not both be built out.

Abbreviations

Abbreviation	Full Reference
AEP	Annual Exceedance Probability
AIS	Air Insulated Switchgear
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
BNG	Biodiversity Net Gain
CoCP	Code of Construction Practice
CSE	Cable Sealing End
DAS	Design and Access Statement
DASSI	Design Approach to Site Specific Infrastructure
DCO	Development Consent Order
DDR	Design Development Report
DRC	Dynamic Reactive Compensator
EACN	East Anglia Connection Node
ES	Environmental Statement
EV	Electric Vehicle
FLT	Full Line Tension
GIB	Gas Insulated Busbar
GIS	Gas Insulated Switchgear
GRP	Glass Reinforced Plastic
Km	Kilometre
kV	Kilovolt
LCA	Landscape Character Area
LED	Light-emitting diode
LEMP	Landscape and Ecological Management Plan
LoD	Limits of Deviation
LTC	Lower Thames Crossing
LVAC	Low Voltage Alternating Current
NETS SQSS	National Electricity Transmission System Security and Quality of Supply Standard

Abbreviation	Full Reference
NPS	National Policy Statement
PAR	Primary Access Route
The Project	Norwich to Tilbury
PRoW	Public Right of Way
SCADA RTU	Supervisory Control and Data Acquisition Remote Terminal Unit
UK	United Kingdom
UKPN	UK Power Networks

Glossary

Term	Description
Abnormal Indivisible Loads	A large load which cannot 'without undue expense or risk of damage' be divided into two or more smaller loads for the purposes of being transported by road, and which exceeds limits set out in terms of weight (>44 tonnes), length (>18.65 m), and width (>2.9 m).
Alignment	The proposed overhead line and underground cable route.
Ancient woodland	Land that has been continually wooded since at least 1600 in England. Regarded as 'irreplaceable habitat' in national planning policy and guidance. Ancient woodland greater than 2 ha is recorded on the Natural England Ancient Woodland Inventory.
Bellmouth	A flared vehicular access point connecting a construction site to the public highway, designed to accommodate turning movements by large vehicles.
Biodiversity	The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.
Biodiversity Net Gain	An approach for developments to ensure habitats for wildlife are left in a measurably better state than they were before the development.
Circuit	A set of wires along which current flows and returns. It is necessary to have a complete circuit for current to flow. The National Grid standard for overhead lines operating at 400 kV is for pylons to carry two circuits, each consisting of three phases, i.e. a double circuit configuration.
Cable	An insulated conductor designed for underground installation.
Cable Sealing End	Structures used to transfer transmission circuits between underground cables and overhead lines.
Cable Sealing End compound	Electrical infrastructure used as the transition point between overhead lines and underground cables. A compound on the ground acts as the principal transition point.
Code of Construction Practice	A code of construction practice sets out the standards and procedures to which a developer (and its contractors) must adhere in order to manage the potential effects of construction works.
Conductor	The overhead wire that carries electricity from one place to another, for example the line between two pylons.
Design Approach for Site-Specific Infrastructure	Document developed by National Grid to outline the design principles that can be taken forward into the detailed design, set out an approach to the design of site-specific infrastructure of non-linear works, and to detail those elements of the design which have some flexibility in their appearance.

Term	Description
Development Consent Order	A statutory instrument which grants consents and other rights to build a Nationally Significant Infrastructure Project, as defined by the Planning Act 2008.
Distribution Network Operator	Companies that own and operate the power lines and infrastructure that connect the National Grid network to individual properties.
Embedded design measures	Mitigation measures are those that are intrinsic to and built into the design of the Project.
Environmental Statement (ES)	The main output from the EIA process, an ES is the report required to accompany an application for development consent (under the Infrastructure Planning (EIA) Regulations 2017) to inform public and stakeholder consultation and the decision on whether a project should be allowed to proceed. The EIA Regulations set out specific requirements for the contents of an ES for Nationally Significant Infrastructure Projects.
Flood Risk Assessment	A Flood Risk Assessment is an assessment of the risk of flooding, particularly in relation to residential, commercial and industrial land use. In England and Wales, the Environment Agency requires a Flood Risk Assessment to be submitted alongside planning applications in areas that are known to be at risk of flooding.
Full line tension gantries	Types of gantries which allow conductors to connect into a substation or compound directly from a pylon, without requiring a bulky terminal pylon. This allows a larger span between the final pylon and the gantry.
Gantry	An overhead bridge-like structure supporting electrical equipment. A transition point from overhead line equipment to equipment in a compound.
Greenhouse gases	The term ‘greenhouse gases’ refers to a number of chemicals in the earth’s atmosphere such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O).
Heavy Goods Vehicles	Goods vehicles weighing more than 3,500 kg.
High voltage	275,000 volts and over. National Grid’s transmission lines generally operate at 275,000 and 400,000 volts. Lower voltage lines, such as 132,000 volts and 33,000 volts, are generally owned by local distribution companies.
Insulator	Used to attach the conductors to the pylons, preventing electrical discharge to the steelwork.
Kilovolt	1,000 volts
Landscape character	A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse.
Lattice pylon	Pylon type widely used on the national electricity transmission networks. Both standard lattice pylons (approximately 50 m in height)

Term	Description
	and low hight lattice pylons (approximately 40 m in height) are proposed on the Project.
Limits of Deviation (LoD)	LoD allow for adjustment to the final positioning of the permanent features, for example to avoid localised constraints or unknown or unforeseeable issues that may arise. This could include previously unidentified poor ground conditions which require a pylon to be moved slightly for geotechnical reasons, such as ground stability. The horizontal LoD define the parameters within which the position on the ground of proposed permanent features may deviate from the position shown on the plans. This applies to both linear (for example overhead lines and underground cables) and non-linear (for example the new EACN Substation and CSE compounds) proposed infrastructure. Vertical LoD limit the maximum vertical height, or the depth below ground, of any new infrastructure.
Local Planning Authority	The public authority whose duty it is to carry out specific planning functions for a particular area.
Mitigation	The action of reducing the severity and magnitude of change (impact) to the environment. Measures to avoid, reduce, remedy or compensate for significant adverse effects.
National Landscape (an Area of Outstanding Natural Beauty)	Formally designated under the National Parks and Access to the Countryside Act of 1949 to protect areas of the countryside of high scenic quality that cannot be selected for National Park status due to their lack of opportunities for outdoor recreation (an essential objective of National Parks). As of November 2023, all AONBs became 'National Landscapes'. This reflects ambitions for the areas to play a key part in the international '30 by 30' commitment (to protect and conserve a minimum of 30% of land and sea for biodiversity by 2030).
Nationally Significant Infrastructure Project	Typically a large-scale development of national importance that requires development consent from the Secretary of State, under the Planning Act 2008.
Order Limits	The maximum extent of land within which the authorised development may take place.
Overhead line	Conductor (wire) carrying electric current, strung from pylon to pylon.
Permanent access	Access required to infrastructure during the operational phase of the Project, for operational and maintenance purposes.
Project Section	Geographical 'sections' have been identified that break the Project down into smaller units for ease of description within the documentation. These Project Sections are broken down into eight sections based largely on Local Planning Authority boundaries.
Public Right of Way (PRoW)	A footpath, bridleway or byway accessible to all members of the public.
Pylon	Structures that support the overhead line (conductors).
Scoping Report	Report determining the content and extent of matters that should be covered in the Environmental Impact Assessment.

Term	Description
Substation	Substations are used to control the flow of power through the electricity system. They are also used to change (or transform) the voltage from a higher to lower voltage to allow it to be transmitted to local homes and businesses.
Terminal pylon	Pylons erected at the end of the overhead line to terminate the line at substations or where overhead lines are connected to underground cables. Because of the uneven load on one side of the pylons, much deeper and heavier foundations are required on the unloaded side.
Transmission line	A National Grid overhead line and underground cable which transmits electricity between National Grid's substations. Power is transmitted at high voltages (275 kV or above) between power stations where it is generated and the local electricity supply networks of the regional Distribution Network Operators where it is transformed to lower voltages (132 kV or below) for supply via distribution lines to local communities.
Temporary construction compounds	Temporary compounds installed during the construction phase of the Project. Each compound may contain storage areas including laydown areas, soils storage and areas for equipment and fuel, drainage, generators, car parking and offices and welfare areas (portacabins).
Underground cable	An insulated conductor carrying electric current designed for underground installation. Underground cables link together two Cable Sealing End compounds.
Voltage	The electrical potential difference between two points.

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Appendix A. Guide to the Approach on Design

nationalgrid

Guide to the approach on design

This Guide to the approach on design includes the key documents that form the project's design approach.

While there is no statutory requirement to produce design-related documents, paragraph 4.7.7 of EN-1 (2024) states that:

"Applicants must demonstrate in their application documents how the design process was conducted and how the proposed design evolved. Where a number of different designs were considered, applicants should set out the reasons why the favored choice has been selected."

This is not the interactive version of the Guide to the approach on design.

To view the interactive version of this guide please visit https://www.nationalgrid.com/electricity-transmission/network-and-infrastructure/infrastructure-projects/norwich-to-tilbury/document-library

Advice issued by the Planning Inspectorate also states that the applicant can submit any document that could help assist in meeting requirements of a National Policy Statement including a design and access statement among other supporting design documents.

Given the linear nature of the proposed electricity transmission project that comprises various components, the following documents have been prepared to capture the design process:

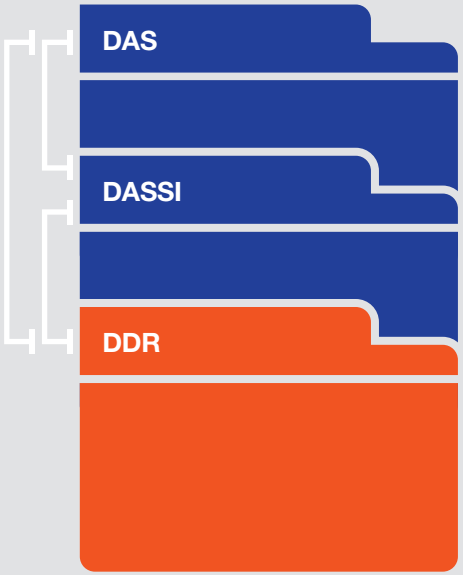
- **DAS –** Design and Access Statement (document reference 7.15)
- **DASSI –** Design Approach Site Specific Infrastructure (document reference 7.16)
- **DDR –** Design Development Report (document reference 5.15)

As you move to the main page of each design document by clicking on the centralised interactive folder to each report, the purpose behind the document and interactions between each report is explained.

The interactive folder therefore provides a central repository to help those interested in understanding where to find key information on design and linkages to other documents that have helped shape and inform the design approach. Access to each design related document and the contents of the report is set out to assist those wanting to access and understand more about the way in which the project design addresses the policy, advice note requirements, regulatory and statutory duties.

Guide to the approach on design

Document



THIS IS AN INTERACTIVE PDF

To explore one of our DCO documents, relating to design click on a folder. To return to the home screen, please click the home icon, top right.

We've produced this interactive PDF to show the design documents that underpin our design approach.

Click on one of the folders on the left to view the document, read a summary and find out more information on our design approach.

Guide to the approach on design

Document

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To explore one of our DCO documents, relating to design click on a folder. To return to the home screen, please click the home icon, top right.

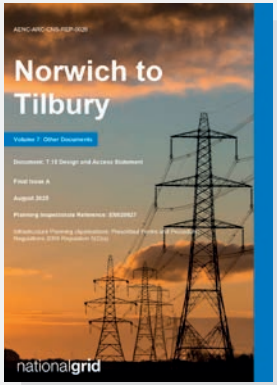
Summary

The Design and Access Statement (DAS) describes the factors that influence design in relation to the permanent linear elements of the Project. The DAS sets out the background to the Project, the design principles applied by National Grid and summarises the approach to and development of good design. It also provides details on the permanent access for both the substations and Cable Sealing End Compounds.

The DAS provides an evaluation and review of the Good Design Process summarising how the design and location have been informed by the Design Principles with reference to the 'Planning Inspectorates Nationally Significant Infrastructure Projects: Advice on Good Design' and the National Infrastructure 'Commission Design Guidance'. It also includes an Internal Design Review Note.

The report acts as the 'central' design Document that links closely with the DDR and DASSI.

Overview



The report is structured as follows:

- **Chapter 1** – Introduction
- **Chapter 2** – Overview of the Project
- **Chapter 3** – Legislation, Policy and Guidance Context
- **Chapter 4** – Physical Context
- **Chapter 5** – Good Design Process
- **Chapter 6** – Conclusions

Guide to the approach on design

Document

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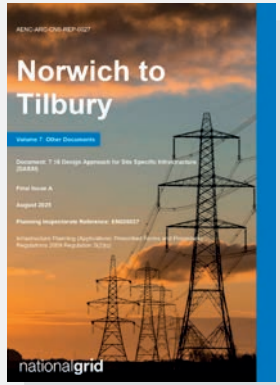
Summary

The Design Approach to Site Specific Infrastructure (DASSI) relates to the details of the site specific infrastructure of the nonlinear works included in the Project, such as the substations and Cable Sealing End Compounds (CSEC's).

This document outlines the design principles that can be taken forward into the detailed design stage, sets out an approach to the design of site specific infrastructure of non-linear works, and details those elements of the design which have some flexibility in their appearance. The document links closely with the DAS and DDR. The DASSI differs from the DDR in that it provides site specific details for non-linear infrastructure.

The document is closely linked with the 'detailed design' Requirement in the draft Development Consent Order (dDCO) and is a "certified" document under Schedule 18.

Overview



The report is structured as follows:

- **Chapter 1** – Introduction
- **Chapter 2** – Site Location and Context
- **Chapter 3** – Examples of Existing Infrastructure
- **Chapter 4** – DCO Design and Operational Function
- **Chapter 5** – Design Principles and Scope for Variation in Developing the Detailed Design
- **Chapter 6** – Approach to Detailed Design and Approval Process

Guide to the approach on design

Document

If you wish to view previous versions of the DDR or a copy of the Consultation Report you can view them in the documents section of the **Planning Inspectorate's website**.

THIS IS AN INTERACTIVE PDF

To explore one of our DCO documents, relating to design click on a folder. To return to the home screen, please click the home icon, top right.

Summary

The Design Development Report (DDR) provides an overview of the main changes in route alignment, infrastructure siting, and technology for the Norwich to Tilbury Project, based on feedback from the 2024 statutory consultation and targeted consultations in 2025.

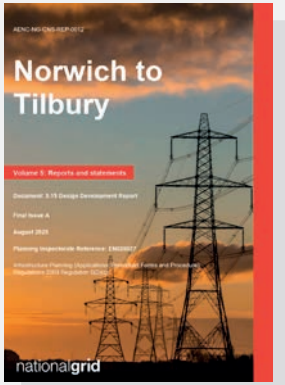
This report highlights the key changes requested in feedback received from consultations, taking into account various factors to ensure balanced decision-making.

It is important to note that the DDR does not encompass all changes, particularly smaller adjustments such as minor pylon relocations, which are addressed in the Consultation Report.

The DDR details the changes being sought, outlines the National Grid's responses, and explains the rationale behind decisions to either proceed with or forgo specific changes.

The DDR provides the details on the linear route and siting with close links to the Consultation Report.

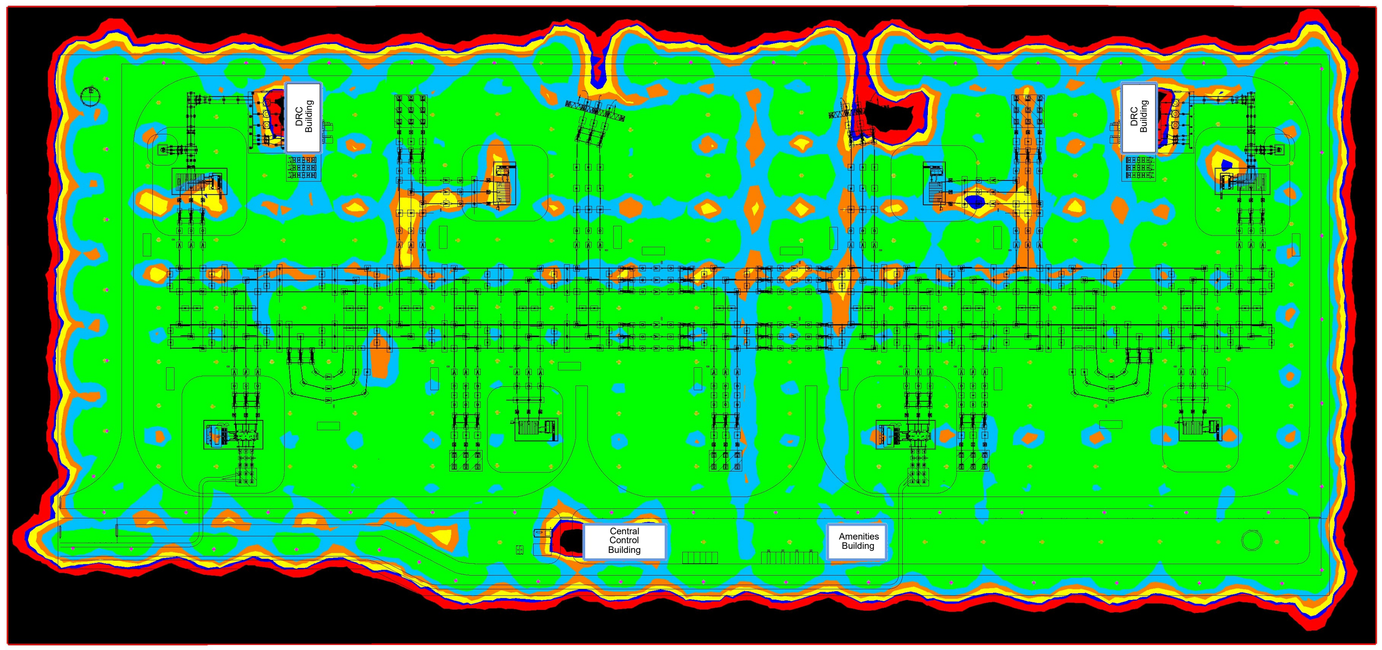
Overview



The report is structured as follows:

- **Chapter 1** – Introduction
- **Chapter 2** – Project wide considerations relevant to the design development
- **Chapter 3** – Overview and Summary of Changes Taken Forwards
- **Chapter 4** – Section A South Norfolk
- **Chapter 5** – Section B Suffolk
- **Chapter 6** – Section C Babergh and Tendring
- **Chapter 7** – Section D Colchester
- **Chapter 8** – Section E Braintree
- **Chapter 9** – Section F Chelmsford
- **Chapter 10** – Section G Brentwood and Basildon

Appendix B. Indicative Lux Plot Plans



Notes

1. Do not scale from this drawing.
2. All dimensions are in metres/millimetres unless otherwise stated.
3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. All spatial coordinates relate to the Ordnance Survey, British National Grid (OSGB36).
6. All levels are in meters and relate to AOD (Ordnance Survey, Newlyn).
7. Shall be in accordance with the recommendations of National Grid TS 2.10.04.

Key to symbols

Reference drawings

2.6.1 Errata Design and Layout Plans - Subs and Cables [REP1-003]

Rev	Date	Drawn	Description	Ch'k'd	App'd
01	MAY 26	TM	FOR INFORMATION	JW	TL

Client

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Master Scheme No:	Sub-Scheme No:	Site:
107850	001190	EACN SUBSTATION

Scheme Name: NORWICH TO TILBURY

Document Title:

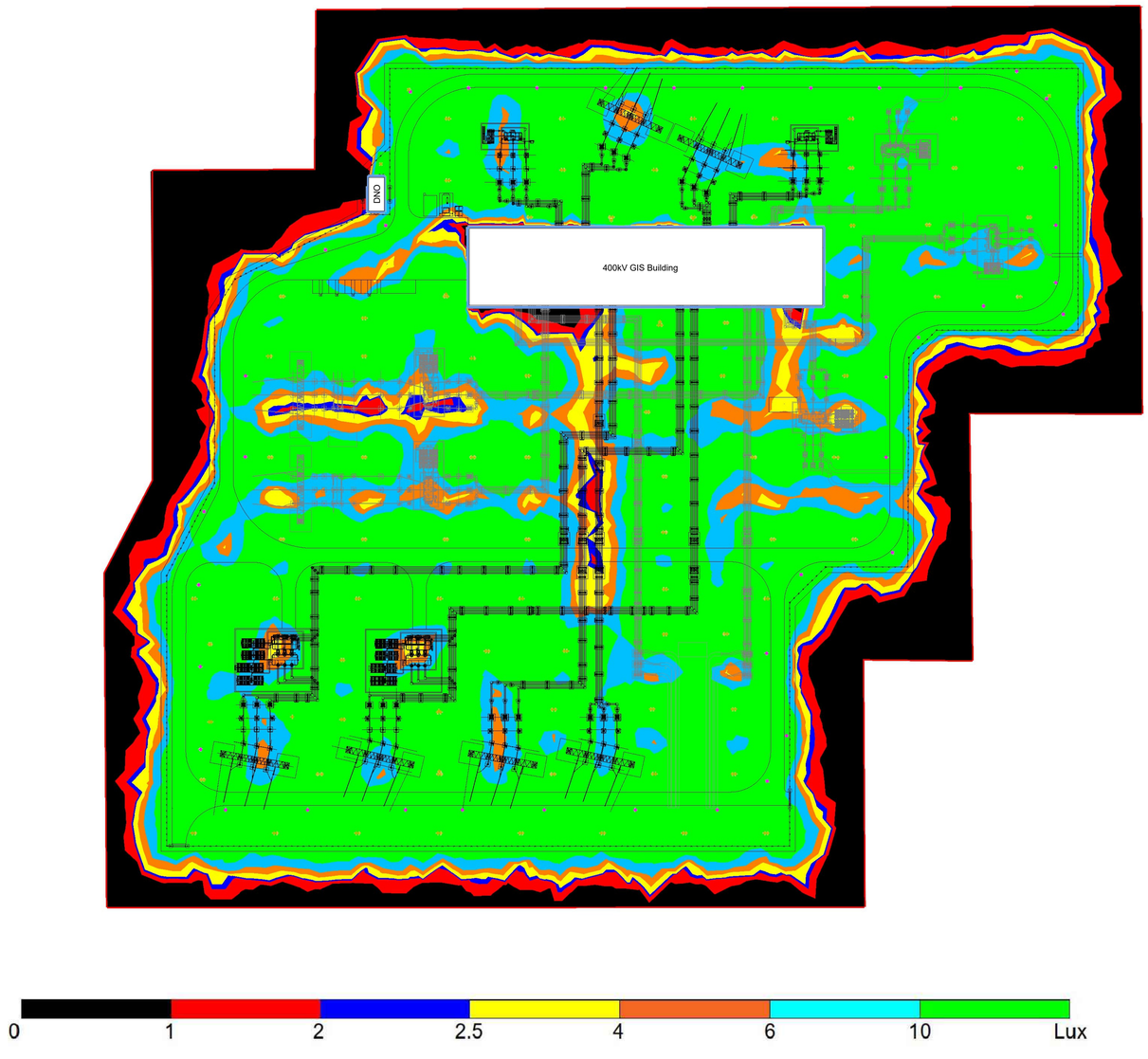
7.16 DESIGN APPROACH FOR SITE SPECIFIC INFRASTRUCTURE (DASSI) APPENDIX B – EACN SUBSTATION INDICATIVE LUX PLOT PLAN

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
T. McDermott	MAY 26	J. Weeks	MAY 26	T. Loxley	MAY 26

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
T. Loxley	PDF	NTS	PDF	01 of 01	01

National Grid Document Number: AENC-ARC-CNS-REP-0027-01

FEED Document Number: AENC-ARC-CNS-REP-0027-01



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6. All levels are in meters and relate to AOD (Ordnance Survey, Newlyn).
7. Shall be in accordance with the recommendations of National Grid TS 2.10.04.

Key to symbols

Reference drawings

2.6.1 Errata Design and Layout Plans - Subs and Cables [REP1-003]

Rev	Date	Drawn	Description	Ch'k'd	App'd
01	MAY 26	TM	FOR INFORMATION	JW	TL

Client

nationalgrid

Master Scheme No:	Sub-Scheme No:	Site:
107850	001190	TILBURY NORTH SUBSTATION

Scheme Name: NORWICH TO TILBURY

Document Title:

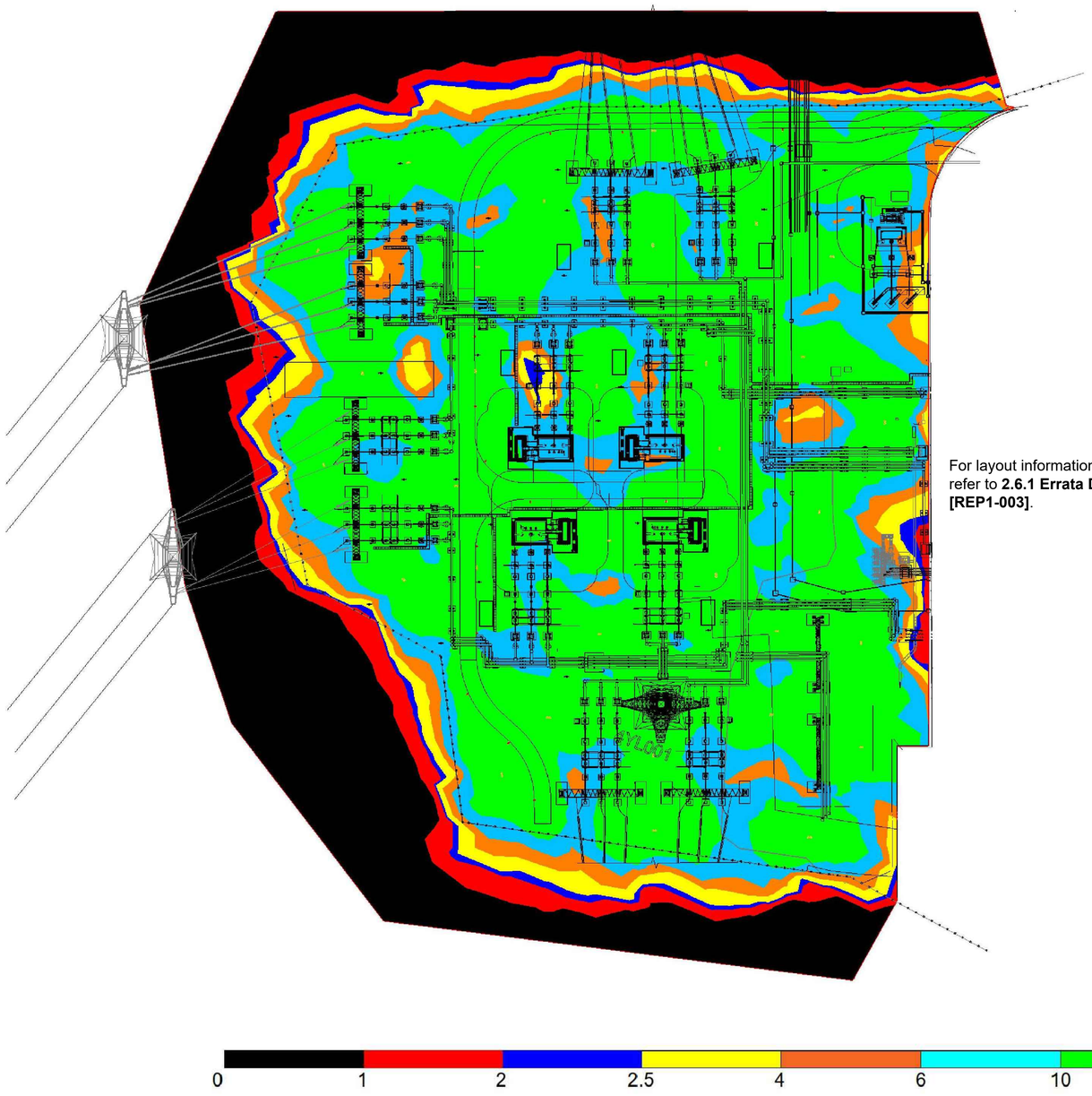
7.16 DESIGN APPROACH FOR SITE SPECIFIC INFRASTRUCTURE (DASSI) APPENDIX B – TILBURY NORTH SUBSTATION INDICATIVE LUX PLOT PLAN

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
T. McDermott	MAY 26	J. Weeks	MAY 26	T. Loxley	MAY 26

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
T. Loxley	PDF	NTS	PDF	01 of 01	01

National Grid Document Number: AENC-ARC-CNS-REP-0027-02

FEED Document Number: AENC-ARC-CNS-REP-0027-02



For layout information with regards to the existing Bramford Substation please refer to **2.6.1 Errata Design and Layout Plans - Subs and Cables [REP1-003]**.

Notes

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Key to symbols

Reference drawings

2.6.1 Errata Design and Layout Plans - Subs and Cables [REP1-003]

Rev	Date	Drawn	Description	Ch'k'd	App'd
01	MAY 26	TM	FOR INFORMATION	JW	TL

Client

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Master Scheme No:	Sub-Scheme No:	Site:
107850	001190	BRAMFORD SUBSTATION

Scheme Name: NORWICH TO TILBURY

Document Title:

7.16 DESIGN APPROACH FOR SITE SPECIFIC INFRASTRUCTURE (DASSI) APPENDIX B – BRAMFORD SUBSTATION INDICATIVE LUX PLOT PLAN

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
T. McDermott	MAY 26	J. Weeks	MAY 26	T. Loxley	MAY 26

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