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The North Wales Wind Farms Connection Project

Environmental Statement Chapter 2 - Description of Proposed Development

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The North Wales Wind Farms Connection Project

Environmental Statement

Chapter 2 Description of Proposed Development

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This Chapter includes the following Appendices:

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Reference is also made to the following documents:

DCO Document Reference	Document
2.4	Access and Rights of Way Plans
6.17	Proposed Works at St Asaph Substation (Appendix 1.1 to this ES)
	Proposed Underground Cable; St Asaph Substation to the Terminal Point (Appendix 1.2 to this ES)
	Proposed Collector Substation; Clocaenog Forest; Environmental Report (Appendix 1.3 to this ES)
	Lower Voltage Diversions (Appendix 1.4 to this ES)
6.19	Arboricultural Survey Report 2014 (Appendix 6.9 to this ES)
7.1	Design and Construction Report; February 2015

2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Introduction

2.1.1 This chapter provides a description of the Proposed Development and how it would be constructed.

2.2 Overview

2.2.1 The Proposed Development includes the following principal elements:

- Construction of a 17km 132kV overhead electricity distribution connection between Clocaenog Forest and St Asaph, both in Denbighshire;
- A temporary construction compound at Broadleys Farm, A453, Denbighshire and temporary storage or 'laydown areas' along the alignment, without which the overhead line could not be constructed;
- Access points for pedestrians and vehicles along the length of the Proposed Development for the duration of construction, without which the overhead line could not be constructed;
- Mitigation planting, and;
- Other integral works such as site preparation and clearance, earthworks, alteration of existing services, vegetation removal/planting and minor street works.

2.2.2 The main component of the Proposed Development is a new 17 kilometre 132,000 volt (132kV) Overhead Line from the proposed North Wales wind farm Collector Substation near Clocaenog Forest and which terminates in a field to the south of Trebanog, Groesffordd Marli, which is located 1.8km from St Asaph substation. It is located in North Wales and crosses the administrative boundaries of Denbighshire County Council and Conwy County Borough Council (see Figure 1.1[1])

2.2.3 The Order Limits also includes land from an un-named highway to the south of Trebanog, Groesffordd Marli to the terminal point of the 132 kV Overhead Line. The DCO includes the rights to install (and keep installed), retain, use, inspect, maintain, renew, remove and relocate an underground cable in this land.

2.2.4 The 132kV Overhead Line would comprise conductors supported by double wood poles. The wood poles are generally no larger than 470mm in diameter, and would range between 11m and 16.6m in length. Taking into account that the nominal depth of the poles is 2.5m and the steel bracings and insulators add typically 2.3m to the length, the net result is that the actual conductor height above ground (at pole positions) is about 0.2m less than the pole length referred to. The average span between poles is 79m.

2.2.5 The Order Limits for the Proposed Development contain a Limit of Deviation (LoD) within which the 132kV Overhead Line would be located. The LoD provides a degree of flexibility to ensure that any environmental constraints,

[1] Figures are included within the 'Figures' Volume of the ES; DCO Document Ref 6.16

technical constraints or landowner requests can be accommodated. The LoD varies between 20m in areas with good ground conditions and 40m in areas with poor ground conditions.

2.2.6 The Proposed Development does not include all elements of the North Wales Wind Farms Connection Project. This is because the following elements are considered to be "Associated Development", which, in Wales, cannot be included in an application for a development consent order. Those elements not included within the Proposed Development are known as the Wider Scheme and comprises:

- proposed works to St Asaph substation, including the development of an underground cable taking the connection point at St Asaph to the terminal point of the Proposed Development located in a field to the south of Trebanog, Groesffordd Marli (which is south of Glascoed Road, B5381). Further information is provided within Appendices 1.1 and 1.2 (DCO Document Ref 6.17);
- a new 132 kV electrical substation at Clocaenog Forest to act as the collector substation for four consented wind farms. (Further information is provided within Appendix 1.3 (DCO Document Ref 6.17));
- temporary storage areas within the existing St Asaph substation and the Collector Substation at Clocaenog Forest; and
- diversions of existing of lower voltage overhead line crossings. (Further information is provided in Appendix 1.4 (DCO Document Ref 6.17)).

2.2.7 The need for the connection and the strategic options considered have been described in Sections 1.3 and 1.4 of this ES. Alternatives are further discussed in Chapter 3 ‘Alternatives and Design Evolution’ (DCO Document Ref 6.3).

2.2.8 The Proposed Development is located primarily within a rural agricultural area. The southern extent is located within the Clocaenog Forest, an area of managed forestry. From here it passes through a farmed landscape with open grazing land before dropping down to pass through a landscape of small pastoral fields enclosed by hedgerows. Field sizes increase as the route moves northwards and scattered mature trees and woodland become more prevalent. At the Afon Elwy the route crosses an area of deciduous woodland before passing through agricultural fields to a point just south of Glascoed Road, Cefn Meiriadog. The road network comprises mostly minor and unclassified roads. Properties are scattered, with Henllan being the largest village in the vicinity.

2.2.9 The Proposed Development was divided into four sections for the purposes of the Preliminary Environmental Information Report and these section have been included within the Environmental Statement. The Sections are illustrated in Figure 2.1 and comprise:

- Clocaenog to Bwlch (Section A);
- Bwlch to Eriviat (Section B);
- Eriviat to Plas Buckley (via Hafod) (Section C); and
- Plas Buckley to Groesffordd Marli (Section D).

2.2.10 The 132 kV Overhead Line terminates at the Terminal Point and an underground cable would connect into the existing SP Manweb substation at St Asaph. The proposed Collector substation, the section of underground cable from the Terminal Point, the works at the existing St Asaph substation do not form part of the application for a DCO but are part of the 'Wider Scheme'. Further information is provided in Appendices 1.1 – 1.4 (DCO Document Ref 6.17) of this ES.

2.3 Order Limits and Limits of Deviation

2.3.1 The Order Limits for the Proposed Development include the following elements;

- Work No. 1A and 1B (as numbered in the draft DCO) are located within Limits of Deviation ("LoD") as shown on the Works Plans submitted with the application for the DCO. The LoD vary in width between 20-40m;
- Temporary Construction Working Areas. This varies in width to allow for construction in areas with poor ground conditions and for locating the equipment necessary for pulling the conductors;
- Access points from the road network to enable the construction, maintenance and decommissioning of the 132 kV Overhead Line;
- A temporary construction compound at Broadleys Farm, which is within the Order Limits but not contiguous to the working corridor;
- Areas for tree and hedgerow planting; and
- Construction works such as scaffolding, laydown areas and site preparation works.

2.3.2 The Proposed Development would be carried out within the LoD. The LoD identify a maximum distance or measurement of variation within which the works must be constructed.

2.3.3 The LoD provide a degree of flexibility which is required as:

- following consent, during pre-construction environmental constraints would be reviewed;
- following consent and pre-construction, micro-siting would take place involving more detailed technical survey information, particularly for unconfirmed ground conditions; and
- minor alterations may be requested by landowners.

2.3.4 The lateral LoD are

- in areas with good ground conditions: 20m; and
- in areas with poor ground conditions: 40m.

2.3.5 There are 218 wood pole positions in total. A LoD of 20m would apply to the majority of the line, however, 30 of the wood pole positions are located in areas of poor ground conditions and 43 are located potentially on shallow rock (as identified by the geotechnical desk study), and for a further 8 stabilization measures may be required due to the presence of ditches and streams. For these areas the LoD has been increased to 40m.

2.3.6 The 20m LoD has been devised using the maximum width of the widest structure proposed (i.e. the failure containment structure). The LoD enables the structure footprint to be shifted by one structure width either side of the centreline of the LoD. This is deemed appropriate to allow a relocation of the pole from an unfavourable position to a suitable position whilst keeping any disturbance to the minimum required.

2.3.7 The lateral LoD have to take into account not only the individual pole locations but also the span length between poles and any proposed movements of other poles. It is unlikely a single pole would be moved without other poles also requiring to be repositioned.

2.3.8 The Order Limits and lateral LoD are illustrated on Figure 2.1.

2.3.9 The 132 kV Overhead Line design ensures minimum ground clearances are maintained. There may be occasions where a pole height might have to increased or decreased due to the overhead line being repositioned within the LoD due to, for example ground conditions.

2.3.10 The proposed vertical LoD are designed to take account of standard 132kV wood pole design. The double wood pole design varies from 10.8m above ground height to 16.4m above ground height. The vertical LoD is +2m based on the tallest structure. The variation in height between adjacent structure positions is generally limited to 2m as a deviation of more than this this would greatly impact on the uplift force at adjacent poles. The final design of poles may be lower in height; there is no restriction placed on a reduction in height.

2.4 Final Route Alignment

2.4.1 The Final Route Alignment provides an indication of the likely pole positions and alignment of the Proposed Development. The Final Route Alignment follows the centreline of the LoD. The indicative pole locations are shown on Figure 2.1.

2.5 Description of the Proposed Development

2.5.1 Throughout this document the 132kV Overhead Line, together with the required accesses, construction and laydown areas and other integral works are referred to as ‘The Proposed Development’. The Collector Substation, works within St Asaph substation and underground cabling are referred to as the ‘Wider Scheme’.

2.5.2 The route of the 132kV Overhead Line is described below, and the sections are illustrated on Figure 2.1.

Clocaenog to Bwlch (Section A)

2.5.3 The 132 kV Overhead Line would exit the proposed Collector substation, located within the Clocaenog Forest, immediately adjacent to the Clocaenog Wind Farm substation. It then runs north through the edge of the upland managed forestry, and crosses open grazing land on the ridge of Tir Mostyn (400m Above Ordnance Datum (AOD)), northeast of the existing Tir Mostyn Wind Farm. The 132 kV Overhead Line would then drop slightly down the western flank of the ridge to 380m AOD and turn northeast as it enters the Denbigh hills area, running along the upper Lliwen valley slopes, parallel and above the B4501, a landscape of small pastoral fields enclosed by hedgerows. After crossing the B5435 (290m AOD) the 132 kV Overhead Line turns closer to the north and drops down to cross a watercourse (235m AOD) before rising up to a local ridge near Bryn Foel. It then turns north near Bryn Foel and continues north over the minor road near Tan yr Allt (280m AOD).

Bwlch to Eriviat (Section B)

2.5.4 From here the 132 kV Overhead Line would cross the ridge (east of Foel Gasyth at approximately 280m AOD) between blocks of coniferous and deciduous woodland, and then continue down a localised valley as it runs past College Farm to the east of Peniel village, before rising up again to cross the B4501 (200m AOD) near Plas Captain.

2.5.5 To the north of the B4501 past Segrwyd it turns north-west, and heads down towards the lowland areas of the Afon Ystrad and Pandy Wood. The 132 kV Overhead Line would pass through an open, medium scale, undulating pastoral landscape bounded by hedgerows with scattered mature trees, until it drops down to cross the wooded river valley of the Afon Ystrad at Pandy (120m AOD). Continuing north-west and crossing a minor road, it turns north at Bodeiliog Uchaf (170m AOD), and continues through this relatively low lying open pastoral landscape, bounded by hedgerows with scattered mature trees with small copses. The 132 kV Overhead Line would cross the A543 and enter the landscape to the east of Eriviat Hall. It then turns slightly to the north-east as it skirts the base of Beacon Hill at 150m AOD, through a shallow valley in the direction of the blocks of woodland and scattered mature trees at Coed-Wern-ddu.

Eriviat to Plas Buckley (via Hafod) (Section C)

2.5.6 At this point the 132 kV Overhead Line would turn and run broadly north-west from Coed Wern-ddu towards Hafod Wood (180m AOD) heading into this rising area, before turning to the north to pass to the west of Berain. From here it runs across undulating land as it rises from the valley to the west of Henllan towards Moel Fodiar, crossing farmland with hedgerows with mature trees bisected by two well wooded river valleys (near Eriviat Bach Isaf and Hafod) which form tributaries of the Afon Elwy. The 132 kV Overhead Line would then run north across more open larger scale pastoral fields as it heads towards Berain, before skirting to the west and rear of Berain (160m AOD).

Plas Buckley to Groesffordd Marli (Section D).

2.5.7 To the immediate north of Berain the 132 kV Overhead Line continues north-west between Tyddyn Bartley and Croen Llwm Mawr (130m AOD) before turning north towards Bod-ysgawen Isaf where it crosses the western ridge of the Elwy valley (140m AOD). The 132 kV Overhead Line then drops down the valley sides of the Afon Elwy (60m AOD) which contains scattered blocks of deciduous woodland. The 132 kV Overhead Line crosses the narrow and well wooded valley bottom near Coed y Fadir before turning north-east and continuing to rise up the valley side to Plas Hafod (125m AOD) with a local concentration of attractive mature trees within the fields and hedgerows. The 132 kV Overhead Line continues past Coed Plas-newydd where there are a number of scattered properties before crossing the Cefn Meiriadog ridge (140m AOD). At a point just south of Glascoed Road and Groesffordd Marli (110m AOD on the Cefn Meiriadog) the 132 kV Overhead Line terminates.

2.5.8 From this point the proposed underground cable route runs north west for approximately 200m through a field to join an unclassified road approximately 200m east of Tyddyn Eos. Further information on the proposed route for the underground cable from this point is included in Appendix 1.2.

Construction Compound and Temporary Storage Areas

2.5.9 A site at Broadleys Farm, on the A453 (approximately 0.8ha), has been identified as a Construction Compound for the construction works. This site is within the Order Limits and is indicated on Figure 2.1 (Sheet 2 of 4). The site fronts the A543 and would hence facilitate the convenient delivery of materials.

2.5.10 An indicative layout for the site is provided on Figure 2.2. The site would accommodate a laydown area for the temporary storage of plant and materials, a number of welfare cabins, temporary lighting and a small number of car parking spaces.

2.5.11 At convenient places along the route, temporary storage or ‘laydown areas’ would be required. Typically these areas would measure a minimum of 34m x 34m and would be level such that articulated vehicles can be safely unloaded. These areas would all be within the Order Limits.

2.5.12 It is also intended that the existing St Asaph substation and the Collector Substation at Clocaenog would be utilised as temporary storage areas.

Access Points

2.5.13 Access would be required to each pole position throughout the duration of the works. Generally a 5m access is required to accommodate the construction vehicles.

Integral Works

2.5.14 The Proposed Development also includes other integral works such as site preparation and clearance, earthworks, alteration of existing services, vegetation removal / planting and minor street works.

2.5.15 Further information is included within the Design and Construction Report (DCO Document Ref 7.1)

2.6 132 kV Overhead Line Design

2.6.1 When designing an overhead line for any given electrical demand there are four main considerations:

- ensuring the mechanical forces exerted from the wind, ice and terrain do not exceed the strength of the structures or other components,
- ensuring there are adequate clearances between the conductors and the ground or from other objects in the vicinity of the line, as well as between the conductors themselves to avoid clashing,
- the requirement, or otherwise, for earthed construction to control Rise Of Earth Potential (ROEP), and
- The overhead line can be constructed and maintained safely and has a minimal visual impact to the surrounding area.

2.6.2 The line must comply with these requirements over the full range of weather and load conditions based on the geographical location of an overhead line and in compliance with British Standard (BS) EN 50341.

2.6.3 The 132kV Overhead Line proposed is a single circuit double wood pole design. It accommodates three individual phase conductors and an underslung earth conductor to ensure that any ROEP is reduced to an acceptable level. The phase conductors are supported on two insulators types, horizontal tension insulators and vertically mounted post insulators, which are secured to galvanised steel cross-arms assemblies. The cross arm assemblies are in turn supported by “H” wood pole structures. The under slung earth conductor would incorporate a fibre optic cable and is fixed to the lower side of the cross arm assembly. Galvanised steel stay wires, designed to provide the structures with support to cater for lateral forces, are attached to the poles where the line changes direction, failure containment structures and at terminal positions.

2.6.4 The wood pole structures are constructed as intermediate, section or terminal structures. Intermediate structures are used where an overhead line follows a straight line and where the route topography is comparatively level. The conductors (or wires) are continuous at these structures and are secured using a clamp arrangement at the top of a vertically mounted insulator. The intermediate “H” pole structure comprises two poles set 3m apart with a galvanised steel cross-arm approximately 6m wide. There is no general requirement to fit stays to intermediate structures, however, in some situations the structure can be fitted with longitudinally placed stays allowing span lengths to be increased albeit the “footprint” of the structure would be increased as a result.

2.6.5 Angle section structures with a similar cross-arm of 6.0m overall length are fitted with stays to enable changes of direction in an overhead line. The structures are "H" pole arrangements and can provide a maximum angle of deviation of 35 degrees. Angle deviation structures require a double stay set arrangement. The conductors at these locations are secured to horizontally mounted tension insulators and are fixed using special mechanical fittings. The conductors on either side of a section structure are joined using a short length of conductor known as a jumper which is supported on a vertically mounted insulator.

2.6.6 Failure containment structures (i.e. a section structure with additional stays in order to deal with a mechanical failure event) are used at strategic points along the route to contain any cascade damage which could arise in the unlikely event of a failure of one or more conductors. These structures are "H" pole arrangements with stays placed longitudinally along the route. These longitudinally placed stays are designed to absorb shock loadings and therefore protect against damage beyond that point of the line. These structures are also commonly used at the crossing point of major roads and railways.

2.6.7 Terminal structures are used at either end of an overhead line. The terminal structure allows an overhead line to be connected either to an underground cable or directly to a substation gantry. For an underground cable the terminal structure comprises a stayed 4 pole construction consisting of an "H" pole with two smaller support poles immediately in front to support the cable terminations. A terminal structure would require three twin stay arrangements which provide a balance against the weight and tension of the conductors. The conductors are secured on horizontally mounted insulators with mechanical type fittings similar to angle towers.

2.6.8 The height of the conductors from the ground varies between each wood pole structure relative to the topography of the land with the lowest point typically being mid-span between poles, although this would vary with the terrain or if the poles are at different heights. The minimum statutory ground clearance for 132kV conductors (including underslung earth wire) is 6.7m over road or other locations. This requirement derives from the Electricity Safety, Quality and Continuity Regulations 2002 and the line must be designed to afford this level of clearance in all circumstances.

2.6.9 For the Proposed Development the average distance between the wood pole structures (referred to as span length) is 79m. The maximum span length is 120m and the shortest 50m. The design includes a total of 218 structures – 2 terminal, 126 intermediate and 87 section or angle type which includes 8 failure containment structures. The terminal structure would accommodate a 132kV underground cable and the design incorporates four poles in order to support the cable terminations. The 218 structures would therefore require a total of 438 wood poles.

2.6.10 The heights and diameter of the poles vary due to changes in topography and other factors such as span length, wind span and weight span, and angles of deviation. The wood poles are generally no larger than 470mm in diameter, and would range between 10.8m and 16.4m in length. Taking into account that the nominal depth of the poles is 2.5m and the steel bracings and insulators add typically 2.3m to the length, the net result is that the actual conductor height above ground (at pole positions) is about 0.2m less than the pole length referred to.

2.6.11 Stays are installed to resist the lateral mechanical forces acting on the pole structures in order to keep them vertical. They are generally required at the end of a line (terminal positions) and where the line direction deviates (angle sections). To ensure there are no stray voltages from the steelwork at the top of the pole the stay wire incorporates an in-line insulator. The stay rod and block are buried 2m to 3m in the ground and between 9.5m to 14m away from the pole depending on its height in order to achieve a stay slope of 45 degrees. The stay wires are fixed at the top of the pole and secured to the stay rod at ground level.

2.6.12 The insulators are made of a suitable electrical insulating material and are used to support the conductor and provide the necessary electrical clearance between the conductor and the supporting galvanized steel cross-arm.

2.6.13 The wood pole structures are designed to support bare overhead metallic conductors. The three phase conductors are made of an aluminium alloy whilst the earth conductor is made of aluminium alloy with steel reinforcement in the centre. The primary circuit conductors would have an overall diameter of 25mm and the earth conductor a diameter of about 20mm.

2.6.14 The proposed design can support a conductor with a nominal cross sectional area of up to 300mm^2. In this instance a 300mm^2 conductor (referred to as “Upas”), providing a summer rating of 176MVA, is necessary to meet the generation capacity of the four wind farms.

2.6.15 To protect the 132 kV Overhead Line and high voltage equipment a reliable communication circuit is required between St Asaph Grid and the new collector substation. This communication circuit would transfer essential system information such as measurements and operational conditions of the switchgear to the distribution network operator. The most economic method to provide a communication circuit is to integrate a fibre optic circuit within a proposed overhead line. The line would therefore include a separate earth wire incorporating an optical communication circuit (known as an Optical Ground Wire or OPGW).

2.6.16 Overhead lines are earthed at each pole set using a copper conductor which in turn connects to copper rods beneath the ground in a cross formation emanating from the base of the pole. The amount of earth conductor laid in the ground at any particular pole position is dependent on the resistance of the surrounding rock/soil at that location. Earth conductors would be installed at the same time as the poles are erected and would involve excavating four trenches each about 0.5m in depth and generally 4m to 5m in length.

2.6.17 When installed and prior to commissioning all poles would be fitted with identification markers, anti-climbing devices and safety “Danger” signs.

2.6.18 The wood pole is illustrated in Figure 2.3 Connection Types: Double Wood Poles.

2.6.19 Further information on designing an overhead line is provided in the 'Design and Construction Report' (DCO Document Ref 7.1). The design described in the Design and Construction Report has been subject to the assessment set out in this Environmental Statement.

2.7 Overhead Line Construction

2.7.1 Information on the construction of a 132 kV overhead line is provided in the Design and Construction Report (DCO Document Ref 7.1) and summarised below.

2.7.2 Generally hours of work are 07:00 to 19:00 in summer and 07:30 to 17:30 (or as daylight allows) in winter over a 5 day period with half day working on Saturday during some periods of the construction programme.

2.7.3 The number of construction staff working on the Proposed Development at any one time including delivery and excavator drivers etc. would be between 20 and 25.

2.7.4 Generally the sequence for construction 132kV overhead lines on double wood poles is as follows:-

Pre-Construction Enabling Works

- Tree trimming;
- Undergrounding or diversion of lower voltage overhead line crossings;
- Alterations to the existing road network if required;

Site Set Up;

- Establishment of secure storage area, welfare cabins, and temporary offices;
- Construction of temporary site access points where required;
- Erection of temporary works access signing and access route signing;
- Construction of temporary stone haul roads;
- Scaffolding of road crossings;
- Construction of hard stands for winches.

Delivery of materials to site;	
Pole Erection and Conductor Stringing;	• Excavations for foundations; • Dressing and erection of poles; • Installation of temporary stays; • Running out of conductor pulling bonds; • Installation of insulators and conductors; • Commissioning.
Demobilisation;	• Removal of welfare cabins, temporary offices, work compounds and storage areas; • Removal of temporary access tracks, working areas and demarcation zones, and reinstatement of fields; • Removal of temporary access points and signing; • Reinstatement of verges & hedgerows.

Pre-Construction Enabling Works

2.7.5 Where the 132 kV Overhead Line passes over, or is in close proximity, to trees that could infringe the safety clearance from the live conductors then these would be either felled or trimmed prior to construction of the overhead line. Details of tree felling locations for the proposed 132 kV Overhead Line, and works to trees to allow access for construction are provided in Appendix 6.7 (DCO Document Ref 6.19).

2.7.6 The construction of the 132 kV Overhead Line would necessitate the crossing of lower voltage distribution lines. These lines provide the electricity supply to residential properties and farms and may be either permanently undergrounded or temporarily diverted. These works do not form part of the Proposed Development but have been assessed as part of the Wider Scheme. At its northern end the 132 kV Overhead Line runs parallel, and relatively close to, an existing 33kV overhead line. This line would be undergrounded between the existing poles 20 – 30.

Site Set Up

Construction Compound

2.7.7 The construction compound at Broadleys Farm would take approximately four weeks to establish and would be in use for the same duration as the overhead line construction, providing welfare facilities for the workforce.

2.7.8 The initial preparatory works would compromise the temporary removal and storage of topsoil and the installation of a temporary surface using geotextile and a stoned surface. Site boundary perimeter fencing would be installed to secure the construction compound. No modifications to the existing access is required.

2.7.9 At convenient places along the route, temporary storage or 'laydown areas' would be required. Typically these areas would measure a minimum of 34m x 34m and would be level such that articulated vehicles can be safely unloaded. These areas would all be within the Order Limits.

Access Arrangements

2.7.10 Access would be required to each pole position on an on-going basis throughout the duration of the construction programme. Generally a 5m access is required to accommodate the construction vehicles.

2.7.11 All vehicle movement would be kept to the absolute minimum. Wherever possible, construction mitigation would be taken to minimise disruption during the construction phase, for example by only using suitably sized vehicles and equipment as is necessary to complete the works.

2.7.12 Typically access is required for excavators (wheeled JCB and/or tracked 360 degree excavator) 4x4 Lorries (often with a crane) and 4x4 pick-ups. Subject to access constraints poles would tend to be erected in sequence from one end of the line to the other albeit there may be construction operations at multiple work locations. Additionally some of the foundation works would require the import of suitable backfill material which would normally be delivered in 20 tonne capacity tipper lorries ($15m^3$ capacity). The backfill material can be unloaded in a convenient location and transported to the pole locations by dumper truck.

2.7.13 During the conductor erection phase of the works, specialised line winches are towed to specified pulling and tensioning positions along the route using agricultural sized tractors. Cable drums would also be delivered to the tensioning positions. These works are critically sequenced and the plant would move in "wiring sections" from one end of the line to the other until the line construction is completed. All equipment is delivered to site only when required to minimise the chances of theft or vandalism.

2.7.14 In certain locations where ground conditions are poor it may be necessary to install temporary access tracks and working areas in order to minimise any damage. The access would be constructed from dry stone roads or a proprietary temporary access way using aluminium panels can be installed.

2.7.15 On completion of the construction works the access ways would be removed and the site fully reinstated.

2.7.16 Details of all the temporary access requirements and associated works are included in the Design and Construction Report (DCO Document Ref 7.1).

Scaffolding

2.7.17 Over major roads (A roads and possibly B roads dependent upon usage) temporary scaffolds are normally constructed either side of the road and a net supported by wire bonds is then supported between the two. This ensures there is no danger to passing vehicles or the public should the conductor sag more than envisaged whilst being pulled out or there is a failure in any of the pulling equipment. The scaffolds are supported by stays anchored to concrete blocks or temporary screw in ground anchors. It is necessary to have short duration road closures to install and recover the netting but these are normally achieved in minutes and cause little or no disruption to traffic flow.

2.7.18 These temporary works are completely removed upon completion of the construction of the section of line where the road is situated. Where consent of the highways authority is required for netted scaffolds this would be obtained.

2.7.19 For minor roads, and particularly if they are narrow, it may be possible to erect a temporary pole to support the conductor or alternatively it may be possible to employ traffic management whilst the work is in progress.

2.7.20 The roads to be crossed are shown in Table 2.1 below. As part of the pre-construction works a risk assessment would be carried out for each crossing and suitable precautions, as described above, implemented as necessary.

Table 2.1 Roads crossed by the Proposed Development

Reference Crossing Point No	Description/Route	Road Type/Designation	Approximate Grid Reference
1	Hafod Ty Ddu	Unclassified	SJ 012, 592
2	Bryn Golau	Unclassified	SJ 018,603
3	Nantglyn to Saron Road	Unclassified	SJ 023,608
4	Bwlch	Unclassified	SJ 031,619
5	Denbigh to Cerrigydrudion Road	B4501	SJ 032,632
6	Denbigh to Nantglyn Road	Unclassified	SJ 025,639
7	Ffordd Gwaenynog	Unclassified	SJ 019,643
8	Lon llewelyn	A543	SJ 017,653
9	Henllan to Groes Road	B5428	SJ 016,670
10	Eriviat Bach Road	Unclassified	SJ 015, 671
11	Henllan to LLansannan Road	B5382	SJ 007,680
12	Henllan to Cefn Berain Road	Unclassified	SJ 005,689
13	Cefn Berain to Bont-newydd	Unclassified	SJ 006,696
14	Henllan to Llannefydd	Unclassified	SJ 006,700

Reference Crossing Point No	Description/Route	Road Type/Designation	Approximate Grid Reference
14	Henllan to Groes Road	B5428	SJ 019,676
15	Henllan to LLansannan Road	B5382	SJ 016,680
16	Henllan to Cefn Berain Road	Unclassified	SJ 015,685
20	Groesffordd Marli to Cefn Meiriadog Road	Unclassified	SJ 002,728

2.7.21 Plans showing accesses and rights of way affected by the Proposed Development are provided as DCO Document Ref 2.4 (Access and Rights of Way Plans).

2.7.22 The DCO grants powers to stop up temporarily PRoW affected by the Proposed Development; however the majority of the PRoW would be stopped up for short durations only and it is SP Manweb's intention to keep the majority of PRoW open via management.

2.7.23 All points where PRoWs cross the Proposed Development would have appropriate signage advising of dates and hours of work. Management would involve the use of construction staff at those crossing points where and when construction works affect a PRoW. In these instances PRoW users may have to wait for a short period of time whilst the PRoW is in use by the construction team. Users would be advised when works are completed and it is safe to cross the PRoW by staff at the crossing point.

2.7.24 The DCO also provides powers to temporarily close or divert a PRoW. PRoW to be temporarily closed or diverted are identified in Table 2.2 below. The temporary closure or diversion could be in effect for the construction period however SP Manweb would endeavour to ensure closure/diversions durations are minimised as far as possible and PRoW would be reopened at the earliest opportunity if no longer affected by the construction activities.

2.7.25 Temporary closures or diversions would be agreed with relevant local PRoW officer and the landowners involved prior to implementation. Signage would be used to advise of the proposed closure with dates and hours of closure.

2.7.26 No permanent PRoW closures are required as part of the Proposed Development and none are sought under the DCO.

Table 2.2: PRoWs and Safety Measures Proposed

Footpath / Bridleway number	Local Authority	Grid Reference at Crossing Point	Management Method	DCO Doc Ref 2.4	Number[1] on Land Affected Plans	Approx Duration of Closure
51	Denbighshire	301756, 360171	Manage by construction staff	Sheet 1	13, 16	n/a
52	Denbighshire	301844, 360267	Temporary closure - immediately adjacent to pole position	Sheet 1	16	2 days
53	Denbighshire	302202, 360657	Manage by construction staff	Sheet 3	23	n/a
23	Denbighshire	303132, 361796	Temporary closure - tree cutting and conductor pulling position	Sheet 3	30	2 weeks
22	Denbighshire	303347, 362518	Temporary closure – conductor pulling position	Sheet 3	35	2 weeks
21	Denbighshire	303324, 362974	Manage by construction staff	Sheet 4	44	n/a
26	Denbighshire	302876, 363662	Manage by construction staff	Sheet	54	n/a
54 Llansannan FP 80	Denbighshire	302364, 364147	Temporary closure - tree cutting and conductor pulling position	Sheet 5	62, 64, 65	2 weeks
Llansannan FP 79	Conwy	301726, 364678	Manage by construction staff	Sheet 7	72	n/a
65	Denbighshire	301987, 366418	Manage by construction staff	Sheet 8	99	n/a

[1] Indicates plot number on Land Affected Plans (DCO Document Ref 2.2)

Footpath / Bridleway number	Local Authority	Grid Reference at Crossing Point	Management Method	DCO Doc Ref 2.4	Number[1] on Land Affected Plans	Approx Duration of Closure
Llansannan FP 30	Conwy	301531, 367153	Manage by construction staff	Sheet 8	106	n/a
Llansannan FP 49	Conwy	300621, 368478	Temporary closure – tree cutting	Sheet 9	119, 120	2 days
Llannefydd FP 34	Conwy	300484, 370244	Manage by construction staff	Sheet 10	138, 139	n/a
Llannefydd FP 22	Conwy	299930, 371557	Manage by construction staff	Sheet 11	160, 163	n/a

Delivery of Materials

2.7.27 The poles would be transported from the designated laydown areas, which are located at Broadleys Farm, the existing St Asaph substation and the Collector substation taken to temporary storage areas, as close to their final position as possible, by general purpose vehicles with incorporated lifting devices.

2.7.28 An advance warning vehicle with flashing beacons may have to accompany the lorry along some routes as some of the poles would overhang the bed of the lorry. Tractors and trailers or excavators would be used if necessary to transport the poles to their individual peg positions.

2.7.29 Where practical all large vehicle movements would be minimised to avoid areas of high congestion during busy periods.

2.7.30 The conductor would be delivered on cable drums by general purpose vehicles as close as possible to the angle or tension pole sites from which the conductors would be pulled. If necessary tractors adapted to carry such loads are used to transport the drums to the pole sites.

2.7.31 All OHL conductors, steelwork, insulators and fittings would be centrally stored and managed within the secure storage area and delivered to site by a general purpose 4 x 4 lorry. Information on vehicle movements is included within Chapter 'Traffic and Transport' (DCO Document Ref 6.12).

Pole Erection and Conductor Stringing

Construction Methodology

2.7.32 Construction requires an approximate area of 1200m^2 (34m x 34m) at individual pole sites to provide sufficient space for excavators to manoeuvre for the excavation of the foundations and subsequent back fill. Additionally sufficient room is required to lay out the poles and either winch or crane them into their final position.

2.7.33 Further working areas would be required at the angle poles to accommodate the winches required for stringing the conductors. Generally these would be required every 1km to 2 km along the line although the locations would be dependent upon the availability of access, and the number and severity of the angle deviations which in turn are dependent upon the final pole positions. Generally a distance of about 70m is required behind the angle pole (or terminal pole) for the pulling equipment and conductor drums.

2.7.34 An overhead line would normally consist of a number of sections, a section being between a terminal and an angle pole, or between two angle poles. Although the individual poles can be erected in any sequence, the conductor stringing process is critically sequenced. To ensure that the conductor is not damaged during its installation, conductor rollers are attached at intermediate pole insulators and a pulling bond is used to pull the conductors. Specialist equipment is used which maintains an adequate back tension such that the conductor is always clear of the ground and obstructions when it is being pulled through the section. These predetermined sections are normally between 1km and 2kms in length dependent upon the number of angles along the route.

2.7.35 The contractor would be provided with a pole schedule which details the pole heights at each individual location together with the length of conductor between poles.

2.7.36 Generally the methodology to construct each section of the line would be very similar other than the foundation works which would be dictated by the ground conditions at any particular pole position. The contractor would provide method statements as appropriate for each stage of the works and in particular these would detail any special precautions that need to be taken in environmentally sensitive areas. There would also be specific method statements for river, road and power line crossings.

2.7.37 The typical sequence of works to install a section of the overhead line would be as described below.

Setting Out

2.7.38 Surveyors would determine the location of each structure and stay and mark them on site normally by means of a small wooden peg marked with the allocated pole number (structures are individually numbered in order to facilitate inspection records and future work instructions).

Foundations

2.7.39 Foundations would be dictated by the ground conditions. For this scheme the majority of pole positions have reasonable ground conditions and it would be possible to use standard wood pole foundations consisting of timber foundation baulks and backfilled with the excavated soil. For those areas where the soil is not suitable for back fill it would be removed from site and replaced with an imported granular material. In all cases the top soil would be separated during the excavation and used to top off the hole when it is backfilled.

2.7.40 The pole hole would be excavated by a 360^{o} mechanical excavator to the required depth and the top soil separated out.

2.7.41 For pole locations with moderate ground conditions the excavated ground is deemed suitable for the back-fill. Excavations in these areas would depend on the structure type but typically an excavation 2.5m deep by 4m long and 2m wide would be necessary to accommodate the foundations which would include timber foundation baulks.

2.7.42 For pole locations with poor ground conditions, although dependent upon the final foundation design, the excavations for the foundations necessary to accommodate the baulks could be up to about 3m deep by 7m long and 3.5m wide, a total of about $80m^3$ when excavated. This material would have to be removed from site and replaced by imported back-fill.

2.7.43 In areas where rock is present an excavator-mounted hydraulic jackhammer would be required. The excavated material would not be suitable as back-fill due to its large size and it would be necessary to use a granular backfill material.

Pole and Stay Installation

2.7.44 The two individual poles are positioned adjacent to the excavation and fitted with the required steel work and foundation baulks as per the design for the type of structure i.e. intermediate, angle etc. The “H” pole is then either winched or, if access arrangements allow, craned into position until it sits on the base of the excavation. Whilst the pole is still supported, the excavation is backfilled ensuring it remains perpendicular. The surrounding excavated soil is replaced and consolidated in layers with a mechanical tamper. The top soil is then replaced.

2.7.45 Excavations and installation of any permanent stays consisting of a rod and concrete block would be completed once the pole is erected. Once the stay blocks are installed the stay wires are connected to the pole top and semi tensioned. Similarly any temporary stays required to maintain stability until the next sequential section is complete would be installed.

2.7.46 This would be repeated until all the structures and stays are installed for the section of conductor to be installed.

Conductor Erection and Sagging

2.7.47 Once installed all the intermediate poles are fitted with the insulator supports. Conductor running out rollers are fitted to the top of the insulators to allow free movement of the conductor when it is pulled through the section and erected. A heavy duty pilot wire is pulled out between the section through each of the conductor rollers, generally by a 4 x 4 Land Rover type vehicle where access permits or possibly by a winch on the steeper slopes.

2.7.48 Back tension is applied to the conductor by means of a specialist tensioner that incorporates a hydraulic brake such that a constant tension is applied to ensure the conductor remains aloft and clear of obstructions during the stringing operation. The tensioner, together with the drums of conductor, is located at one end of the section with the pulling winch at the other. For the Proposed Development there would be a total of four drums of conductor, three phase wires and the underslung earth wire. The conductor is connected to the pilot wire and drawn through the section one conductor at a time. During the stringing operation radio communications are maintained between the operators of the pulling winch, the tensioner, and intermediate observation points such as road crossings, so that the pulling can be immediately stopped should a problem arise.

2.7.49 The conductors are usually erected from one end of a line in a continuous sequence along the route to minimise the requirement for temporary stays.

2.7.50 Once the conductor has been installed on the full length of a section, one end is terminated in a special mechanical fitting and connected in turn to a tension insulator which is then “back hung” from its termination point on the steel cross arm. A winch at the other end is used to tension the conductor to a prescribed sag and tension and the remaining end is similarly terminated via a tension insulator. Finally permanent stays are adjusted to ensure their tension is correctly matched to that of the conductors.

2.7.51 To maintain the continuity of the conductor, it is connected across angle poles from one side to the other and then joined by means of a fitting designed to maintain a low resistance electrical contact. At the terminal pole south of the Glascoed Road the connection to the underground cable would be via a special cable termination, known as a sealing end. For the terminal pole at Clocaenog Collector Substation the connection would be via a slack span direct onto a gantry in the Collector Substation. All infrastructure above ground is part of the Proposed Development.

2.7.52 At the intermediate poles the conductor rollers are removed and the conductors clamped to the insulators using appropriate clamps.

2.7.53 The earth wire is strung in a very similar fashion but requires specialist splicing at joint positions in order to maintain the integrity and continuity of the fibre.

2.7.54 Upon completion of the section any temporary scaffolds or pole structures at road crossings would be removed.

2.7.55 Following the same methodology the conductors would be erected in the next adjacent section along the route. The tensioner would remain in its location and would be repositioned on the other side of the pole whilst the winch would be transported to the other end of the section. This sequence would continue until the final section is completed when the stringing equipment would be removed from site.

Waterways

2.7.56 The Proposed Development crosses the River Elwy and Afon Ystrad, and several small streams.

2.7.57 Waterways generally are not a problem provided access to the line is available from both sides. For the smaller streams it is likely it would be possible to walk the pulling bond (used to pull the conductors as part of the installation process) across due to their limited depth and width. However, where a waterway is wider (the River Elwy for example), it may be necessary to employ an alternative method, such as using a harpoon from one bank to the other, and then pulling the main pulling bond into position.

2.7.58 As none of the rivers and streams along the Proposed Development are navigable it would not be necessary to take any additional precautions whilst the conductors are being erected.

Demobilisation

2.7.59 Reinstatement is carried out as soon as possible after each part of the Proposed Development is completed. Construction areas would be reinstated where possible to their previous grade and condition. Foundations and track verges would be regarded with stored soil adjacent to each excavation and then reseeded or cultivated as appropriate. Any temporary access roads would be removed and reinstated to original conditions following construction. There is no requirement for permanent access tracks to the overhead line.

2.7.60 Any hedgerows removed in order to provide temporary access ways would be re-planted and fences and gateways, which may have been altered to accommodate the construction traffic, reinstated.

2.7.61 Lower voltage overhead line crossings which may have been temporarily diverted to accommodate the new line build would be returned to their original arrangement soon after completion of the works. These works are described in Appendix 1.4 (DCO Document Ref 6.17) and form part of the Wider Scheme.

2.8 Control of Environmental Effects During Construction

2.8.1 SP Manweb has produced a Construction Environmental Management Plan (CEMP) (Appendix 2.1, (DCO Document Ref 6.18) which identifies those responsible for overseeing the construction works and outlines a series of established good practice working methods intended to minimise environmental disturbance. The CEMP provides a mechanism to secure the environmental recommendations and mitigation measures identified in this ES and formulated during the design and development process. Compliance with the CEMP is secured as a requirement within the draft DCO. It would be a contractual requirement for the appointed contractor and would be audited at regular intervals by a SP Manweb environmental representative on site.

2.8.2 The CEMP also incorporates number of other more specific plans, including:-

- an Ecological Management Plan;
- a Hedgerow Management Plan; and
- a Traffic Management Plan.

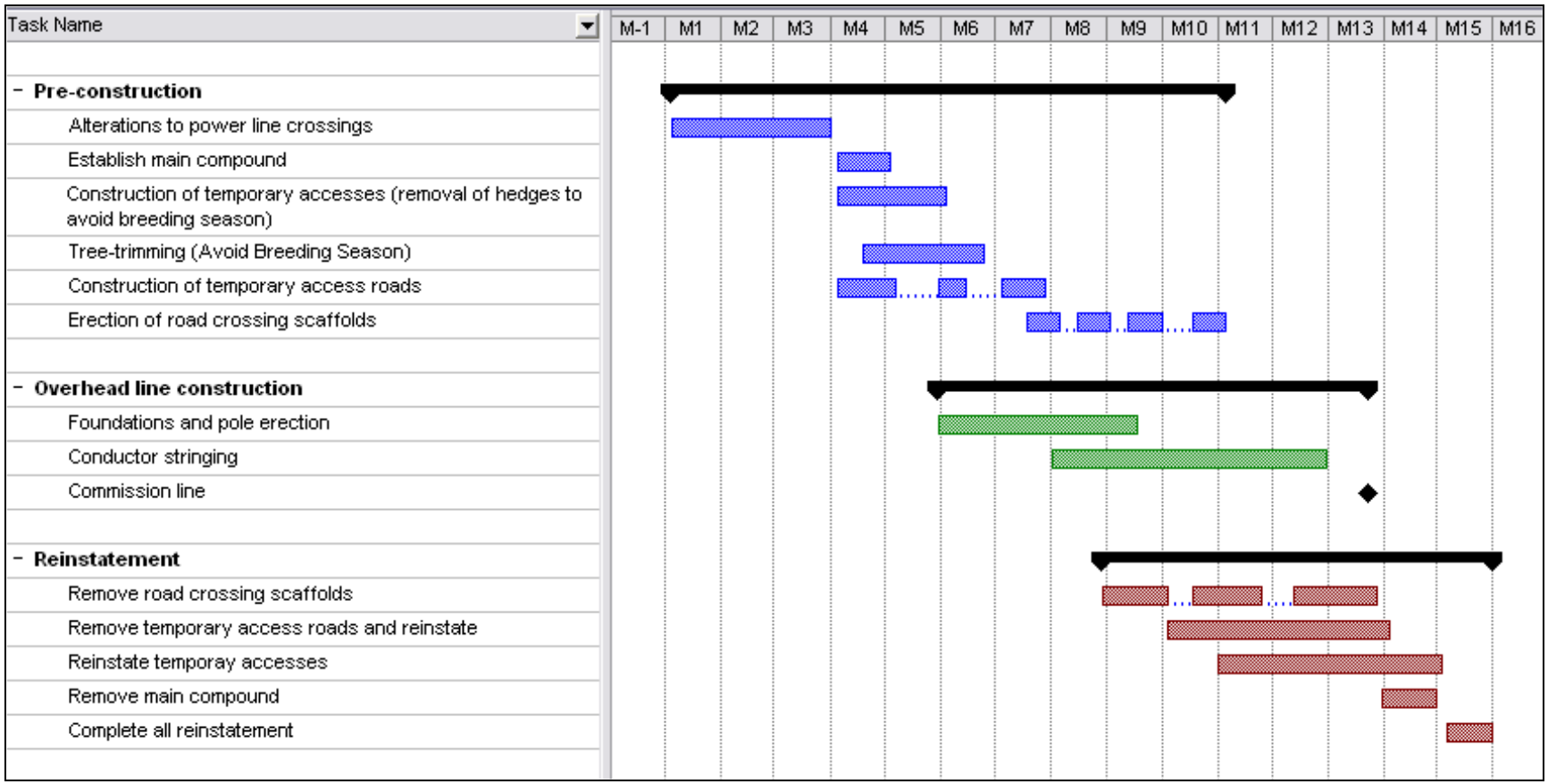
2.8.3 The appointed contractors are also required to produce Construction Method Statements (CMSs) to detail the methodology and control of any operations for works identified in the CEMP as potentially environmentally sensitive. For example, a CMS may include measures to avoid disturbance to protected species such as bats and otters.

2.8.4 All site staff would be given appropriate environmental training before starting work on site. The CEMP would also include a series of specialist information packs, ‘toolbox talks’, to inform site operatives of the sensitivity of particular sites and of wider safeguards to protect natural and cultural heritage.

2.9 Programme

2.9.1 It is anticipated that construction would last for 16 months. An indicative programme is provided below.

Indicative Programme



2.10 Operation of the Development

2.10.1 During operation the 132kV Overhead Line would be maintained from SP Manweb depots in Wrexham and Llandudno Junction. No permanent presence would be required on site.

2.10.2 Most components of overhead lines are maintenance free and once installed the 132kV Overhead Line would require only monthly and annual site inspections and periodic maintenance.

2.11 Decommissioning

2.11.1 The need for the connection is dependent on the four wind farms, which have an operational life of 25 years. The operational life of a 132kV overhead line is approximately 40 years therefore longer than the lifespan of the wind farms. Operational requirements of the local electrical network and associated demand would be kept under continuous review throughout this period to determine the long term use and retention of the connection, prior to any decommissioning decision being taken. If it's useful life has expired and the connection is to be removed, much of the material would be taken for recycling. A similar process to remove the connection would be required as for construction.