

7 CONSTRUCTION

7.1 INTRODUCTION

- 1 The purpose of this chapter is to describe the construction of the proposed development. It outlines the associated construction methodology and activities along the specific route alignment as described in **Chapter 6** of this volume of the Environmental Impact Statement (EIS).
- 2 The ESB and any contractors employed during the construction phase of the project will be obliged to comply with all the commitments set out in this EIS, in addition to any conditions which may be attached by An Bord Pleanála (the Board) to any planning approval that may be granted.
- 3 This chapter has been prepared and should be read, in conjunction with the following chapters of the EIS:
 - **Chapter 4** Consideration of Alternatives – Technology, of this volume of the EIS;
 - **Chapter 5** Consideration of Alternatives – Routing, of this volume of the EIS;
 - **Chapter 6** Description of Development – of this volume of the EIS; and
 - **Chapter 13** Material Assets – Traffic, **Volumes 3C** and **3D** of the EIS.

7.2 CONSTRUCTION METHODOLOGY

- 4 The purpose of this section is to outline the construction methods which will be implemented on the proposed development.
- 5 In the event of approval being granted for the proposed development and prior to commencement of works, the contractor(s) which will be appointed by the Electricity Supply Board (ESB) will prepare a detailed *Construction Environmental Management Plan* (CEMP) and a final *Traffic Management Plan* (TMP). An outline CEMP and outline TMP are included as, **Appendix 7.1 and 7.2, Volume 3B Appendices**, of the EIS. The detailed CEMP can only be completed post-consent as it will include method statements and work programmes that provide more detailed phasing of work based on the methodologies described in this chapter, and the mitigation measures contained in this EIS (see **Chapter 11** for further details), all of which must first be approved by An Bord Pleanála as part of any statutory consent. The appointed contractor(s) will develop a series of detailed plans for the construction of the existing substation elements, the erection of the towers and the stringing of the line. The construction and environmental plans will detail the temporary vehicular access to tower sites and identify archaeological and ecological sensitive sites (identified in the EIS - see 1:5,000

aerial drawings included in **Volume 3B Figures**, of the EIS) and mitigation measures. Again, these plans will be required to incorporate the material elements of the mitigation measures outlined in the Summary of Mitigation Measures or Schedule of Commitments (see **Chapter 11** of this volume of the EIS).

- 6 The detailed contents of the CEMP produced by the contractor(s) will be agreed with ESB and subsequently with local and other appropriate authorities. ESB will employ a team to monitor the construction phase of the project and ensure works are being carried out by the appointed contractor in accordance with the CEMP and agreed method statement, safety procedures, pollution control etc.
- 7 It should be noted that while the construction methodology described in this EIS is based on experience in similar electricity transmission infrastructure projects, it considers the particular characteristics of the receiving environment in respect of this proposed development. Any issues specific to this project, for example the project specific mitigation measures contained in the EIS, or any planning conditions attached to any approval which the Board may decide to grant, will be incorporated fully into the appointed contractors' scope of works and careful supervision and management will be carried out to ensure full compliance.

7.3 ACTIVITIES ASSOCIATED WITH THE CONSTRUCTION AND MAINTENANCE OF OVERHEAD LINES

- 8 The following is a description of activities required for the construction of the proposed development and activities associated with its subsequent maintenance.

7.3.1 Construction Material Storage Yard

- 9 The construction yard for the overhead line (OHL) elements of the project is proposed to be located in the townlands of Monaltyduff and Monaltybane, Carrickmacross, County Monaghan. The compound, of approximately 1.4ha, is located immediately adjacent to the southern side of the N2 National Primary Road, with access thereto and therefrom via a local road (L4700) – see Planning Drawing MT-009-002 included in **Volume 1B** of the application documentation. This location ensures appropriate accessibility to all parts of the alignment of the proposed transmission line.
- 10 The compound has a history of such use, being a former construction yard facility associated with the construction of the N2 National Primary Road. It will provide for the secure storage of all materials associated with the construction of the proposed development, as well as staff car parking, temporary site offices and welfare facilities (comprising Portaloos - no foul drainage will occur on the site).

- 11 The proposed use of the site as a construction material storage facility will require a new site entrance off the L4700 at a central location along the southern boundary of the site. Internal access within the compound will occur by means of an approximately 4m wide road laid out in hardcore material (such material will be laid throughout the site). Other site development proposed to occur within the site includes the laying of interceptor traps in a demarcated area for refuelling, and other necessary and appropriate site drainage works. The site will be bounded by a 2.6m high palisade fence. A 2m tall sound barrier will be affixed to the inside of three sides of the boundary fence to reduce noise levels.
- 12 Given the temporary nature of the compound to facilitate construction of the proposed development, all materials and works on the site will be removed following completion of construction. The site will be restored to its former condition prior to its use as a storage compound associated with the proposed development.
- 13 Individual members for each tower section are identified from a pick list in the main steelyard. These identified section members are picked out from the main storage bales and brought to the top of the yard near the main gate using a teleporter where they are stored in individual bundles as tower sections for each individual tower. Bundles of tower sections are loaded onto the truck or tractor and trailer using the teleporter, secured and carried to their relevant tower sites locations.
- 14 As outlined above, if the tractor and trailer are being used the steel will be delivered to the areas surrounding the base of the tower. If a lorry is being used due to distance from steel yard, this will be unloaded close to final tower site location destination onto a tractor and trailer using the hi-ab on the lorry. The tractor and trailer will then complete delivery to each tower site location.

7.3.2 Stringing Areas including Crossings over Public Roads

- 15 Stringing of OHLs refers to the installation of the phase carrying conductors and shieldwires on the supporting towers. The conductor is kept clear of all obstacles along the straight by applying sufficient tension. During the stringing operation for safety reasons the conductor will be kept clear of roads / railway crossings and transmission or distribution lines. These obstacles along a straight have to be guarded (see **Figure 7.1**).



Figure 7.1: Typical Guarding Arrangements in Overhead Line Construction

7.3.3 400 kV Overhead Line Construction

- 16 OHL construction is undertaken effectively on a long linear alignment with isolated areas of activity which are limited in size. While a 400 kV OHL is a major infrastructural project, the machinery and equipment required to construct such a line is relatively modest and generally similar in size to machinery utilised for normal farming activities, or construction of a domestic dwelling.
- 17 The construction of the 400 kV OHL will be undertaken by ESB. ESB may use external contractors who carry out transmission line construction on its behalf. The OHL construction will be split into two distinct contracts, namely foundation installation and tower erection and stringing. EirGrid shall appoint a Client Engineer for this stage of the development. The Client Engineer shall monitor and inspect the detailed designs, plant, material, and works including scheduling to ensure they meet the requirements of its functional specification, designs and transmission standards.
- 18 The construction techniques carried out will fully comply with all health and safety requirements. In general the construction phase can be broken down into the following parts:
- Verify that all planning and environmental conditions have been satisfied;
 - Carry out pre-construction site investigations including access review and ground conditions to confirm the conditions as predicted;
 - Delineation of any on-site working area (e.g. erection of temporary fencing to mark out for health and safety purposes the construction works area);

- Setting out of tower foundations (tower foundation areas are marked out on the ground using timber pegs to guide the excavator when digging to remove soil);
 - Site preparation including minor civil works such as removal of fences and erection of temporary fencing;
 - Installation of tower foundations;
 - Erection of tower; and
 - Stringing of conductors and commissioning.
- 19 The proposed 400 kV line will consist of galvanised steel lattice towers of varying heights at intermediate and angle locations. The construction methodology will be similar to that used on the existing 220 / 400 kV lines previously constructed in Ireland and currently being constructed throughout Europe and internationally. **Figure 6.25** in **Chapter 6** of this volume of the EIS shows the proposed tower arrangement.
- 20 In wet areas bog-mats, or aluminium tracking may be required in order to access sites without causing excessive damage (see **Section 7.3.4.1.3** for further details on the types of access proposed for this development). The proposed temporary access routes have been considered by the environmental consultants in their appraisal of the proposed development (refer to **Volumes 3C** and **3D** of this EIS). Prior to construction, notices and schedules, as well as maps confirming the position of towers, will be issued to all landowners. EirGrid representatives will meet with landowners to confirm the exact position of the towers on the ground and deal with any other queries the landowner may have following the issuing of the Notice. Construction may commence at this stage.
- 21 The proposed development also includes modifications to the existing Lisdrum-Louth 110 kV, Louth-Rathrussan 110 kV and Arva-Navan 110 kV OHL transmission lines. The modifications involve lowering the height of the existing 110 kV transmission lines, at the point of the crossing of the proposed 400 kV route. This will be achieved with the insertion of additional wood polesets and / or the replacement of existing structures with wood polesets that are lower in height. Replacement polesets will be positioned immediately adjacent to existing poles. Intermediate tower 101 on the Louth – Rathrussan 110 kV line will be retired. The existing steel structure will be disassembled. The structure foundation will be removed to approximately 1m below ground level. The new 110 kV wood poleset will be erected at the existing tower position once the tower structure is retired.
- 22 The poles are installed to a minimum depth below ground of 2.3m. The excavation for each hole will be carried out using a wheeled or tracked excavator. Each of the two poles are lined up with the excavated holes and the machine operator then drives forward pushing the pole up until the pole is

in an almost vertical position. The pole never passes through the point of balance in the vertical position. The pole is supported at all times and the holes manually backfilled initially to a minimum depth of 1.0m to ensure temporary stability prior to installing the sleepers. Following the initial backfilling, a strip approximately 2.7m long is excavated to a depth of 0.8m parallel to the line. This is necessary to install the rectangular wooden sleepers which add additional stability to the poleset and are attached to the poles using U-bolts. The two installed poles are connected near the top by a steel crossarm from which insulators are attached. The existing conductor is then attached to these insulators.

7.3.4 Construction Programme

- 23 The construction period for the proposed linear development is anticipated to be approximately three years from the commencement of the site works. However construction at any one tower location is of short duration as works at each tower take place in a series of different stages based on the estimated durations outlined below.
- 24 The construction of the OHL will be undertaken in five general stages, according to the following sequence, on a rolling programme of estimated durations:
- Stage 1 – Preparatory Site Work (1 – 7 days);
 - Stage 2 – Tower Foundations; standard installation (3 – 6 days), piling installation (5 – 10 days);
 - Stage 3 – Tower Assembly and Erection and Preliminary Reinstatement (3 – 4 days);
 - Stage 4 – Conductor / Insulator Installation (7 days); and
 - Stage 5 – Final Reinstatement of Land (1 – 5 days).
- 25 Typically, Stages 1, 2 and 3 are carried out as part of one contract, and when completed, lands around the construction site are reinstated. Stages 4 and 5 can only be carried out when Stages 1, 2 and 3 are completed.
- 26 The addition of a new circuit along Towers 402 to 410 of the existing Oldstreet to Woodland 400 kV OHL (refer to **Figure 6.21** and **Figure 6.30**) is a Stage 4 activity. Of the five OHL construction stages, only Stage 4 applies in the case of Towers 402 – 410.
- 27 On a project of this linear distance, there is likely to be an interval of up to 12 months between the completion of Stages 1, 2 and 3 and commencement of Stages 4 and 5. Lands will be reinstated so that they can continue to be used for agricultural activities during this interval.

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- 28 Having regard to the estimated durations detailed previously for each individual stage, it is estimated that Stages 1, 2 and 3 would cumulatively take 7-17 days for standard installation or 9-21 days for piling installations. Lands will be preliminarily reinstated and contractors will return approximately 12 months later for 8-12 days to complete the works and final land reinstatement.
- 29 Therefore, the cumulative time required at any one site over the 3 year construction period of the project is estimated at 15-29 days for the standard installation or 17-33 days for piling installation.
- 30 The construction methods carried out by ESB and its contractors will fully comply with all relevant health and safety requirements. The principal OHL construction methods are outlined in this section, as detailed below, and are based on ESB's long and successful OHL construction experience, both in Ireland and internationally.
- 31 The ground conditions encountered will vary along the proposed OHL route and hence the construction techniques and machinery / equipment required may vary to accommodate this.
- 32 Access to the tower location sites will be during hours of daylight for all construction stages (see **Figure 7.2** for typical construction stage sequence). It is not anticipated that construction works will be carried out on Sundays, Bank Holidays or that any construction works will be carried out in hours of darkness.

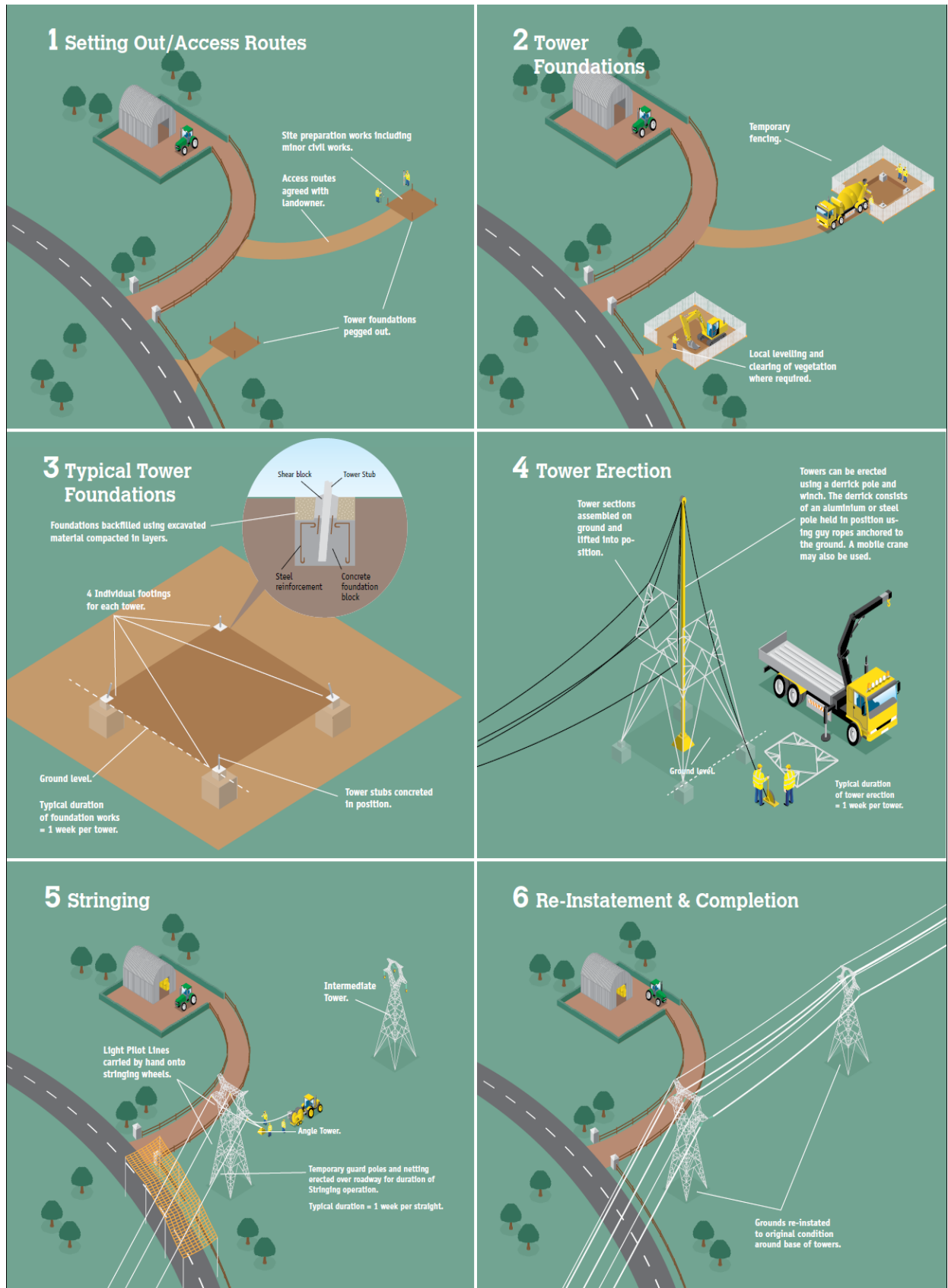


Figure 7.2: Typical Construction Works

(Source: *Landowner Information Brochure* (July 2013) for illustrative purposes only)

7.3.4.1 Stage 1 - Preparatory Site Work

7.3.4.1.1 Pre-Construction Activities

- 33 Pre-construction surveys will be undertaken immediately prior to the construction phase, including ground investigations, to confirm the ground conditions which have been predicted in this EIS.
- 34 Prior to commencing any works, discussions will take place between the appointed landowner agents and landowners to ensure awareness of the activities and specific works that will take place pursuant to the proposed development. All landowners will be contacted prior to access being required on their lands and a date of commencement for the works will be provided to the landowner before any work begins. The detailed design of access routes and construction methodology based on condition of land at the time of construction will be agreed and recorded with the landowner prior to the commencement of works.

7.3.4.1.2 Site Enabling Works including Guarding and Services

- 35 Site preparation for OHL construction includes the laying, where necessary, of temporary access tracks to the tower positions (refer to **Section 7.3.4.1.3** for further detail) and may include minor civil works around the tower location including *inter alia*:
- Clearing the site (e.g. removal of fences, cutting back of trees and vegetation etc.): All vegetation adjacent to the conductors which has the potential to fall onto the conductors will be cut or trimmed to ensure safety clearances. This will form part of the ongoing maintenance of the proposed OHL. This is standard practice and is done for all existing OHLs. Less trimming will be required further from the conductors as there will be less potential for falling vegetation onto the OHL. The trimming regime will involve a scalloping or profiling effect which will minimise the effect on vegetation. It is assumed that an area adjacent to the line and up to 30m from the position below the conductors (on either side) will be required to be examined for falling hazards. The level of trimming required will be directly related to the distance from the OHL and the height of the vegetation – i.e. the further from the OHL, the less vegetation that is required to be trimmed. There would be a loss of localised vegetation to the tower sites including tree, shrub and hedge removal to allow for the construction of towers for supporting the OHLs. Vegetation will be reinstated. Temporary access routes to the towers may also result in loss of localised vegetation; again this vegetation will be reinstated. As part of the EIS an assessment has been carried out to identify the positions and quantities of vegetation clearance due to this development (refer to Chapter 6, **Volumes 3C** and **3D** of the EIS, for further detail). ESB will employ the services of a forester and / or tree surgeon during

construction to remove vegetation which has been identified as being in violation of required clearance for the development.

- Levelling of the tower foundation area: The towers are designed such that a difference in ground level can be accommodated from one side of the tower to the other, hence minimising the quantity of local disturbance. Where the gradient between two legs is greater than 1m, the tower will be installed with a leg extension. The towers as per design do not increase in height. Gradients at the proposed tower locations greater than 1m have been accounted for in the design, by the selection of the appropriate leg extensions to match the gradient. Depending on the particular gradient at each location, the tower may require a single leg extension, or it is possible to add an extension to any number of the four tower legs to overcome a gradient. Where the gradient is less than 1m, and the impact is moderate, consideration will be given to levelling the site foundation area. Prior to construction a site survey will be conducted at each tower location to confirm the requirement for leg extensions and / or site levelling.
- The gradient at four tower sites is too significant to be overcome by the use of tower leg extensions alone. Towers 164, 166, 168 and 207 will require additional excavations above the standard foundation excavations noted in **Section 7.3.4.2.3** to ensure the ground at a higher level above the foundation site remains stable for the duration of the foundation works. The designated excavation areas for these sites, have been increased to cater for the additional excavations required. The working area for towers 166 and 168 have also been increased.



Figure 7.3: Illustration of excavation necessary at Tower 164

- Once the foundations are constructed the ground level around the excavated area will be assimilated into existing landscape contours as much as is feasible, avoiding sharp changes of angle within the constraints of the working area and achieving the objective of minimising land use impacts.
- Diversion of field drains: Where existing drainage is present at the location of a tower foundation, typically this drainage will be removed from the tower foundation construction area. New drainage trenches will be dug to pass the tower foundations on one or as many sides of the foundations as required, or alternatively a number of drains can be replaced by a larger single drain inserted, which bisects the tower foundation.
- Delineation of any on-site working area (e.g. erection of temporary fencing etc.).
- Diversion of any existing utilities (e.g. underground water pipes, cables etc.).
- Works to existing OHL crossings: See **Appendix 7.3 North-South 400 kV Interconnection Development Identification and Resolution of Conflicts with Existing Overhead Line Infrastructure, Volume 3B Appendices.**

- Erection of temporary guarding positions: Where the conductor is to be strung over roads and electricity lines, protective structures will be erected prior to the commencement of stringing. These structures will be in the form of guard poles. For transmission line crossings a catenary stringing method will be used as an alternative to erecting large guarding arrangements, (see **Section 7.3.4.4.1** for details). The protective structures will be positioned both sides of a crossing and will be temporary in nature, for the duration of the stringing operation. They will help to ensure that the stringing operation does not interfere with road users or disrupt the supply of electricity (See 1:5,000 aerial drawings **Volume 3B Figures** of the EIS).

7.3.4.1.3 Access Routes

- 36 Temporary access routes capable of accommodating construction plant, construction materials and personnel are required for the construction of each tower, installation of the conductor and the setting up of guarding locations (see 1:5,000 aerial drawings **Volume 3B Figures** of the EIS).
- 37 There are three locations along the proposed route where vehicular access is typically required for the construction of OHL:
- **Access to tower sites:** Temporary access routes will be used to gain access to the working areas from the public road network. The proposed access routes will be selected to minimise disruption to agricultural land by using existing routes and access points as far as possible.
 - **Access to stringing locations:** Generally access for the stringing equipment (see **Figure 7.11**) is directly from the nearby proposed angle tower to the stringing location, where the two points are in the same fields and there are no obstructions. Where obstructions (e.g. a hedgerow) occur between these points, an alternative access route has been chosen.
 - **Access to guarding locations:** The guarding locations will be accessed by 4x4 vehicle and excavator with two trips, one for erection, and one for disassembly.
- 38 Access routes to tower sites enable the deployment of excavators or piling rigs together with foundation materials (shuttering, concrete, steel re-enforcement, piles), and for the removal of excess spoil. For tower erection, approximately 10 tonnes for an intermediate tower to 32.5 tonnes for an angle tower of steelwork will be delivered to each tower location site and erected using a gin / derrick pole.

- 39 As noted previously, appropriate route and site selection is the most effective method of avoiding or minimising the environmental effects of development.
- 40 The first part of the identification process is to develop some general principles to guide the decisions about identifying potentially suitable temporary access routes to construct the proposed development. The general guidelines are set out below:
- Access routes could be up to 4m in width. The width of routes and any associated works would be minimised where possible and where safety and design are not compromised;
 - Defining the route of temporary access to work sites (on private lands) will seek to:
 - Minimise disturbance to current land use and farm / land management practices, where possible;
 - Avoid sensitive areas where possible (e.g. cSAC / pNHA / NHA / SPAs);
 - Cause least disturbance to and minimise impacts to natural heritage interests (including watercourses);
 - Cause least disturbance to and minimise impacts to cultural heritage interests;
 - Minimise intrusion to and disturbance of the surrounding area and local communities;
 - Maximise use of existing farm entrances, farm tracks, roads and bridges, where possible. The use of private accesses to residential properties should be avoided wherever possible for safety and amenity reasons;
 - Minimise the amount of new temporary entrances, and access tracks / roads, where possible; and
 - Take appropriate precautions to protect animal welfare and crop fertility by avoiding the spreading of diseases and noxious and invasive plants between farms.
 - Prior to commencement of construction, a project traffic management plan will be produced and implemented which will be subject to revision in conjunction with local authorities. (Refer to Chapter 13, **Volumes 3C** and **3D**, of the EIS for further details on construction traffic).
- 41 Based on the above guidelines, temporary access routes for the proposed development have been identified in this EIS (See 1:5,000 aerial drawings in **Volume 3B Figures** of the EIS).

- 42 Temporary access tracks tend only to be laid where there may be poor ground conditions, a sensitive receptor or sensitive land use (see **Figures 7.4** and **7.5**). While the terrain of the proposed development is generally undulating with favourable ground conditions likely to be encountered for a vast majority of the proposed route, construction techniques and machinery / equipment may vary to accommodate localised ground conditions along specific parts of the route and / or as a result of weather conditions during the construction period. For the purposes of this appraisal, all temporary access routes have been assessed based on very wet weather conditions, expansive construction techniques with heavy machinery / equipment.
- 43 Details of alternative types of temporary access route for wet conditions relative to land use, condition and having regard to specific environmental conditions are set out below. It is noted that these are not mutually exclusive in all cases and that a particular temporary access route may incorporate different track types along its length.

- **Type 1**

Good quality land (i.e. in areas of very dry pasture): In general, the laying of temporary tracks is not required. Using tracked machinery (low ground pressure vehicles where possible) usually means that access to tower sites can be achieved with relative ease using existing roadways where available and the crossing of fields.

- **Type 2**

Relatively dry / peat land or very sensitive areas: Where a defined track is required, temporary rubber matting or aluminium road panels would be used to distribute the weight evenly. Low ground pressure vehicles would also be used where possible.



Figure 7.4: Temporary Aluminium and Rubber Panel Tracks

- **Type 3**

Very poor, soft, wet boggy and / or undulating land with unfavourable ground conditions: In such conditions roads with stone or wooden sleepers may need to be constructed. This involves the excavation of the topsoil and storage of this to one side of the track. A geotextile reinforcement would be placed on the subsoil surface and stone placed on top and compacted to form the track.



Figure 7.5: Temporary Stone Road and Wooden Sleepers

44 Based on the assessment criteria set out in paragraph 35, the vast majority of access routes identified in **Volume 3B Figures** will be Type 1. The access routes or part of the routes to the following tower locations and associated ancillary works have been identified as Type 2 which potentially require temporary rubber matting or aluminium tracks: Towers 103, 104, 106, 116, 117, 119, 120, 123, 126, 130, 168, 180, 181, 182, 202, 222, 223, 229, 232 in the CMSA; and Towers 269, 279, 287, 292, 379 in the MSA. Type 3 roads constructed with stone or wooden sleepers will not be required at any of the proposed tower locations, stringing areas or guarding locations.

7.3.4.1.4 Duration Period Required to Lay Rubber Matting or Aluminium Road Panel Tracks

45 The duration period required to lay rubber matting or aluminium road panels in relation to temporary access routes, where necessary, is typically very short with one day being the norm for 0.5km temporary access route. For a very long route, greater than 1km, two working days may be required. In cases where rubber matting or aluminium panels have been installed over wet or boggy accesses, they may need to remain in place until the full construction period has elapsed.

7.3.4.2 Stage 2 – Tower Foundations

7.3.4.2.1 Setting Out and Excavation of Tower Foundations

- 46 The average duration of foundation works for a 'Base Construction Crew' of 4 - 6 workers is six days for an angle tower, four days for an intermediate tower and 5 - 10 days for piled / rock anchor foundations.
- 47 Excavations are set out specifically for the type of tower (e.g. angle, intermediate or transposition) and the type of foundation required for each specific site (depending on ground conditions). As noted in **Section 7.3.4.2.3** tower foundations typically range from 2m to 3.5m in depth to the invert level of the foundation and anywhere from 2 x 2 metres squared to 9 x 9 metres squared in plan area depending on tower type. Each of the four corners of the tower stubs (i.e. lower part of the tower leg) will be separately anchored below ground in a block of concrete. The standard ESB practice is to use a concrete pipe in the foundation holes which is as an integral part of the foundation.

7.3.4.2.2 Installation of 400 kV Steel Tower Foundations

- 48 The foundation of the tower is the means by which the loads are transmitted from the tower into the surrounding soil. The foundation is designed to withstand the maximum uplift, compression, transverse shear, and, longitudinal shear loads imposed by the tower as derived from the tower design. The foundation will be sufficiently stable to prevent any movement of the tower under the maximum load conditions. The foundations will be excavated using a rubber tyre or tracked excavator. Depending on the location a wheeled or tracked dumper may deliver the ready-mix concrete to the excavation site. For the range of foundations to be used in this project see planning drawing Numbers MT-007-001, MT-007-002, and MT-007-003.



Figure 7.6: Typical Excavator and Dumper used in OHL Foundation Installation

- 49 The standard ESB foundation practice is to have four individual footings for each tower leg. The tower will be set out and pegged prior to foundation excavation. In some cases this will require excavation of existing hedges and / or drains to allow clear pegging of each individual leg footing for excavation. All such removals are restored upon completion of foundation works. A maximum size footing may be required (see **7.3.4.2.3** foundation sizes) in the case of weak soils, pile foundations may be required in the case of deep bog and reduced footing size foundations may be required in the case of rock being encountered at shallow depths (no deep bog is expected based on the soils and geology review of the tower sites).
- 50 All tower sites will be checked for underground services such as cables, water pipes etc. as part of normal pre-construction verification. If field drains are encountered these will be diverted and all diversions identified and discussed with the landowner.
- 51 In areas of poor ground and high water table, it may be necessary to use sheet piles supported by hydraulic frame(s) to prevent collapse of the sides and also to prevent the excavation becoming too large. In this case the requirement for a concrete pipe (which is normally used in tower foundations) is removed. During any dewatering activities a standard water filtration system will be utilised to control the amount of sediment in surface water runoff (see Chapter 7, **Volumes 3C** and **3D**, for further details).
- 52 When each leg is excavated the formation levels (depths) are checked by the on-site engineer. Once the levels have been achieved the concrete pipes (if used) are lowered into position. Once in position and all water is pumped from the excavation, concrete is poured outside the concrete ring. When this concrete has set a paving slab is set within the concrete pipe to provide a stable base on which the tower stubs will rest.

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- 53 A setting template (see **Figure 7.7**) is used to set and hold the tower stubs in position while the concrete is being poured and cured. Any water in the excavation is pumped out prior to any concrete being poured into the foundation. Concrete trucks will be brought as close as possible to the excavation to pour directly into the excavation. In the event of this not being possible concrete will be transported in six tonne dumpers fitted with concrete chutes.
- 54 After the concrete is poured the remaining part of the foundation, the shear block or neck is shuttered. Once the shuttering is complete the concrete may be poured and the foundation completed. The tower foundations are backfilled one leg at a time usually with the soil material already excavated. The backfill is placed and compacted in layers.
- 55 In locations where the soil investigation shows that the ground conditions do not conform to the bearing and / or ground conditions catered for by the range of generic pad and chimney foundations, either a piled, or rock augured site specific foundation will be required. It will be the engineering preference to use an excavator with an attachable hydraulic hammer to install the piles. This will remove the requirement for any larger plant.
- 56 The use of piled or rock anchor foundations may require the drilling or 'auguring' of several holes for each leg of the tower. In the case of piled foundations there will be two options. The holes are drilled and then reinforced with steel and concreted or grouted, or the contractor will use precast concrete piles and drive these into the ground. The piles form a stable base at ground level, upon which a typical foundation will be installed. In the case of rock foundation, a site specific rock anchor foundation will be designed. Rock anchors of a specified length are drilled and grouted into the bedrock. The quantity of concrete used will be no greater than the worst case quantity for that of a generic 'pad' and 'chimney' foundation for the particular tower location.
- 57 Once the tower base is completed and fully cured it is ready to receive the tower body. When the base construction crew leave site they will ensure to remove all surplus materials from the site including all unused excavated fill.



Figure 7.7: Photograph of Setting Template being prepared for Final Concreting

7.3.4.2.3 Foundation Size

58 The foundation size for each tower leg used on the 400 kV transmission system range from approximately 3.8m x 3.8m x 3.5m to 8.8m x 8.8m x 3.5m for a single circuit 400 kV angle tower, 2.2m x 2.2m x 2.5m to 3.7m x 3.7m x 2.5m for a single circuit 400 kV intermediate tower (refer to Drawings MT-007-001, MT-007-002 and MT-007-003, submitted with the planning application, for foundation details). It is likely that the large majority of tower foundations will be constructed using the generic foundation types within the minimum to maximum ranges. A number of towers are considered to be in locations where poor ground conditions may be encountered, specifically tower numbers, 104, 105, 106, 117, 119, 120, 122, 163, 187, 269, 279, 287, 292 and 379. The tower locations may require a piled or rock anchor foundation (as described in **Section 7.3.4.2.2**). Piled and / or rock anchor foundations will not exceed the maximum foundation plan sizes as listed above.

7.3.4.2.4 Working Area

59 The working area for construction of a 400 kV tower is approximately 30m x 30m for the majority of structure locations.

7.3.4.2.5 Construction Equipment Required for Foundation Installation Stage

60 The equipment required for the foundation installation stage of construction includes the following:

- 4 x 4 vehicle;
- Concrete vibrator;
- Water pump;
- Wheeled dumper or track dumper (6 to 8 tonnes);
- Timber or other shuttering boxes;
- 360° tracked excavator (13 tonnes normally, 22 tonnes for rock breaker);
- Transit van;
- Road sweeper;
- Chains and other small tools; and
- Concrete delivered by supplier to closest convenient point (38 tonnes gross).

7.3.4.2.6 Duration of Foundation Works

61 The average duration (continuous days) of foundation works is as follows:

- Angle / intermediate tower 3 - 6 days
- Piled / rock anchor foundation 5-10 days
- Crew size 4 to 6 workers

7.3.4.3 Stage 3 – Tower Assembly and Erection

7.3.4.3.1 Erection of Tower Body

62 The most common methods of constructing a transmission line of this nature is by using a 'derrick pole' or a mobile crane. Both methodologies are outlined below.

7.3.4.3.2 Derrick Pole Methodology

63 The tower can be erected using a derrick / gin pole and tractor. The derrick pole is a very simple and straight forward way to build the tower where small sections of steel are lifted into place using the derrick and a winch. As illustrated in **Figure 7.8** the derrick pole consists of either a solid or lattice aluminium or steel pole which is held in position using guy ropes anchored to the ground.



Figure 7.8: Derrick Pole at Tower Base



Figure 7.9: Lower Part of the Tower Head being dropped into Position

7.3.4.3.3 Construction Equipment Required for Tower Erection Works by Derrick Pole

64 The equipment required for the tower erection stage by derrick pole includes the following:

- 4 x 4 vehicle;
- Winch Tractor and trailer;
- Derrick pole;
- Teleporter;
- Transit van; and
- Chains and other small tools.

7.3.4.3.4 Duration of Tower Erection Works

65 The average duration (continuous days) of tower building works is as follows:

- Angle tower 4 days
- Intermediate / transposition tower 3 days
- Crew size 7 workers

7.3.4.3.5 Mobile Crane Methodology

66 Mobile cranes can also be used to construct steel towers, however due to cost and access issues they are generally restricted to sites which provide optimal construction conditions. End towers in or close to a substation site are good examples of where use of a mobile crane can present advantages. Crane size and weight is generally dependent upon the properties of the tower in question, with the tower erection procedure completed in separate sections due to the weight of the differing components. Tower sections are assembled on the ground and lifted into place. Tower sections are assembled on the ground and lifted into place.



Figure 7.10: Tower Erection by Mobile Crane

7.3.4.3.6 Construction Equipment Required for Tower Erection Works by Mobile Crane

67 The equipment required for the tower erection stage by construction using a mobile crane includes the following:

- 4 x 4 vehicle;
- All terrain mobile crane;
- Tractor and trailer;
- Teleporter;
- Transit van; and
- Chains and other small tools.

7.3.4.3.7 Duration of Tower Erection Works

68 The average duration (continuous days) of tower building works is as follows:

- Angle tower 4 days
- Intermediate / transposition tower 3 days
- Crew size 7 workers

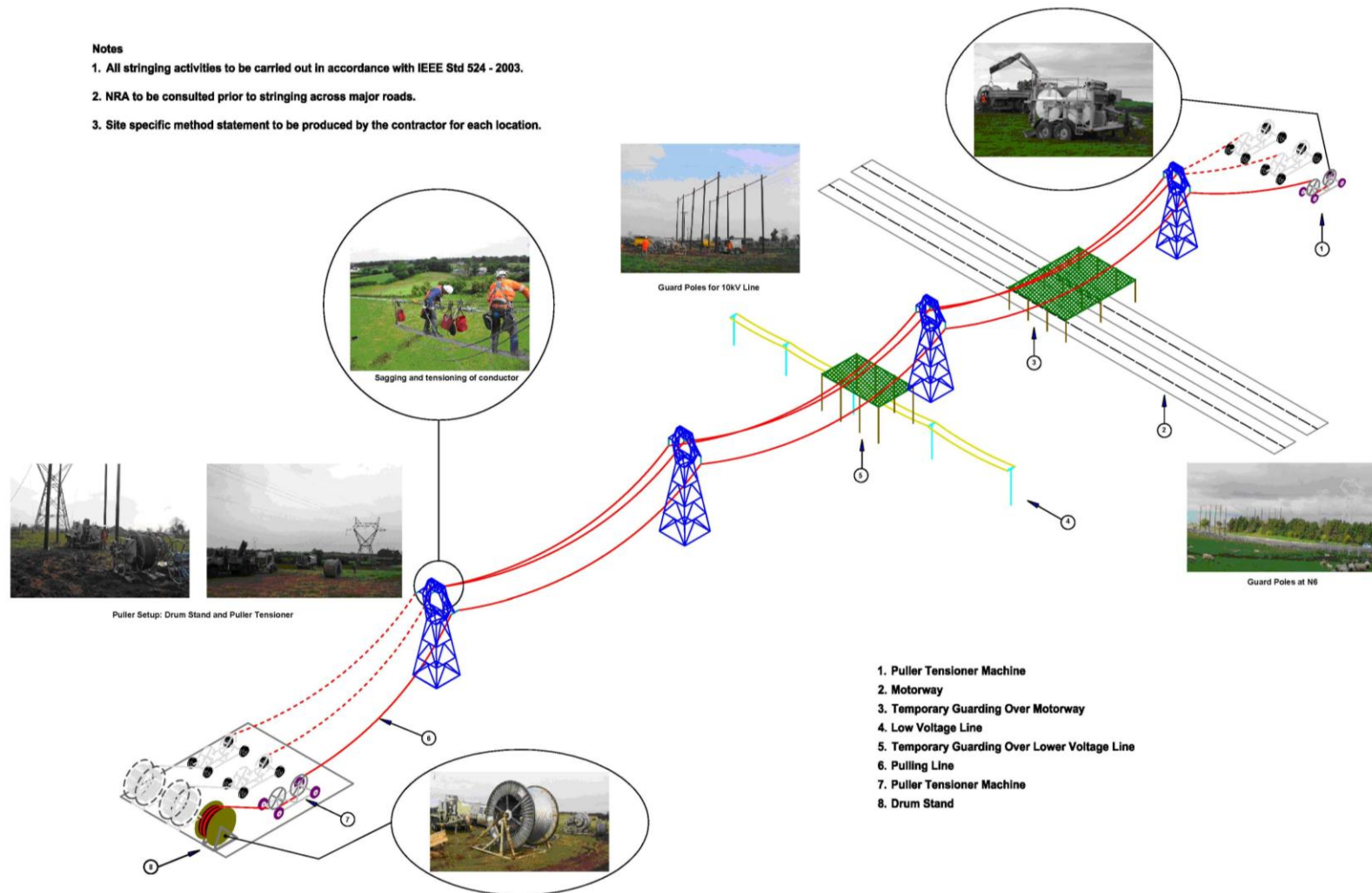
7.3.4.4 Stage 4 – Conductor / Insulator Installation

7.3.4.4.1 Stringing of Overhead Lines

69 Stringing of OHLs refers to the installation of phase conductors and shieldwires on the transmission line supporting towers. The conductor is kept clear of all obstacles along the straight by applying sufficient tension. Certain obstacles along a straight have to be guarded such as road / railway crossings and other transmission or distribution lines. See generic layout in **Figure 7.11**. For further details on the crossing of overhead lines, refer to the *North-South 400 kV Interconnection Development Identification and Resolution of Conflicts with Existing Overhead Line Infrastructure* included as, **Appendix 7.3, Volume 3B Appendices**, of the EIS.

Notes

1. All stringing activities to be carried out in accordance with IEEE Std 524 - 2003.
2. NRA to be consulted prior to stringing across major roads.
3. Site specific method statement to be produced by the contractor for each location.



1. Puller Tensioner Machine
2. Motorway
3. Temporary Guarding Over Motorway
4. Low Voltage Line
5. Temporary Guarding Over Lower Voltage Line
6. Pulling Line
7. Puller Tensioner Machine
8. Drum Stand

Figure 7.11: Generic Tension Stringing Layout

[This figure is also provided in A3 format in Volume 3B Figures]

- 70 This stringing method involves the pulling of a light pilot line (nylon rope) which is normally carried by hand into the stringing wheels. This in turn is used to pull a heavier pilot line (steel rope) which is subsequently used to pull in the conductors from the drum stands using specifically designed 'puller – tensioner' machines (see **Figure 7.12**). The main advantages with this method are (a) the conductor is protected from surface damage and (b) major obstacles such as road and rail crossings can be completed without the need for major disruption. The temporary working area utilised for the stringing equipment are generally 20m x 20m.



Figure 7.12: Puller – Tensioner Machine

- 71 Once the conductor has been pulled into position, one end of the straight is terminated on the appropriate tension fittings and insulator assemblies. The free end of the straight is then placed in temporary clamps called 'come-alongs' which take the conductor tension. The conductor is then cut from the puller-tensioner and the conductor is sagged using a chain hoist. This stringing method will be used to string the conductors for the proposed development including the approximate 2.85km section on the existing double circuit structures near Woodland Substation. In the case of a small number of alignments where major road and / or existing transmission line crossings occur and in order to avoid having to construct large guarding structures it is proposed to use the catenary stringing method as outlined below.

- 72 The catenary support system is a secondary support used in OHL stringing where an additional safety factor is required over and above those used in normal tension stringing. Catenary support systems are typically used where motorways are crossed with movement of vehicles unhindered. In addition where an outage cannot be obtained the catenary support system can be used for crossing over live transmission and distribution lines. The catenary support system essentially consists of a high strength, low elasticity rope, which is deployed to the pilot wire, carried or hurred across the obstacle and connected to the conductor with rollers at spacing determined to provide adequate working clearances to the conflict below. The system in deployment is illustrated in **Figure 7.13** where the rope is pulled along by a robot over the conflicting span with double wheel rollers connected at a distance specified by the designer.

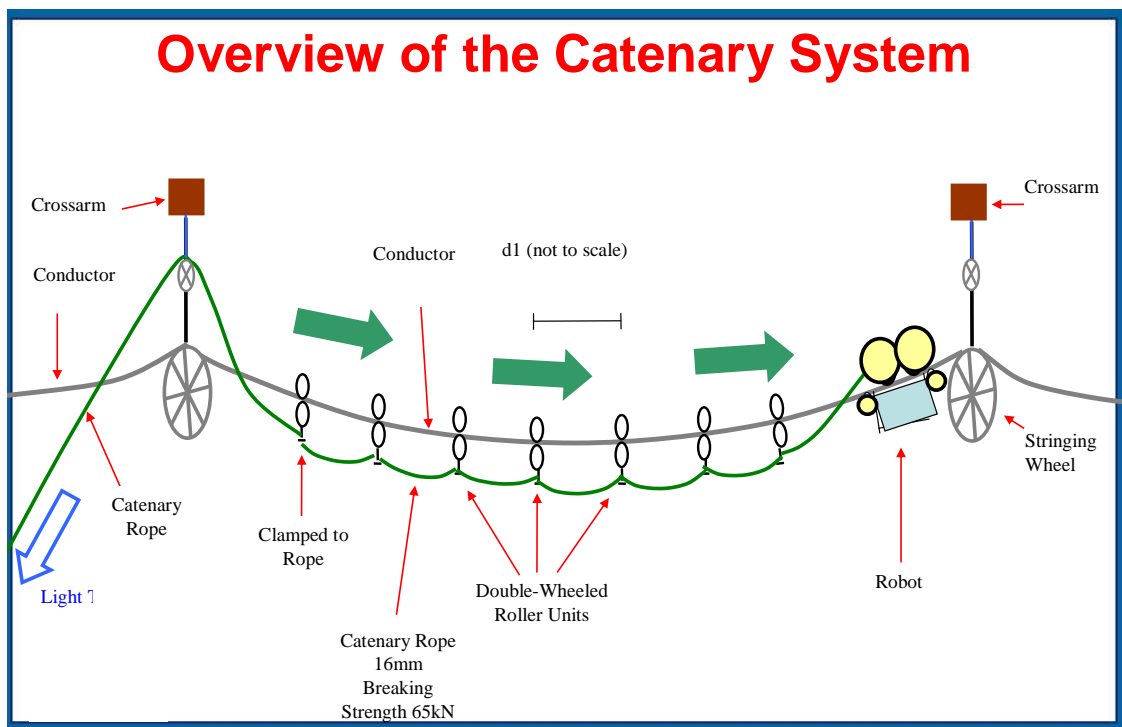


Figure 7.13: Typical Catenary Arrangement

- 73 When the rope and rollers are fully deployed and tied off either to a tower or to ground anchors, tension is then applied to the rope to flip it over the pilot wire. The rope is now supporting the conductor (see **Figure 7.14**).

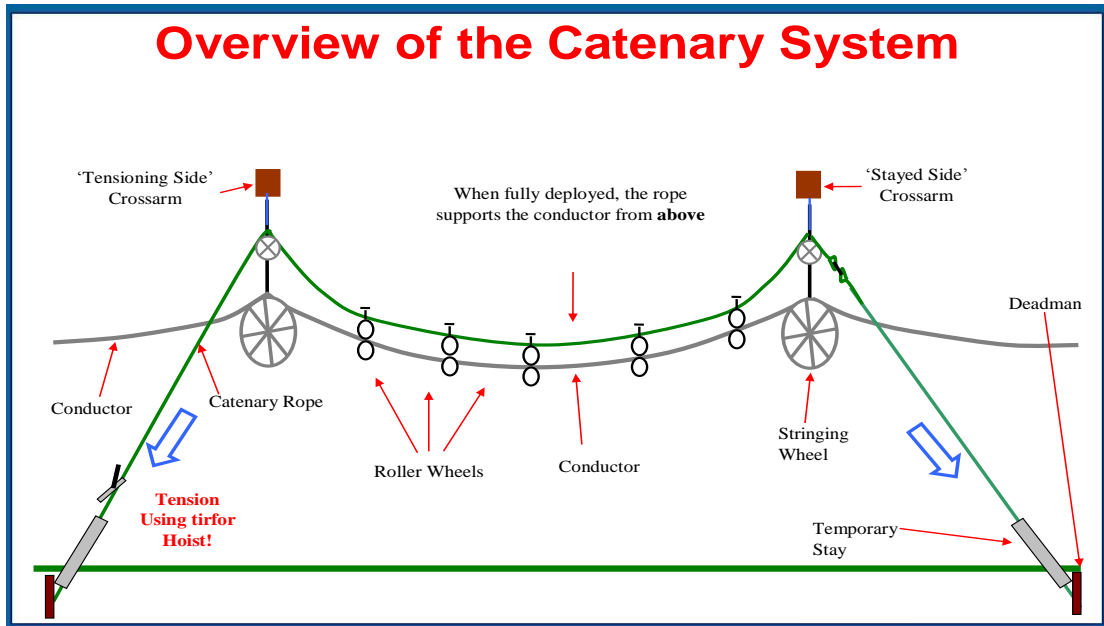


Figure 7.14: Catenary Arrangement when Flipped for Conductor Support

74 Essentially the catenary support system is a secondary support system. Should the conductor break during stringing the conductor would only fall by 1 wheel spacing. Therefore the spacing of the rollers will dictate how far the conductor can infringe into the safety zone for the conflict in question.



Figure 7.15: Typical Stringing Equipment

7.3.4.4.2 Construction Equipment Required for Stringing Stage

75 The equipment required for the stringing stage of construction includes the following:

- 4 x 4 vehicles;
- Puller - tensioner X 2;
- Teleporter X 2;
- Drum stands X 2;
- Drum carriers X 2;
- Stringing wheels;
- Conductor drums;
- Compressor & head;
- Transit vans;
- Road sweeper;
- Chains and other small tools; and
- Conflict guardings.

7.3.4.4.3 Duration of Stringing Works

76 The average duration of stringing works is typically one week per straight. This figure is similar for all straights regardless of length as the most time consuming aspect is the movement and setup of stringing equipment. Stringing crews are typically quite large and could have as many as 15 workers.

7.3.4.5 Stage 5 - Reinstatement of Land

77 Once all works are complete, the access route and the construction areas around the OHL towers are reinstated as close as possible to their original condition. Generally this work is carried out by a specialised agricultural contractor and is carried out in accordance with the relevant *ESB / IFA Code of Practice for Survey, Construction and Maintenance of OHL in relation to the rights of Landowners* and in consultation with the individual landowner.

7.3.5 Substation Works

78 The extension of the existing Woodland 400 kV substation is necessary to allow the connection of the new Turleenan 400 kV line bay. The works are described in **Section 6.3.3**. The approximate location of the works is identified on **Figure 6.31, Chapter 6** of this volume of the EIS. The proposed extension will take place entirely within the existing ESB lands and will involve works to an area of approximately 5,440sq.m. (0.544ha) including the area to accommodate the proposed electrical equipment and the extension of the existing palisade fence.

79 The proposed works associated with extending / modifying the existing Woodland Substation will consist of, but not limited to, the following elements:

- Site preparation works, including the removal of part of the existing fence, site clearance and earthworks;
- Installation of the new 2.6m high palisade fence;
- Excavation of trenches and laying of ducts for electrical cables, communication cables, lighting, etc.;
- Excavation of trenches and laying of pipework for connection to the existing surface water drainage network;
- Foundations works for the installation of equipment, structures and monopole;
- Installation of miscellaneous outdoor electrical equipment including support structures, gantries and bases and associated cabling and wiring;
- Stringing of OHL conductors;
- Installation of lightning conductor equipment; and
- Completion of external finishes.

80 The following machinery will be necessary to carry out all the construction works above:

- Concrete truck;
- Mobile crane;
- Pulling and tension devices for overhead conductors;

- Excavator;
- Dumper truck; and
- Bulldozer.

81 The proposed substation extension will take place entirely within the existing ESB lands. Excavation works will be undertaken to lower the ground level and install foundations to a maximum of 3.5m. Excess soils / subsoils will be disposed of at licensed / permitted waste management facilities. It is estimated that approximately 3,500m³ (equivalent to approximately 7,350 tonnes) of material will be removed off site as a result of these works at the proposed substation.

82 Throughout the construction of the proposed development the client, designers, project supervisors, contractors, and workers will be required to comply with all applicable health and safety legislation and practice specific to works within an existing substation.

7.3.6 Traffic Management

83 Traffic Signs Manual issued by the Department of Transport provides details of the traffic signs which may be used on roads in Ireland, including their layout and symbols, the circumstances in which each sign may be used and rules for positioning them. Chapter 8 Temporary Traffic Measures and Signs for Roadworks of the *2008 Traffic Signs Manual* will be used on this project.

84 Refer to Chapter 13, **Volumes 3C and 3D** of the EIS for further details on construction traffic. In addition, an outline Traffic Management Plan is included as **Appendix 7.2, Volume 3B Appendices**, of the EIS.

7.3.7 Working Hours

85 Site development and building works will generally be carried out during normal working hours. In exceptional circumstances works may be required outside of these hours.

7.3.8 Waste Management

86 Similar to any infrastructure project, there will be excavated material during the construction of the proposed towers. At the depths below ground at which tower foundation bases are installed, various types of soil, gravelly soil, and rock will be excavated. All topsoil excavated in the construction of tower foundations will be reinstated where possible. Where practical and

appropriate, excavated subsoil will be used for associated construction and landscaping purposes. All surplus waste arising during the construction phase will be managed and disposed of in a licensed landfill, this ensures the provisions of the *Waste Management Act 1996* (as amended) and subsequent amendments and regulations and any of the relevant local authorities Waste Management Plans. A Construction Waste Management Plan will be implemented to minimise waste and ensure correct handling and disposal of construction waste streams in accordance with the *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects*, Department of the Environment, July 2006 (see Chapter 12, **Volumes 3C** and **3D** of the EIS).

7.3.9 Commercial Forestry and Hedging

7.3.9.1 Commercial Forestry

87 The proposed development crosses commercial forestry. The normal corridor widths centred on the line to be left clear of trees for 400 kV lines is a maximum 74 metres.

7.3.9.2 Hedgerow

88 Hedgerows need to be managed under electricity lines. All trees should be outside their falling distance from any part of any OHL support.

7.3.10 Construction Environmental Management Plan

89 For infrastructural projects of this nature, it will be a requirement of the construction contractor to prepare a *Construction Environmental Management Plan* (CEMP) in the event that planning approval is granted. For similar projects where planning approval has been granted, a condition has been attached in relation to preparing a CEMP. An outline CEMP is provided in **Appendix 7.1, Volume 3B Appendices**, of the EIS.

7.3.11 Maintenance

90 The design life for all the units of the proposed development is 50 to 80 years.

91 During this lifespan there will be on-going maintenance on the different units. The maintenance on the OHL will require access through third-party lands from time to time. The following section describes the expected maintenance requirements for the OHLs over the lifetime of the project.

7.3.11.1 Overhead Lines Maintenance

Overhead Line Patrolling

92 Following commissioning of the proposed 400 kV line it will be subject to maintenance patrols. These include an annual visual survey by helicopter, a climbing patrol every eight years (frequency increases 40 years post energisation to once every six years) and an infrared patrol by helicopter one year post energisation and once every five years thereafter. Follow up foot patrols may be completed to specific sites upon completion of a helicopter patrol. A conductor sag check is also completed 20 years post energisation in the same year a climbing patrol is completed. Emergency maintenance patrols may also be required following severe storms. Arising from these patrols, corrective maintenance work may be identified as being required. The type of corrective maintenance required varies from replacement of worn or damaged hardware, insulators or earthwire straps to timber cutting. Access to lands will be required on these occasions and shall occur in accordance with the relevant ESB/IFA Code of Practice and relevant statutory provisions. ESB also provides advance notification to landowners in advance of helicopter patrols occurring.

Tree and Hedge Cutting to Maintain Clearances

93 Tree and hedge cutting requirements along the proposed 400 kV route will be identified primarily by the annual helicopter patrols. The landowners will be contacted in advance. ESB contractors will identify vegetation which has grown within the electrical clearance envelopes. Vegetation adjacent to the conductors which has the potential to fall onto the conductors and / or vegetation directly underneath the electricity line which has grown with close proximity will be cut or trimmed to ensure safety clearances. This maintenance activity will form part of the ongoing maintenance of the electricity line.

Towers

94 After approximately 35 years' service, the entire circuit will be condition assessed for corrective maintenance works that will extend the life of the circuit to the stated 50 to 80 year design life. A major element of this life extension corrective maintenance is tower painting. After approximately 35 to 40 years' service the galvanised steel would be expected to require painting to ensure the steel is still adequately protected.

Insulator and Earthwire Hardware

95 It is estimated that 25% earthwire hardware replacement and less than 5% insulator replacement on the 400 kV line will be required after 30 years.

Foundation

96 No foundation maintenance work is generally required.

Conductor

97 No conductor maintenance work is generally required.

7.3.12 Decommissioning

98 The proposed development will become a permanent part of the transmission infrastructure. The expected lifespan of the development is in the region of 50 to 80 years. This will be achieved by routine maintenance and replacement of hardware as required. There are no plans for the decommissioning of the overhead line or existing substation. In the event that part of, or the entire proposed infrastructure is to be decommissioned, all towers, equipment and material to be decommissioned will be removed off site and the land reinstated. Material from the overhead line, such as steel members from the towers will be taken for recycling where possible. Specific decommissioning works would include:

- Fittings and / or hardware such as spacers dampers, and insulators would be removed from the circuit. The conductors would be winched onto drums in a reverse stringing process to that described in **section 7.3.4.4.1**;
- The tower would be dismantled, with sections disconnected for removal from site; and
- Typically the foundations would be removed to approximately 1m deep and subsoil and topsoil reinstated.

99 The decommissioning of the proposed development, if it is to occur, would be undertaken many decades into the future. It is likely that the baseline conditions will have changed to a greater or lesser degree, however, it is likely that the effects of decommissioning would be temporary and of a similar scale or less than the construction phase. Similar mitigation measures as described in the EIS (and as summarised in **Table 11.1**) should be implemented to ensure the minimisation or elimination of any environmental impacts.

7.4 HEALTH & SAFETY

7.4.1 Design & Construction

- 100 During the design and throughout the construction of the proposed development the client, designers, project supervisors, contractors, and workers will be required to comply with all applicable Health and Safety legislation and practice.
- 101 ESB has policies, procedures and systems, which will be in place, in the unlikely event of an accident or emergency incident occurring during the construction of the proposed development.