4 Construction Activities

4.1 Introduction

This chapter describes the construction operations associated with the development of the three main components of the proposed development, namely the overhead lines, underground cables and the 220KV substation compound.

A client engineer will be appointed for this stage of the proposed development. The client engineer will 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.

It is anticipated that construction will commence in the summer/autumn of 2016 subject to planning and other approvals and will be of 14 months duration.

It is anticipated that, with the proper management, the construction phase of the development will have no significant or long-term impact.

4.2 Construction Methodology for Overhead Lines

4.2.1 Overview

The overhead line (OHL) construction will include foundation installation and tower erection and stringing.

The construction techniques carried out will fully comply with all health and safety requirements.

In general, the construction phase can be broken down into as follows;

- Verification that all planning and environmental conditions have been satisfied.
- 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 and to delineate the Vicia orobus conservation areas).
- 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.
- Stringing of conductors and commissioning.

The construction period at any one tower location will be of short duration as works at each tower take place in a series of different stages based on the estimated durations outlined below.

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),
- Stage 3 – Tower Assembly and Erection and Preliminary Reinstatement (3 – 4 days)
- Stage 4 – Conductor / Insulator Installation (7 days)
- Stage 5 – Final Reinstatement of Land (1 – 5 days)

4.2.2 Stage 1: Preparatory Site Work

Site preparation for OHL construction will include the laying, where necessary, of temporary access tracks to the tower positions 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.
- 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 leg extensions. Prior to construction, a site survey will be undertaken at each tower location to confirm the requirement for leg extensions and / or site levelling.
- Diversion of field drains (if required): If 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 would be dug to pass the tower foundations on one or as many sides of the foundations as required, or alternatively a number of drains would be replaced by the insertion of a larger single drain, which bisects the tower foundation.
- Diversion of any existing utilities.
- Erection of temporary guarding positions, as required.

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.

Access routes to tower sites enable the deployment of excavators together with foundation materials (shuttering, concrete, steel re-enforcement, piles), and for the removal of excess spoil. For tower erection, approximately 8-15 tonnes, for an

angle tower, of steelwork will be delivered to each tower location site and erected using a crane or in certain circumstances a gin / derrick pole.

Access routes will be up to 4m in width. 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.
- 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.

4.2.3 Stage 2: Tower Foundations

The average duration of foundation works for a Base Construction Crew of 6 workers is six days for an angle tower and four days for an intermediate/suspension tower.

Tower foundations for 220kV single circuit overhead lines will be approximately 3.5m in depth to the bottom of the excavation. The top of concrete is generally at least 1m below ground level to allow for farming to continue without interrupting the foundations. The base of the foundation can be anywhere from approximately 3.2 x 3.2 metres squared to 4.5 x 4.5 metres squared in plan area depending on the soil type and function of the foundation (compression or uplift).

Foundations act either under compression or tension forces or a combination of both, depending of the direction of loads. Compression foundations are generally shallow and wide, having a large footprint to counteract the compressive forces experienced during operation. Uplift foundations are generally narrow and deep, using the self-weight of the soil to anchor the foundation into the ground to counteract the uplifting forces during operation.

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.

The working area for construction of a 220kV tower is approximately 30m x 30m for the majority of structure locations.

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)
- Van/personnel transport
- Road sweeper
- Chains and other small tools
- Concrete delivered by supplier to closest convenient point (38 tonnes gross)

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 will be restored upon completion of foundation works.

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.

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.

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.

Any water in the excavation will be pumped out prior to any concrete being poured into the foundation. The resultant water will be filtered before discharge. In such circumstances, groundwater can be filtered using bunds / tanks filled with filter material. Single sized aggregates 5–10 mm, geotextiles or straw bales can be used as a filter. Monitoring will be undertaken on the discharge water quality. The volume of treated water to be discharged is likely to be very small and can be discharged to ground.

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.

The use of rock anchor foundations may require the drilling or 'auguring' holes for each leg of the tower. In the case of rock anchored foundations, a site specific rock anchor foundation will be designed. Rock anchors of a specified length would be drilled and grouted into the bedrock.

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.

Stage 3: Tower Assembly and Erection and Preliminary Reinstatement

The most common methods of constructing a transmission line of this nature is by using a 'derrick pole' or a mobile crane.

4.2.3.1 Construction using Derrick

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. 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. Derricks are most commonly used in areas where access is limited and a crane cannot be brought to site. The derricks would raise up the structure as construction progresses and continually lift subsequent sections of the tower into place.

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
- Van
- Chains and other small tools

The average duration (continuous days) of tower building using derricks is as follows;

- Angle tower 6 days
- Intermediate / transposition tower 4 days
- Crew size 7 workers

The following **Figure 4.1** shows a derrick in use during the construction of a tower.

Figure 4.1 Derrick constructing a 400kV tower near Birmingham UK
[Source: National Grid UK]

4.2.3.2 Construction using Crane

Mobile cranes are also used to erect the steel towers. However due to cost and access issues they are generally restricted to sites which provide optimal construction conditions. Cranes are quicker to use than derricks and allow larger sections of steelwork to be lifted at any one time.

Terminal towers in or in close to a substation are good examples of where the 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 will be assembled on the ground and lifted into place. The equipment required for the tower erection stage by construction using a mobile crane will include the following:

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

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

Figure 4.2 shows a crane being used to lift large sections of towers into place. There is less manual handling involved in comparison to construction using derricks. It is quicker to erect towers using cranes as larger sections of tower can be lifted at any one time.

Figure 4.2 Crane lifting a large section of an overhead line tower

4.2.4 Stage 4: Conductor / Insulator Installation

Stringing of OHLs refers to the installation of phase conductors and shieldwires on the transmission line supporting towers. The conductor will be kept clear of all obstacles along the straight by applying sufficient tension.

The stringing method will involve pulling a light pilot line (nylon rope) which is normally carried by hand into the stringing wheels. This in turn will be used to pull a heavier pilot line (steel rope) which will subsequently be used to pull in the conductors from the drum stands using special pulling machines. The main advantages with this method are (a) the conductor is protected from surface damage and (b) conductors can be installed at 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 is generally 20 metres x 20 metres.

Once the conductor has been pulled into position, one end of the straight will be terminated on the appropriate tension fittings and insulator assemblies. The free end of the straight will then be placed in temporary clamps which will take the conductor tension. The conductor will then be cut from the puller-tensioner and the conductor will be sagged using a chain hoist.

Figure 4.3 Typical Conductor Pulling Station

Protection will be required to be erected over the M6 Motorway during the conductor pulling stage of works. ESB Networks recommend the erection of a guarding net over the national roadway using 38kV size poles as the support structures. A catching net will be placed between the structures which will support the conductor in the event of slippage or failure during the pulling in stage. **Figure 4.4** illustrates the proposed road crossing support structure. Traffic calming, contra flow or traffic stoppage may be required during the erection of the stay wires.

The methodology for carrying out conductor stringing operations over road/motorway crossings is as per the requirements specified by ESB networks and refers to their code of practice No. PE432-COP020-001-001 “Erection of Netting Guarding Under HV Lines Over Roads and Railways” (hereafter referred to as ESBN Code of Practice).

1. To protect the motorway wood poles and stay wires will be erected. Gaining access to areas between the slip road and the M6 motorway will require consultation with TII in advance of any work to minimise disruption. The general configuration of these poles and wires is shown in Appendix 3 view B-B of the ESBN Code of Practice.

2. Catenary support wires will be pulled into position. Catenary support wires are used as a support system to pull netting and other material over the motorway safely without disruption. The catenary wires are attached to the poles using brackets and stay wire terminations as shown in appendix 8 photo No 1 of the ESBN Code of Practice.

3. A short traffic stoppage will be required while pulling catenary wires across the motorway. The traffic stoppage may be 30 minutes with diversions in place; or a restriction of flow for approximately 1 – 2 hours with intermittent stoppages may be required. Traffic restrictions on both sides of the M6 motorway would be required.

4. If the M17 interchange is completed before the stringing of the overhead line conductor a staged approach for traffic stoppage will take place. A typical staged approach would result in traffic stoppage/restriction of 1-2 hours on the north slip road of the M17 interchange. The next 1-2 hours restriction/stoppage would be both sides of the M6 motorway stopped simultaneously. The final stage would be a traffic stoppage/restriction of 1-2 hours on the south slip road of the M17 interchange.
5. Traffic stoppages typically take place in the early hours of the morning between 1 and 6am to minimise disruption.
6. A pulling rope will be secured to two catenary wires that will be connected to the poles at either side of the motorway, as shown in Appendix 3 view B-B of the ESBN Code of Practice.
7. A small pulley is attached to the stay grip terminating the catenary wires to the poles at either side of the crossing. These blocks are used for pulling the netting over from one side of the crossing to the other.
8. The catenary wires are terminated on poles 1 and 6, as shown in Appendix 2 view A-A of the ESBN Code of Practice.
9. All netting materials are arranged on the ground at the side of poles as indicated in Section View A-A of Appendix 4 of the ESBN Code of Practice remote from the motorway in preparation for hoisting up to the catenary wires.
10. The catenary wires are then used to hoist the netting.
11. Netting is fastened to the catenary wires at both sides of the crossing i.e the catenaries at right angles to the crossing as shown in Appendix 2 view A-A of the ESBN Code of Practice.
12. The sag of the netting is then checked to ensure the required minimum clearances are achieved between the netting and the motorway.
13. All guarding must remain in position until the HV conductors above them are secured on the structures at either side of the motorway i.e. clamped or terminated. Ideally spacers should be installed on twin conductors in spans crossing motorways before the guarding is removed.
14. Pulling machines which will be located in the working areas denoted in drawings MMD-360988-E-DR-00-XX-0550_P1 and MMD-360988-E-DR-00-XX-0551_P1 will be used to string the conductor of the overhead line.
15. Once the guarding is in place to protect the motorway, stringing the conductor will take approximately 2-3 weeks.

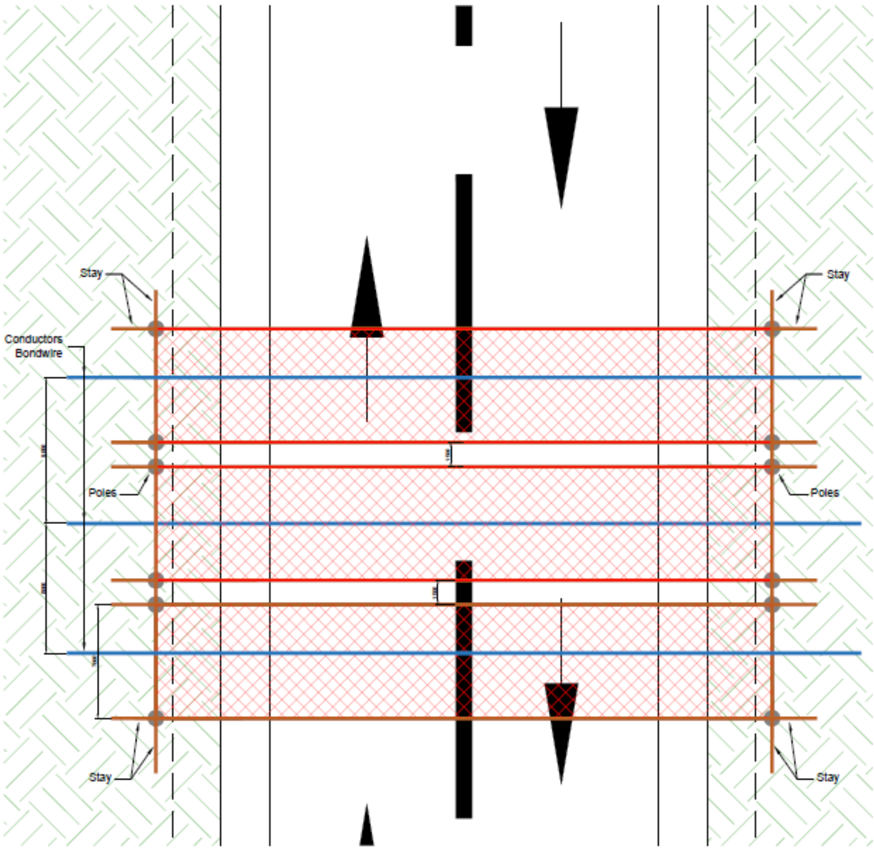

Figure 4.4 Typical Netting Details for Motorway Crossing

The equipment required for the road protection and the stringing stage of construction will include the following:

- A minimum of 12 no. 16m minimum height 38kV poles for 220 guarding.
- Tubular bars and brackets suitable to mount the tubular bars on to the poles.
- Sufficient 7 /3.25mm catenary wire (stay wire) to complete the crossing. Note: requirement for lengths greater than 50m is by special order.
- Rigging snap hooks to be placed at 0.5m centres on each catenary wire
- JCB to install the 38kV corner poles.
- 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
- Conflict guardings

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

4.2.5 Stage 5: Final Reinstatement of Land

Once all works are complete, the access route and the construction areas around the overhead line towers will be reinstated as close as possible to their original condition. Generally this work is carried out by a specialised agricultural contractor and will be carried out in accordance with the relevant ESB / IFA Code of Practice for Survey, Construction and Maintenance of OHL (1) in relation to the rights of Landowners and in consultation with the individual landowner.

4.3 Construction Methodology for Underground Cables

The installation of the HV cable system will involve a number of key construction stages as listed below and further detailed in the following subsections;

- Preparatory Work
- Trench Construction
- Joint Bays
- Sealing Ends and Sealing End Compounds.

4.3.1 Construction Preparatory Work

A number of activities will be required to be undertaken after detailed design and before construction before the main installation activities commence including;

- Construction compound completion.
- Setting out of route and sealing end foundations areas with timber pegs.
- Minor civil works such as removal of fences and erection of temporary fencing.

4.3.2 Trench Construction

The overall construction swathe required for trench construction will be 50m-60m.

Installation of the underground cables will require excavation of a trench of approximately 1 metre width, at a depth of approximately 1.2 metres. The cable will typically be installed in ducts, in flat formation, surrounded by approximately 500mm of cement bound material.

During the excavation of the trench, the excavated subsoil and top soil will be stored and capped for re-use in separate stockpiles alongside the trenches. Surplus material will be stored or reused elsewhere inside the allocated construction boundary. The trench will be backfilled and reinstated, as appropriate. The cables will be pulled through the ducts in lengths of approximately 700 metres, which correspond to the approximate length of cable on a standard size cable drum. The sections of cable will be jointed at carefully selected joint bay positions, which will also be backfilled and reinstated after jointing to complete the installation.

The section of underground cable to be installed within agricultural grassland will be finished with gravel (between 2 and 2.5 metres in width) for identification purposes to prevent accidental damage.

An access track of approximately five metres width will be provided for plant and equipment during the construction works.

A typical cross section for a 220kV duct installation is presented in **Figure 4.5** below.

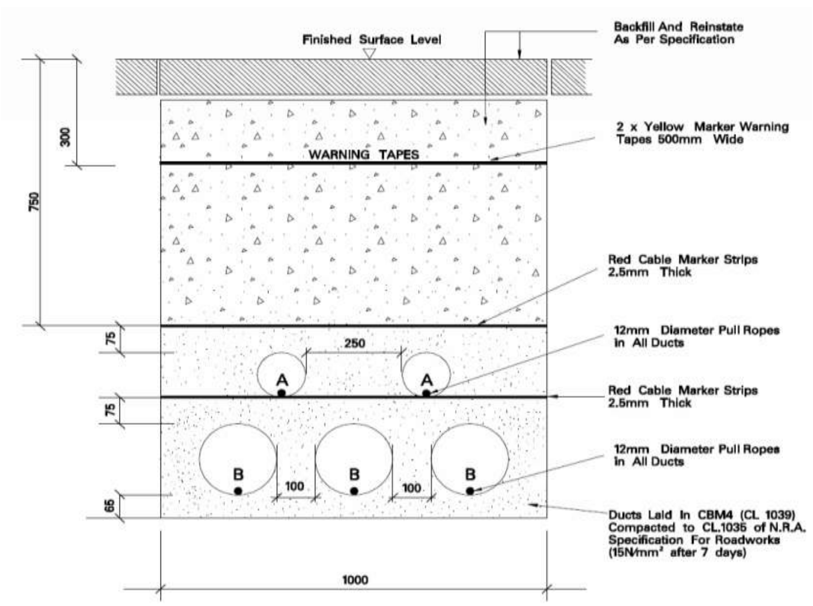

Figure 4.5 Flat spaced ducted Installation arrangement
[Source: EirGrid Specifications PE424-D7001-019-002-000]

Photographs of a typical concrete ducted trench with protective tiles and hazard marker tape taken during construction are shown below (See **Figure 4.6** and Figure **4.7**).

Figure 4.6 Typical Concrete Duct Construction 1

Figure 4.7 Typical Concrete Duct Construction 2

4.3.3 Joint Bays

Joint bays will be required to join the sections of cable together, typically at 700 metre intervals. The joint bays will be excavated to the required depth and temporarily supported using appropriate temporary works to suit existing ground conditions (refer **Figure 4.8** below). Typically, sheet piles will be used together with timber supports and steel support struts. The excavated material and top soil will be stored and capped for re-use in two separate bunds which will be positioned next to the joint bay. If there is insufficient space, the surplus material will be stored elsewhere inside the allocated construction boundary.

Once the joint bay has been excavated, a separation membrane will be installed to prevent leaching of concrete into the ground below. A reinforced concrete slab, including sumps, will subsequently be installed at the bottom of the joint bay and on top of the membrane. The sumps will be included to allow dewatering to take place during the cable jointing process. After erection of shuttering, concrete will be poured to form the side walls of the joint pit.

The cable jointing process is labour intensive, very technically demanding and essential to the effective operation of the cables. For this reason, a temporary waterproof shelter system is built around the joint bay (refer **Figure 4.9** below) to provide a clean environment in which the jointing process can be undertaken. These works are usually carried out 24/7 to reduce the risk of any malformation within the joints.

Figure 4.8 Typical Joint Bay Excavation

Figure 4.9 Covered Joint Bay Excavation

Link pillar boxes or pits, will be installed near the joint bay location. The link pillars will be required to be installed in close proximity to the joints as they will provide an essential connection from the cable system to ground.

Once the jointing process is complete, the excavation will be backfilled including thermally suitable material together with protective tiles and hazard marking tape.

4.3.4 Sealing Ends and Sealing End Compounds

The construction of the cable sealing end compounds will include all civil works required to prepare the ground to provide a flat level surface, install foundations for all equipment and erect the security fence.

The final termination will be completed with the use of a temporary scaffold structure around the termination, which may be netted or covered with tarpaulin as shown in the partially completed scaffold shown in **Figure 4.13,** although the scaffold will cover the termination in its entirety with appropriate clearance to the termination itself.

Figure 4.10 Partially completed Sealing End Scaffolding structure

4.4 Construction Methodology for Substation

4.4.1 Construction Compound

The construction compound will be located as shown on the planning drawings. It will be located within the overall development site and to the south of the proposed route for the underground cables.

4.4.2 Site Preparation and Groundworks

It is intended that the site access for construction will be via the R348, where a traffic management plan will be implemented to mitigate any potential nuisance/delays due to construction traffic. All construction activities including construction traffic will be managed through a site Construction Environmental Management Plan (CEMP).

Where required, heavy/abnormal traffic will be guided by a dedicated banks man. A laydown area (approx. 4,000 sq. metres), and site access roads will then be cleared, in order to set up welfare facilities, site offices, site construction car parking, laydown area for storing material, loading and unloading area, etc. The surface of the parking area will be 75mm stone filled over 300mm Type-1 naturally draining or similar designed considering the ground conditions. Modular office buildings with amenities will be provided (these are modular built portal cabins attached together or placed independently). A sample layout for the amenities block is shown in **Figure 4.11** below.

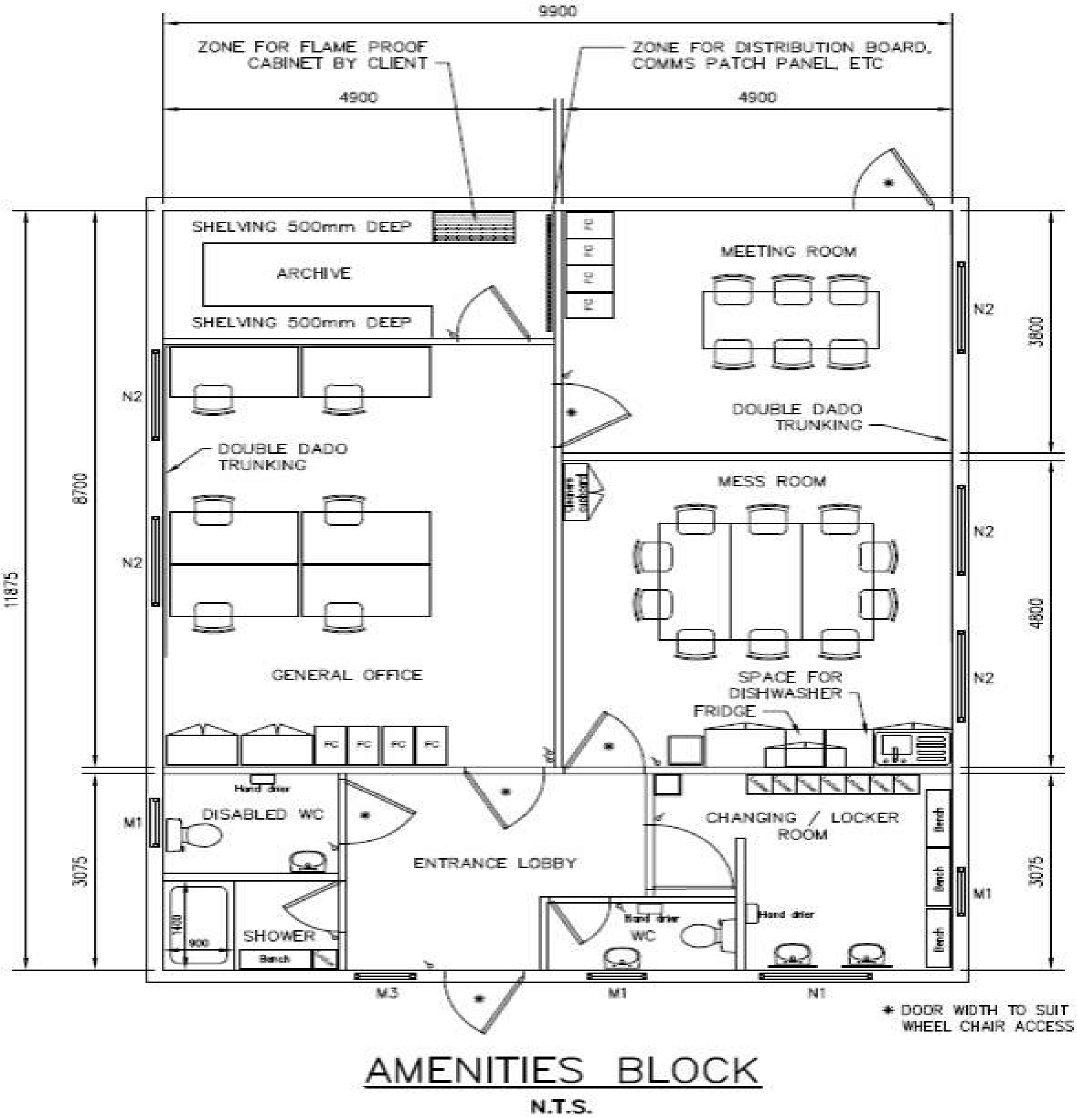

Figure 4.11 Typical Amenities Block | Not to Scale

Enabling works will also include the setting up of site security and perimeter fencing for the primary construction of the substation. In addition, any temporary drainage required will be constructed at this time. Following this, the bulk earthworks will commence, along with site levelling and entrance road construction. These earthworks will be required for the clearance and preparation of the site. The finished plateau (enabling level) level of 45.5m will be built up to a finished site level (or yard level) of 45.9m. This 400mm site level will comprise:

- 250mm layer of loose subsoil; and
- 150mm layer of loose stone chippings/capping layer.

In general, the site is underlain by limestone rock (refer to the soils and geology chapter). The overburden is relatively shallow. To create the roads, level building platforms and to install the underground services, significant bulk excavations will be required. Building and road levels have been chosen to allow an optimum cut and fill solution to be adopted. We will not be removing any excavated material off site. Excavated material will be reused as engineering fill,

landscaping and other uses throughout the site. Rock crushing may be required in order to re-use the excavated material. It is envisaged that crushed stone aggregate will need to be imported onto site for the construction of road bases and bases of buildings, etc.

The rock will be excavated using either rock splitting or blasting. A combination of both may also be required. Both processes will cause cracks in the rock that allows the rock to be broken up further using mechanical excavators. The rock splitting method will be undertaken using the insertion of expanding grout into numerous holes drilled in the rock. The grout will be inserted in an enclosed sealed plastic sheath which will prevent any emissions to soil or ground. Expansion of the grout occurs rapidly following exposure to air. Blasting, if required, will be carried out in a controlled manner in accordance with a pre-approved plan in order to minimise noise, and ground vibrations. This will be done by designing a blast pattern with a small charge in numerous holes drilled in the rock with close spacing. The individual charges will then be set off in a sequence using an electronic relay so that the maximum charge going off at any instant (this is referred to as the 'maximum instantaneous charge') will only be the small amount of charge in any one of the holes.

The finished site platform will accommodate drainage and other service infrastructure and will provide a stable platform suitable for accommodating the substation switchgear and buildings.

Once the excavation of the foundations has taken place, the foundations will then be poured for the 220kV High Voltage (HV) Equipment steel support structures, transformer bases/plinths, control and amenities buildings, protection and control cabins, 20 kV switchgear cabins, lightning masts, communication mast, standby diesel generator and cable sealing ends). Foundations will be designed in accordance with the appropriate and relevant EirGrid Technical Specifications, and typically they will have a design life of approximately 40 years.

Figure 4.12 Example of Some HV Equipment Foundations [Source: Mott MacDonald]

Construction of the transformer bund walls and standby diesel generator fuel tank bund walls will take place during the period of foundation construction. These bunds will be used to contain oil/fuel in the unlikely event that a spill occurs.

4.4.3 Earth Mat Installation

When the foundations have been set, the copper earth mat will be installed into the soil in and around the foundations and will cover the entire substation site. The reasons for the earth mat are two fold; it will provide a means of dissipating electric current into the earth without exceeding the operating limits of the HV equipment, and it will provide a safe environment to protect personnel in the vicinity of earthed facilities from the dangers of electric shock under fault conditions. Following this, earth tails will be brought up from the earth mat to the foundations in order to connect equipment steel support structures and buildings to the earth mat. The earth mat will eventually be covered over with the subsoil which had been removed from the site and a layer of crushed rock will be installed on top and around the substation site.

The earth mat installation and permitted operating limits will be designed in accordance with the appropriate and relevant EirGrid Technical Specifications.

Figure 4.13 Example of Earth Mat and Tails brought up to Equipment Foundation
[Source: Mott MacDonald]

When the earth tails have been brought up, the erection of the steel for the HV Equipment will be undertaken. Once the steel support structures have been erected, the earth tails will then be connected at the relevant points.

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Figure 4.14 High Voltage Equipment Steel Support Structures [Source: Mott MacDonald]

4.4.4 Drainage

The permanent foul and surface water systems will also installed on site at this stage of the project. Details on the drainage strategy for the site are described in **Section 3.6.8** Drainage in **Chapter 3**.

4.4.5 Fencing

As soon as it is practicable, the permanent substation fencing will be installed. Following this stage, delivery will then be taken of the HV Equipment. Once this has been achieved, a layer of 'substation surfacing' (crushed rock) will be installed on top of, and around, the substation site in external areas other than permanent roads, hard standings and footpaths.

4.4.6 Fuel Storage

There will be limited fuel storage on site during the construction phase as all fuel will be delivered regularly by mobile delivery and stored in locally bunded fuel tanks.

The construction controls of oils and fuels will follow best practice and will be supervised by a Resident Engineer. The storage of fuels, lubricants and hydraulic fluids will be properly secured against unauthorised access and vandalism. These will be stored in impermeable bunds with a capacity equal to the greater of 110% of the largest tank, or 25% of the total maximum capacities of all tanks held within a particular bund. The bunded areas will be managed in accordance with the EPA guidance, *Bunding and Spill Management* (2007). All vehicles will be re-fuelled in a designated hard-stand area served with a petrol interceptor.

4.4.7 Electrical Installation

The electrical works will include:

- Delivery and installation of HV equipment.
- Wiring and cabling of HV equipment and protection and control cabinets.
- Commissioning of all newly installed equipment.

During installation of the HV equipment hiab trucks (trucks equipped with loader cranes) will be required to offload the station equipment. These will access the site via the access route and unload within the compound area. There will be sufficient stone build up in the compound area for unloading the HV equipment.

Delivery will then be taken of the 220kV/20kV step down power transformers. These are large loads and the deliveries will be managed in accordance with regulations governing the movement of large loads, in this case it is known as an Abnormal Indivisible Load (AIL). Once the transformer is delivered to site, it will be removed from the transporter and then will be delivered into position on to its foundation/plinth within the transformer bund. A crane will be used to offload and position the HV transformers on their plinths and to assist with their assembly on site. A crane will also be required for the installation of the lightning masts due to their heights. The crane will work within the compound area meaning no separate crane platform construction will be required. Mobile hoists such as cherry pickers will be used to install the HV equipment. A cable pulling machine will be required to pull the HV cables into place.

Hiab trucks will be used to offload the control cable drums. Once these are on site, the cables and wiring is hand pulled into place.

Once all other HV Equipment has arrived on site, it will be stored in situ in a laydown area until it will be ready to be erected on to the steel support structures. This HV Equipment will make up the primary equipment in the substation and will include the following key equipment:

- Disconnectors (switches used to isolate an electrical circuit so that they can be completely de-energised for service or maintenance).
- Earth Switches (switches used to establish a connection between the equipment and the earth).
- Current Transformer (converts system current to levels which can be safely measured by control and protection equipment).

- Voltage Transformer (converts system voltage to levels which can be safely measured by control and protection equipment).
- Circuit Breaker (an automatic electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit).
- Surge Arrestors on either side of the super grid transformer (Surge Arrestors are used to protect a high value asset such as the super grid transformer from damage due to lightning strikes).
- Cable Sealing Ends (Structures for facilitating connection of incoming 220kV cables)
- Busbar (an electrical conductor, maintained at a specific voltage and capable of carrying a high current, usually used to make a common connection between several circuits in a system).

Along with the above mentioned primary plant, other items of control and protection equipment will be required for the operation of the substation. In the EirGrid compound, this equipment will be housed in modular units known as portable relay rooms. These portable relay rooms will contain the protection and control cabinets associated with the protection and control of the HV circuits of the substation.

In the EirGrid control building further equipment will be housed. This equipment will include some of the following;

- Low Voltage Alternating Current (LVAC) equipment: its main element is a distribution board which will provide the low voltage power required within the substation. It will operate on voltages at 400V and 230V. Its essential function will be to provide a low voltage power source to the ancillary equipment of the HV Equipment. It will also supply power to the amenities and control buildings i.e. lighting and heating.
- Telecoms: This equipment will be used for the communication of signals between the various items of HV Equipment and their corresponding devices for protection and control schemes.
- Battery Room: this room will contain the DC batteries to supply the various critical items of equipment requiring a direct current source throughout the substation. The batteries will be constantly kept charged by chargers supplied from the LVAC system.

With the primary HV Equipment installed, the wiring and cabling of this equipment and the protection and control cabinets will be undertaken. The cables associated with this equipment, from power cables to telecommunications cables, will be delivered to site in cable drums at an appropriate time, preferably to minimise the length of time the cable is stored on site prior to installation.

Once the wiring and cabling has been completed, commissioning of all newly installed equipment will be completed.

4.5 Construction Traffic

The impact of the generated traffic on the local road network during the construction of the proposed development is assessed in **Chapter 7** *Roads and Traffic,* and mitigation measures are proposed where necessary.

The chapter also describes the existing traffic in the area surrounding the site and provides a description of the local road network.

The appointed contractor will be required to develop a Construction Stage Traffic Management Plan in advance of commencing the works on site. This will need to comply with this EIS, any specific requirements imposed by Galway County Council in the planning process and will also need to take account of local conditions. The implementation of this plan will be monitored by the Apple Site Management team during the course of the project and will also be reviewed at the main site meetings.

4.5.1 Civil Enabling Works

During the civil enabling works phase of the project it is anticipated that there will be approximately 75-100 construction workers on site.

Site levels have been selected to minimise the importation of fill. Importation of material from offsite will be required for the earth mat under the 220kV substation and it is envisaged that site won material will be used for the majority of the remaining filling operations required.

4.5.2 Abnormal Loads

There will be ten 220/20 kV transformers delivered to the substation, which will be transported on multi-axle low loaders. Typical shipping dimensions are 7 metres (length) x 3 metres (width) x 4.5 metres (height). The shipping weight will be approximately 70 tonnes.

4.5.3 Electrical installation

Approximately 120 construction workers will be located on site during the electrical installation phase of theproject. It is anticipated that there would be approximately 50 delivery vehicles per day during peak construction periods.

4.6 Services and Utilities Requirements for Construction

4.6.1 Electricity

Power for the construction phase will be obtained from power distribution lines located adjacent to the site and as advised by ESBN. The construction phase power will be supplied by a temporary on-site substation located adjacent to the contractor compound.

4.6.2 Water

The nature of the construction activities proposed will mean that the demand for water during the construction phase will be relatively small. It is estimated that the peak demand for water will be approximately 9 cubic metres per day, primarily based on the demand requirement for the construction workers and the associated support facilities. The water will be sourced from the existing water mains on the R348 where there is ample supply to meet this demand.

4.6.3 Storm Water and Foul Water Disposal

A dedicated holding tank for storage of construction foul effluent will be constructed prior to commencement of the main construction activities. The effluent will be regularly disposed of off-site by tanker by a contractor with an appropriate permit to an approved licenced facility. Refer to **Appendix 4.1** for a copy of the permit from one such contractor. In general, storm water will be infiltrated to ground via managed soakaways. The laydown areas will be suitably drained and any areas which will involve the storage of fuel and refuelling will have paved areas with bunding and hydrocarbon interceptors to ensure that no spillages will get into the surface water or groundwater systems.

4.7 Construction Method Statement

Prior to commencement of work, the Contractor will prepare a Method Statement which will incorporate all the requirements of this EIS to ensure maximum protection is afforded to the protected habitats and species. It will also include the contractor(s) health and safety commitments The contractor will be required to adhere to the measures as set out in the EIS and to incorporate these in full into their detailed method statements indicating how they will be implemented and managed.

The method statements, which will give more detail on the implementation of the mitigation measures proposed in this chapter, including resources, management, control and verification, will be developed prior to construction commencing.

A construction management team will be employed on site to monitor the construction of the project and ensure works are being carried out in accordance with the agreed contractors method statements, safety procedures, pollution controls, etc.

4.8 Employment, Welfare

Through the construction phase there will be some variation in the numbers working on site. It is anticipated that 120 construction workers could be employed on site at any one time.

Temporary office accommodation and other construction facilities will be installed on site for the construction phase. All temporary units will be of a high standard in accordance with statutory regulations as a minimum.

The co-ordination of people and materials on-site will be one of the key activities throughout the construction phases. A construction management plan will be put in place prior to the commencement of the works. This plan will designate traffic routes, timings and parking arrangements.

The allowable working hours will be determined by the granted planning permission but typical working hours during the construction phases would be envisaged as:

Start	Finish	
0700	1900	Monday – Friday
0700	1600	Saturday

It may be necessary to work overtime or night shifts (including at weekends) at certain critical stages, during the project. Consideration of safety, weather or sub-contractor availability may necessitate working outside normal hours. Heavy or noisy construction activities will be avoided outside normal hours and the amount of work outside normal hours will be strictly controlled.

4.9 Construction Waste Management

4.9.1 General

All waste arising during the construction phase will be managed and disposed of in a way that ensures the provisions of the Waste Management Act 1996 and associated amendments and regulations are met.

4.9.2 Waste Arisings

In general construction waste materials may include construction debris, scrap timber and steel, machinery oils and chemical cleaning solutions. The practice of excessive purchase of materials and equipment to allow for anticipated wastage will be avoided.

Typically, excavated material that is unsuitable for use as backfill will be reused on site as non-structural fill material. Soil which is not re-used will be disposed of to a facility with an appropriate permit. In the unlikely event of any evidence of soil contamination being found during work on site, the appropriate remediation measures will be employed. Any work of this nature would be carried out in consultation, with, and with the approval of the Environmental Protection Agency and the Environmental Department of Galway County Council.

Timber from trees felled as part of the site preparation will be sold to the timber industry.

4.9.3 Waste Management Plan

The Contractor will be required to develop, implement and maintain a Construction Waste Management Plan during construction in accordance with the

Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects (2006) published by the Department of the Environment, Community and Local Government.

A member of the construction team will be appointed as Waste Manager and will have overall responsibility to oversee record and provide information to the relevant authorities on waste management for the project in accordance with the requirements of the Waste Management Plan.

The Waste Manager will be trained in how to set up and maintain a record keeping system, how to perform an audit and how to establish targets for waste management on site. He/she will be also be trained in the best methods for segregation and storage of recyclable materials, have information on the materials that can be reused on site and know how to implement a project specific Waste Management Plan.

Waste prevention and minimisation objectives will be implemented through careful planning, including the avoidance of overstocking of materials. An assessment of the Waste Management Plan, and detailed design plans, will inform the appropriate quantities of materials required for the project thereby minimising, and potentially preventing, the generation of certain waste streams.

Waste generated during the project will be re-used on-site, wherever possible. If re-use on site is not possible opportunities for off-site re-use will be investigated and exploited. Opportunities for recycling will be employed for any waste that cannot be re-used. Waste will only be sent for disposal if no other economically or technically feasible alternative can be found.

All wastes will be handled in a responsible manner with due regard to relevant legislation, codes and best practice guidelines.

Only authorised waste contractors with appropriate waste collection permits will be authorised to collect waste streams from the facility. Waste will only be transferred to facilities authorised to treat or dispose of the material in accordance with the requirements of the Waste Management Acts 1996 – 2011. Copies of all permits and licences will be retained with other waste-related documentation. Comprehensive waste descriptions will be provided on all documentation.

All wastes destined for disposal to landfill will be categorised and classified in accordance with the requirements of 2003/33/EC, The Landfill Directive, which establishes the criteria for acceptance of waste to landfill.

4.10 Potential Construction Impacts

4.10.1 General

This section addresses potential construction phase impacts. Potential construction phase impacts are also addressed in other chapters of this EIS, as highlighted below. Potential impacts represent the worst case scenario in the absence of mitigation.

4.10.2 Do Nothing Impacts

If the proposed development did not go ahead, it is likely that the forestry lands would continue to be used for commercial forestry or could perhaps be developed by some other developer for another purpose. The lands outside the forestry will continue to be used for agricultural purposes post the construction of the development. The only exception to this would be the fenced off sealing compounds.

4.10.3 Dust and Debris

Construction activities have the potential to generate some dust emissions. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with ambient conditions, including rainfall, wind speed and on the distance to potentially sensitive locations.

The potential for dust from substation construction activities being an issue external to the main site is negligible due to the buffer zone that will exist between the heavy construction activities and the perimeter of the site. There is potential for dust emissions from construction activities proposed outside the main site boundary associated with the underground cable works and the works associated with the tower construction. In order to minimise dust nuisance, a dust management plan will be implemented (refer also to **Section 4.11.2**).

4.10.4 Noise and Vibration

Noise and vibration during construction and mitigation measures are addressed in **Chapter 7** *Noise and Vibration* of this EIS.

4.10.5 Soils, Geology, and Hydrology and Hydrogeology

Geology, soils, hydrology and hydrogeology potential impacts and mitigation measures are addressed in **Chapters 10** and **11** *Geology and Soils* and *Hydrology and Hydrogeology*, respectively.

4.10.6 Other Potential Construction Impacts

Other impacts arising from the construction phases of the project are addressed with in the relevant sections of this EIS. Landscape and Visual impacts are addressed in **Chapter 5**. The assessment of potential impacts on air quality during construction is addressed in **Chapter 8** *Air Quality and Climate*. There is an evaluation of the impacts on *Ecology/Biodiversity* in **Chapter 9** with particular reference to the protection of the rare plant, Wood bitter-vetch. The evaluation of construction impacts on archaeological, architectural and cultural heritage is addressed in **Chapter 13**.

4.11 Construction Mitigation Measures

4.11.1 General

It is the policy of Apple to minimise the environmental impact of the construction activities. The construction planning will be geared towards keeping disruption and nuisance to a minimum.

There will be a construction management team on the project site for the duration of the construction phase. The team will supervise the construction of the project, including monitoring the contractor's performance to ensure that the proposed construction phase mitigation measures are implemented and that construction impacts and nuisance are minimised. Apple will liaise with neighbours and the general community during the construction phase to ensure that any disturbance is kept to a minimum.

The contractor will implement a neighbour information and liaison programme to ensure that all anticipated nuisances are minimised and that the construction activity will have the lowest possible impact on the neighbours.

4.11.2 Dust

A dust minimisation plan will be prepared and implemented by the building contractor during the construction phase of the project. Construction activities are likely to generate some dust emissions, particularly during the site clearance and excavation stages.

The following avoidance, remedial or reductive measures will be implemented as part of the dust minimisation plan:

- During very dry periods when dust generation is likely, construction areas will be sprayed with water.
- Exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor through regular servicing of machinery.
- Vehicle speeds will be limited in the construction site.
- Surrounding roads used by trucks to access to and egress from the site will be cleaned regularly using an approved mechanical road sweeper. Roads will be cleaned subject to local authority requirements. Site roads will be cleaned on a daily basis, or more regularly, as required.
- Wheel-wash facilities will be provided with rumble grids to remove excess mud from wheels. These facilities will be located at the exit from the site and away from sensitive receptors, where possible.
- Internal haul roads will be paved at the earliest possible opportunity and inspected regularly for cleanliness.

The technique adopted for all works shall minimise the release of dust into the atmosphere. The appointed contractor will be required to carry out dust deposition

monitoring at agreed and appropriate locations on the site boundary of the development site using the Bergerhoff method (German Standard VD 2119, 1972). The Bergerhoff dust deposition gauges will be deployed on site throughout the construction stage for a 30 day period at a time. Weather conditions such as wind speed and direction and rainfall frequency and amounts that prevail over the monitoring period will be observed and recorded. Dust deposition will be calculated in a laboratory and will be expressed as mg/m2/day. Results will be compared to the TA Luft guidelines of 350mg/m2/day. Should an exceedance of the TA Luft limit occur during the construction phase, additional mitigation measures will be implemented.

Daily visual inspections will be carried at locations around the site boundary as required. These inspections will monitor the effectiveness of dust mitigation measures.

4.11.3 Debris

The following are some of the measures that will be taken to ensure that the site and surroundings are maintained to a high standard of cleanliness:

- Daily inspections will be undertaken to monitor tidiness.
- A regular program of site tidying will be established to ensure a safe and orderly site.
- If necessary, scaffolding will have debris netting attached to prevent materials and equipment being scattered by the wind.
- Food waste will be strictly controlled on all parts of the site.
- Wheel wash facilities will be provided for vehicles exiting the project site. Wheel wash run off will be stored in an onsite storage tank and will be disposed of by licenced waste haulage company and disposed of off-site at a licenced facility.
- In the unlikely event that mud is carried over from the project site to the public roads, they will be cleaned regularly as required and will not be allowed to accumulate.
- Loaded lorries and skips will be covered if required.
- Surrounding roads used by trucks for access to and egress from the site will be inspected regularly and cleaned, using an approved mechanical road sweeper, when required.
- In the event of any fugitive solid waste escaping the site, it will be collected immediately and removed to storage on site, and subsequently disposed of in the normal manner.

4.11.4 Noise and Vibration

The construction contractor will be required to manage noise and vibration aspects of the project in accordance with BS 5228 Part 1 (2009) and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations,

2001 '*Code of Practice for Noise and Vibration Control on Construction and Open Sites*'. Construction-phase noise impacts are described in **Chapter 7** *Noise and Vibration,* of this EIS.

The contract documents will specify that the contractor, undertaking the construction of the works, will be obliged to take specific noise abatement measures and will comply with the recommendations of *BS5228: Noise and Vibration Control on Construction and Open Sites, Part 1: Code of Practice for Basic Information and Procedures for Noise and Vibration Control (1997)* and the NRA guidelines *Good Practice Guideline for the Treatment of Noise during the planning of National Road Schemes* (NRA 2014).

There will be no significant construction noise impacts on neighbouring residences. With the implementation of low vibration techniques (refer to **Section 4.4.2** for details), it is anticipated that no significant vibration will be generated during the construction phases of the project.

The appointed Contractor will be required to carry out Live 24 hour noise and vibration monitoring on the site. This will be achieved by setting up noise and vibration monitoring stations at appropriate locations across the site. These stations will be constantly monitored to ensure compliance. The results will also be tabled for client review at the main site meetings.

4.11.5 Ecology

The known populations of Wood bitter-vetch near the substation site will be identified, and securely fenced-off for the duration of the construction activities, to ensure that the works will have no direct impact on the plant. A tool box talk will be given to the site workforce to explain the significance of this plant and to give due regard to the Conservation Management Plan for *V. orobus* which was prepared for the overall data centre site.

4.12 Soil, and Surface and Groundwater Issues

There are no watercourses in the vicinity of the site.

The employment of good construction management practices will minimise the risk of pollution of soil, storm water run-off or groundwater. The Construction Industry Research and Information Association (CIRIA) in the UK has issued a guidance note on the control and management of water pollution from construction sites, *Control of Water Pollution from Construction Sites, guidance for consultants and contractors* (Masters-Williams et al 2001).

The guide is written for project promoters, design engineers and site and construction managers. It addresses the main causes of pollution of soil, groundwater and surface waters from construction sites and describes the protection measures required to prevent pollution of groundwater and surface waters and the emergency response procedures to be put in place so that any pollution, which occurs, can be remedied. The guide addresses developments on green field and potentially contaminated brownfield sites. The construction management of the site will take account of the recommendations of the CIRIA

guidance to minimise as far as possible the risk of soil, groundwater and surface water contamination.

Site activities considered in the guidance note include the following:

- excavation
- earthmoving
- concreting operations

Additional specific guidance is provided in the CIRIA technical guidance on *Control of Water Pollution from Linear Construction Projects* (Murnane *et al* 2006).

Surface run-off from wheel washing areas can contain pollutants such as:

- detergents
- oil and fuel
- suspended solids
- grease

Measures, as recommended in the guidance above, that will be implemented to minimise the risk of spills and contamination of soils and waters include:

- Careful consideration will be given to the location of any fuel storage facilities. These will be designed in accordance with guidelines produced by CIRIA, and will be fully bunded.
- All vehicles and plant will be regularly inspected for fuel, oil and hydraulic fluid leaks. Suitable equipment to deal with spills will be maintained on site.
- Where at all possible, soil excavation will be completed during dry periods and undertaken with excavators and dump trucks. Topsoil and subsoil will not be mixed together.
- Ensure that all areas where liquids are stored or cleaning is carried out are in a designated impermeable area that is isolated from the surrounding area, e.g. by a roll-over bund, raised kerb, ramps or stepped access.
- Use collection systems to prevent any contaminated drainage entering surface water drains, watercourses or groundwater, or draining onto the land.
- Minimise the use of cleaning chemicals.
- Use trigger-operated spray guns, with automatic water-supply cut-off.
- Use settlement lagoons or suitable absorbent material such as flocculent to remove suspended solids such as mud and silt.
- Ensure that all staff are trained and follow vehicle cleaning procedures. Post details of the procedures in the work area for easy reference.

The above measures will be implemented, as appropriate.

4.13 Construction Safety

As required by the *Safety, Health and Welfare at Work (Construction) Regulations 2013*, a Health and Safety Plan will be prepared which will address health and safety issues from the design stages through to the completion of the construction and maintenance phases. This plan will be reviewed as the development progresses. The contents of the Health and Safety Plan will comply with the requirements of the Regulations.

Safety on site will be of paramount importance. During the selection of the relevant contractor and the respective subcontractors their safety records will be investigated. Only contractors with the highest safety standards will be selected.

Prior to working on site, each individual will receive a full safety briefings and will be provided with all of the safety equipment relevant to the tasks the individual will be required to perform during employment on site.

Safety briefings will be held regularly and prior to any onerous or special task. 'Toolbox talks' will be held to ensure all workers are fully aware of the tasks to be undertaken and the parameters required to ensure the task will be successfully and safely completed.

All visitors will be required to wear appropriate personal protective equipment prior to going on to the site and will undergo a safety briefing by a member of the site safety team.

Regular site safety audits will be carried out throughout the construction programme to ensure that the rules and regulations established for the site are complied with at all times.

At any time that a potentially unsafe practice is observed, the site safety manager will have the right as well as the responsibility to halt the work in question, until a safe system of working is again put in place.

4.14 Cumulative Impacts

The potential for cumulative construction impacts, should the construction of the proposed development take place simultaneously with the construction of the M17/M18 motorway and nearby interchange, and the construction of the data centre, is addressed in **Chapters 5** *Landscape and Visual*, **6** *Roads and Traffic, 7 Noise and Vibration,* ***8*** *Air quality and Climate,* ***9*** *Ecology/Biodiversity,* ***10*** *Soils and Geology,* ***11****, Hydrology and Hydrogeology,* ***12*** *Material Assets,* ***13*** *Archaeological, Architectural and Cultural Heritage* and **15** *Cumulative Impacts*, *Other Impacts and Interactions.*

These cumulative impacts could be as a result of dust emissions, noise, vibration, construction traffic and visual impacts.

A comprehensive Construction Stage Traffic Management Plan will be developed in due course in conjunction with the appointed Contractor. This plan will take account of all other works that are being carried out local to the site

simultaneously to this project so that a co-ordinated approach can be developed such that local disruption is minimised.

4.15 Residual Impacts

It is anticipated that with proper management, there will be no significant environmental impacts as a result of the construction of the proposed development. Any impacts likely to occur will be of a temporary nature.

4.16 References

British Standards *BS5228: Noise and Vibration Control on Construction and Open Sites, Part 1: Code of Practice for Basic Information and Procedures for Noise and Vibration Control (1997).*

Masters-Williams et al (2001) *Control of Water Pollution from Construction Sites, guidance for consultants and contractors* CIRIA UK.

Murnane E. Heap A. and Swain A. (2006) Control of Water Pollution from Linear Construction Projects

Safety, Health and Welfare at Work (Construction) Regulations 2013,

BS5228: Noise and Vibration Control on Construction and Open Sites, Part 1: Code of Practice for Basic Information and Procedures for Noise and Vibration Control