TOBIN

Rooaunalaghta Green Energy Project

Appendix 2-3
Grid Construction Methodologies

ROOAUNALAGHTA
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BUILT ON KNOWLEDGE

CONSTRUCTION METHODOLOGY

Rooaunalaghta Wind Farm

33kV Collector Network & Loop-in Substation

Project No: 300-101121
Document No: 300101121-R01-03

TOBIN
CONSULTING ENGINEERS

ROOAUNALAGHTA
Green Energy

Revision:	Author:	Checked:	Date:	Notes:
00	LR	DB	31/08/26	Initial version for Client review
01	AD	DB	12/10/2026	Updated for Client review
02	AD	DB	14/10/2026	Final Issue for Planning Application
03	AD	DB	20/10/2026	Updates to figures

Table of Contents

Table of Contents 2
Table of Figures 4
1.0 Introduction 5
2.0 Proposed Loop-in Substation 6
3.0 110kV UGC Grid Connection route 8
4.0 33kV UGC Collector Network Route 9
5.0 Preliminary Site Investigations 11
6.0 Loop-in Masts Construction Methodology 12
6.1 Existing 110 kV OHL 12
6.2 Steel Mast Structures 12
7.0 Proposed Substation Build Construction Methodology 15
7.1 110 kV Loop-in Substation 15
8.0 Underground Cable Construction Methodologies 17
8.1 110kV Grid Connection UGC Construction Methodology 17
8.2 110kV Grid Connection UGC Trenching Methodology 17
8.3 110kV Grid Connection UGC Ducting Installation Methodology 18
8.4 Joint Bays and Associated Chambers 20
8.5 110kV Joint Bays and Associated Chambers 20
8.6 Marker posts 21
8.7 Managing Excess Material from Trench 22
8.8 Storage of Plant and Machinery 22
9.0 33kV Collector Network UGC Construction Methodology 23
9.1 33kV Collector Network Ducting Installation 23
9.2 33kV Collector network Trenching Methodology 24
9.3 33kV Collector Network UGC Ducting Installation Methodology 25
9.4 33kV Joint Slabs and Associated Chambers 26
9.4.1 UGC Installation on Public Road 28
9.4.2 UGC Installation on Grasslands 28
9.5 Marker Posts 28
9.6 Managing Excess Material from Trench 28
9.7 Storage of Plant and Machinery 29
9.8 Cable Installation/ Cable Pulling 29
10.0 Existing Services Crossing 30
10.1 Underground Cables 30
10.2 Water Mains 30
11.0 Major Water Crossing: Culvert, Drainage & Bridge Crossing 31
11.1 Shancloon Stream Crossing – Culvert – 01. Chainage 200m 31
11.1.1 Watercourse Damming and Reinstatement Methodology 32
11.1.2 Standard Methods - Dam & Flume Work: 32
11.1.3 Standard Methods - Dam & Divert Work 32
11.1.4 Standard Methods - Reinstatement of the Watercourse at Dam and Flume Locations 33
11.1.5 Standard Methods - Reinstatement of the Watercourse at Dam and Divert Locations 33
11.2 Installation of Prefabricated/Preformed Bridge Deck Structure 33
11.3 Crossing 02 – Culvert Crossing. Chainage 5400m 35
11.4 Crossing 03 – Culvert Crossing. Chainage 5810m 36

11.5 Crossing 04 – Bridge Crossing River Black. Chainage 6780m 36
12.0 Drainage Management Plan. 37
12.1 Silt Control 37
12.2 Additional Mitigation Measures 37
13.0 Horizontal Directional Drilling (HDD) 38
14.0 Best Practice Design and Construction & Environmental Management Methodology 39
15.0 Access Routes to Work Area. 40
16.0 Road Opening Licence 41
17.0 Reinstatement of Private Land 41
18.0 Invasive Species Best Practice Measures 41
19.0 Waste Management 41
20.0 Archaeology 41
21.0 Compliance with Government and Industry Specifications. 42
22.0 Programme 42

Table of Figures

Figure 1 - Rooaunalaghta Wind Farm & Loop-in Substation Location 5
Figure 2 - Proposed Loop-in Substation Layout 7
Figure 3 - Typical 110kV mast foundation excavation 13
Figure 4 - Base of mast structure backfilled 13
Figure 5 - Cable End Mast Lateral view 14
Figure 6 - Cable Mast front view 14
Figure 7 - Typical 110kV Underground Duct Installation 18
Figure 8 - Typical Trench in Public Road Section 19
Figure 9 - Typical Section 110kV Pre-Cast Joint Bay 21
Figure 10 - Typical ESB Marker Posts Example 22
Figure 11 - Triple circuit trench ducting through roadway 26
Figure 12 - Typical Section through Earth Link Box 27
Figure 13 - Typical Section through Communications Chamber 27
Figure 14 - Section through Double Circuit 33kV Cable Joint Slab 27
Figure 15 - Marker Posts 28
Figure 16 - Typical Cable Pulling Drum Set Up 29
Figure 17 – Existing Culvert at Ch.200m. 34
Figure 18 – Proposed Under Crossing at Drain Crossing (Ch.200m) 34
Figure 19 – Local Road network through Culvert 35
Figure 20 - Culvert 02 at Chainage 5275m 35
Figure 21 - Culvert undercrossing arrangement 35
Figure 22- River Black Bridge 36
Figure 23 – HDD Crossing Layout at the River Black Bridge 36
Figure 24 - Typical HDD Installation 38
Figure 25: Temporary Aluminium Panel Tracks 40

1.0 Introduction

The purpose of this document is to outline and explain the construction techniques and methodologies which will be implemented during the construction of the proposed 33 kV underground collector network to interlink the Rooaunalaghta Wind Farm site with a new proposed 110 kV loop-in substation. The proposed substation will be located in the townland of Killamanagh, to the east of the Shrule, County Mayo. Furthermore, the wind farm site is located within the townlands of Rooaunalaghta, Carrowoughteragh, Kinlough, Cloghmoyne, Toorard, and Brodullagh South, County Mayo, See Figure 1. The wind farm will consist of 13 turbines of 4.5 MW, with a maximum export capacity of 58.5 MW.



Figure 1 - Rooaunalaghta Wind Farm & Loop-in Substation Location.

The interconnector will consist entirely of underground cables (UGC), installed within the wind farm access tracks and the existing public road network.

The UGC works will include:

- **Wind Farm Collector Network:** UGC circuits that collect power from each wind turbine and transmit it to the Wind Farm Control Building
- **Export Collector Route:** Three 33 kV UGC circuits, including an approximately 8.7 km extension, which will export the full generating capacity of the wind farm from the collector network to the proposed Loop-In Substation.
- **Loop-In / Loop-Out Connection:** An approximately 1 km long 110 kV UGC loop-in and loop-out connection linking the proposed new substation to the existing Dalton–Cashla 110 kV overhead line (OHL).

This underground cable network will facilitate the collection and export of electricity generated by the wind farm to the national transmission system.

This document is intended to be used as an aid to understand the methodologies to be employed during construction. In addition, this document is in outline form only and will be revised and updated before the commencement of any construction activities. Detailed Method Statements will be prepared in respect of each aspect of the proposed development.

2.0 Proposed Loop-in Substation

The proposed 110kV loop-in substation will be subject to a Strategic Infrastructure Development (SID) application to An Coimisiún Pleanála. The proposed 110kV substation will be designed and constructed to meet all the required EirGrid standards. An area will be levelled and built to the required level with stone fill material, capped by high-quality compacted stone. Two control buildings will be constructed using traditional techniques for constructing small buildings (i.e. concrete block walls, timber and slate tile roof). Foundations will be built for all of the proposed electrical infrastructure. All the electrical equipment will be installed to EirGrid requirements. Perimeter fencing will be constructed around the substation compound for security and safety purposes.

Rooaunalaghta 110kV loop-in substation will be made up of 1 No. Control building, 1 No. Independent Power Producer (IPP) Medium Voltage (MV) Switch room, Transformer compound and Busbar compound.

The control building works will consist of foundation works, block work, roofing, low voltage electrical fit out, cladding and building finishing works. The transformer, gantry and structural steelwork will be installed in the transformer compound. Two cable sealing ends will be installed to incorporate the radial underground circuits in and out of the station. The busbar compound structural steelwork will be erected with lightning masts also installed. Substation electrical equipment will be installed once the control building and compound is complete. Fencing will be erected around the compound for security/protection. Permanent access tracks will also be installed to allow trafficking in and out of the proposed substation compound, access road to loop in interface mast structures and internal access road for compound use.

The expected duration of works is expected to be approximately 12 months.

The following section outlines the methodology to be followed during construction works of the new 110kV loop-in substation

1. This new substation will be in a compound of circa 114.6m x 95m plan area secured by a 2.65m high palisade fence.
2. The substation compound and drainage will be marked out by a qualified engineer.
3. A drainage system will be excavated and installed around the compound area.
4. Topsoil and subsoil will be removed from the footprint of the compound using an excavator. The excavated material will be temporarily stored in adjacent berms for later use during reinstatement works.
5. A layer of geotextile material will be laid over the footprint of the compound.
6. Using an excavator, a base layer of Clause 804 material will be laid followed by a 6F2 capping layer which will provide the finished surface.
7. Each layer will be compacted using a vibrating roller.
8. Earthing cable will be laid underground around the substation for connection to the various electrical components during the electrical fit out phase.
9. The construction of a 13830m² substation compound comprising of approximately 450m² single story 110kV substation control building, 220m^2 single story MV building and associated outdoor electrical equipment, including 1 no. 33/110kV transformer, associated internal access road, including 2.65m high station perimeter fencing will be built.
10. Permanent access tracks will be constructed to allow site vehicular activity in and out of construction area.
11. Adequate lighting will be installed around the compound on the lighting masts within the compound.
12. 110kV cable sealing ends and associated accessories will be required to incorporate the new 110kV loop-in substation. The support structures will be located outdoors.
13. Transformers will be installed in bunded enclosures within the substation compound.

The electrical installation is expected to take 20 weeks and includes the following:

- Delivery and installation of 33/110kV transformer. These are unusually large, and the deliveries will be managed in accordance with regulations governing the movement of large loads.
- Delivery and installation of all other HV equipment.
- Wiring and cabling of HV/LV equipment, protection and control cabinets.
- Commissioning of all newly installed equipment.

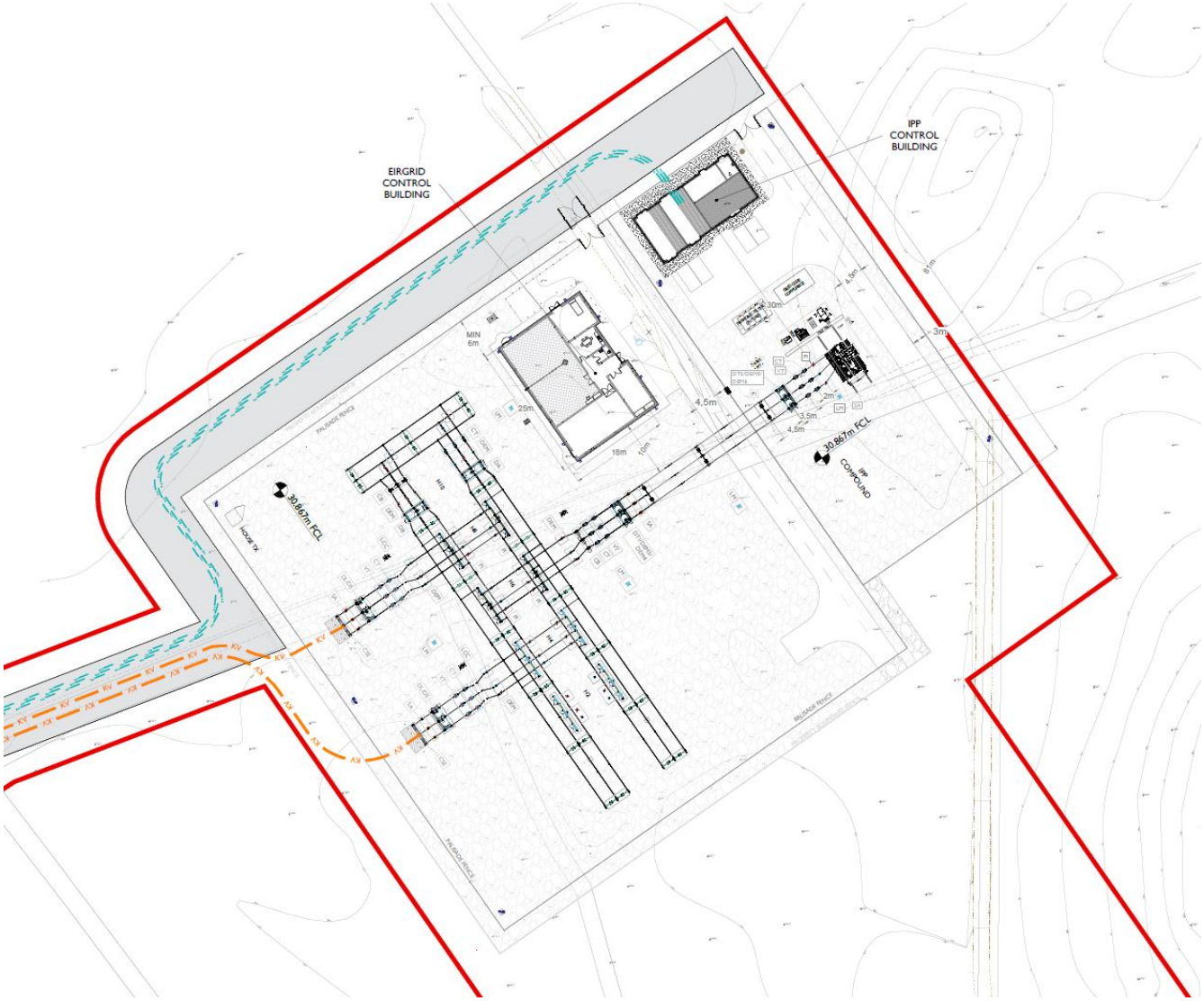


Figure 2 - Proposed Loop-in Substation Layout

3.0 110kV UGC Grid Connection route

The 110 kV UGC grid connection route will be subject to a Strategic Infrastructure Development (SID) application to An Coimisiún Pleanála. The 110 kV UGC grid connection exits in a south-west direction from the proposed loop-in substation, running parallel to the proposed 3 × 33 kV collector network through the proposed access track for approximately 1.07 km until it reaches the Dalton–Cashla 110 kV overhead line, where two new mast ends are proposed for the transition from the UGC to the OHL connection.

The cable location will take into consideration Galway County Council, Mayo County Council and all other relevant stakeholders' requirements. Installation of the underground cable will consider all environmental protection measures forming part of the planning application submitted to An Coimisiún Pleanála for the development at Rooaunalaghta Wind Farm and accompanying technical reports.

Table 1 - Summary of Preliminary Loop-in & Loop-out Grid Connection 110kV Design Route	
Section	**Description (all lengths are approximate and to be confirmed at detailed design stage)**
Section 1 **UGC**	The proposed 110kV double-circuit underground cable (UGC) leaves the proposed Loop-in Substation on its southwest side and follows the proposed access track for approximately 750 m. It then diverges to the north, undercrossing the three 33kV UGC circuits to each of the steel line cable interface masts. Circuit 1 will have a total length of 895 m, while Circuit 2 will have a total length of 1,066 m. Both circuits will be connected to the existing Dalton–Cashla Overhead Line. ***Section 1 contains 2 Nr. Joint Bays,*** • Joint Bay 01A (JB-01A) will be located approx 790m south of Rooaunalaghta 110kV substation (Ch. 900m) • Joint Bay 01B (JB-01B) will be located approx 800m south of Rooaunalaghta 110kV substation (Ch. 875m) **Features** • Installation of 2 Steel line Cable Interface Masts. • UGC Circuit 1 Length: 895m. • UGC Circuit 2 Length: 1066m **Section 1** of route is shown in Site Layout Plan Drawings 300101121-U-DR-106 to 300101121-U-DR-107.
Refer to Figure 1 and to the planning drawings submitted for location details. Note: The precise location of the proposed route within the planning application boundary is subject to change as result of existing services/utility locations, ground conditions	

Table 1 - Summary of Features along Grid Connection Design Route.

4.0 33kV UGC Collector Network Route

The 33kV UGC collector network route is approximately 8.7 km in length and traverse's westwards from the proposed Loop-in 110kV Substation location in County Galway, to the Wind Farm Control Building, located in County Mayo, utilising public roads and consented private lands.

Rooaunalaghta Wind Farm is expected to export a Maximum Export Capacity (MEC) of 58.5 MW. It is envisaged that at least three 33kV UGC circuits will be required for this connection. The exact location of the 33kV UGC within the curtilage of the public roads and consented private lands may be subject to minor modifications following confirmation site investigations undertaken prior to construction. The cable location will take into consideration the requirements of Mayo County Council, Galway County Council, and all other relevant stakeholders. Installation of the cable will consider all environmental protection measures forming part of the permitted planning application for the Rooaunalaghta Wind Farm development and all environmental protection measures and the accompanying technical reports.

Table 1 shown below gives a summary of the route composition and location. Figure 1 shows the grid connection route. The route is split into three sections and examined in detail in **Table 2**.

Table 1 – UGC Route Location Summary				
Wind Farm Site	**Private Land**	**Public Road**	**Substation Access Track**	**Total**
UGC	**UGC**	**UGC**	**UGC**	**UGC**
440m	900m	6090m	1270m	8700m

Table 2 - 33kV UGC Collector Network Route Location Summary

Table 2 - Summary of Features along Collector Network Route	
Sections	**Description**
Section 1 **1270m**	**From Loop-in Substation until Public Road** Three 33 kV circuits will exit the 110kV Substation along the western periphery to the proposed access track. At chainage (Ch.150m), these will converge with the 110 kV underground cable circuits and continue in parallel with these two circuits for approximately 750 m. At chainage 200m, the cable arrangements encounter a culverted drain crossing which is to be undercrossed by means of replacing the culvert, under a Section 50 license, to allow access to the substation. This will involve the removal of the existing culvert to replace with a more robust structure at this location, Ch.200m. Continuing southeast, a second arterial drain at Ch.510m. **Section 1** of route is shown in Site Layout Plan Drawings 300101121-DR-106 to 300101121-DR-107 **Features** ***Section 1 contains 1 Nr. Joint Slab,*** • Joint Slab 01 (JS-01S) will be located Approx 790m south of Rooaunalaghta 110kV substation (Ch. 790m) • Joint Slab 01 (JS-01D) will be located Approx 810m south of Rooaunalaghta 110kV substation (Ch. 790m) **Features of Interest** • 2 Nr. Culvert crossings

Section 2 **6090m**	**From Loop-in substation Access track entrance to Third party lands.** The cable route heads north-westerly onto the L-2104. At Ch.1470m an existing cattle underpass is encountered (Ch.1425m) and will be over crossed in the standard trefoil formation. The route remains on the L-21044 for approximately 3.8 km. The collector circuits will converge on the national road N84 at Ch.4040m in with an open cut trench reinstatement to conform to NRA standards will be adhered to. Now within the local tertiary road, L-21044, the collector circuits carry within this roadway and will traverse between the jurisdictions of Mayo & Galway County council boundaries respectively at Ch.5275m. An existing culvert is encountered at this location, and it is proposed to under cross in a trefoil formation. At Ch. 5400m, at a minor road junction, the cable continues to head in a westerly direction, converging on the L-16157. The cables continue along the remainder of this L16157 roadway before turning right to carry north wards, where the route now carries within the local road L-16152. At Ch. 6780m, the collector cables will approach the River Black and the associated bridge structure is encountered. A trenchless crossing strategy, such as Horizontal Directional Drilling (HDD), will be mobilised to enable the collector circuits to cross beneath. Once the crossing of the bridge has been navigated, at chainage 7380m the route converges onto consented private lands prior to approaching the wind farm development boundary at Ch.7330m. **Section 2** of route is shown in Site Layout Plan Drawings 300101121-DR-108 to 300101121-DR-115 **Features** ***Section 2 contains 16 Nr. Joint Slabs,*** • Joint Slab 02 (JS-02D) within the local road L-2104 at Ch. 1560m. • Joint Slab 02 (JS-02S) within the local road L-2104 at Ch. 1570m. • Joint Slab 03 (JS-03D) is west of JS-02D within the local road L-2104 at Ch. 2370m. • Joint Slab 03 (JS-03S) is west of JS-02S within the local road L-2104 at Ch. 2385m. • Joint Slab 04 (JS-04D) will be located west of JS-03D within the local road L-2104 at Ch. 3250m. • Joint Slab 04 (JS-04S) will be located west of JS-03S within the local road L-2104 at Ch. 3270m. • Joint Slab 05 (JS-05D) will be located within the local road L-2104 on approach to the N84 national road at Ch. 3960m. • Joint Slab 05 (JS-05S) will be located within the local road L-2104 on approach to the N84 national road at Ch. 3980m. • Joint Slab 06 (JS-06S) will be located within the local road L-21044 at Ch. 4820m. • Joint Slab 06 (JS-06D) will be located within the local road L-21044 at Ch. 4830m. • Joint Slab 07 (JS-07D) within the local road L-16157 at Ch. 5490m. • Joint Slab 07 (JS-07S) within the local road L-16157 at Ch. 5510m. • Joint Slab 08 (JS-08D) within the local road L-16157 at Ch. 6350m. • Joint Slab 08 (JS-08S) within the local road L-16157 at Ch. 6370m. • Joint Slab 09 (JS-09D) will be located within the local road L-16152 at Ch 7170m. • Joint Slab 09 (JS-09S) will be located within the local road L-16152 at Ch 7185m.

	Features of Interest • Cattle Underpass crossing Ch.1475m in a trefoil formation. • Mayo / Galway County boundary at Ch.5275m • HDD Bridge/River Black crossing, Ch.6780m
Section 3 **1340m**	**Consenting lands, Wind farm development boundary to Control Building** The route continues in a westerly direction, crossing consented private lands under folio numbers MY52806, MY52808 and MY52811 until it reaches the Wind Farm boundary. Along this section, the collector network and the proposed GCR passes through c. 1.25 km of previously undisturbed greenfield, including to the south and west of AH81 (MA123-042). Once within the Wind Farm boundary, the UGC follows the access track to the Control Building. **Features** • Joint Slab 10 (JS-10D) will be located northwest from JS-09D within third party lands at chainage 7970m. • Joint Slab 10 (JS-10S) will be located northwest from JS-09S within third party lands at chainage 7985m. **Section 3** of route is shown in Site Layout Plan Drawing 300101121-DR-116

Table 3 - Summary of Features along collector network design route

5.0 Preliminary Site Investigations

It will be required to carry out Preliminary site investigations along the cable route before construction in order to confirm design assumptions.

The following items may be carried out:

- Slit trenches at locations of major service crossings (Half Road width).
- Trial holes along the route to ascertain ground conditions and thermal resistivity of the soil.
- Trial holes at all chamber positions to ascertain ground conditions and thermal resistivity of the soil
- Traffic Management – Single Road closure for public local road network.

Equipment:

- 4x4 vehicle
- Soil compactor
- Wheeled dumper
- Concrete vibrator
- 360° tracked excavator

6.0 Loop-in Masts Construction Methodology

6.1 Existing 110 kV OHL

The proposed 110kV loop-in station will connect to the existing Dalton–Cashla 110kV line. Two new cable interface masts (No. 147A and 147B) will be installed on either side of existing pole set 147, which will be removed upon completion of the works. The existing overhead line conductor will be terminated at the new masts and connected to the substation via underground cable (UGC).

The duration of works for the overhead line construction is expected to be approximately 12 weeks. Construction of foundations for masts circa. 7 days each with time allowing for curing of the concrete, erection of the masts circa 5 days each, weather dependant. Stringing of conductor will be a 2-week process and final connection to the existing grid will be carried out by ESBN and at that point in time commissioning of the substation can start.

6.2 Steel Mast Structures

The proposed mast structure locations have been selected based on ground surveys, ground profiles, sight lines and ruling span checks.

The proposed construction scope will require the relevant personnel, machinery and materials which is as follows:

Equipment	**Materials**
5 operatives	2 Cable Interface Masts
4x4 vehicle	Insulators
Winch	Electrical connections
Tractor and trailer	Concrete (foundation)
Crane	Aggregate
Teleporter	
Chains / small tools	
Tracked Excavator	
Tracked Dumper	

Table 4 - Steel Mast Equipment and Materials

The following section outlines the methodology to be followed during construction works of the new mast structures.

1. Mast sites are scanned for underground services such as cables, water pipes etc. Consultation with the landowners will help to identify hazards and ensure there are no unidentified services in the area.
2. For each leg of the 2 No. masts (8 legs in total) a foundation circa. 4.3m x 4.3m x 3m deep is required. To allow for safe construction, the excavation will be stepped back which requires additional area to be excavated, or shutter piles used if ground material is not suitable for benching. The formation levels (depths) will be checked by the onsite engineer. The excavated material will be temporarily stored close to the excavation and excess material will be used as berms along the site access tracks.
3. To aid construction, a concrete pipe is placed into each excavation to allow operatives level the mast at the bottom of the excavation. The frame of the reinforcing bars will be prepared and strapped to a concrete pipe with spacers as required. The reinforcing bars will be lifted into each excavated foundation using the excavator and chains/slings. The base and body section of each mast will then be assembled next to the excavation.

4. Concrete trucks will pour concrete directly into each excavation in distinct stages.
5. A final pour for the mast is the encasing of the mast leg which will be finished 300mm over finished ground level. The leg of the mast is required to be shuttered with metal panels to form the required shape.
6. Once the concrete is set after five days the shuttering is removed and if used sheet piles removed.



Figure 3 - Typical 110kV mast foundation excavation

7. The Mast foundations will be backfilled one leg at a time with the material already excavated at the location. The backfill will be placed and compacted in layers. All dimensions will be checked following the backfilling process. All surplus excavated material will be removed from the mast locations and stored in berms for reuse across the construction site.



Figure 4 - Base of mast structure backfilled

8. Once the base is in place the line will be de-energised by ESB so the remainder of the tower can be built during the approved outage.
9. An earth mat consisting of copper or aluminium wire will be laid circa 400mm below ground around the mast. This earth mat is a requirement for the electrical connection of the equipment on the mast structure.
10. Once the base section of each mast is completed and the concrete sufficiently cured, it is ready to receive the mast body.
11. A hardstand area for the crane will be created by laying geogrid material on the ground surface and overlaying this geogrid with a suitable grade of aggregate.
12. A physical barrier (Heras Fence Site Boundary) will be put in place to restrict plant from coming too close to the OHL.
13. The mast will be constructed lying flat on the ground beside the recently installed mast base.
14. The conductor will be moved off centre using a stay wire and weights to anchor the stay wire to ground.
15. The mast section will be lifted into place using the crane and guide ropes.
16. The body sections will be bolted into position.
17. The conductor will be centred over the masts and held in place. Once the conductor is secured at both ends it is then cut and attached onto each mast. The section of conductor in between the two masts will be removed and utilised as connector wire for the new masts.
18. Down dropper conductors (for electrical connections, insulators, surge arrestors), shackles and all associated accessories required for transition from line to cable will be installed on the interface masts.
19. The circuit will be tested in both directions before the line is re-energised.



Figure 5 - Cable End Mast Lateral view



Figure 6 - Cable Mast front view

7.0 Proposed Substation Build Construction Methodology

The 110kV Substation will be constructed to loop-in to the existing Dalton–Cashla 110kV line. The substation will be made up of a control building, transformer compound, electrical equipment and a shunt filter. The control building works will consist of foundation works, block work, roofing, low voltage electrical fit out, cladding and building finishing works. The transformer, cable chair and structural steelwork will be installed in the transformer compound. Substation electrical equipment will be installed once the control building and compound is complete. Palisade fencing will be erected around the compound for security/protection and a concrete post and rail fence to mark the substation boundary.

7.1 110 kV Loop-in Substation

The proposed construction scope will require the relevant personnel, machinery and materials which is as follows:

Equipment	**Materials**
Up to 10 Electrical/Civil Crews Tracked Excavators 360˚tracked excavators (13 ton normally, 22 ton for rock breaker) Tracked dumpers / tractors and trailers Crane Hoist Power Tools Generator Scaffolding	Stone Geotextile Lighting Paving. Fencing Steel Uprights Concrete Timber Cladding Doors

The following section outlines the methodology to be followed during construction works of the new 110 kV substation.

1. This new substation will consist of a costumer compound (IPP side) of circa 450m^2 and an EirGrid compound of circa 13830m^2 surrounded by a 2.65m high palisade fence.
2. A level compound area will be created using cut and fill methods.
3. The substation compound and drainage will be marked out by a qualified engineer.
4. A drainage system will be excavated and installed around the compound area.
5. Topsoil and subsoil will be removed from the footprint of the compound using an excavator. The excavated material will be stored separately and temporarily on adjacent berms for later use during reinstatement works.
6. A layer of geotextile material will be laid over the footprint of the compound.
7. Using an excavator, a base layer of Clause 804 material will be laid followed by a 6F2 capping layer which will provide the finished surface.

8. Each layer will be compacted using a vibrating roller.
9. Earthing cable will be laid underground around the substation for connection to the various electrical components during the electrical fit out phase.
10. The construction of a substation compound circa 17,750m², comprising of approx. 437.5m² single storey 110kV substation control building, a 403.5m² IPP building and associated outdoor electrical equipment, including 1 no. 110kV transformer, associated internal access track, 2.6m high station perimeter fencing and concrete post and rail property boundary fence will be built.
11. Adequate lighting will be installed around the compound on the lighting masts.
12. Lightning protection masts of approximate height 18m will be installed to protect the station from direct lightning strikes.
13. The electrical installation is expected to take 16 weeks and includes the following:
    - Delivery and installation of 33/110kV transformer. The deliveries will be managed in accordance with regulations governing the movement of large loads.
    - Delivery and installation of all other HV equipment.
    - Wiring and cabling of HV/LV equipment, protection, and control cabinets.
    - Commissioning of all newly installed equipment.

8.0 Underground Cable Construction Methodologies

8.1 110kV Grid Connection UGC Construction Methodology

The underground 110kV grid connection ducting will consist of 1 No. trench, the trench will contain 3 No. 160mm diameter HDPE power ducts, 2 No. 125mm diameter HDPE communications ducts and 1 no. 125mm diameter earth continuity duct to be installed in an excavated trench, typically 825mm wide by 1315mm deep, with variations on this design to adapt to service crossings and watercourse crossings, etc. The communications duct will accommodate a fibre cable to allow communications between the 110kV substation and the Loop In mast locations. The inclusion of 1 No. earth continuity conductor duct will also be required. The ducts will be installed, the trench reinstated in accordance with landowner/ local authority specification. Once all are satisfied, then the electrical cabling/fibre cable is pulled through the installed ducts in approximately 750/850m sections. Construction method statements and templates will be implemented to ensure that the underground HV ducting is installed in accordance with the correct requirements, materials, and specifications of ESBN and EirGrid.

8.2 110kV Grid Connection UGC Trenching Methodology

The following section outlines the methodology to be followed during trenching works:

- The Contractor, and their appointed Site Manager, will prepare a targeted Method Statement concisely outlining the construction methodology and incorporating all mitigation and control measures included within the planning application and accompanying reports and as required by planning conditions where relevant;
- All existing underground services shall be identified on site prior to the commencement of construction works;
- At watercourse crossings, the contractor will be required to adhere to the environmental control measures outlined within the planning application and accompanying reports, the construction contractor will update the Construction Environmental Management Plan (CEMP) prior to the commencement of construction, the CEMP will be used to clearly document for construction staff the proposed mitigation, as set out in the application, and any subsequent planning conditions that may be imposed. The CEMP document has been prepared in line with best practice construction methodologies including the following measures;
- Where the ducting routes intersect with culverts, the culvert will remain in place (where possible) and the ducting will be installed either above or below the culvert to provide minimum separation distances in accordance with ESB and Irish Water specifications;
- In the event that culverts require removal for ducting installation, it is proposed that a suitable method of damming the water source and pumping the water around the work area would be set out in a method statement and agreed with the relevant stakeholders. Once the ducts are installed the culvert will be reinstated to match existing levels and dimensions. If works of this nature are required, the contractor will liaise with Inland Fisheries Ireland in advance of works;
- Excavated material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2m in height. Stockpiles will be located a minimum of 50m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW);
- Excavated material shall be employed to backfill the trench where appropriate and any surplus material will be transported off site and disposed of at a fully authorised soil recovery site;
- The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, dirty water will be fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature;
- Where required, grass will be reinstated by either seeding or by replacing with grass turves;
- No more than a 100m section of trench will be opened at any one time. The second 100m will only be excavated once the majority of reinstatement has been completed on the first;

- The excavation, installation and reinstatement process will take on average of 1 no. day to complete a 100m section;
- Where the ducting is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together;

Equipment:

- 1 Excavator Operator;
- 2-3 General Operatives;
- 1 no. tracked excavator (only rubber tracked machines will be allowed on public roads);
- 1 no. dumper or tractor and trailer.

Materials:

- Ready-mix Concrete (delivered to site);
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- 160mm & 125mm diameter HDPE ducting;
- Temporary Surface Reinstatement Materials.



Figure 7 - Typical 110kV Underground Duct Installation

8.3 110kV Grid Connection UGC Ducting Installation Methodology

For the trenching and ducting works the following step by step methodology will apply:

1. Grade, smooth and trim trench floor when the required 1315mm depth and 825mm width have been obtained.
2. Place bedding layer of Cement Bound Granular Mixture B (CBGM B) material in accordance with the specification and compact it so that the compacted thickness is as per the drawings.
3. Lay the bottom row of ducts in trefoil formation as detailed on the design drawings. Use spacers as appropriate to establish horizontal duct spacing. Fit a secure cap / bung to the end of each duct run to prevent the ingress of dirt or water.
4. Carefully surround and cover ducts with CBGM B in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
5. Place protection strips on compacted CBGM B directly over the ducts.
6. Lay the top row of ducts onto the freshly compacted CBGM B including the protection strips above the bottom row of ducts. Place a secure cap at the end of each duct to prevent the ingress of dirt or water.

7. Carefully surround and cover ducts with CBGM B material in accordance with the drawings and thoroughly compact without damaging ducts.
8. Place red protection strip on top of compacted CBGM B over each set of ducts as shown on the drawings.
9. Place and thoroughly compact CBGM B material or Clause 804 backfill or soil backfill as specified and place warning tape at the depth shown on the drawings.
10. For concrete and asphalt/bitmac road sections, carry out immediate permanent reinstatement in accordance with the specification and to the approval of the local authority and/or private landowners, unless otherwise agreed with local authorities (Figure 8).
11. Clean and test the ducts in accordance with the specification by pulling through a brush and mandrel. Install 12mm polypropylene draw rope in each duct and seal all ducts using robust duct end seals fitted with rope attachment eyes. All the works should be witnessed by ESBN Clerk of Works (CoW) as required.

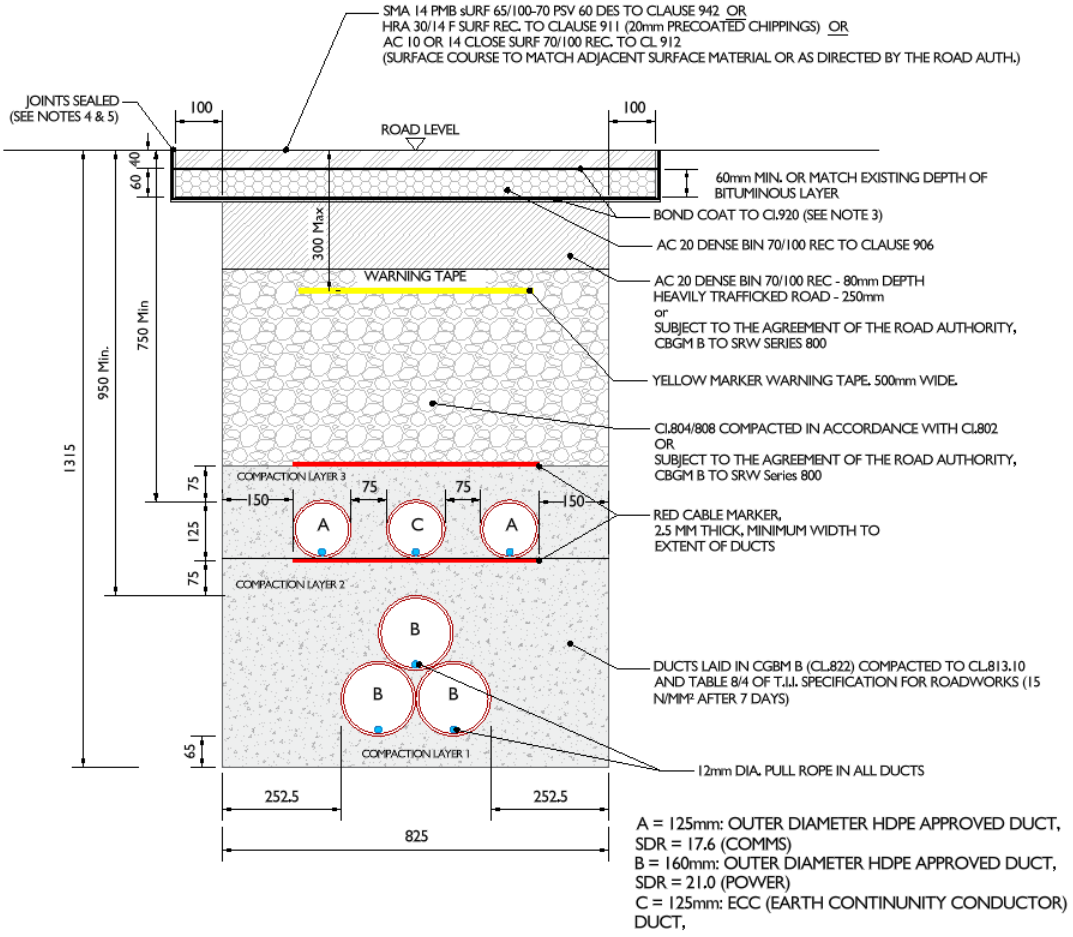


Figure 8 - Typical Trench in Public Road Section

8.4 Joint Bays and Associated Chambers

Before starting construction, the area around the edge of the joint bay which will be used by heavy vehicles will be surfaced with a terram cover (if required) and stone aggregate to minimise ground damage. Any drains within the temporary works area will be culverted and check dams made from stone or sandbags covered with terram will be inserted upstream and downstream of these culverts to intercept any solids generated during the insertion or which wash out during the works. If the ground slopes from the working area toward a watercourse or if there is evidence of solids washing off the works area toward nearby watercourses or drains, a silt fence with straw bales, will be interposed between the works area and the watercourse.

All excavated material will be stored near the excavations and reused for reinstatement works. Any soil required for reinstatement that will be temporarily stockpiled on site will be placed at least 15m back from the nearest watercourse on level ground and will be ringed at the base by silt fencing and be regularly monitored by a designated competent person for signs of solids escape. In which case an additional line of silt fencing with straw bales will be added in line with the relevant environmental control measures.

If the joint bay needs to be dewatered, this will be pumped to a percolation area if the soil is not saturated, otherwise a settlement tank will be used to remove any solids from the dewatering process to comply with the environmental control measures.

The risk of concrete reaching surface waters is considered very low given that all concrete will be poured into the pit excavated for the joint slab so that spills will be contained. The basic requirement therefore is that all pouring operations be constantly supervised to prevent accidental spillages occurring outside the pit.

Temporary storage of cement bound sand (if required) will be on hardstand areas only where there is no direct drainage to surface waters and where the area has been bunded e.g. using sandbags and geotextile sheeting or silt fencing to contain any solids in run-off.

8.5 110kV Joint Bays and Associated Chambers

Joints Bays are to be installed approximately every 850m along the UGC route to facilitate the jointing of 2 No. lengths of 110kV UGC. Joint Bays are typically 6m x 2.5m x 2.05m pre-cast concrete structures installed below finished ground level.

In association with Joint bays, Communication Chambers will be required at every joint slab location to facilitate communication links. Earth Sheath Link Chambers are also required at every joint bay along the cable route. Earth Sheath Links are used for earthing and bonding cable sheaths of underground power cables, so that the circulating currents and induced voltages are eliminated or reduced. Earth Sheath Link Chambers and Communication Chambers are located in close proximity to joint bays. Earth Sheath Link Chambers and Communication Chambers will typically be pre-cast concrete structures with an access cover at finished surface level.

The precise siting of all Joint Bays, Earth Sheath Link Chambers and Communication Chambers is subject to detailed design. Marker posts will be used on non-roadway routes to delineate the duct route and joint bay positions.

The following steps outline the methodology for joint bay construction and reinstatement:

1. The contractor will excavate a pit for joint bay construction, including for a sump in one corner.
2. Grade and smooth floor; then lay a 50 mm depth thick sand on 200 mm thick Clause 804 granular material.
3. Place pre-cast concrete sections on sand bedding.
4. Where joint bays are located under the road surface the joint bay will be backfilled with compacted layers of Clause 804 and the road surface temporarily reinstated as specified by the local authority.
5. Precast concrete covers may be used as temporary reinstatement of joint bays at off road locations. These covers are placed over the constructed joint bay and are then removed at the cable installation stage of the project.

6. At a later date to facilitate cable installation and jointing, reinstate traffic management signage, secure individual sites, re-excavate three consecutive joint bays and store excavated material for reuse.

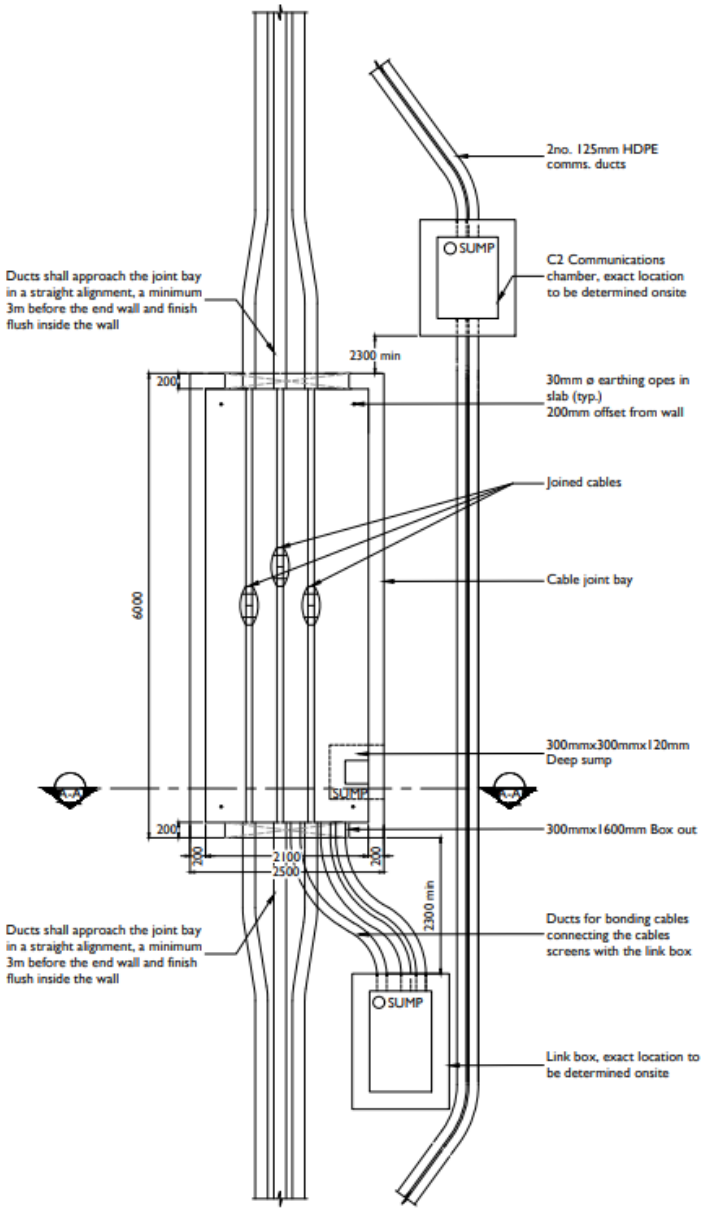


Figure 9 - Typical Section 110kV Pre-Cast Joint Bay

8.6 Marker posts

Surface cable markers will be placed along the route where cable depth is unavoidably shallow, due to constraints such as existing services, to indicate the precise location of the UGC. These markers will be metallic plates in accordance with ESBN and EirGrid standards.

Marker posts will be used on non-roadway routes to delineate the cable route and joint bay positions. Corrosion proof aluminium triangular danger sign, with 700mm base, and with centred lightning symbol, on engineering grade fluorescent yellow background shall be installed in adequately sized concrete foundations. Marker post shall also be placed in the event that burial depth is not to standard. Siting of marker posts to be dictated by ESBN as part of the detailed design process *(*Figure 10*)*.



Figure 10 - Typical ESB Marker Posts Example

8.7 Managing Excess Material from Trench

All excavated material will be temporarily stored adjacent to the trench prior to re-use in the trench reinstatement (where applicable). Stockpiles will be restricted to less than 2m in height. Excavated tar from the public road network will be transported off site by an appropriately authorised waste collector and disposed of at an appropriately licenced waste facility.

8.8 Storage of Plant and Machinery

All plant, machinery and equipment will be stored on site within the UGC works area or within the temporary construction compounds to be located within the Rooaunalaghta wind farm site. Oils and fuels will be stored in an appropriately bunded area within the temporary construction compounds.

9.0 33kV Collector Network UGC Construction Methodology

The 33kV collector network UGC will consist, 3 No. 125mm diameter HDPE power cable ducts, 1 No. 110mm diameter HDPE communications duct and 1 No. 110mm diameter earth continuity duct to be installed in an excavated trench, typically 450mm wide by 1250mm deep, with variations on this design to adapt to watercourse crossings and service crossings, etc. The power cable ducts will accommodate 1 No. power cables per duct. Sections of this collector network will require a double circuit UGC. This UGC typically will consist of 6 No. 125mm diameter HDPE power cable ducts, 2 No. 110mm diameter HDPE communications duct and 2 No. 110mm diameter earth continuity duct to be installed in an excavated trench, typically 1000mm wide by 1250mm deep, with variations on this design to adapt to watercourse crossings and service crossings, etc. Sections of this collector network will require a triple circuit UGC. This UGC arrangement typically will consist of 9 No. 125mm diameter HDPE power cable ducts, 3 No. 110mm diameter HDPE communications duct and 3 No. 110mm diameter earth continuity duct to be installed in an excavated trench, typically 1550mm wide by 1250mm deep, with variations on this design to adapt to watercourse crossings and service crossings, etc.

The ducts will be installed, and the trench reinstated in accordance with the specifications of the Roads Section within Mayo County Council and Galway County Council where installed in public roads and reinstated in accordance with the landowner's requirements where installed in private lands. Once all are satisfied, then the electrical cabling/fibre cable is pulled through the installed ducts in approximately 800/900m sections. Construction method statements and templates will be implemented to ensure that the UGC is installed in accordance with the correct requirements, materials, and specifications.

9.1 33kV Collector Network Ducting Installation

For the ducting works the following methodology will apply:

- Grade, smooth and trim the trench floor when the required depth (1250mm) and width 450mm for a single circuit (wider when more circuits are in one trench) have been obtained.
- Place a bedding layer of thermal sand in accordance with the specification and compact it so that the compacted thickness is as per the drawings.
- Lay the bottom row of ducts as detailed on the design drawings. Use spacers as appropriate to establish horizontal spacing. Fit a secure cap / bung to the end of each duct to prevent the ingress of dirt or water.
- Carefully surround and cover ducts with thermal sand in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
- Lay the top row of ducts onto the freshly compacted thermal sand above the bottom row of ducts. Place a secure cap at the end of each duct to prevent the ingress of dirt or water.
- Carefully surround and cover ducts with thermal sand material in accordance with the drawings and thoroughly compact without damaging ducts.
- Place a yellow protection strip on top of the compacted thermal sand over the top row of ducts as shown on the drawings.
- Place and thoroughly compact CBGM B material or Clause 804 backfill, or soil backfill as specified and place warning tape at the depth shown on the drawings.
- For concrete and asphalt/bitmac road sections, carry out immediate permanent reinstatement in accordance with the specification and to the approval of the local authority.
- Clean and test the ducts in accordance with the specification by pulling through a brush and mandrel. Install 12 mm polypropylene draw rope in each duct and seal all ducts using robust duct end seals fitted with rope attachment eyes.

9.2 33kV Collector network Trenching Methodology

The following section outlines the methodology to be followed during trenching works:-

- The Contractor, and their appointed Site Manager, will prepare a targeted Method Statement concisely outlining the construction methodology and incorporating all mitigation and control measures as required by conditions where relevant.
- All existing underground services shall be identified on-site before the commencement of construction works.
- Traffic management measures will be implemented by those included in the Traffic Management Report, and a detailed Traffic Management Plan will be prepared and agreed upon with Mayo County Council and Galway County Council.
- At watercourse crossings, the contractor will be required to adhere to the environmental control measures outlined within the planning application and accompanying reports, the construction contractor will prepare a detailed Construction Environmental Management Plan (CEMP) prior to the commencement of construction, the CEMP will be used to clearly document for construction staff the proposed mitigation, as set out in the application, and any subsequent planning conditions that may be imposed. The CEMP document will be prepared in line with best practice construction methodologies including the following measures;
- Where the ducting routes intersect with culverts, the culvert will remain in place (where possible) and the ducting will be installed either above or below the culvert to provide minimum separation distances in accordance with Irish Water specifications;
- In the event that culverts require removal for ducting installation, it is proposed that a suitable method of damming the water source and pumping the water around the work area would be set out in a method statement and agreed with the relevant stakeholders. Once the ducts are installed the culvert will be reinstated to match existing levels and dimensions. If works of this nature are required, the contractor will liaise with Inland Fisheries Ireland in advance of works;
- The excavated trench will be approximately 1250mm deep both within the public road network and on private lands, with widths of 450mm, 1000mm, and 1550mm for single, double, and triple circuits respectively.
- Excavated material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2m in height. Stockpiles will be located a minimum of 15m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW).
- Excavated material shall be employed to backfill the trench where appropriate and any surplus material will be transported off-site and disposed of at a fully authorised soil recovery site;
- Any earthen (sod) banks to be excavated will be carefully opened with the surface sods being stored separately and maintained for use during reinstatement.
- The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, dirty water will be fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature.
- Where required, grass will be reinstated by either seeding or by replacing with grass turves;
- No more than a 100m section of the trench will be opened at any one time. The second 100 meters will only be excavated once the majority of reinstatement has been completed on the first;
- The excavation, installation, and reinstatement process will take on average of 1 no. day to complete a 100m section;
- Where the cable is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together;
- Works will only be conducted in normal working hours of Monday to Friday 08:00 to 20:00 and Saturday 08:00 to 13:00, with no work on Sundays or Bank Holidays except in exceptional circumstances or in the event of an emergency;
- Following the installation of ducting, pulling the cable will take approximately 1 no. days.

Equipment:

- 1 Excavator Operator;
- 2-3 General Operatives;
- 1 no. tracked excavator (only rubber tracked machines will be allowed on public roads);
- 1 no. dumper or tractor and trailer.

Materials:

- Sand for Pipe Bedding
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- 125mm diameter HDPE ducting;
- 110mm diameter ducting.

9.3 33kV Collector Network UGC Ducting Installation Methodology

For the trenching and ducting works the following step by step methodology will apply:

1. Grade, smooth and trim trench floor when the required 1250mm depth and 450mm width have been obtained.
2. Place bedding layer of thermal sand material in accordance with the specification and compact it so that the compacted thickness is as per the drawings.
3. Lay the bottom row of ducts as detailed on the design drawings. Use spacers as appropriate to establish horizontal spacing. Fit a secure cap / bung to the end of each duct run to prevent the ingress of dirt or water.
4. Carefully surround and cover ducts with thermal sand in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
5. Lay the top row of ducts onto the freshly compacted thermal sand above the bottom row of ducts. Place a secure cap at the end of each duct to prevent the ingress of dirt or water.
6. Carefully surround and cover ducts with thermal sand material in accordance with the drawings and thoroughly compact without damaging ducts.
7. Place yellow protection strip on top of compacted thermal sand over the top row of ducts as shown on the drawings.
8. Place and thoroughly compact CBGM B material or Clause 804 backfill or soil backfill as specified and place warning tape at the depth shown on the drawings.
9. For concrete and asphalt/bitmac road sections, carry out immediate permanent reinstatement in accordance with the specification and to the approval of the local authority and/or private landowners, unless otherwise agreed with local authorities.
10. Clean and test the ducts in accordance with the specification by pulling through a brush and mandrel. Install 12 mm polypropylene draw rope in each duct and seal all ducts using robust duct end seals fitted with rope attachment eyes.

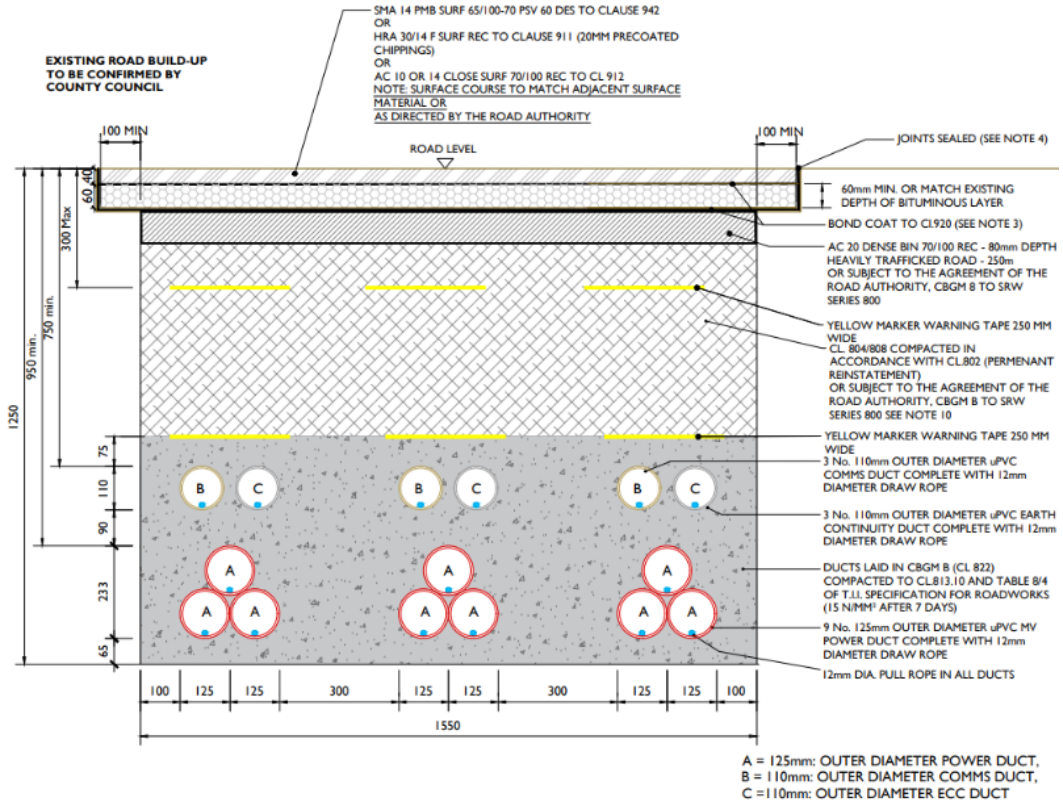


Figure 11 - Triple circuit trench ducting through roadway

9.4 33kV Joint Slabs and Associated Chambers

Joints Slabs are to be installed approximately every 900m along the 33kV Collector Network UGC route to facilitate the jointing of 3 No. lengths of 33kV UGC. Joint slabs are typically 2.2m x 1.8m x 0.1m concrete slabs installed below finished ground level. Joint slabs will be located in the non-wheel bearing strip of roadways/access tracks.

In association with joint slabs, Communication Chambers will be required at selected joint slab location to facilitate communication links.

The precise siting of all Joint slabs, & Communication Chambers is subject to detailed design. Marker posts will be used on non-roadway routes to delineate the duct route and joint bay positions.

The following steps outline the methodology for joint bay construction and reinstatement:

1. The contractor will excavate a pit for joint slab construction.
2. Grade and smooth floor; then lay a 75 mm depth blinding concrete Clause 804 granular material.
3. Construct 100 mm thick reinforced concrete floor slab with sump
4. Remove formwork and backfill with suitable backfill material in grassed areas or Clause 804 material once ducting has been placed in the bay. Backfill externally with granular material to local authority/TII Specification for Roadworks.
5. Precast concrete covers may be used as temporary reinstatement of joint slabs at off road locations. These covers are placed over the constructed joint slab and are then removed at the cable installation stage of the project.
6. At a later date to facilitate cable installation and jointing, reinstate traffic management signage, secure individual sites, re-excavate three consecutive joint bays and store excavated material for reuse.

Equipment:

- 1 Excavator Operator;
- 2-3 General Operatives;
- 1 no. tracked excavator (only rubber tracked machines will be allowed on public roads);
- 1 no. dumper or tractor and trailer.

Materials:

- Sand for pipe bedding;
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- 160mm diameter HDPE ducting;
- 125mm diameter HDPE ducting;
- 110mm diameter ducting
- Precast Chamber Units / Construction materials for chambers

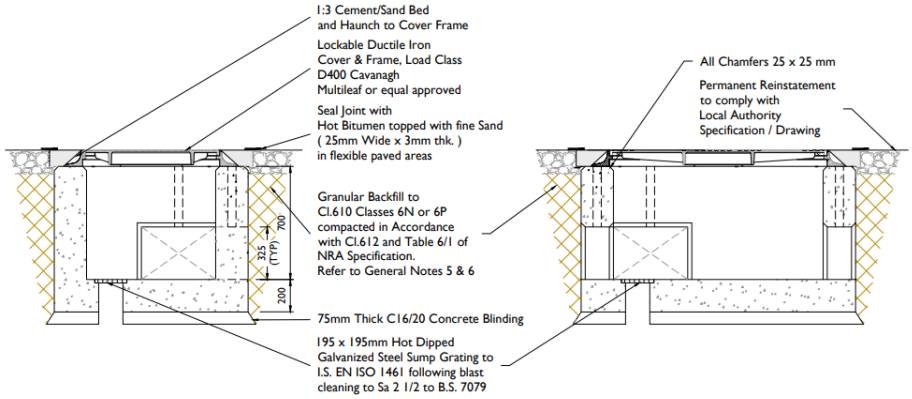


Figure 12 - Typical Section through Earth Link Box

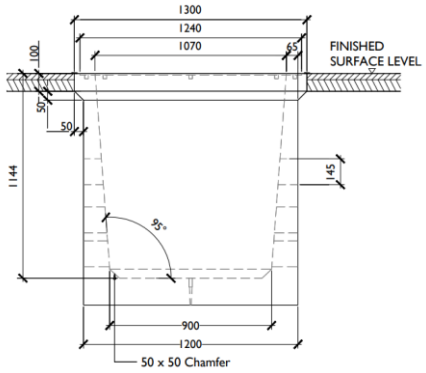


Figure 13 - Typical Section through Communications Chamber

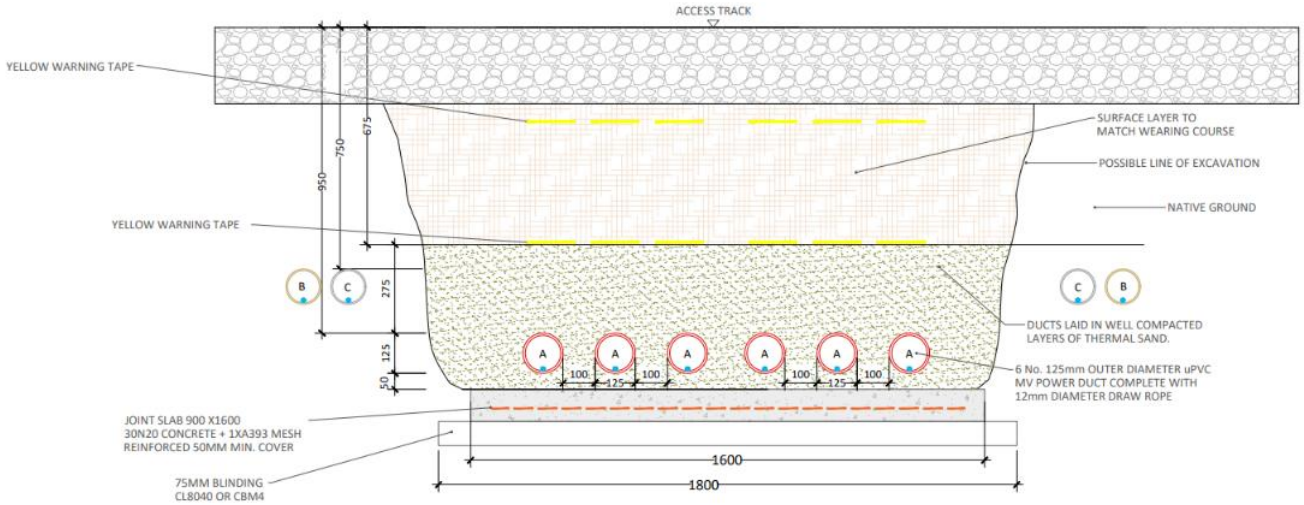


Figure 14 - Section through Double Circuit 33kV Cable Joint Slab.

9.4.1 UGC Installation on Public Road

Where the trenching is in a public road, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together.

Where the route is within public road carriages and where possible the trench will be installed in the non-trafficked strip between the wheel marks on the road. The cable route will be micro-sited based on the presence of existing utilities and the nature of the road and the adjoining terrain. It is preferable to excavate a trench within the middle of the lane, or the middle of the roadway to reduce load on the cable.

9.4.2 UGC Installation on Grasslands

A section of the UGC route is within the proposed wind farm development. The location where the cable is laid will depend on several factors such as, width of access track, bends along the access track and crossings. Where the wind farm access tracks need to be widened, stone will be brought in to build up the area to the same level of the track. The excess material from the track will be used elsewhere on reinstatement works.

9.5 Marker Posts

Surface cable markers will be placed along the route where cable depth is unavoidably shallow, due to constraints such as existing services, to indicate the precise location of the UGC. These markers will be metallic plates in accordance with ESB standards.

Marker posts will be used on non-roadway routes to delineate the duct route and joint bay/joint slab positions. Corrosion-proof aluminium triangular danger signs, with a 700mm base, and with centred lightning symbol, on fluorescent yellow background shall be installed in adequately sized concrete foundations. Marker posts shall also be placed if burial depth is not to standard. The precise siting of marker posts will be dictated by ESBN as part of the detailed design process.



Figure 15 - Marker Posts

9.6 Managing Excess Material from Trench

All excavated material will be temporarily stored adjacent to the trench before re-use in the trench reinstatement (where applicable). Stockpiles will be restricted to less than 2m in height. Where excess material exists, it may be used in the reinstatement of the wind farm sites or disposed of at a licensed facility.

9.7 Storage of Plant and Machinery

All plant, machinery and equipment will be stored on site within the UGC works area or within the temporary construction compounds to be located within the Wind Farm site. Oils and fuels will be stored in an appropriately bunded area within the temporary construction compounds.

9.8 Cable Installation/ Cable Pulling

The electrical cable is supplied in pre-ordered lengths on large cable drums (Figure 16). Once the ducting installation works are completed, the ducts have a 12mm polyethylene rope blown through them. This guide rope is then used for proving the ducts by attaching a mandrel, a sponge and brush, for cleaning the duct installed. Once the ducting is proved, the electrical cables (situated on a drum) are pulled through the ducting by a specialised mechanical winch. The electrical cable will be connected to the winch rope using approved suitably sized and rated cable pulling stocking and swivel or the pulling head fitted by the cable manufacturer**.** Installing "one section" of electrical cable normally involves pulling three individual conductors into three separate ducts via the winch. The winch will also monitor the tension on the cables being pulled so as not to damage the cables. The cable pulling winch must be set at a predetermined cut off pulling tension as specified by the designer. Cable lubricant is applied to the outside of the cables being pulled through the duct. The lubricant assists in the pulling process by removing friction between the cable and the rollers. This not only speeds up the process but also prevents snagging and therefore damage to the cable.



Figure 16 - Typical Cable Pulling Drum Set Up

Once the "two sections" of cable are pulled into the joint bay, a jointing container is positioned over the joint bay and the cable jointing procedure is carried out in this controlled environment. Following the completion of jointing and duct sealing works in the joint slab, place and thoroughly compact cement-bound sand in approximately 200 mm layers to the level of the cable joint base to provide vertical support. Install additional layers of cement-bound sand and compact each layer until the cement-bound sand is level with the top of the joint. Install an additional 100 mm cement-bound sand layer. Install cable protection strip. Backfill with cement-bound sand to a depth of 250 mm below surface and carry out permanent reinstatement including placement of warning tape at 300 mm depth below finished surface.

10.0 Existing Services Crossing

To facilitate the installation of the proposed UGC, it may be necessary to relocate existing underground services such as water mains, telecoms, or existing cables. In advance of any construction activity, the contractor will undertake additional surveys of the proposed route to confirm the presence or otherwise of any services. If found to be present, the relevant service provider will be consulted to determine the requirement for specific excavation or relocation methods and to schedule a suitable time to carry out works.

10.1 Underground Cables

If existing underground cables are found to be present, a trench will be excavated, and new ducting and cabling will be installed along the new alignment and connected to the network on either end. The trench will be backfilled with suitable material to the required specification. Warning strip and marking tape will be laid at various depths over the cables as required. Marker posts and plates will be installed at surface level to identify the new alignment of the underground cable, and the underground cables will then be re-energised.

10.2 Water Mains

Uisce Eireann has been consulted and advised on details of the project proposals in the form of a completed Building-over or Near an Irish Water Asset Application Form and associated technical information largely comprising drawings and schedules with details of proposed crossings etc with as much available information as possible. Uisce Eireann will be involved in the early engagement on projects that may involve any infrastructure which may be located near their assets with the intention of identifying as early as possible, if bespoke design measures or diversions are necessary.

Rooaunalaghta Green Energy Ltd. have been engaging with Glencorrib Group Water Scheme (GWS) and the design team have been made aware of the as-built infrastructure. Cable design and crossings have taken this into consideration.

11.0 Major Water Crossing: Culvert, Drainage & Bridge Crossing

The proposed cable route will require a total of four watercourse crossings, comprising 3 Nr culvert crossings and 1 Nr Bridge crossing via Horizontal Directional Drilling. Where the cable route intersects with existing watercourses, a detailed construction method statement will be prepared by the Contractor before the commencement of construction and is to be approved by the relevant environmental agency.

Crossing existing watercourses will be implemented using open trenching with either an undercrossing or an overcrossing, depending on the depth of the watercourse and the crossing method employed. Where the cable route intersects with existing watercourses, a detailed construction method statement will be prepared by the Contractor prior to the commencement of construction and is to be approved by the Local Authority and relevant environmental agencies.

Culverts are to be of adequate size to carry peak flows corresponding to a 1 in 100-year (1% AEP) storm event flow, with a minimum diameter of 750mm. They should be installed to conform wherever possible to the natural slope and alignment of the stream or drainage line. Culverts greater than 1m diameter should be buried to a minimum depth of 300mm below the streambed and the original bed material placed in the bottom of the culvert.

Inland Fisheries Ireland has published guidelines relating to construction works along water bodies entitled 'Requirements for the Protection of Fisheries Habitats during Construction and Development Works at River Sites", and these guidelines will be adhered to during the construction of the proposed development.

11.1 Shancloon Stream Crossing – Culvert – 01. Chainage 200m

An open drainage channel is located approx. 200m from the proposed new 110kV Substation. Vehicle access across the drain is currently facilitated by a culvert, as shown in Figure 18. As this culvert is located within the future access track, its replacement will be necessary to ensure that the structure can withstand heavy machinery and vehicle loading.

- Prior to commencement of works, appropriate sediment and erosion control measures will be installed downstream of the crossing location. These may include silt fences, geotextile filtration measures, straw bales, settlement tanks and other suitable controls to prevent sediment migration and protect downstream water quality.
- The crossing works will be scheduled during a suitable low-flow period and, where required, within the agreed fisheries working window.
- Temporary upstream and downstream cofferdams will be installed using sandbags, water-filled dams or other suitable impermeable diversion systems to isolate the work area.
- Flume pipe(s) of sufficient capacity will be installed to maintain downstream flow and convey all surface water around the works area for the duration of the crossing works.
- Once the diversion system has been established and operating effectively, the existing culvert will be removed.
- Any residual water within the isolated work area will be collected in a temporary sump and pumped to a vegetated infiltration area where ground conditions allow. Where infiltration is not feasible due to saturated ground conditions, water will be directed through an appropriately sized settlement tank prior to discharge to ensure removal of suspended solids.
- Excavation works and installation of the cable ducting will be undertaken within the isolated and dewatered section of channel.
- All excavated material will be stored away from the channel and managed to prevent sediment entrainment or runoff to the watercourse.
- Upon completion of the duct installation, the stream bed, banks will be reinstated to their pre-construction profile and condition using suitable materials.
- The culvert will be appropriately sized to accommodate 1:1000 yr flows with a 20% allowance for climate change

- The temporary diversion system, flume pipe(s), cofferdams and associated sediment control measures will then be removed in a controlled manner.
- Natural surface water flows will be restored through the reinstated channel and culvert structure.
- All disturbed areas will be stabilised and reinstated as soon as practicable following completion of the works to minimise the potential for erosion, sediment release and scour.

11.1.1 Watercourse Damming and Reinstatement Methodology

A number of sections of trenching and ducting will involve instream works at watercourse crossing locations in order to install cabling. To facilitate the works, these watercourses will be dammed, and the water diverted over or around the works using either a flume pipe or a diversion channel. Following the completion of works at the watercourse, the dam will be removed, and the watercourse reinstated. These works will require engagement with IFI to agree environmental controls required. Duration: 1-2 Days per location

Crew/Equipment:

- 2-3 operatives
- Wheeled dumper or track dumper (6 to 8 tons)
- 360° tracked excavator.

Materials:

- Pipe culvert
- Box culvert
- Clear Span Bridge (Prefabricated)
- Cable ducting and trenching backfill
- Sandbags
- Water pump
- Geotextile membrane
- Straw bales

11.1.2 Standard Methods- Dam & Flume Work:

1. The flume pipe(s) will be set out on the bed of the existing stream.
2. A dam will be constructed using sandbags around the flume pipe(s) and across the watercourse so that all the flows are diverted through the pipe(s).
3. Silt traps, such as geotextile membrane, straw bales etc. will be placed downstream of the in-stream trenching location prior to construction, to minimise silt loss.
4. The ducting installation works will be carried out in the dry stream bed and under/around the flume pipe(s). If required, a temporary sump will be established and used to collect any additional water. This water will be removed by pumping to a percolation area if the soil is not saturated, otherwise a settlement tank will be used to remove any solids from the de-watering.

11.1.3 Standard Methods- Dam & Divert Work

1. A suitable channel for the watercourse will be excavated adjacent to the original channel. Bedding stone will be placed on the bed of the new channel.
2. A dam will be constructed using sandbags across the watercourse so that the flow is diverted down the new channel.
3. Silt traps, such as geotextile membrane, straw bales etc. will be placed downstream of the in-stream trenching location prior to construction, to minimise silt loss.
4. The trench will be excavated in the dry watercourse bed. If required, a temporary sump will be established and used to collect any additional water. This water will be removed by pumping to a percolation area if the soil is not saturated, otherwise a settlement tank will be used to remove any solids from the de-watering.

11.1.4 Standard Methods- Reinstatement of the Watercourse at Dam and Flume Locations

1. Following the completion of works, the watercourse bed will be reinstated with original or similar material and the spawning gravels replaced under the supervision of an aquatic ecologist.
2. Once the watercourse bed is appropriately re-instated the dam and the flume pipe(s) will be removed thus restoring the watercourse to its original condition.

11.1.5 Standard Methods- Reinstatement of the Watercourse at Dam and Divert Locations

1. Following the installation of the cable ducts, the watercourse bed will be reinstated with original or similar material and the spawning gravels replaced under the supervision of an aquatic ecologist.
2. Once the watercourse bed is appropriately reinstated, the dam will be removed thus restoring the watercourse to its original alignment.
3. The temporary channel will then be reinstated with the previously excavated material.

11.2 Installation of Prefabricated/Preformed Bridge Deck Structure

Construction of the proposed new bridge deck structure will require transportation, handling and lifting of prefabricated elements. The use of prefabricated units facilitates the speed of construction and minimises the period of time required for works within a platform on the bridge structure.

The following gives an indication of the envisaged construction sequence:

1. Maintain solid crash mat/scaffold and debris netting;
2. Install double silt fence around extents of embankments;
3. Fabricate beam / girder units (off site);
4. Excavate to the base of bankseat level. If dewatering of excavation is required, the water will be pumped for treatment via settlement tanks. There will be no direct pumping of water from the works to watercourses at any time;
5. Install and test bored piles at the locations (if required);
6. Construct reinforced concrete bankseat abutments and approach retaining walls;
7. Transport prestressed concrete bridge beams to site and crane into place from adjacent lands;
8. Fix reinforcement and pour concrete deck slab and parapet upstands at both structures;
9. Install back of wall drainage and below ground waterproofing;
10. Backfill bankseat excavation with Class 6N granular fill and construct road embankments on approaches;
11. Install new parapets;
12. Complete road surfacing and finishes;
13. Remove scaffold, debris netting, Sedimats, sandbags and silt fence.

Crew/Equipment:

- 5-6 Operatives
- 360° tracked excavator
- Crane
- Wheeled dumper or Tracked dumper (6 to 8 tonms)
- Two-way intercom system

Materials:

- Prefabricated Structure
- N2W2 Barriers
- Class 6N granular fill
- 200mm CL 804 Stone
- 160mm HDPE Power ducting
- 125mm HDPE Comms ducting
- 125mm HDPE Earth ducting

The proposed works will be carried out by employing accepted good work practices during construction, and environmental management measures. Please note that the following measures will be supplemented by further specific environmental protection measures that will be included in method statements prepared for specific tasks during the works and will form part of the detailed CEMP.



Figure 17 – Existing Culvert at Ch.200m.

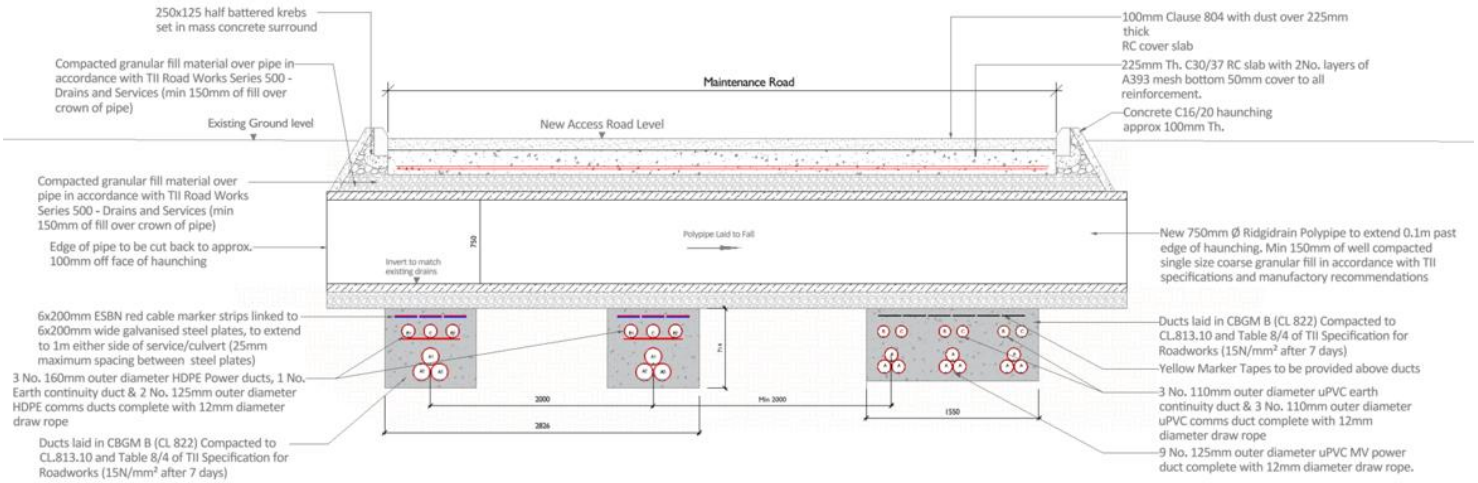


Figure 18 – Proposed Under Crossing at Drain Crossing (Ch.200m)

11.3 Crossing 02 – Culvert Crossing. Chainage 5400m

An existing 800 mm diameter culvert, encased in mass concrete and buried to a depth of approximately 1.2m, is located at chainage 5400 m along the proposed underground cable route.

The concrete culvert is encountered within L-16157 at the boundary between County Galway and County Mayo, as shown in Figure 19 and Figure 20. The concrete culvert will be crossed implementing the crossing strategy shown in Figure 21.



Figure 19 – Local Road network through Culvert



Figure 20 - Culvert 02 at Chainage 5275m

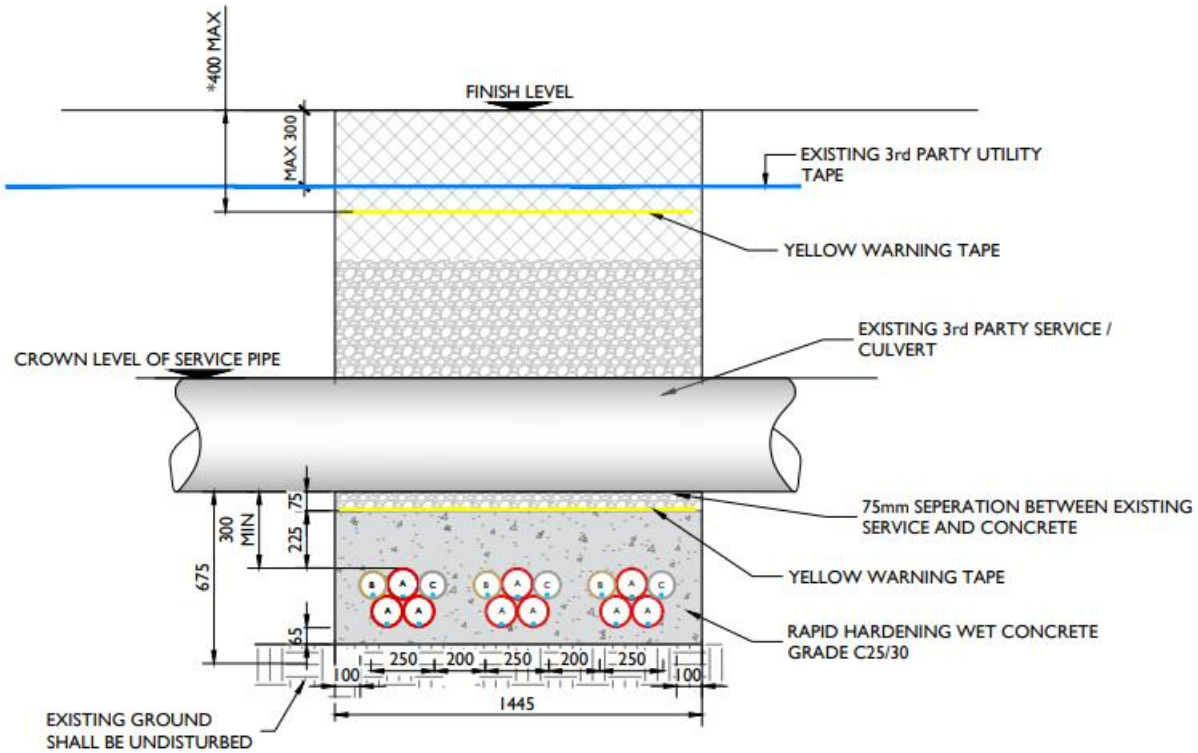


Figure 21 - Culvert undercrossing arrangement

11.4 Crossing 03 – Culvert Crossing. Chainage 5810m

An existing 300mm square, stone clapper culvert with 600mm cover will be encountered within L-16157 and located at chainage 5810 m along the proposed underground cable route. Under-crossing will be as per Figure 21.

11.5 Crossing 04 – Bridge Crossing River Black. Chainage 6780m

Located along L-16152, a bridge to facilitate River Black crossing is encounter, as Figure 22 shows. it is proposed to utilise a Horizontal Directional Drill (HDD) to install the 33kV UGC triple circuit within the public road boundaries as shown in Figure 23. The methodology for HDD is outlined in Section 13 below.



Figure 22- River Black Bridge

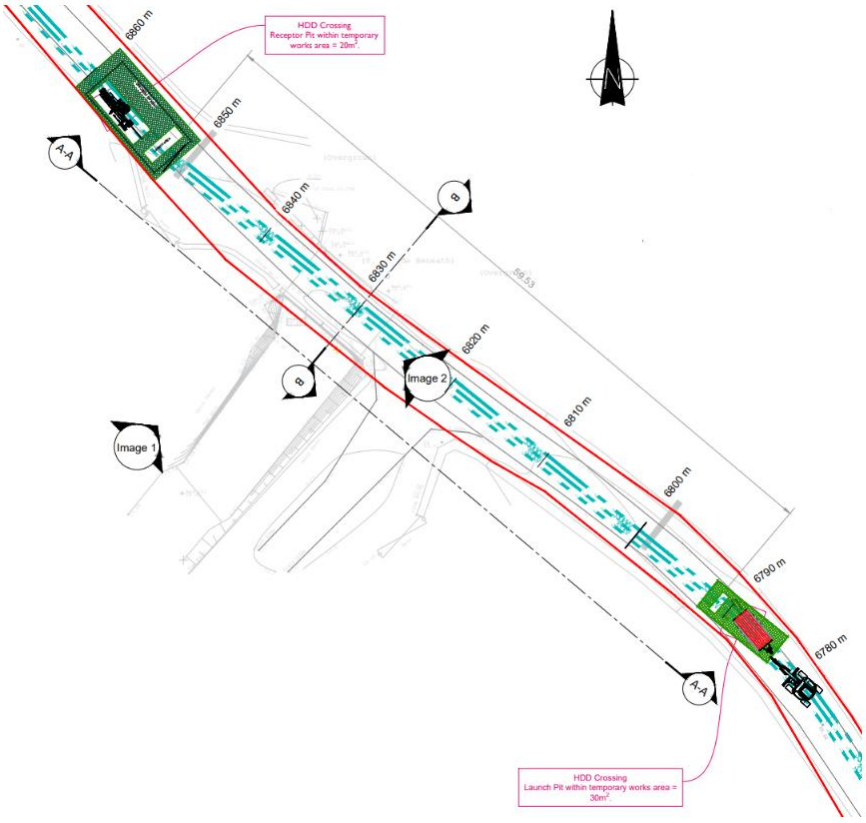


Figure 23 – HDD Crossing Layout at the River Black Bridge

12.0 Drainage Management Plan.

Please refer to Appendix 2-2, Construction Environmental Management Plan (CEMP), and Appendix 9-2, Surface Water Management Plan (SWMP), of the EIAR.

The measures described in this section will be adopted during the construction phase in order to manage on-site drainage in accordance with current best practice and legislation.

The Site Manager shall contact:

- The Client;
- Environmental Protection Agency ("EPA") 24-hour emergency incident line 1890 33 55 99;
- Inland Fisheries 24-hour pollution line 1890 34 74 24. The pollution hotline number shall be referenced in the construction site rules and displayed in the Site Office, within Rooaunalaghta Wind Farm facility, and in the Emergency preparedness & response plan.

Each Contractor working with controlled substances shall supply appropriate spill kits which shall be kept on site. The spill kits shall be made accessible at all times to all site personnel.

12.1 Silt Control

Silt-laden runoff should be expected from any areas of recently exposed soil. There is also potential for pollution to occur from machinery used in the construction.

The introduction or artificial materials required (e.g. silt fencing, straw bales, sandbags etc.) will need to be deployed onsite and will be removed on completion of the works. A suitable buffer and barriers (silt fences) will be provided between any excavated material and any surface water features to prevent sediment washing into the receiving water environment.

Discharge from the silt control measures will be discharged into an area of vegetation for dispersion or infiltration, in accordance with Sustainable drainage system (SuDS) techniques. Where drains or watercourses are crossed with underground cables the release of sediment will be prevented through the implementation of best practice construction methodologies.

12.2 Additional Mitigation Measures

- The contractor shall ensure that silt fences are regularly inspected and maintained during the construction phase.
- If very wet ground must be accessed during the construction process bog mats/aluminium panel tracks will be used to enable access to these areas by machinery. However, works will be scheduled to minimise access requirements during very wet periods and predominantly aiming to carry out works during the summer season.
- The contractor will carry out visual examinations of local watercourses from the proposed works during the construction phase to ensure that sediment is not above baseline conditions. In the unlikely event of water quality concerns, the Environmental Manager and ECoW will be consulted.
- Excavations will be left open for minimal periods to avoid acting as a conduit for surface water flows.
- Entry by plant equipment, machinery, vehicles, and construction personnel into watercourses or wet drainage ditches shall not be permitted. All routes used for construction traffic shall be protected against migration of soil or wastewater into watercourses.
- Cabins, containers, workshops, plant, materials storage, and storage tanks shall not be located near any surface water channels.

13.0 Horizontal Directional Drilling (HDD)

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles, such as bridges, railways, watercourses, etc., in order to install cable ducts under the obstacle. This method is employed where installing the ducts using standard installation methods is not possible. There is one bridge crossing along this UGC route which will require using HDD, so it is traversed in the least intrusive manner possible.

The proposed drilling methodology is as follows:

- A works area of circa 20m² for the HDD entry side, and circa 20m² on the HDD exit side, will be required for the HDD equipment and vehicles. These areas will be fenced off during the HDD implementation.
- The drilling rig and fluid handling units will be located on the designated entry side of the bridge and will be appropriately bunded using sandbags, which will contain any fluid spills and stormwater run-off.
- Entry and exit pits (approximately 2m (width) x 3m (length) x 1m depth) will be excavated using an excavator. The excavated material will be temporarily stored within the works area and used for reinstatement or disposed of to a licensed facility.
- The HDD pilot bore will be undertaken using a wireline guidance system. Assembly will be set up by the drilling team and steering engineer.
- The pilot bore will be drilled to the pre-determined profile and alignment under the bridge crossing.
- The steering engineer and drill team will monitor the drilling works to ensure that modelled stresses and pressures are not exceeded.
- The drilled cuttings will be flushed back by drilling fluid to the entry pit and treated for re-use.
- Once the first pilot hole has been completed, a hole-opener or back-reamer will be fitted in the exit side which will then be pulled back to the entry side as part of the pre-reaming/hole opening process to enlarge the hole to the needed size.
- When the pre-reaming/hole opening/hole cleaning has been completed, a reamer of slightly smaller diameter than the final cut will be installed on the drill string to which the ducts will be attached for installation.
- The drilling fluid will be disposed of to a licensed facility. The interior of the ducts will be cleaned, and the ducts will be proven to ascertain their suitability. Their installed location will be mapped.
- The entry and exit pit areas will be reinstated to the specification of ESB Networks and any requirements of Mayo County Council and Galway County Council.
- A joint bay/transition chamber/transition coupler will be installed on either side of the drill shot, following the horizontal directional drilling procedure, as per ESB requirements, which will serve as interface between the HDD ducts and the standard ducts.

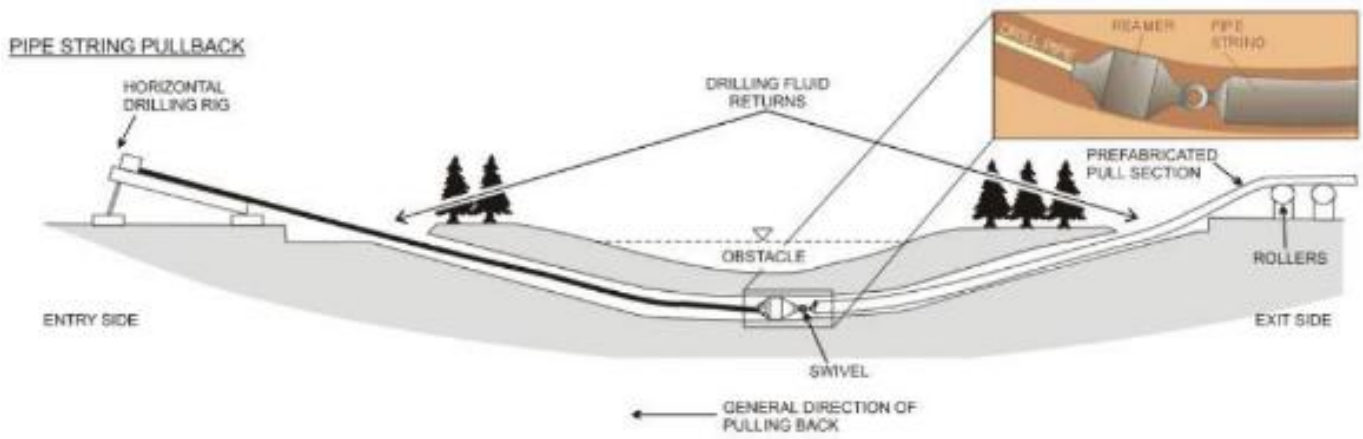


Figure 24 - Typical HDD Installation

14.0 Best Practice Design and Construction & Environmental Management Methodology

Before commencement of construction works the contractor will draw up detailed Method Statements which will be informed by this Outline Construction Methodology, measures proposed within the CEMP, and the guidance documents and measures listed below. This method statement will be adhered to by the contractors and will be overseen by the Project Manager, Environmental Manager, and ECoW where relevant.

The following documents will contribute to the preparation of the method statements in addition to those measures proposed below:

- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters*. Inland Fisheries Ireland*, Dublin.*
- *National Roads Authority (2008) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*. National Roads Authority, Dublin.
- E. Murnane, A. Heap, and A. Swain. (2006) *Control of water pollution from linear construction projects.* Technical guidance (C648). CIRIA.
- E. Murnane et al., (2006) *Control of water pollution from linear construction projects*. Site guide (C649). CIRIA.
- Murphy, D. (2004) Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin.
- H. Masters-Williams et al (2001) *Control of water pollution from construction sites. Guidance for consultants and contractors* (C532).
- Enterprise Ireland (unknown). *Best Practice Guide (BPGCS005) Oil storage guidelines.*
- Law, C. and D'Aleo, S. (2016) *Environmental good practice on site pocketbook*. (C762) 4th edition. CIRIA.
- CIRIA *Environmental Good Practice on Site (fourth edition) (C741) 2015*.

The proposed works will be carried out by employing accepted good work practices during construction, and environmental management measures such as those discussed below. Please note that the following measures will be supplemented by further specific environmental protection measures that will be included in method statements prepared for specific tasks during the works and will form part of the detailed CEMP.

- All materials shall be stored at the temporary compounds within the wind farm sites and transported to the works zone immediately before construction.
- Where drains and watercourses are crossed with underground cables, the release of sediment will be prevented through the implementation of best practice construction methodologies.
- Weather conditions will be taken into account when planning construction activities to minimise the risk of runoff from the site.
- Provision of 50m exclusion zones and barriers (silt fences) between any excavated material and any surface water features to prevent sediment from washing into the receiving water environment.
- If dewatering is required as part of the proposed works e.g. in trenches for underground cabling or in wet areas, water must be treated before discharge.
- The contractor shall ensure that silt fences are regularly inspected and maintained during the construction phase.
- If very wet ground must be accessed during the construction process bog mats/aluminium panel tracks will be used to enable access to these areas by machinery. However, works will be scheduled to minimise access requirements during the winter months.
- The contractor shall ensure that all personnel working on site are trained in pollution incident control response. A regular review of weather forecasts of heavy rainfall is required, and the Contractor is required to prepare a contingency plan for before and after such events.
- The contractor will carry out visual examinations of local watercourses from the proposed works during the construction phase to ensure that sediment is not above baseline conditions. In the unlikely event of water quality concerns, the Environmental Manager and ECoW will be consulted.

- Excavations will be left open for minimal periods to avoid acting as a conduit for surface water flows.
- Only emergency breakdown maintenance will be carried out on site. Emergency procedures and spillage kits will be available and construction staff will be familiar with emergency procedures.
- Appropriate containment facilities will be provided to ensure that any spills from vehicles are contained and removed off-site. Adequate stocks of absorbent materials, such as sand or commercially available spill kits shall be available.
- Concrete or potential concrete contaminated water run-off will not be allowed to enter any watercourses. Any pouring of concrete (delivered to site ready mixed) will only be carried out in dry weather. Washout of concrete trucks shall be strictly confined to a designated and controlled wash-out area within the wind farm site; remote from watercourses, drainage channels, and other surface water features.
- Entry by plant equipment, machinery, vehicles, and construction personnel into watercourses or wet drainage ditches shall not be permitted. All routes used for construction traffic shall be protected against migration of soil or wastewater into watercourses.

Cabins, containers, workshops, plant, materials storage, and storage tanks shall not be located near any surface water channels and will be located beyond the 50m hydrological buffer at all times.

15.0 Access Routes to Work Area.

The proposed grid route will consist entirely of UGC. Where the proposed underground cable will be installed within grassland, it will be accessed via the existing road network. Temporary access tracks on private land (if required due to ground conditions and/or landowner requirements) will consist of timber or aluminium bog mats (Figure 25) to spread the weight of machinery over a greater area to prevent damage to the ground. If necessary, a low ground pressure excavator may also be utilised. This machine is designed to spread its weight across a wider area thereby reducing the pressure exerted on the ground. No invasive works will be undertaken when placing the matting. Upon completion of the work, all mats will be removed immediately. Access routes will be carefully selected to avoid any damage to the land. Local consultation will be carried out with all relevant landowners to ensure that any potential disturbance will be minimised. Before the commencement of construction, the contractor will assess all access routes and determine the requirement for bog mats. Any such requirements will be incorporated into the relevant method statement.



Figure 25: Temporary Aluminium Panel Tracks

16.0 Road Opening Licence

The proposed UGC works will require a road opening license from Mayo County Council and Galway County Council. A Traffic Management Plan (TMP) has been included in Appendix 17-1 of the EIAR and will be updated and agreed with Mayo County Council and Galway County Council before the commencement of the development. This TMP will outline the location of traffic management signage, together with the location of any necessary road closures and the routing of appropriate diversions. Where diversions are required, these will be agreed upon with Mayo County Council and Galway County Council in advance of the preparation of the TMP.

17.0 Reinstatement of Private Land

Once all construction works are complete, the work areas will be reinstated with excavated soil and either seeded out with native species, allowed to vegetate naturally, or reinstated with excavated grass turves and will be restored to their original condition. This work will be carried out in consultation with the landowner and in line with any relevant measures outlined in the CEMP and associated conditions.

18.0 Invasive Species Best Practice Measures

Invasive species can be introduced into a location by contaminated plant, machinery, and equipment that were previously used in locations that contained invasive species. Good site organisation and hygiene management shall be maintained always on-site, and best practice measures will be implemented, as follows:

- The contractor will prepare an Invasive Species Action Plan to be implemented during construction, and all personnel will be made aware of the requirements contained within;
- Plant and machinery will be inspected upon arrival and departure from site and cleaned/washed as necessary to prevent the spread of invasive aquatic/ riparian species such as Japanese knotweed *Fallopia japonica* and Himalayan Balsam *Impatiens glandulifera*. A sign off sheet will be maintained by the contractor to confirm the implementation of measures;
- Site hygiene signage will be erected in relation to the management of non-native invasive material.

19.0 Waste Management

All waste products (general waste, plastic, timber, etc.) arising during the construction phase will be managed and disposed of by the provisions of the Waste Management Act 1996 and associated amendments and regulations, and a Waste Management Plan will be prepared by the contractor before the commencement of construction. All waste material will be disposed of at a fully licensed facility.

20.0 Archaeology

The following are the mitigation measures that will be carried out during construction where required;

- If required a project archaeologist will be appointed to oversee the project.
- Demarcation of protective buffer zones around cultural heritage sites where there is a potential for disturbance during the construction phase and inclusion of the same in site induction.

21.0 Compliance with Government and Industry Specifications.

The developer is cognisant of the work by government on Climate Action Plan 2025[1], as it sets a course for Irelands emission targets by 2030 and reaching net-zero no later than 2050. In particular, in relation to the Electricity Transmission Infrastructure Development Road Sector Engagement Framework[2] set out by EirGrid in February 2025, collaboration between all stakeholders is welcome. The developer recognises the guidance given in the document "Interim Guidance to Road Authorities (placement of Medium or High Voltage electricity assets)"[3]. The design and construction of the 33kV interconnector network shall comply with all industry specifications and government guidelines.

22.0 Programme

Estimates for the duration of the construction works are included in the table below. Please note that some of the elements are likely to happen concurrently, therefore the overall start-to-finish duration is estimated to be 12 months.

Table 3: Estimated Construction Duration	
Development Element	**Estimated Construction Duration**
Cable route	10 Months
110kV Substation	12 Months
On site Control Building	4 Months
HDD	4 weeks

Table 5: Estimated Construction Duration