CONSTRUCTION METHODOLOGY

Glenora Wind Farm 110kV Grid Connection

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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 Glenora Wind Farm 110kV grid connection to the existing Tawnaghmore 110kV substation. The grid connection will consist entirely of underground cabling (UGC) with the majority of the UGC to be installed within the public road network and some elements in forestry access tracks.

The UGC works will consist of the installation of 6 No. ducts in an excavated trench to accommodate 3 No. power ducts, 2 No. fibre communications ducts to allow communications between the Glenora Wind Farm Substation and the existing Tawnaghmore 110kV substation and 1 No. earth continuity conductor duct.

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 prior to the commencement of any construction activities. Detailed method statements will be prepared in respect of each aspect of the proposed development.

The grid connection cabling trench is not included in the planning application for the proposed Glenora Wind Farm. However, the methodologies and techniques to be implemented in the construction of the grid connection cabling trench are assessed in the Environmental Impact Assessment Report (EIAR).

2.0 Proposed Grid Connection Route

The UGC route is approximately 28km in length and runs in a predominately north westerly direction from the existing Tawnaghmore 110kV substation to the Glenora Wind Farm substation location utilising public local road networks, existing access tracks and forestry access tracks.

The exact location of the UGC within the curtilage of the existing access tracks, public local road network and forestry access tracks may be subject minor modification following confirmatory site investigations, to be undertaken prior to construction of the proposed wind farm development, to confirm the conditions predicted in the EIAR (Environmental Impact Assessment Report). The cable location will take into consideration Mayo County Council and all other relevant stakeholder requirements. Installation of the cable will be carried out in line with the methodologies outlined in this document and all relevant environmental protection measures included in the EIAR.

Figure 1 outlines the proposed UGC grid connection route, with the total length of each road type detailed in Table 2.

Table 1 - Glenora Wind Farm to Tawnaghmore 110kV Substation – UGC Route Location Summary

Table 1 – Approximate UGC Route Location of Preliminary Design:		
Private Access Rd	**Public Roads**	**Forestry Roads**
1,306m	21,870m	4,872m

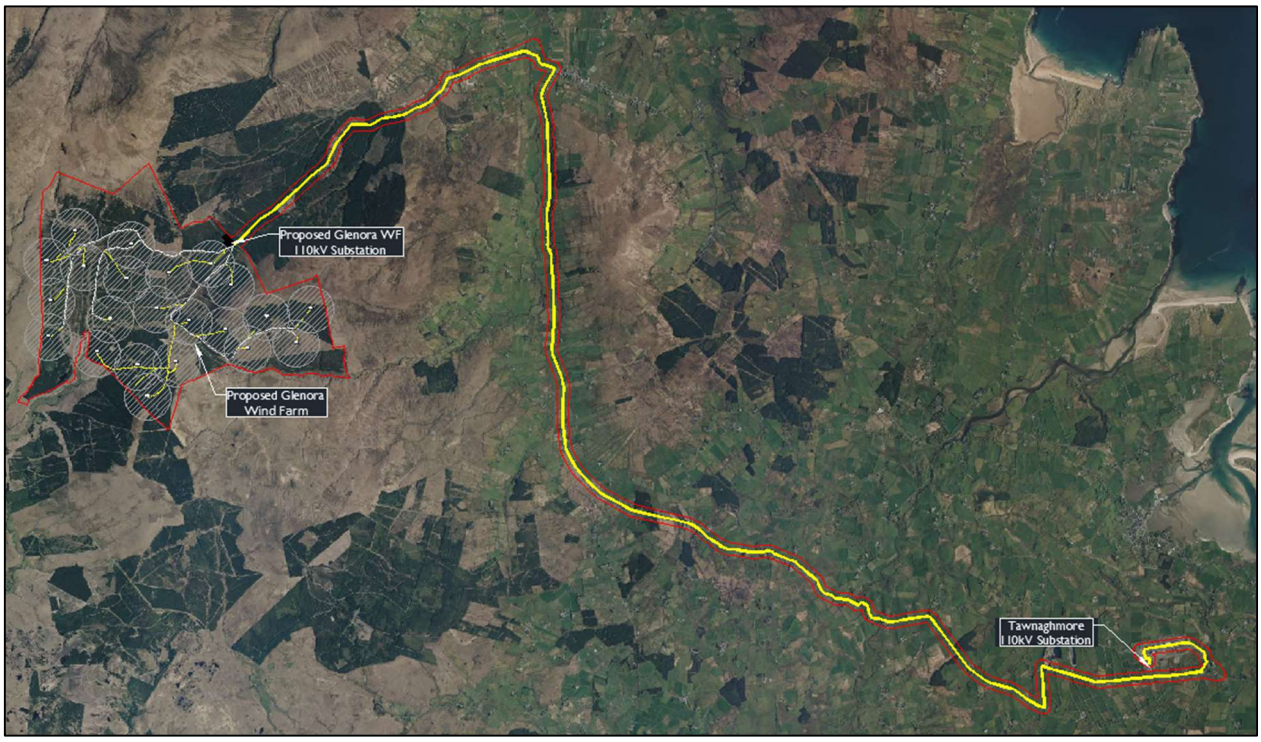


Figure 1 - Grid Connection Route Layout Plan

Table 2 below separates the UGC route into a number of sections and describes the specific construction requirements of each individual section with access routes to the work areas. All plant and equipment employed on the works will be subject to good site organisation (signage, vehicles parked within works areas etc.) and hygiene (washing down plant and cleaning road surfaces, as required), particularly during construction activities.

Table 2 - Summary of Grid Connection Design Route

Section	Description
Section 1 UGC 13,863 m	**UGC from Tawnaghmore 110kV substation to R315 Road.** The underground cable route initially begins within the site of the existing Tawnaghmore substation. The UGC then briefly travels north and then east for approx. 1.3km through private lands (Killala Business Park) until it reaches the public road (R-314). Here the UGC travels in a southern direction along the R-314 for approx. 170m where the UGC then heads southwest along a local tertiary road. After circa. 190m the route will encounter a junction where it turns and heads west along the local tertiary road for approx. 2960m, crossing beneath Bridge 1 and a Cattle underpass along the local tertiary road. The route then travels south, traversing within the deck of Bridge 2 and continues south for approx. 625m. The UGC then turns west at the junction, crossing beneath Bridge 3 and follows this local tertiary road northwest for approx. 8470m, encapsulating both Tonrehown Bridge (Bridge 4) and Bridge 5 along the route. From here the UGC merges onto the R-315 at a junction.

Features

Section 1 contains 18 No. joint bays.

Joint bays, described in Section 6.6 below, will be located below ground, within the curtilage of the existing road and finished/reinstated to the required roads specification. All joint bays will have associated communication chambers and mentioned joint bays will also include earth link boxes which will have a surface access hatch which will match existing ground levels.

- Joint Bay 01 (JB01) will be located at the northern entrance of Tawnaghmore 110kV Substation. An earth link box will also be located at this joint bay location.
- Joint Bay 02 (JB02) will be located approximately 770m northeast of JB01 within Killala Business Park. The joint bay is positioned on the access/entrance road for the Business Park.
- Joint Bay 03 (JB03) will be located approximately 755m southeast of JB02 positioning the joint bay within the local tertiary road.
- Joint Bay 04 (JB04) will be located approximately 770m west of JB03 in the local tertiary road. JB04 is located approx. 376m west of Bridge 1.
- Joint Bay 05 (JB05) will be located approximately 770m west of JB04 in the local tertiary road.
- Joint Bay 06 (JB06) will be located approximately 770m west of JB05 in the local tertiary road.
- Joint Bay 07 (JB07) will be located approximately 772m west of JB06 in the local tertiary road. An earth link box will also be located at this joint bay location.
- Joint Bay 08 (JB08) will be located approximately 978m southwest of JB07 in the local tertiary road. JB08 is located approx. 192m west of Bridge 3.
- Joint Bay 09 (JB09) will be located approximately 770m northwest of JB08 in the local tertiary road.
- Joint Bay 10 (JB10) will be located approximately 770m northwest of JB09 in the local tertiary road.
- Joint Bay 11 (JB11) will be located approximately 770m northwest of JB10 in the local tertiary road.
- Joint Bay 12 (JB12) will be located approximately 782m northwest of JB11 in the local tertiary road. JB12 is located approx. 274m east of Bridge 4.
- Joint Bay 13 (JB13) will be located approximately 768m west of JB12 in the local tertiary road.
- Joint Bay 14 (JB14) will be located approximately 785m northwest of JB13 in the local tertiary road.
- Joint Bay 15 (JB15) will be located approximately 765m west of JB14 in the local tertiary road.
- Joint Bay 16 (JB16) will be located approximately 780m west of JB15 in the local tertiary road.
- Joint Bay 17 (JB17) will be located approximately 770m northwest of JB16 in the local tertiary road. JB17 is located approx. 63m east of Bridge 5.

	• Joint Bay 18 (JB18) will be located approximately 757m west of JB17 in the local tertiary road. Section 1 has 5 No. bridge crossings: The UGC route crosses over a variation of bridges in section 1. These include flat slab, shuttered, single and multi-arch bridges. Insufficient clearance exists within a number of the bridge structures across grid connection route. Each of these bridges are described in further detail below in Section 8. Section 1 has 7 No. Culvert Crossings. A standard culvert crossing method is shown in drawing no. 05795-DR-115.
Section 2 UGC 14,318 m	**UGC from R-315 to Wind Farm Access Track (Via Ballycastle)** The UGC merges onto the Regional Road (R-315) at a junction with the local tertiary road. The route continues in a northern direction following the regional road (R-315) for approx. 7480m, encapsulating Bridge 6 and Bridge 7 along the UG route. The UGC then enters the village of Ballycastle where it turns onto the regional road (R-314) heading west for approx. 388m. Here the route then follows a local tertiary road to the west where it crosses Ballyglass Bridge (Bridge 8). The UGC route then continues west along this local tertiary road for approx. 1353m. Here the UGC route turns off the local tertiary road and continues mainly southwest along the forestry access track for approx. 4788m. Two flat slab bridges (Bridge 9 & Bridge 10) are crossed along the forestry access track. The UGC the turns to the north where it enters the proposed Glenora WF 110kV substation location. <u>Features</u> Section 2 contains 17 no. joint bays. Joint bays, described in Section 6.6 below, will be located below ground, within the curtilage of the existing road and finished/reinstated to the required roads specification. All joint bays will have associated communication chambers and mentioned joint bays will also include earth link boxes which will have a surface access hatch which will match existing ground levels. • Joint Bay 19 (JB19) will be located approximately 770m northwest of JB18 in the regional road (R-315). • Joint Bay 20 (JB20) will be located approximately 745m north of JB19 in the regional road (R-315). • Joint Bay 21 (JB21) will be located approximately 860m north of JB20 in the regional road (R-315). An earth link box will also be located at this joint bay location. • Joint Bay 22 (JB22) will be located approximately 766m north of JB21 in the regional road (R-315). JB22 is located approx. 82m south of Bridge 6. • Joint Bay 23 (JB23) will be located approximately 770m north of JB22 in the regional road (R-315). JB23 is located approx. 36m south of Bridge 7.

	• Joint Bay 24 (JB24) will be located approximately 750m north of JB23 in the regional road (R-315). • Joint Bay 25 (JB25) will be located approximately 760m north of JB24 in the regional road (R-315). • Joint Bay 26 (JB26) will be located approximately 750m north of JB25 in the regional road (R-315). • Joint Bay 27 (JB27) will be located approximately 765m north of JB26 in the regional road (R-315). • Joint Bay 28 (JB28) will be located approximately 870m north of JB27 in the regional road (R-315). An earth link box will also be located at this joint bay location. • Joint Bay 29 (JB29) will be located approximately 760m northwest of in the local tertiary road. JB 29 is approx. 111m east of Bridge 8. • Joint Bay 30 (JB30) will be located approximately 760m southwest of JB29 in the local tertiary road. • Joint Bay 31 (JB31) will be located approximately 760m southwest of JB30 on the forestry access track. JB31 is located approx. 361m east of Bridge 9. • Joint Bay 32 (JB32) will be located approximately 850m southwest of JB31 on the forestry access track. An earth link box will also be located at this joint bay location. • Joint Bay 33 (JB33) will be located approximately 760m southwest of JB32 on the forestry access track. JB33 is located approx. 356m east of Bridge 10. • Joint Bay 34 (JB34) will be located approximately 770m southwest of JB33 on the forestry access track. • Joint Bay 35 (JB35) will be located approximately 770m southwest of JB34 on the forestry access track. An earth link box will also be located at this joint bay location. • Joint Bay 36 (JB36) will be located approximately 842m southwest of JB35 on the forestry access track. An earth link box will also be located at this joint bay location. Section 2 has 5 No. bridge crossings: The UGC route crosses over a variation of bridges in section 2. These include flat slab, shuttered, single and multi-arch bridges. Insufficient clearance exists within a number of the bridge structures across grid connection route. Each of these bridges are described in further detail below in Section 8. Section 2 has 23 No. Culvert Crossings. A standard culvert crossing method is described in drawing no. 05795-DR-115.
Note: The precise location of the UGC route within the curtilage of the existing access tracks, public roads and forestry tracks may be subject to minor modifications following confirmatory site investigations prior to the construction phase of the proposed wind farm development.	

3.0 Description of Proposed Electrical Infrastructure

The proposed 110kV substation will consist of both EirGrid and IPP Control Room buildings, HV electrical equipment and associated infrastructure including palisade fences and concrete post and rail fences. The installation of HV electrical equipment will include a 110/33kV Transformer (TRAFO) with associated equipment along with:

- Cable Sealing End (CSE);
- Surge Arrestor (SA);
- Earth Disconnect (DT);
- Current /Voltage Transformer (CT/VT);
- House Transformer (HT);
- Circuit Breaker (CB);
- Lightning Mast (LM);
- 110kV underground cable to Tawnaghmore 110kV Station comprising 3 No Power Ducts, 2 No Telecoms Ducts and 1 No Earth Continuity Duct;
- Diesel Generator;
- Security Fencing and Cameras.

4.0 Description of Proposed Battery Energy Storage System (BESS)

The proposed development comprises a battery-based energy storage system (BESS) adjacent to the proposed Glenora Wind Farm 110kV Substation.

The development primarily consists of steel containers assembled in rows at the development site. Prior to installing the steel containers, clearance of the site area, levelling of the ground surface and creation of a hard stand will be undertaken. These containers and the adjacent infrastructure house the batteries, inverters, transformers, fire suppression equipment and associated electrical components. The containers will be mounted onto concrete plinth foundations. The containers shall be spaced to allow airflow around the containers, feeding their climate control systems.

In addition to the modular steel containers, other components of the development include:

- A grid transformer within the electrical compound;
- Above ground cable junction boxes/ cabling cabinets and cable racks/steel trunking facilitating the necessary electrical connections between containers;
- Underground ducting and cabling;
- A security fence around the perimeter of the proposed development;
- Communications equipment;
- Lightning protection poles;

5.0 Access Routes to Work Area

The proposed grid route will consist entirely of UGC. Where the proposed underground cable will be installed predominantly within the existing roads network, it will be accessed via the existing road network. The contractor(s) will be required to utilise the local public road network in the vicinity of the work area

and from there utilise private tracks, where appropriate. Prior to the commencement of development, precise access arrangements will be agreed with the respective landowners.

A detailed Traffic Management Plan will be prepared and agreed with Mayo County Council, prior to the commencement of construction.

Careful and considered local consultation will be carried out, to minimise the amount of disturbance caused during works. Prior to the commencement of construction, the contractor will assess all access routes and determine any additional access requirements which will be incorporated as part of the method statement. All plant and equipment employed during the proposed works (e.g., diggers, tracked machines, footwear etc.) will be inspected prior to arrival on site and on leaving site and cleaned where necessary to prevent the spread of invasive aquatic / riparian species.

6.0 Traffic Management

Traffic management and road signage will be in accordance with the Department of Transport: Traffic Signs Manual - Chapter 8: Temporary Traffic Measures and Signs for Road Works and in agreement with Mayo County Council. All work on public roads will be subject to the approval of a road opening license application by Mayo County Council. The contractor will prepare a detailed traffic management plan for inclusion as part of the road opening applications. Where road widths allow, the UGC installation works will allow for one side of the road to be open to traffic at all times by means of a 'Stop/Go' type traffic management system, where a minimum 2.5m roadway will be maintained at all times.

Where it is not possible to implement a 'Stop/Go' system a full road closure will be required. Temporary traffic signals will be implemented to allow road users safely pass through the works area by channelling them onto the open side of the road. Typically, the UGC will be installed in 150m sections, and no more than 100m will be excavated without the majority of the previous section being reinstated. Where the construction requires the crossing of a road, works on one carriageway will be completed before the second carriageway is opened, to maintain traffic flows.

All construction vehicles will be parked appropriately within the works area so as not to cause additional obstruction or inconvenience to road users or local residents. The traffic signals will be in place prior to the works commencing and will remain in place until after the works are completed. The public road will be checked regularly and maintained free of mud and debris. Road sweeping will be carried out as appropriate to ensure construction traffic does not adversely affect the local road condition.

In the event of emergency; steel plates, which will be available on site, can be put in place across the excavation to allow traffic to flow on both sides of the road. Access for local residents can be accommodated, although traffic flows during works may have to minimised.

All traffic management measures will comply with those outlined in the EIAR and will be incorporated into a detailed Traffic Management Plan (TMP) to be prepared, in consultation with Mayo County Council, prior to the commencement of UGC construction.

7.0 Road Opening Licence

The proposed UGC works will require a road opening licence under Section 254 of the Planning and Development Act 2000-2015 from Mayo County Council. A Traffic Management Plan (TMP) will be agreed with Mayo County Council prior to 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 with Mayo County Council in advance of the preparation of the TMP.

8.0 UGC Construction Methodology

The UGC trench will consist of 3 no. 160mm diameter HDPE power cable ducts and 2 no. 125mm diameter HDPE communications 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. The power cable ducts will accommodate 1 No. power cable per duct. The communications duct will accommodate a fibre cable to allow communications between the Glenora Wind Farm substation and Tawnaghmore 110kV substation. The inclusion 1 No. earth continuity conductor duct will also be required.

The ducts will be installed and the trench reinstated in accordance with the specifications of the Roads Section within Mayo County Council where installed in public roads and reinstated in accordance with the landowner's requirements where installed in private lands. The installation of the electrical cabling/fibre cable will be pulled through in one section in approximately 700 to 850m section lengths. Construction methodologies to be implemented and materials to be used will ensure that the UGC is installed in accordance with the requirements of the Council and private landowners.

8.1 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 within the EIAR where relevant;
- All existing underground services along the UGC route shall be identified on site prior to the commencement of construction works;
- Traffic management measures will be implemented in accordance with those included in Section 14.1 of the EIAR, and a detailed Traffic Management Plan will be prepared and agreed with Mayo County Council;
- The excavated trench will be approximately 825mm in width and approximately 1315mm deep both within the public road network and within private lands;
- The 160mm diameter HDPE cable ducting will be placed into the prepared trench, inspected and backfilled as per 3 & Figure 4.
- 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 Environmental Clerk of Works (ECoW);
- Excavated material shall be employed to backfill the trench where appropriate and any surplus material will be transported to one of the proposed on-site borrow pits;

- 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. (Please refer to Chapter 9 of the EIAR)
- 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 100 metres 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 07:00 to 19:00 and Saturday 07:00 to 13:00, with no works 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 between each joint bay, with the jointing of cables taking approximately 1 week per joint bay location.

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 diameter HDPE ducting;
- 125mm diameter HDPE ducting;
- 63mm diameter HDPE duct;
- Temporary Surface Reinstatement Materials.

Figure 2 - Typical 110kV Underground Duct Installation

8.2 Ducting Installation Methodology

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

- Grade, smooth and trim trench floor when the required 1315mm depth and 825mm width have been obtained.
- 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.
- 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.
- Carefully surround and cover ducts with CBGM B in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
- Place cable protection strips on compacted CBGM B directly over the ducts.
- Lay the top row of ducts onto the freshly compacted CBGM B including the cable 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.
- Carefully surround and cover ducts with CBGM B material in accordance with the drawings and thoroughly compact without damaging ducts.
- Place red cable protection strip on top of compacted CBGM B over each set 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 and/or landowners, unless otherwise agreed with local authority *(*Figure 3*).*
- For unsurfaced/grass sections, backfill with suitable excavated material to ground level leaving at least 100 mm topsoil or match existing level at the top to allow for seeding or replace turves as per the specification of the local authority or landowner *(*Figure 4*).*
- 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 in preparation for cable installation at a later date. All the works should be witnessed by ESBN Clerk of Works (CoW) as required.

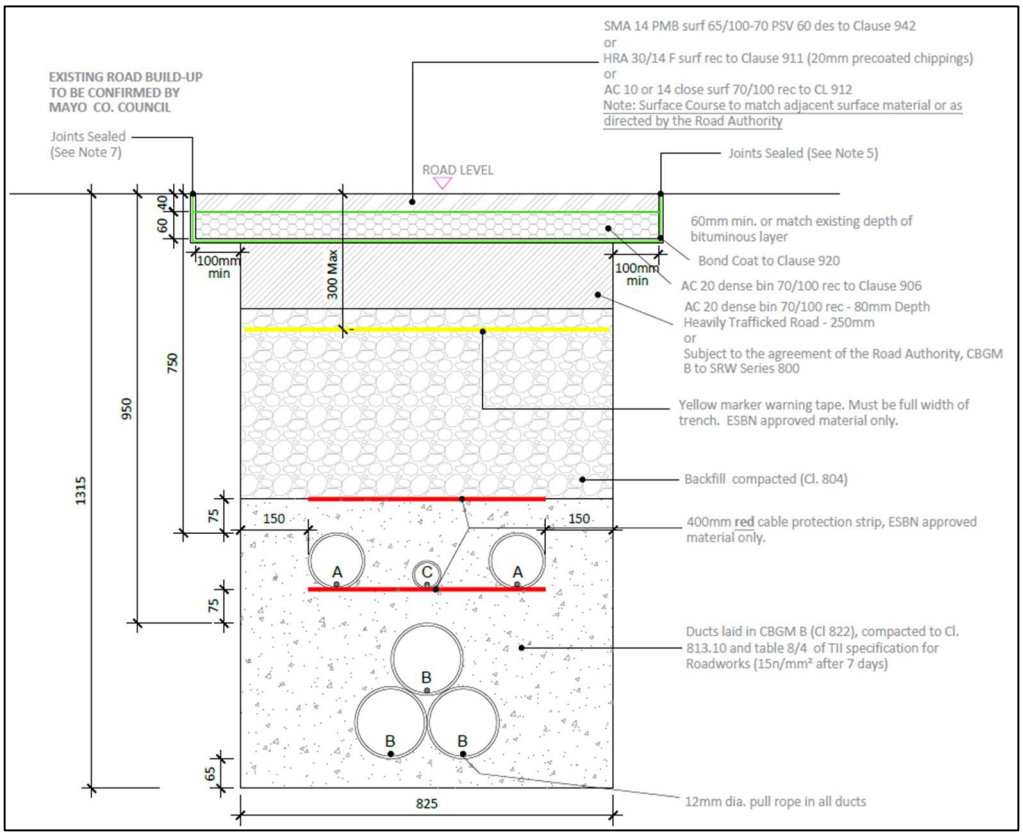


Figure 3 - Typical Trench in Road Section

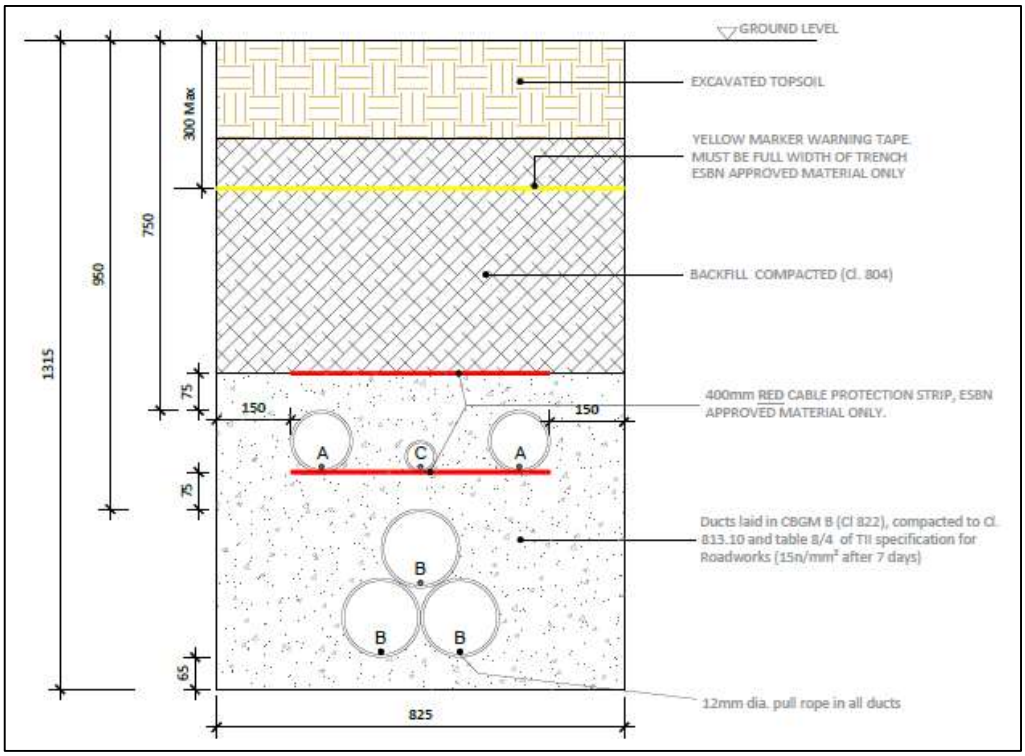


Figure 4 - Typical Trench in Off-Road Section

8.3 Cable Pulling

Once the ducting is installed the electrical cables (situated on a drum) are pulled through the ducting by a specialised mechanical winch. The winch will also monitor the tension on the cables being pulled so as not to damage the cables. A guide rope is installed with the ducting to assist in the cable pulling process. The guide rope also is used for proving the ducts by attaching a mandrel, a sponge or brush, for cleaning the duct installed. 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.

8.4 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 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 in the event that burial depth is not to standard. The precise siting of marker posts will be dictated by ESBN as part of the detailed design process.

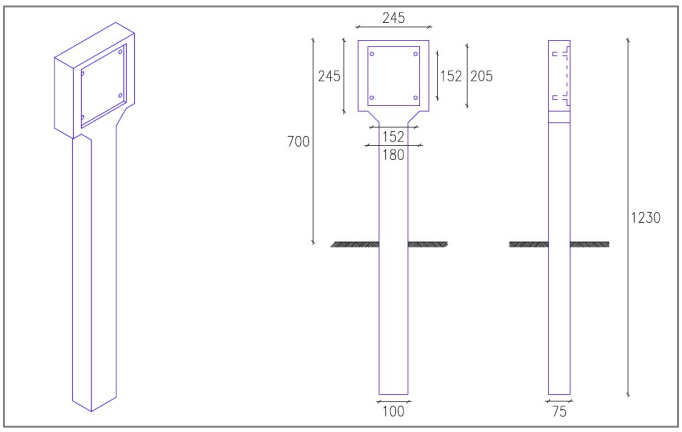


Figure 5 - ESB Marker Posts

8.5 Major Watercourse Crossings

The cable route will involve 10 No. bridge crossings including 10 No. HDD crossings. 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. The cable will be located within the bridge deck where there is sufficient depth and width available on the bridge, where there is insufficient depth and width available horizontal directional drilling (HDD) may be employed as an alternative.

The underground cable will encounter 30 no. culverts along the route. 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. The intended crossing methodology for each of the 30 no. culverts is included in Appendix A.

Existing culverts will be crossed using open trenching with either an undercrossing or an overcrossing, depending on the depth of the culvert. A confirmatory site survey of all culverts has been completed as part of this phase of the project prior to planning to confirm the crossing methods. The proposed standard culvert crossing methods are detailed in Figure 6 and Figure 7 and can be found in drawing 05795-DR-229.

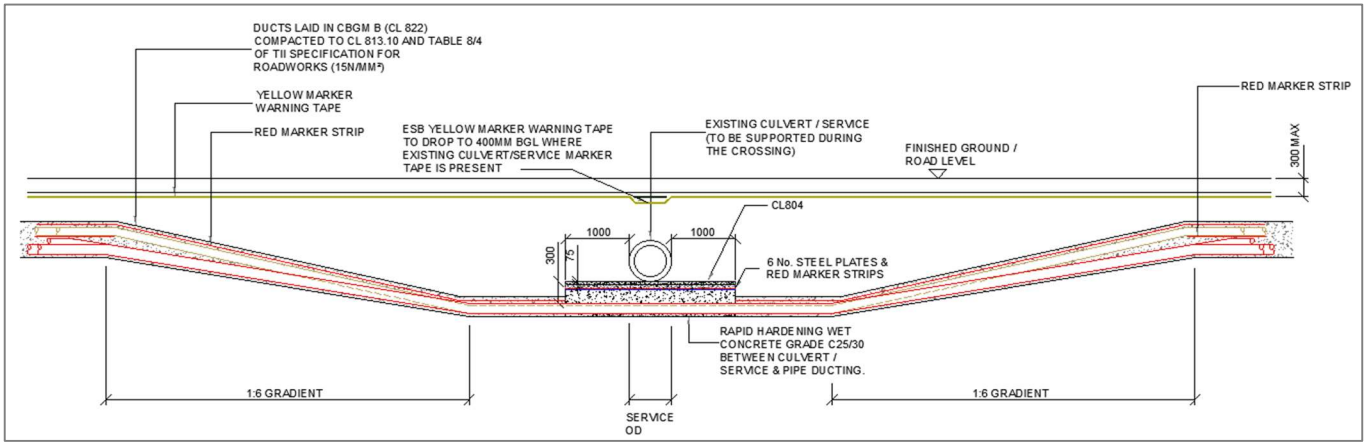


Figure 6 – 110kV UGC Culvert/Service Undercrossing

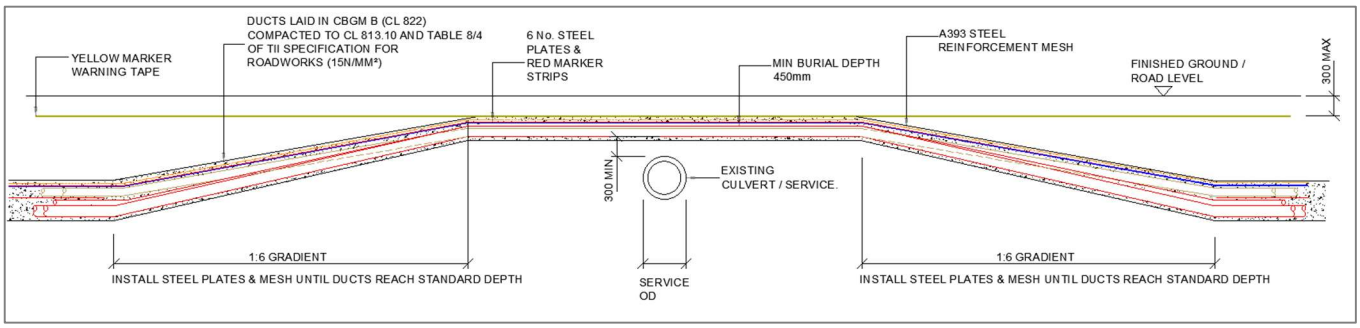


Figure 7 - 110kV UGC Culvert/Service Overcrossing

Inland Fisheries Ireland have 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 development.

8.5.1 Bridge 1 – Horizontal Directional Drilling

ITM Coordinates: 521146.15, 827499.32

Bridge 1 is located on a local tertiary road approx. 376m east of JB04 crossing over the 'Moyne 34' Stream (EPA Name). This steam flows in a northeast direction and into the Killala Bay/Moy Estuary S.A.C (Special Area of Conservation) & Killala Bay/Moy Estuary S.P.A (Special Protected Area).

The Bridge has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) therefore the suitability of the bridge is inadequate to accommodate the works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.** The methodology for HDD is outlined in Section 9 below.

See Drawing 05795-DR-231 for further details.

Figure 8 - Bridge 1

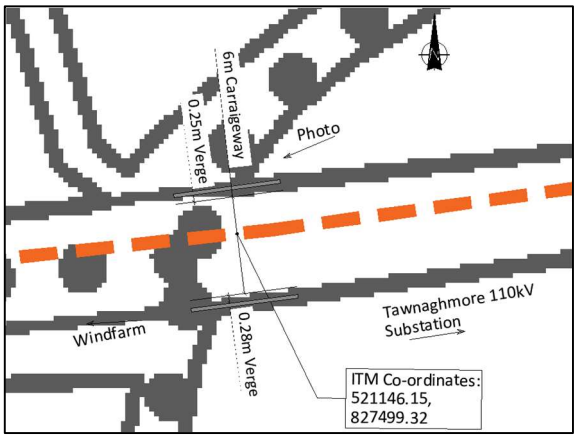


Figure 9 - Bridge 1 superimposed within OSI background.

8.5.2 Bridge 2 – Horizontal Directional Drilling

ITM Coordinates: 518521.59, 827062.75

Bridge 2 is located on a local tertiary road approx. 226m southeast of JB04 crossing over the 'Magherabrack 34' Stream (EPA Name).

The Bridge has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) therefore the suitability of the bridge is inadequate to accommodate the works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.** The methodology for HDD is outlined in Section 9 below.

See Drawing 05795-DR-232 for further details.

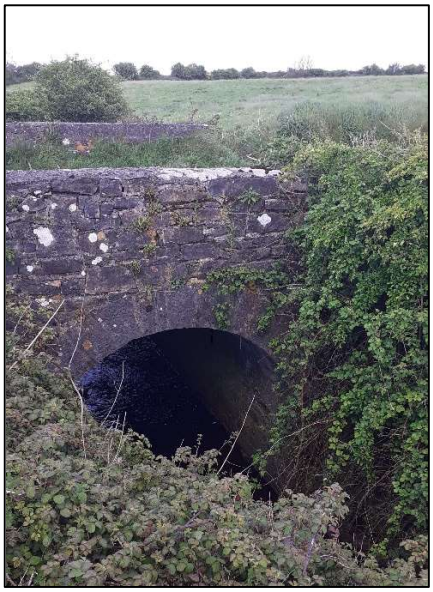


Figure 10 - Bridge 2

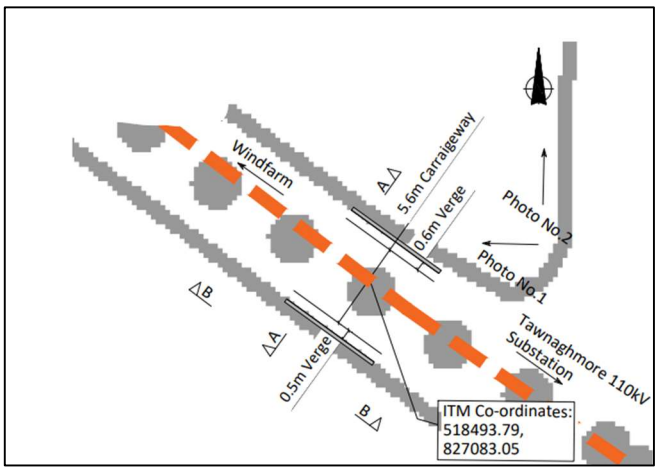


Figure 11 - Bridge 2 superimposed within OSI background.

8.5.3 Bridge 3 – Horizontal Directional Drilling

ITM Coordinates: 518493.79, 827083.05

Bridge 3 is located on a local tertiary road approx. 195m southeast of JB04 crossing over a stream. The Bridge has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the scope of works.

Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Due to the acute angle of the bridge to the road entering and exiting the bridge, drilling may not be feasible to take place from the road carriageway. Therefore, third-party lands will be required to drill the bridge structure.

See Drawing 05795-DR-233 for further details.

Figure 12 - Bridge 3

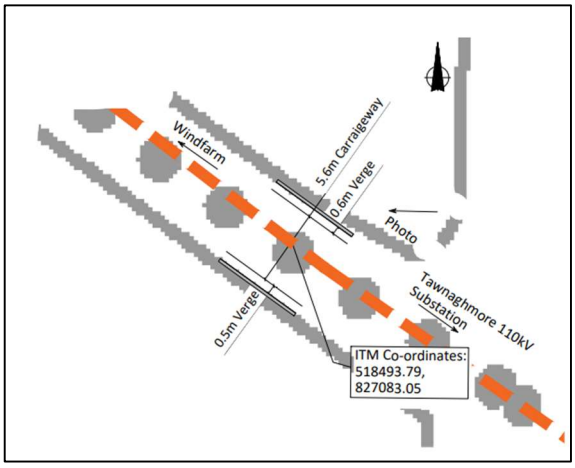


Figure 13 - Bridge 3 superimposed within OSI background.

8.5.4 Bridge 4 – Horizontal Directional Drilling

ITM Coordinates: 515681.64, 828681.55

Tonrehown Bridge (Bridge 4) is located on the local tertiary road approx. 274m west of JB12 crossing over the Cloonaghmore River. The Cloonaghmore River flows north downstream into the Killala Bay/Moy Estuary S.P.A (Special Protected Area). The Bridge has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the scope of works.

Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Due to the acute angle of the bridge to the road entering and exiting the bridge, drilling may not be feasible to take place from the road carriageway. Therefore, third-party lands will be required to drill parallel downstream from the bridge structure.

See Drawing 05795-DR-234 for further details.

Figure 14 - Bridge 4

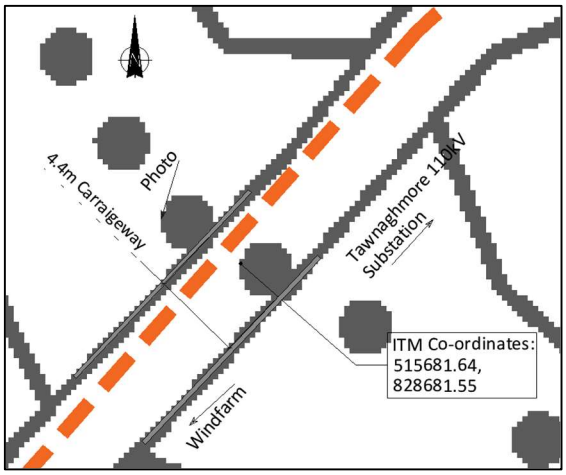


Figure 15 - Bridge 4 superimposed within OSI background.

8.5.5 Bridge 5 – Horizontal Directional Drilling

ITM Coordinates: 512647.61, 830072.02

Bridge 5 is located on a local tertiary road approx. 64m east of JB17 crossing a stream. Bridge 5 has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

See Drawing 05795-DR-235 for further details.

Figure 16 - Bridge 5

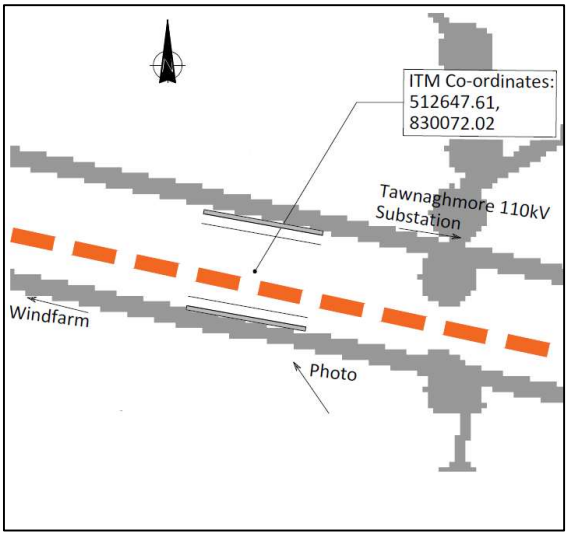


Figure 17 - Bridge 5 superimposed within OSI background.

8.5.6 Bridge 6 – Horizontal Directional Drilling

ITM Coordinates: 510515.40, 832929.22

Bridge 6 is located on the R315 approx. 83m north of JB22 crossing over the 'Annagh More 33' stream (EPA Name) which is a tributary stream to the Ballinglen River. Bridge 6 has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

See Drawing 05795-DR-236 for further details.

Figure 18 - Bridge 6

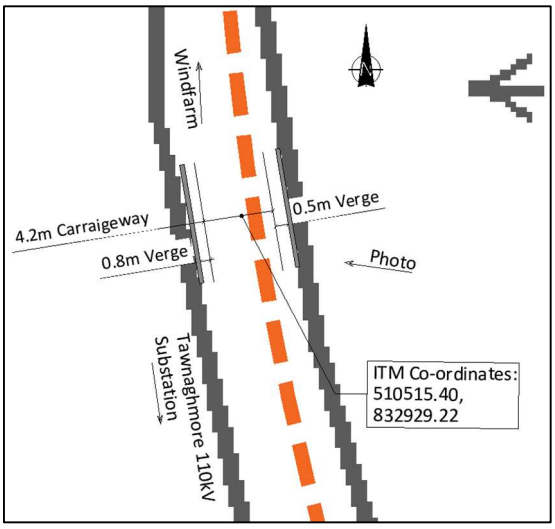


Figure 19 - Bridge 6 superimposed within OSI background.

8.5.7 Bridge 7 – Horizontal Directional Drilling

ITM Coordinates: 510548.22, 833648.85

Bridge 7 is located on the R315 approx. 40m north of JB23 crossing over a tributary Stream to the Ballinglen River. Bridge 7 has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

Bridge ID: MO-R315-018.00

See Drawing 05795-DR-237 for further details.

Figure 20 - Bridge 7

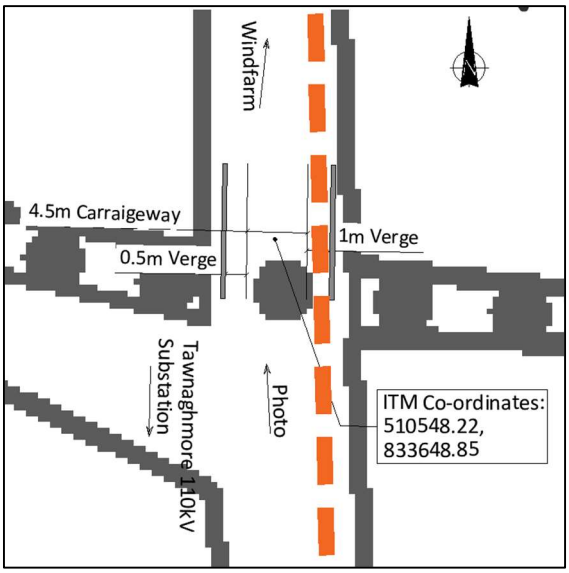


Figure 21 - Bridge 7 superimposed within OSI background.

8.5.8 Bridge 8 – Horizontal Directional Drilling

ITM Coordinates: 510050.29, 837939.32

Ballyglass Bridge (Bridge 8) is located on the local tertiary road approx. 109m west of JB29 crossing over the Ballinglen River. Bridge 8 has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. The preferred option is for drilling to take place from the road carriageway, however from onsite surveys this option may not be feasible given the angle of both the road entering and leaving the bridge.

See Drawing 05795-DR-238 for further details.

Figure 22 - Bridge 8

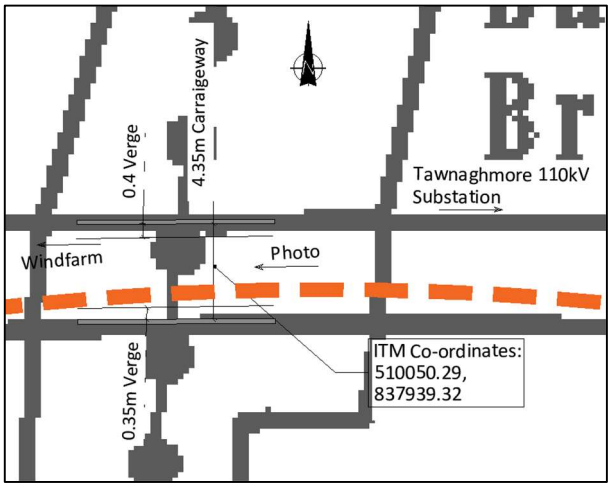


Figure 23 - Bridge 8 superimposed within OSI background.

8.5.9 Bridge 9 – Horizontal Directional Drilling

ITM Coordinates: 508536.07, 837161.08

Bridge 9 is located on a forestry access track approx. 361m southwest of JB31 crossing over 'Sralagagh East' River (EPA Name) a tributary River to the Glencullin River (Bellanaminnaun River). Bridge 9 is a flat concrete slab which has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

See Drawing 05795-DR-239 for further details.

Figure 24 - Bridge 9

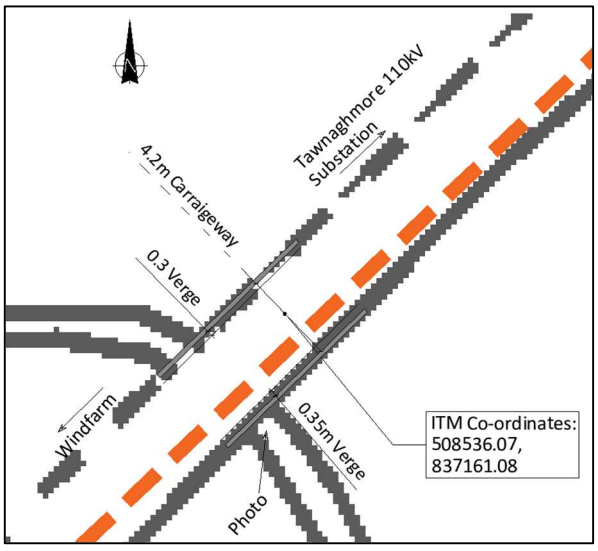


Figure 25 - Bridge 9 superimposed within OSI background.

8.5.10 Bridge 10 – Horizontal Directional Drilling

ITM Coordinates: 507730.07, 836822.01

Bridge 10 is located on a forestry access track approx. 407m southwest of JB32 crossing over the Glencullin River. Bridge 10 is also a flat concrete slab which has insufficient room to install the cable to ESBN and EirGrid specifications (450mm cover to top of ducts) and the suitability of the bridge is inadequate to accommodate the proposed works. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.**

See Drawing 05795-DR-240 for further details.

Figure 26 - Bridge 10

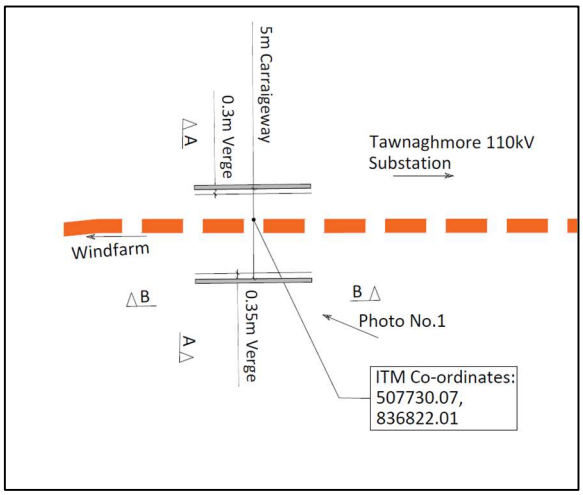


Figure 27 - Bridge 10 superimposed within OSI background.

8.6 Horizontal Directional Drilling

Horizontal Directional Drilling (HDD) is a method of drilling under obstacles such as bridges, railways, water courses, 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 are a number of bridges on this UGC route which will require HDD due to there being insufficient cover and depth in the bridge to cross within the bridge deck. The drilling methodology is as follows: -

1. A works area of circa. 40m^2 will be fenced on both sides of the river crossing,
2. The drilling rig and fluid handling units will be located on one side of the bridge and will be stored on double bunded 0.5mm PVC bunds which will contain any fluid spills and storm water run-off.
3. Entry and exit pits (1m x 1m x 2m) 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.
4. A 1m x 1m x 2m steel box will be placed in each pit. This box will contain any drilling fluid returns from the borehole.
5. The drill bit will be set up by a surveyor, and the driller will push the drill string into the ground and will steer the bore path under the watercourse.
6. A surveyor will monitor drilling works to ensure that the modelled stresses and collapse pressures are not exceeded.
7. The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit.
8. Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit pit and will pull a drill pipe back through the bore to the entry side.
9. Once all bore holes have been completed, a towing assembly will be set up on the drill and this will pull the ducting into the bore.
10. The steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.
11. The ducts will be cleaned and proven and their installed location surveyed.
12. The entry and exit pits will be reinstated to the specification of ESBN, EirGrid and Mayo County Council.
13. A transition coupler will be installed at either side of the bridge/ following the horizontal directional drilling as per ESBN and EirGrid requirements, this will join the HDD ducts to the standard ducts.

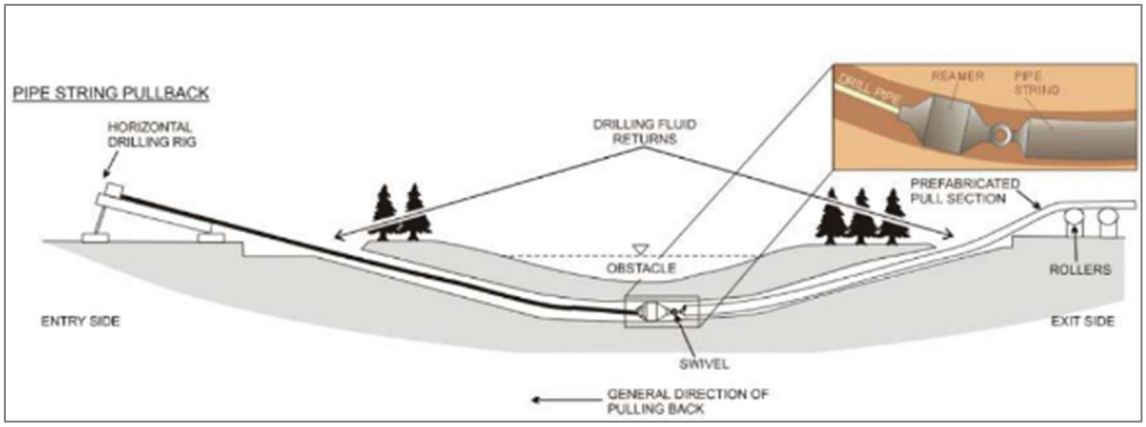


Figure 28 - Typical HDD Installation

8.7 Storage of Plant 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 proposed Glenora Wind Farm site. Oils and fuels will be stored in an appropriately bunded area within the temporary construction compounds.

8.8 Joint Bays and Associated Chambers

Joints Bays are to be provided approximately every 700m to 850m along the UGC routes to facilitate the jointing of 2 no. lengths of UGC. 110kV Joint Bays are typically 2.5m x 6m x 2.05m pre-cast concrete structures installed below finished ground level. Joint Bays will be located in the non-wheel bearing strip of roadways, however given the narrow profile of local roads this may not always be possible.

In association with Joint Bays, Communication Chambers are required at every joint bay location to facilitate communication links between Glenora Wind Farm and the existing Tawnaghmore 110kV Substation. Earth sheath links are used for earthing and bonding cable sheaths of underground power cables, installed in a flat formation so that the circulating currents and induced voltages are eliminated or reduced. Earth sheath link chambers and communication chambers are located close to joint bays. Earth sheath link chambers and communication chambers will typically be pre-cast concrete structures with an access cover at the finished surface level.

The precise siting of all joint bays, earth sheath link chambers, and communication chambers is subject to approval by ESBN. Marker posts will be used on non-roadway routes to delineate the duct route and joint bay positions. The marker posts will consist of a corrosion-proof aluminium triangular danger sign, with a 750mm base, and with a centred lightning symbol, on engineering grade fluorescent yellow background. They will be installed inadequately sized concrete foundations and will also be placed where the cable has not been buried to the standard depth, due to existing road conditions. Drawings of the joint bays and communication chambers are included within this planning package.

The precise siting of all Joint Bays, Earth Sheath Link Chambers and Communication Chambers, within the curtilage of the public road, is subject to approval by ESBN and EirGrid.

Equipment:

- 360° tracked excavator (wheeled excavator where required)
- 1 no. tracked dumper or tractor and trailer.

Materials:

- Sand for pipe bedding
- Ready-mix Concrete where necessary (delivered to site);
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- Precast Chamber Units / Construction materials for chambers
- Cable ducting

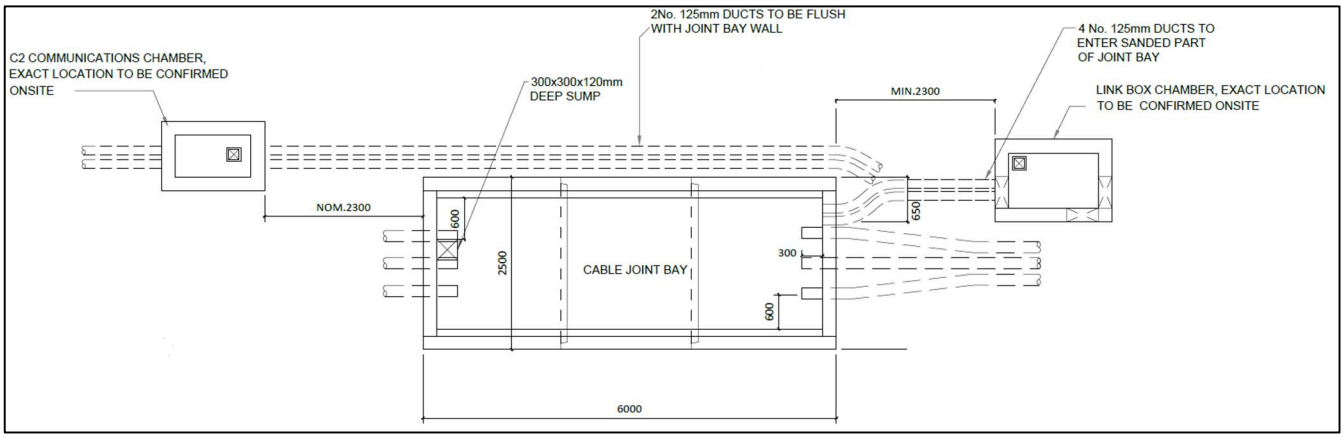


Figure 29 - 110kV Joint Bay Plan Layout

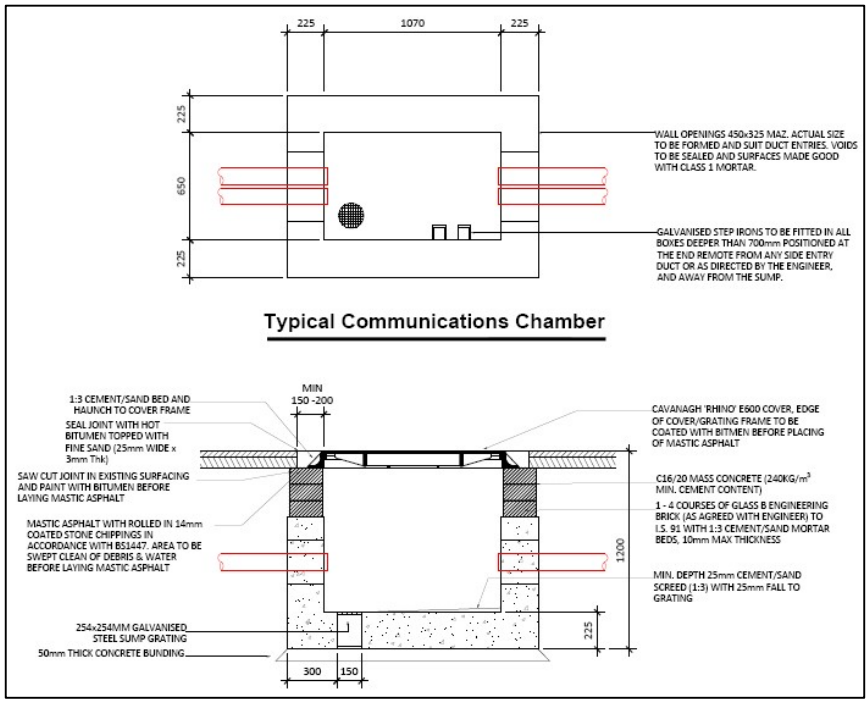


Figure 30 - Typical Communications Chamber

Figure 31 - Typical Sheath Link Chamber

9.0 Best Practice Design and Construction & Environmental Management Methodology

Prior to commencement of construction works the contractor will draw up detailed Method Statements which will be informed by this Construction Methodology, measures proposed within the CEMP, and the guidance documents and measures listed below. These 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 grid connection 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 proposed Glenora Wind Farm site and transported to the works zone immediately prior to 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 risk of run off from site;
- Provision of 50m exclusion zones and barriers (silt fences) between any excavated material and any surface water features to prevent sediment 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 prior to 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 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 spill kits 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 sites; 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.

10.0 Relocation of Existing Services

In order 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 with in order to determine the requirement for specific excavation or relocation methods and to schedule a suitable time to carry out works.

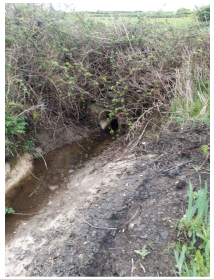
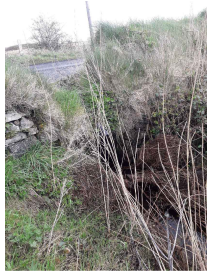
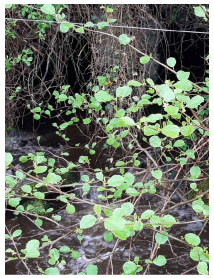
Appendix A

Culvert Crossing Schedule

ISO A2 420mm x 594mm

Project Management Initials: Designer: POS Checked: GH Approved: RG

Culvert Crossing Schedule

Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Crossing Methodology	Photo
1.	900 Ø (x2)	Concrete Pipe	1700	OVERCROSSING	
2.	300 Ø	Concrete Pipe	600	UNDERCROSSING	 
3.	1500 high x 1300 wide	Concrete Box Culvert	500	UNDERCROSSING	
4.	900 high x 500 wide	Stone Masonry Box	500	UNDERCROSSING	 
5.	TBC	Twin Stone Masonry Box	500	UNDERCROSSING	 

tli GROUP

Head Office
Beenreigh, Abbeydorney,
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Tel: 00353 66 7135710

PROJECT

Glenora Windfarm
110kV Grid Connection

CLIENT

Ireland FuturEnergy

SSE Renewables

CONSULTANTS

MKO

NOTES: -

- No structural surveys have been carried out and the proposals are subject to detailed design.
- Crossings are in compliance with EirGrid specification requirements for shallow formation, min depth, etc.
- Additional culverts may be encountered on the route.

LEGEND: -

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P00	31.05.22	Issued for EIAR Screening

PROJECT NUMBER

05-795

SHEET TITLE

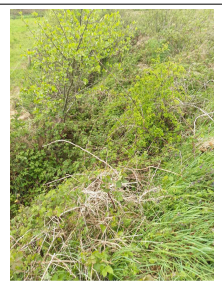
Culvert Crossing Schedule
Sheet 1 of 6
Culverts 1 to 5

SHEET NUMBER

05795-DR-250

ISO A2 420mm x 594mm

Culvert Crossing Schedule

Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Crossing Methodology	Photo
6.	TBC	Concrete Pipe	2000	OVERCROSSING	 
7.	TBC	Stone Masonry Box	300	UNDERCROSSING	 
8.	TBC	TBC	TBC	TBC	 
9.	TBC	Twin Stone Masonry Box	200	UNDERCROSSING	 
10.	TBC	Twin Stone Masonry Box	0	UNDERCROSSING	

Project Management Initials: Designer: POS Checked: GH Approved: RG

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LEGEND: -

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P00	31.05.22	Issued for EIAR Screening

PROJECT NUMBER

05-795

SHEET TITLE

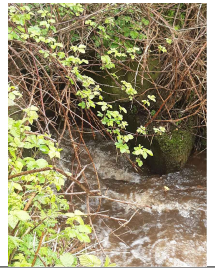
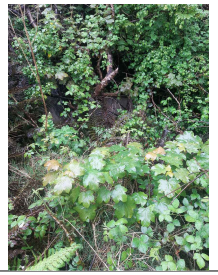
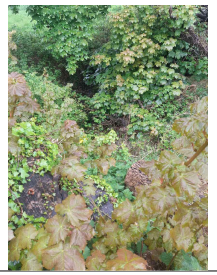
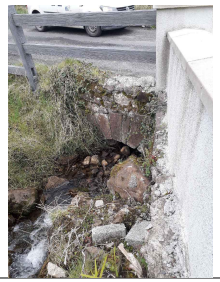
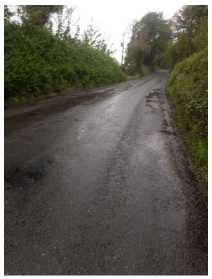
Culvert Crossing Schedule
Sheet 2 of 6
Culverts 6 to 10

SHEET NUMBER

05795-DR-251

ISO A2 420mm x 594mm

Culvert Crossing Schedule

Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Crossing Methodology	Photo
11.	TBC	Stone Masonry Box	400	UNDERCROSSING	 
12.	TBC	TBC	TBC - DEEP	OVERCROSSING	 
13.	TBC	Stone Masonry Arc	0	UNDERCROSSING	
14.	750	Concrete Pipe	1100	OVERCROSSING	 
15.	TBC	Stone Masonry Box	700	OVERCROSSING	 

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- Additional culverts may be encountered on the route.

LEGEND: -

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P00	31.05.22	Issued for EIAR Screening

PROJECT NUMBER

05-795

SHEET TITLE

Culvert Crossing Schedule
Sheet 3 of 6
Culverts 11 to 15

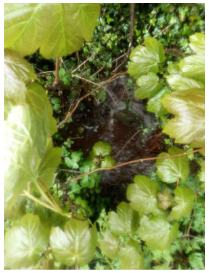
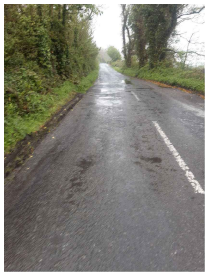
SHEET NUMBER

05795-DR-252

Project Management Initials: Designer: POS Checked: GH Approved: RG

ISO A2 420mm x 594mm

Culvert Crossing Schedule

Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Crossing Methodology	Photo
16.	500 high x 500 wide (x2)	Twin Stone Masonry Box	450	UNDERCROSSING	
17.	600 high x 800 wide	Stone Masonry Box	150	UNDERCROSSING	 
18.	TBC	Concrete Pipe	300	UNDERCROSSING	 
19.	TBC	Stone Masonry Box	700	UNDERCROSSING	 
20.	TBC	Stone Masonry Box	1200	OVERCROSSING	 

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Tel: 00353 66 7135710

PROJECT

Glenora Windfarm
110kV Grid Connection

CLIENT

Ireland FuturEnergy

SSE Renewables

CONSULTANTS

MKO

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PROJECT NUMBER

05-795

SHEET TITLE

Culvert Crossing Schedule
Sheet 4 of 6
Culverts 16 to 20

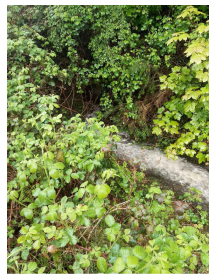
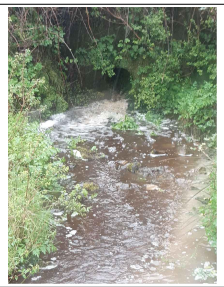
SHEET NUMBER

05795-DR-253

Project Management Initials: Designer: POS Checked: GH Approved: RG

ISO A2 420mm x 594mm

Culvert Crossing Schedule

Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Crossing Methodology	Photo
21.	300 Ø	Concrete Pipe	TBC	TBC	 
22.	300 Ø	Concrete Pipe	2000	OVERCROSSING	
23.	TBC	Concrete Pipe	1800	OVERCROSSING	
24.	TBC	Concrete Pipe	400	UNDERCROSSING	 
25.	TBC	Concrete Pipe Stone Surround	1400	OVERCROSSING	

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PROJECT

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PROJECT NUMBER

05-795

SHEET TITLE

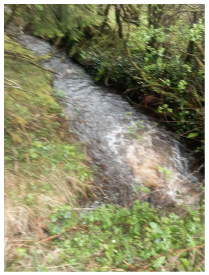
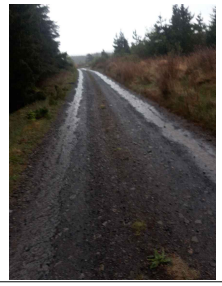
Culvert Crossing Schedule
Sheet 5 of 6
Culverts 21 to 25

SHEET NUMBER

05795-DR-254

ISO A2 420mm x 594mm

Culvert Crossing Schedule

Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Crossing Methodology	Photo
26.	300 Ø	Concrete Pipe	1000	OVERCROSSING	 
27.	300 Ø	HDPE Twin Walled Pipe	200	UNDERCROSSING	 
28.	TBC	HDPE Twin Walled Pipe	600	UNDERCROSSING	 
29.	TBC	Stone Masonry Box	1500	OVERCROSSING	 
30.	400	Concrete Pipe	1000	OVERCROSSING	 

Project Management Initials: Designer: POS Checked: GH Approved: RG

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PROJECT NUMBER

05-795

SHEET TITLE

Culvert Crossing Schedule
Sheet 6 of 6
Culverts 26 to 30

SHEET NUMBER

05795-DR-255