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# OUTLINE CONSTRUCTION METHODOLOGY

Proposed Kellystown Wind Farm, 38kV Grid  
Connection

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Client: EDF Renewables c/o Jennings O Donovan

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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 proposed Kellystown Wind Farm 38kV grid connection to the Drybridge 110 kV Substation, Drogheda, Co. Louth. The 38kV grid connection route will consist entirely of underground cables (UGC) which will be installed in the public road network and private lands. The UGC works will consist of the installation of 4 No. ducts in an excavated trench to accommodate 3 no. power cables and 1 no. fibre communications cable.

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 Grid Connection Route

The grid connection utilises UGC with a route length of approx. 12.65km in total. A UGC will exit the Drybridge 110kV Substation Compound and turns west onto the Slane Road, L-20000 for 100m before turning north along the L-2322 for 200m. The UGC veers north-east onto the N51 toward the roundabout at Drogheda North, which is junction 10 on the M1 motorway.

The cable then is routed north-west on the R168 for 750m. At Tullyallen, the cable route turns south east onto a disused section of road for 250m. A cul de sac is reached at the the M1 motorway. It is proposed to utilise Horizontal Directional Drilling (HDD) method to cross beneath the M1 motorway. On the east side of the motorway the UGC cable continues along the L-63324.

At the fork on the road the UGC route veers south east along the L-6332. At the bridge named Waterunder Bridge, a HDD method will be employed to cross beneath the bridge. The UGC turns east at the roundabout at Mell and carries on along the R-166. At Moneymore, the route turns north-west onto R-132 and continues for 2.6km along the R-132. The UGC then crosses into the L-23083, a quiet residential section of road. A sharp south-east turn is taken at Tulliskar onto the L-2308 for approximately 3km. On the L-2308, there is a bridge, with a stone arch underneath the road without bridge parapets, at Carntown. A HDD method will be employed to cross beneath this bridge.

The UGC turns north onto the L-2310 for 0.9km and thereafter transitions into the L-2275. On the L-2275 there is two culverts to be crossed. A HDD will be employed to cross beneath these culverts. As the UGC route approaches Piperstown there is an old stone built bridge, where again a HDD will be employed to cross beneath this bridge. At Piperstown the UGC turns west and enters wind farm lands via a private access route. Accessing the windfarm from the southeast corner, the grid connection route will then head north along the boundary of the windfarm before reaching the on site windfarm substation. The cable route distance from the public road L-2275 to the windfarm substation is circa. 900m.

The exact location of the UGC will be determined following a further detailed assessment to be undertaken before construction and following consultation with Louth County Council and all other relevant stakeholders, having regard for all environmental protection measures required.

**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 two sections and examined in detail in **Table 2**.

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Table 1 – UGC Route Location Summary			
Wind Farm Site	Private Land	Public Road	Total
900m	0m	11750m	12650m

Table 1: Drybridge 110kV Substation to Kellystown Windfarm 38kV Substation – UGC Route Location Summary



Figure 1 - Proposed Grid Connection Route

Table 2 below describes the specific construction features along the routes described above and identifies access routes to the work areas. All plant and equipment employed on the proposed works will be subject to good site organisation and hygiene, particularly during construction activities.

Table 2 - Summary of Features along Grid Connection Design Route	
Section	Description
<p><b>38kV UGC Route</b></p> <p><b>Section 1</b></p> <p><b>6325m</b></p>	<p><b>Drybridge 110kV Substation to turnoff onto L2308 at Tullyeskar</b></p> <p>A UGC will exit the Drybridge 110kV Substation Compound and turns west onto the Slane Road, L-20000 for 100m before turning north along the L-2322 for 200m. The UGC veers north-east onto the N51 toward the roundabout at Drogheda North, which is junction 10 on the M1 motorway. The cable then is routed north-west on the R168 for 750m. At Tullyallen, the cable route turns south east onto a disused section of road for 250m. A cul de sac is reached at the the M1 motorway. It is proposed to utilise Horizontal Directional Drilling (HDD) method to cross beneath the M1 motorway. On the east side of the motorway the UGC cable continues along the L-63324. At the fork on the road the UGC route veers south east along the L-6332. At the bridge named Waterunder Bridge, a HDD method will be employed to cross beneath the bridge. The UGC turns east at the roundabout at Mell and carries on along the R-166. At Moneymore, the route turns north-west onto R-132 and continues for 2.6km along the R-132. The UGC then crosses into the L-23083, a quiet residential section of road. A sharp south-east turn is taken at Tullyeskar.</p> <p><b>Features</b></p> <p>This section contains 8 No. joint bays. The Joint Bays will be located below ground and finished within the existing carriageway and reinstated as per Purple Book specifications whilst adhering to the ESN functional specification. Every second joint bay will have an associated communication chamber which will have a surface access hatch that will match existing ground levels. The location of the joint bay is shown on the Site Layout Plans.</p> <ul style="list-style-type: none"> <li>▪ Joint Bay 01 (JB-01) will be located at the entrance of Drybridge 110kV Substation compound within ESB property.</li> <li>▪ Joint Bay 02 (JB-02) will be located approx. 1050m subsequent to the location of JB-01. It is proposed that this Joint Bay will be installed within the R-168.</li> <li>▪ Joint Bay 03 (JB-03) will be located approx. 700m subsequent to the location of JB-02. It is proposed that this Joint Bay will be installed within the L-63324.</li> <li>▪ Joint Bay 04 (JB-04) will be located approx. 920m subsequent to the location of JB-03. It is proposed that this Joint Bay will be installed within the R-166.</li> <li>▪ Joint Bay 05 (JB-05) will be located approx. 830m subsequent to the location of JB-04. It is proposed that this Joint Bay will be installed within the R -132.</li> <li>▪ Joint Bay 06 (JB-06) will be located approx. 700m subsequent to the location of JB-05. It is proposed that this Joint Bay will be installed within the R-132.</li> <li>▪ Joint Bay 07 (JB-07) will be located approx. 960m subsequent to the location of JB-06. It is proposed that this Joint Bay will be installed within the R-132.</li> <li>▪ Joint Bay 08 (JB-08) will be located approx. 990m subsequent to the location of JB-07. It is proposed that this Joint Bay will be installed within the L-23083.</li> </ul>

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	<p>This section of the route contains 2 No. HDD Crossing.</p> <p>The UGC encounters the M1 motorway at Drogheda North. It is proposed to utilise Horizontal Directional Drilling(HDD) method to cross beneath the motorway. The HDD will launch from the west side of the motorway exit on the east side of the M1 via a transition chamber. See drawing 05949-DR-119 for reference.</p> <p>The UGC encounters the Waterunder Bridge on the L-6332. This is a small stone built bridge. It is proposed to utilise Horizontal Directional Drilling (HDD) method to cross beneath the river and bridge structure. It will be necessary to cross this bridge using HDD as there is insufficient cover within the bridge deck to facilitate the power and communication duct while maintaining sufficient cover over the ducts (450mm cover required). See drawing 05949-DR-120 for reference.</p> <p><b>Section 1</b> of route is shown in Site Layout Plan Drawings 05949-DR-101,102,103,104.</p>
<p><b>38kV UGC Route</b></p> <p><b>Section 2</b></p> <p><b>6325m</b></p>	<p><b>L-2308 to Kellystown Wind Farm 38kV Substation</b></p> <p>Section 2 of this route begins on the L-2308, and progresses through the L-2308 for 3km. There is a bridge, with a stone arch underneath the road without bridge parapets, at Carntown. A HDD method will be employed to cross beneath this bridge/culvert. The UGC turns north onto the L-2310 for 0.9km and thereafter transitions into the L-2275. On the L-2275 there is two culverts to be crossed by HDD. A HDD will be employed to cross beneath these culverts. As the UGC route approaches Piperstown there is an old stone built Bridge, where again a HDD will be employed to cross beneath this bridge. At Piperstown the UGC turns west and enters wind farm lands via a private access route. Accessing the windfarm from the southeast corner, the grid connection route will then head north along the boundary of the windfarm before reaching the on site windfarm substation. The cable route distance from the public road L-2275 to the windfarm substation is circa. 900m.</p> <p><b>Features</b></p> <p>This section contains 6 No. joint bays. The Joint Bays will be located below ground and finished/reinstated to the specification of the required road. Every second joint bay will have an associated link box chamber which will have a surface access hatch that will match existing ground levels. The location of the joint bay is shown on the Site Layout Plans.</p> <ul style="list-style-type: none"> <li>▪ Joint Bay 09 (JB-09) will be located approx. 960m subsequent to the location of JB-08. It is proposed that this Joint Bay will be installed within the road L-2308.</li> <li>▪ Joint Bay 10 (JB-10) will be located approx. 1070m subsequent to the location of JB-09. It is proposed that this Joint Bay will be installed within the road L-2308.</li> <li>▪ Joint Bay 11 (JB-11) will be located approx. 1040m subsequent to the location of JB-10. It is proposed that this Joint Bay will be installed within the road L-2308.</li> <li>▪ Joint Bay 12 (JB-12) will be located approx. 990m subsequent to the location of JB-11. It is proposed that this Joint Bay will be installed within the road L-2310.</li> <li>▪ Joint Bay 13 (JB-13) will be located approx. 970m north to the location of JB-12. It is proposed that this Joint Bay will be installed within the road L-2275.</li> </ul>

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- Joint Bay 14 (JB-14) will be located approx. 940m subsequent to the location of JB-13. It is proposed that this Joint Bay will be installed within the private access path to the windfarm.

This section of route contains 4 No. HDD Crossing.

The UGC encounters a Bridge watercrossing on the L-2308 between JB10 and JB11 at Carntown. This is a Bridge with stone built arch in substructure under the road and no bridge parapets at road level. It is proposed to utilise Horizontal Directional Drilling (HDD) method to cross beneath the waterway and bridge structure. It will be necessary to cross this bridge using HDD as there is insufficient cover within the bridge deck to facilitate the power and communication duct while maintaining sufficient cover over the ducts (450mm cover required). See drawing 05949-DR-121 for reference.

The UGC encounters a Culvert watercrossing on the on the L-2310 between JB12 and JB13 at Tullyard, located 300m north of JB12. This is a Culvert not visible from the road. It is proposed to utilise Horizontal Directional Drilling (HDD) method to cross beneath the culvert. See drawing 05949-DR-122 for reference.

The UGC encounters a Culvert watercrossing on the on the L-2310 between JB12 and JB13 at Tullyard, located 500m south of JB13. This is a stone built Culvert in poor condition. It is proposed to utilise Horizontal Directional Drilling (HDD) method to cross beneath the culvert. See drawing 05949-DR-123 for reference.

The UGC encounters a Bridge watercrossing on the on the L-2275 between JB13 and JB14 at Piperstown. This is a rustic Bridge with stone built double box construction in substructure under the road and stone parapets at road level. It is proposed to utilise Horizontal Directional Drilling (HDD) method to cross beneath this Bridge structure. It will be necessary to cross this bridge using HDD as there is insufficient cover within the bridge deck to facilitate the power and communication duct while maintaining sufficient cover over the ducts (450mm cover required). See drawing 05949-DR-124 for reference.

**Section 2** of route is shown in Site Layout Plan Drawings 05949-DR-104,105,106.

**Table 2: Summary of Features along Grid Connection Design Routes**

### 3.0 Preliminary Site Investigations

It may be proposed to carry out Preliminary site investigations along the cable route before construction to confirm design assumptions.

The following items may be carried out:

#### 3.1 UGC Route

Slit trenches at locations of major service crossings (Half road width).

Boreholes at specified HDD locations either side of obstacle to assert ground composition

7 No. trial holes along the route to ascertain ground conditions and thermal resistivity of the soil.

Traffic Management – Single road closure for public local road network.

#### Equipment:

- 4x4 vehicle
- Concrete vibrator
- Wheeled dumper
- Soil compactor
- 360° tracked excavator (only rubber-tracked machines will be allowed on public roads)

### 4.0 UGC Construction Methodology

The proposed UGC trench will consist of 3 no. 110mm diameter HDPE power cable ducts and 1 no. 110mm diameter HDPE communications duct to be installed in an excavated trench, typically 600mm wide by 1220mm deep, with variations on this design to adapt to service crossings and watercourse crossings. The power cable ducts will accommodate 3 no. power cables. The communications duct will accommodate a fibre cable to allow communications between the Kellystown Windfarm Substation and the ESB Drybridge 110 kV Substation.

The ducts will be installed and the trench reinstated in accordance with the local road's authority within Louth County Council where installed on public roads and reinstated in accordance with the landowner's requirements where installed on private lands. The installation of the electrical cabling/fibre cable will be pulled through in some sections. 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.

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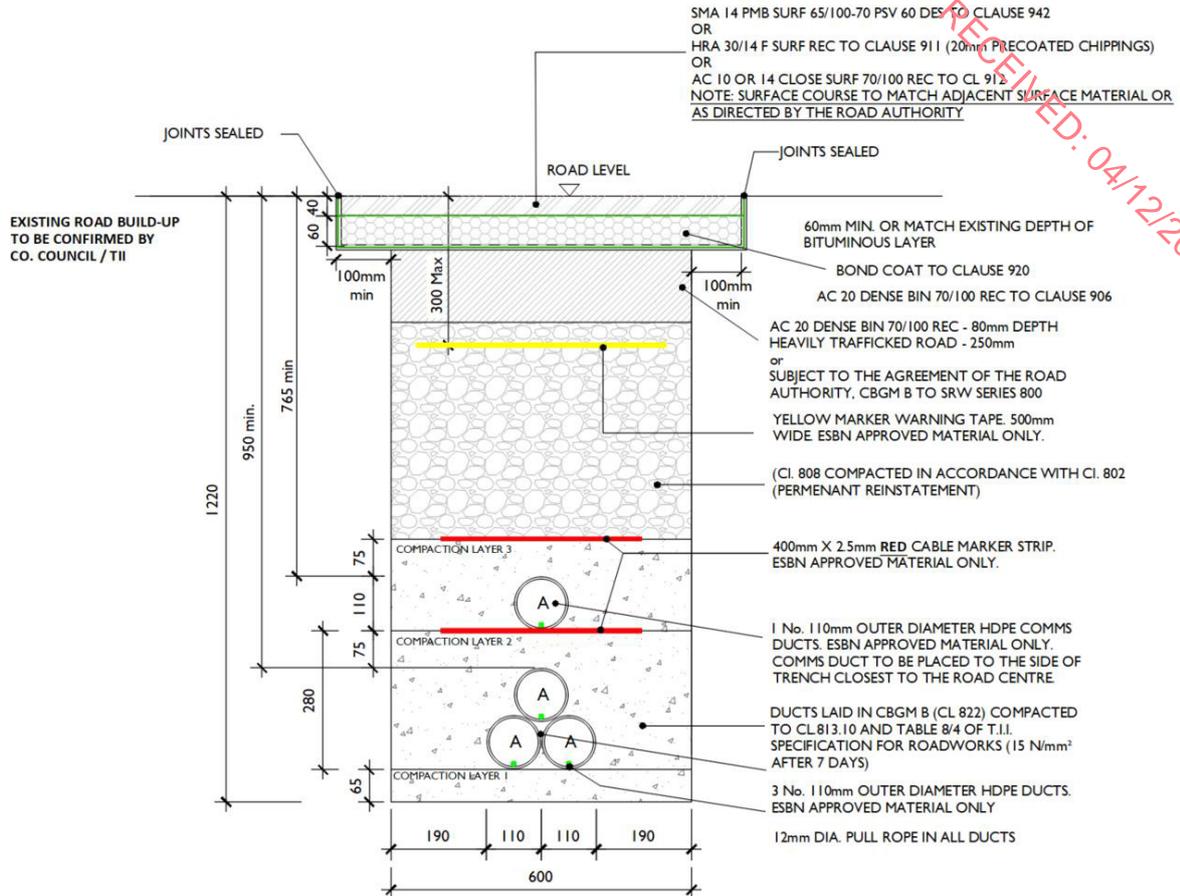
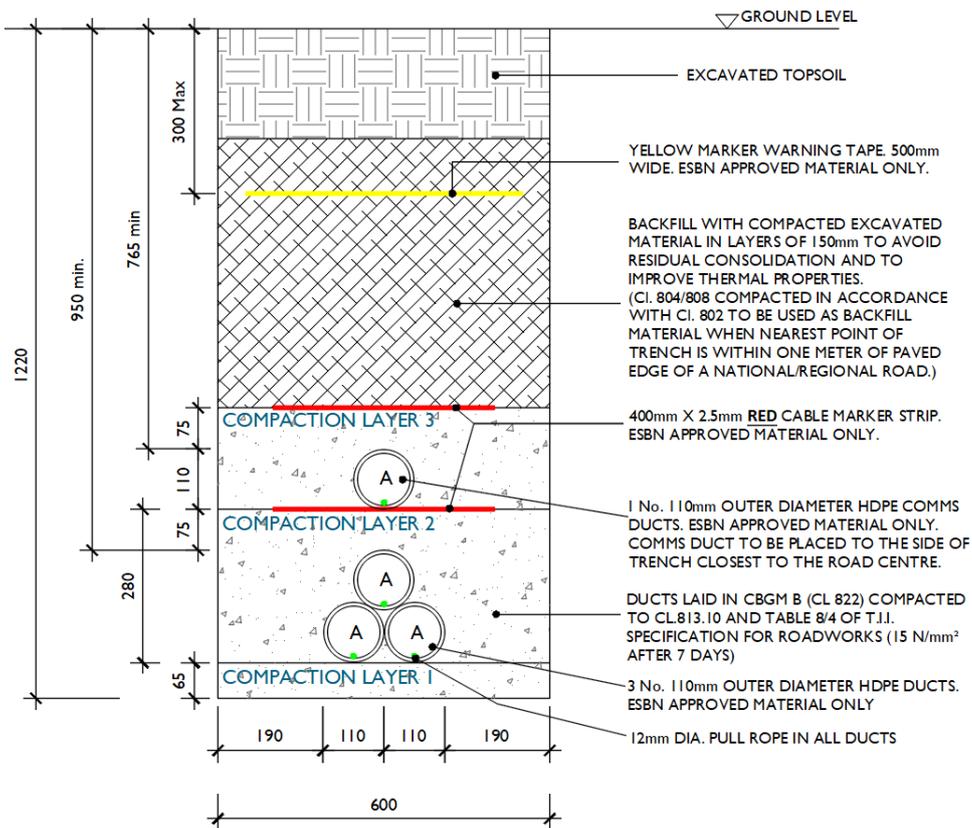


Figure 2 - Typical Trench in Road Section



A = 110mm OUTER DIAMETER HDPE ESB APPROVED DUCT, SDR=17.6

Figure 3 - Typical Trench in Off-Road Section

## 4.1 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 aluminum triangular danger signs, with a 700mm base, and with centered lightning symbol, on fluorescent yellow background shall be installed inadequately 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.

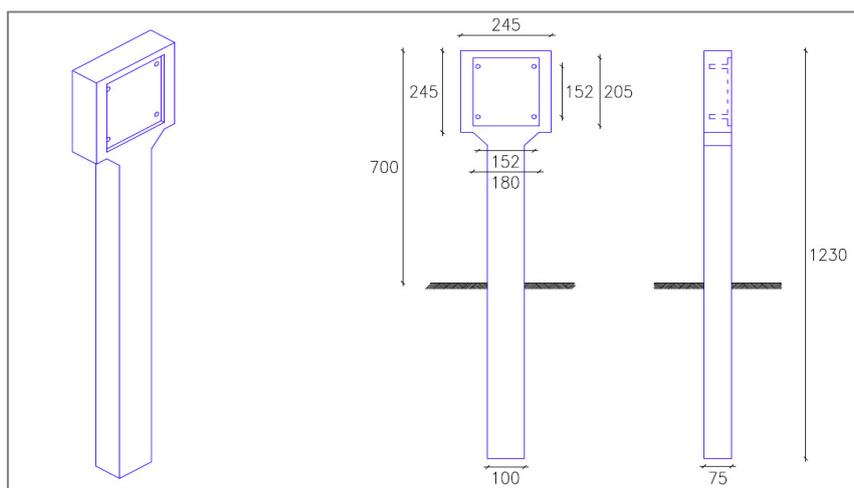


Figure 4 - ESB Marker Posts

## 4.2 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 Fingal County Council;
- The excavated trench will be approximately 600mm in width and approximately 1220mm deep both within the public road network and within private lands;
- The base of the excavated trench will be lined with sand bedding to be imported to the site from a local licensed supplier. The 110mm diameter HDPE cable ducting will be placed into the prepared trench, inspected, and backfilled as per Figures 2 & 3.
- 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;

- 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 70m 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 18:00, 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;
- Ready-mix Concrete where necessary (delivered to site);
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- 110mm diameter HDPE ducting;
- Temporary Surface Reinstatement Materials.



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Figure 5 - Typical 38kV Underground Duct Installation

### 4.3 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.

### 4.4 Storage of Plant and Machinery

All plant, machinery, and equipment will be stored on-site within the works area or within the temporary construction compound to be located within the permitted wind farm sites. Oils and fuels will not be stored on-site and will be stored in an appropriately bunded area within the temporary storage compound.

### 4.5 Joint Bays and Associated Chambers

Joint Bays are to be provided approximately every 850-1000m along the UGC routes to facilitate the jointing of 2 no. lengths of UGC. 38kV Joint Bays are typically 2.03m x 4.5m x 1.475m pre-cast concrete structures installed below the finished ground level.

In association with Joint Bays, Communication Chambers are required at every second joint bay location to facilitate communication links between Kellystown Windfarm and the existing 110kV substation at Drybridge, Co Louth. Communication Chambers are located close to Joint Bays and will typically be pre-cast concrete structures with an access cover at the finished surface level.

The precise siting of all Joint Bays 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 aluminum triangular danger sign, with a 750mm base, and with a centered lightning symbol, on an 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.

**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

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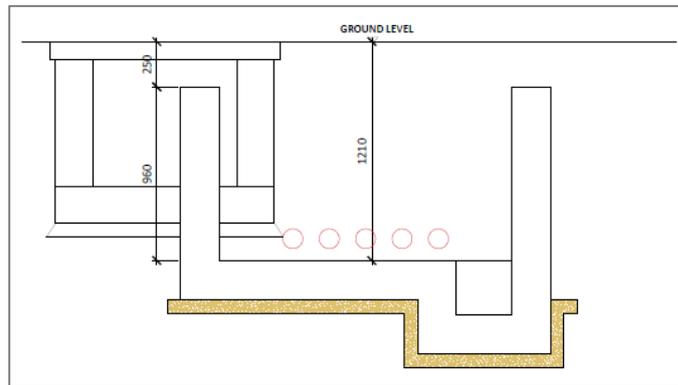


Figure 6 - Typical Section through Joint Bay

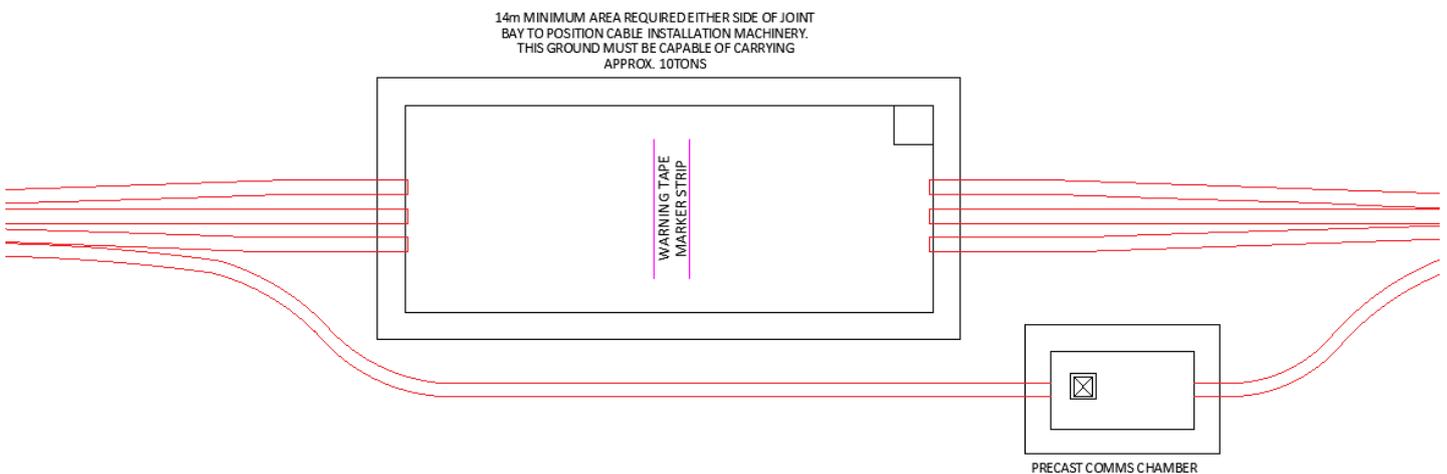


Figure 7 - Typical Joint Bay Plan Details

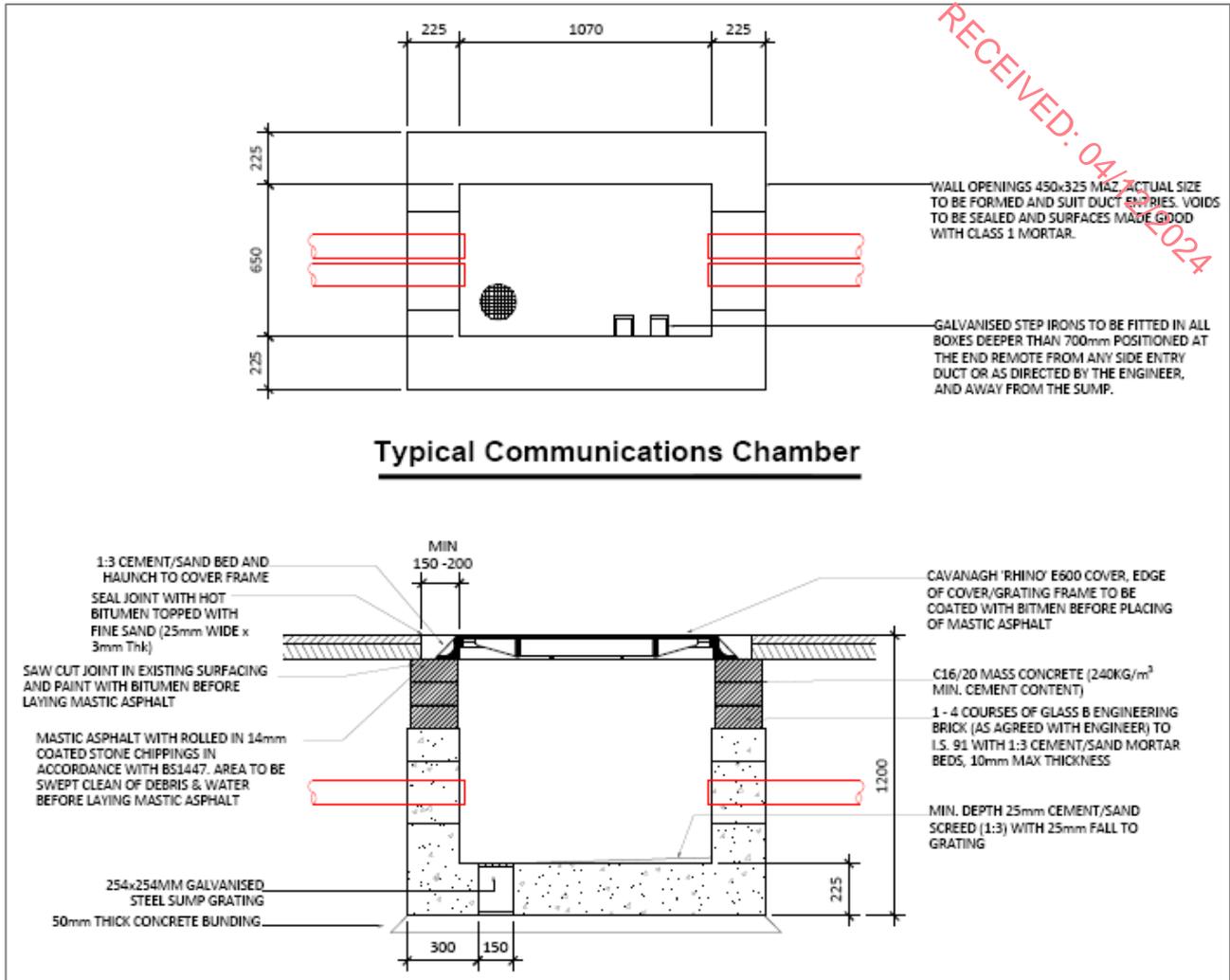


Figure 8 - Typical Communications Chamber

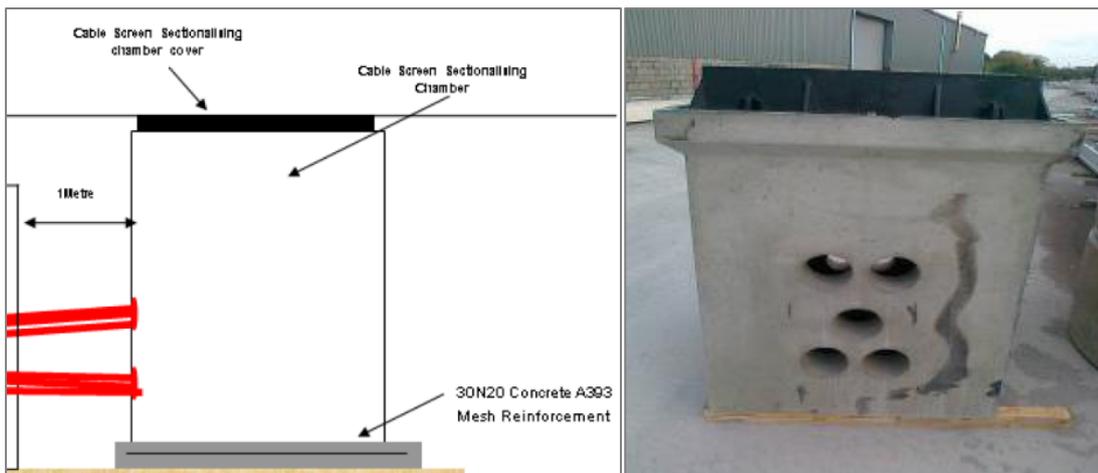


Figure 9 - Typical Section through Comms Chamber

#### 4.6 Horizontal Direction Drilling (HDD)

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles such as bridges, watercourses, existing UG infrastructure, etc. This method is employed where installing the ducts using standard installation methods is not possible and is implemented to install cable ducts under this obstacle. There will be a requirement to drill beneath 6 obstacles in this underground grid connection route. These include 1 No Motorway, 3 No. Bridges, 2 No. Culverts.

The proposed drilling methodology is as follows:-

- A works area of circa 40m<sup>2</sup> for the HDD entry side, and circa 20m<sup>2</sup> 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 entry side and will be appropriately banded using sandbags, which will contain any fluid spills and stormwater run-off.
- Entry and exit pits (approximately 2m (w) x 3m (L) x 1m deep) will be excavated using an excavator, and 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 watercourse crossings.
- The steering engineer and drill team will monitor the drilling works to ensure that modeled stresses and pressures are not exceeded.
- The drilled cuttings will be flushed back by drilling fluid to the entry and exit pits and re-cycled 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 correct size.
- When the pre-reaming/hole opening/hole cleaning has been completed, a reamer of a 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 at a licensed facility.
- The ducts will be cleaned and proven and their installed location surveyed.
- The entry and exit pits will be reinstated to the specification of ESB Networks and any requirements of Louth County Council.
- A joint bay/transition chamber/transition coupler will be installed on either side of the road following the horizontal directional drilling as per ESB requirements.

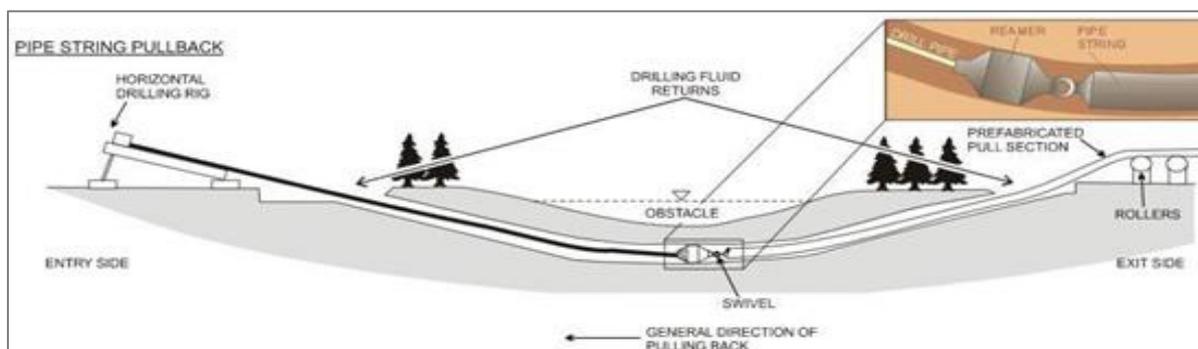


Figure 10 - Typical HDD Installation (not to scale)

## 5.0 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 compound 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/aluminum 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 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.

## 6.0 Watercourse and Motorway Crossings

The proposed cable route will require six Horizontal Directional Drilling (HDD) crossings. The cable will cross under the M1 motorway in the townland of Mell, north of junction 10 using HDD method under the motorway subject to detailed discussion and approval by TII and Louth County Council. There are three stone built bridges and two culverts that will also require HDD undercrossing. 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.

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.

### 6.1 Bridge 1 :Water Under Bridge - Horizontal Directional Drilling [Chainage – 2248m]

**Coordinates (ITM): 706351.7497, 776768.0851**

This Bridge has insufficient cover to install the cable to ESB specification (450mm cover to the top of ducts) within the bridge deck. It is proposed to HDD a minimum of approximately 1500mm beneath the waterway. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. All drilling and associated works will take place within the road corridor. The HDD process is outlined in Section 4.6 above. *See drawing 05949-DR-120 for reference.*

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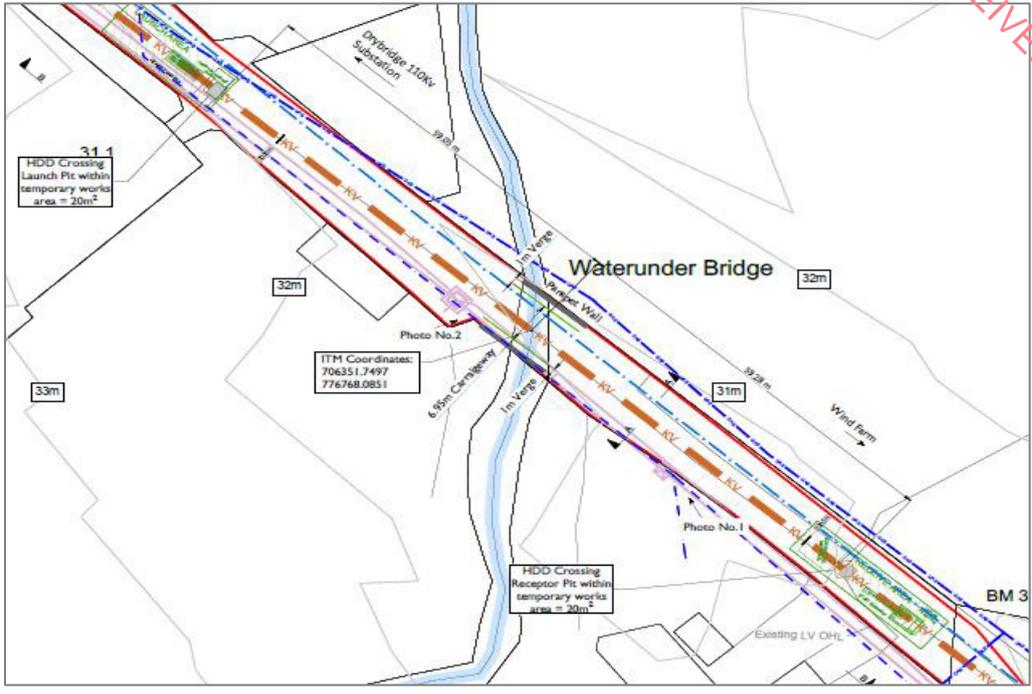


Figure 11 - Bridge 1 Waterunder HDD Crossing with Tailte Eireann Background



Figure 12 – Bridge 1 Parapet at Road Level

**6.2 Bridge 2 - Horizontal Directional Drilling [Chainage – 8937m]**  
**Coordinates (ITM): 708864.6884, 780136.3646**

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This Bridge has insufficient cover to install the cable to ESB specification (450mm cover to the top of ducts) within the bridge deck. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. All drilling and associated works will take place within the road corridor. The HDD process is outlined in Section 4.6 above. See drawing 05949-DR-121 for reference.



Figure 13 - Bridge 2 at Carstown

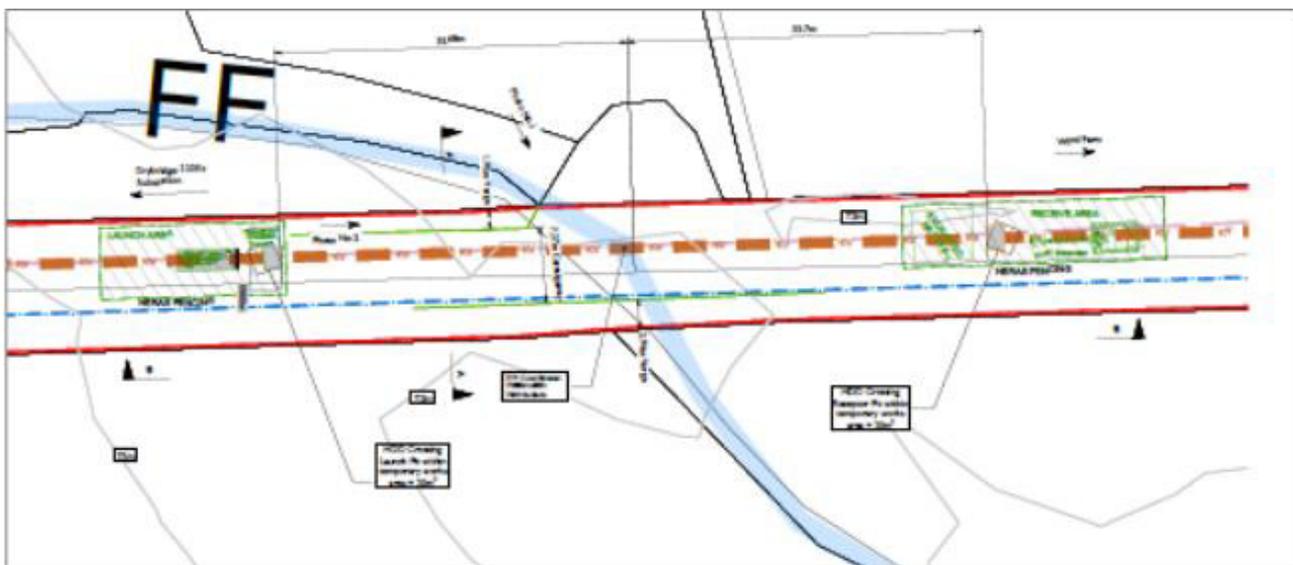


Figure 14 - Bridge 2 HDD Crossing with Tailte Eireann Background

### 6.3 Bridge 3 - Horizontal Directional Drilling [Chainage – 11490m]

**Coordinates (ITM): 709261.9739, 709261.9739**

This Bridge has insufficient cover to install the cable to ESB specification (450mm cover to the top of ducts) within the bridge deck. It is proposed to HDD a minimum of 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. All drilling and associated works will take place within the road corridor. The HDD process is outlined in Section 4.6 above. See drawing 05949-DR-124 for reference.



Figure 15 - Bridge 3 at Piperstown



Figure 16 - Bridge 3 Location on Tailte Eireann Background

#### 6.4 Culverts

There are two culverts on the underground cable route which will require Horizontal Directional Drilling. The location of these together with the number of the detailed drawing for the watercrossing is shown below

- Culvert 4: Chainage – 10521m.Coordinates (ITM): 709144.9012, 781289.8798. See drawing 05949-DR-122 for reference.
- Culvert 5: Chainage – 10747m.Coordinates (ITM): 709148.6194, 781516.3934. See drawing 05949-DR-123 for reference.

All other culverts to be traversed using standard 38kV Service/Culvert Crossing detail. See drawing 05949-DR-116,117.

#### 6.5 Motorway Crossing Horizontal Direction Drilling [Chainage – 1617m] Coordinates (ITM): 705783.9529, 777007.3026

It is proposed to cross under the M1 motorway using Horizontal Directional Drilling Method. The drilling rig and launch pit shall be located west of the M1 motorway on a private stretch of road, off the R168. The receptor pit shall be located east of the M1 on the L6322. See drawing 05949-DR-119 for reference.

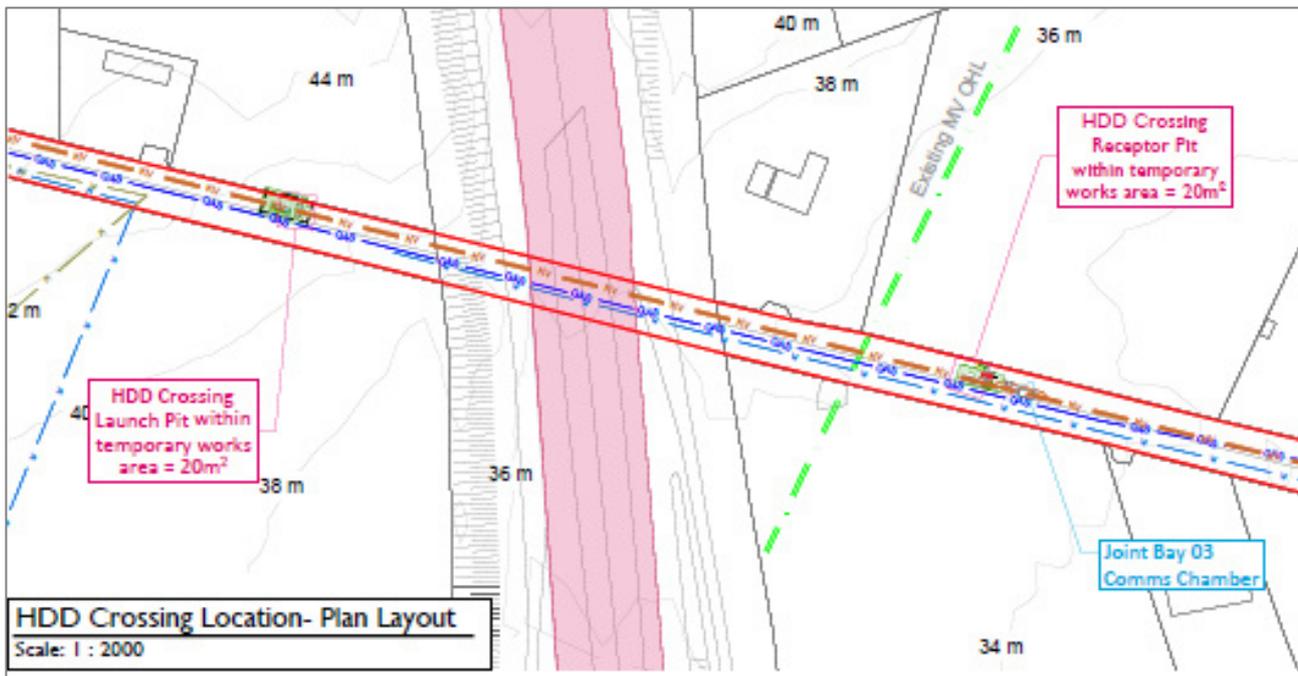


Figure 17 - HDD Crossing of M1 Motorway

## 7.0 Drainage Management Plan.

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 the previously consented Kellystown 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.

### 7.1 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 of artificial materials required (e.g. silt fencing, straw bales, sand bags 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.

### 7.2 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.

## 8.0 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. A permanent access track will be required above the cable route to access the windfarm substation. This will consist of a 3m track with ten tonne axle weight bearing capacity. 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. Before the commencement of development, precise access arrangements will be agreed upon with the respective landowners.

A detailed Traffic Management Plan will be prepared, and agreed upon with Louth County Council, before the commencement of construction.

Temporary access roads on private land (if required due to ground conditions and/or landowner requirements) will consist of timber or aluminum bog mats (Figure 18) 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 18 - Temporary Aluminium Panel Tracks

## 9.0 Road Opening Licence

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

## 10.0 Relocation of Existing Services

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.

### 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.

### Gas Networks

Consultation with Gas Networks Ireland must take place before starting works where gas pipes are present. Gas Networks Ireland will advise on the safety measures required and will arrange for the exact location of the pipe to be marked out on site.

### Water Mains

Uisce Eireann will need to be 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.

The water supply will be turned off by the utility so work can commence on diverting or crossing the service. The section of the existing pipe will be removed and will be replaced with a new pipe along the new alignment of the service. The works will be carried out in accordance with the utility standards.

## 11.0 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.

## 12.0 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.

### 13.0 Emergency Response Plan

All site personnel will be inducted into the provisions of the Emergency Response Plan. The following outlines some of the information, on the types of emergency, which must be communicated to site staff (list not exhaustive);

- Release of hazardous substance - Fuel or oil spill
- Concrete spill or release of concrete
- Flood event – extreme rainfall event
- Environmental buffers and exclusion zones breach
- Housekeeping of materials and waste storage areas breach
- Stop Works order due to environmental issue or concern

The Emergency Response Plan must be completed by the appointed contractor before the project begins.

### 14.0 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.

### 15.0 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.

### 17.0 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.

## 18.0 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 nine months.

Table 3: Estimated Construction Duration	
Development Element	Estimated Construction Duration
Cable route (not including HDDs)	9 Months
HDD	2 Months

Table 3 - Estimated Construction Duration

# TECHNICAL NOTE 01



Project: Proposed Kellystown Wind Farm – 38kV Grid Connection

Ref: Rev0

Section: Underground Cable Ampacity Study

Job No: 05-949

Date: 29.05.24

Made By: CK

Checked By: DB

Sheet No: 1 of 13

## Instruction

**Technical Lead:** Damien Browne (TLI Group)

**Date of Writing:** 29.05.2024

**Scope of Note:** Review of the cable ampacity rating for the proposed 38kV underground cable route of the grid connection for the permitted Kellystown Wind Farm

**Documents & Data Issued for Review:** N/A

## Background

EDF Renewables c/o Jennings O Donovan (“the Client”) wish to develop the Proposed Kellystown Wind Farm in Drumshallon, Co Louth. The proposed grid connection for the project is a Single Circuit 38kV underground cable connection to Drybridge 110kV Substation. There is approx. 12.6 km of underground cable to be installed, which will be either 630 mm<sup>2</sup> or 1000mm<sup>2</sup> Al XLPE cable.

TLI Group (the Consultant) were engaged by the Client to complete the detailed design for the 38kV grid connection. The solar farm will have a maximum export capacity (MEC) of 35MW. As part of the detailed design works, the Consultant completed a cable rating study for the 38kV underground cable to ensure that the cables selected for the project will have sufficient capacity to carry the MEC for the project. This Technical Note outlines the results of the cable rating study.

The cable ratings which have been completed as part of this study include:

Trench Type	Description	Notes
Standard Trench Design	110mm duct, 950mm depth	<i>Standard arrangement for the majority of the cable route</i>
Flat Formation – Overcrossing	110mm duct, 450mm depth	<i>Min depth for service/culvert overcrossings</i>
HDD	125mm duct, 4000mm depth	<i>Bentonite filled duct surround</i>

**Table 1 - Trench Type Summary**

# TECHNICAL NOTE 01

Project: Proposed Kellystown Wind Farm – 38kV Grid Connection

Ref: Rev0

Section: Underground Cable Ampacity Study

Job No: 05-949

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## Details

Below are the key parameters considered for this study.

<b>Cable Study Parameters</b>			
<b>Cable Size:</b>	630mm <sup>2</sup> Al Cable or 1000mm <sup>2</sup> Al Cable.		
<b>Nominal Voltage:</b>	38kV assumed ( <i>Range 30kV to 52kV</i> )		
<b>Power:</b>	Required 35.0 MW		
<b>Power Factor:</b>	0.95 assumed ( <i>Range 0.85 lag to 0.93 lead</i> )		
<b>Avg. Cable Section Length:</b>	1000/1200m ( <i>trefoil</i> ), 100m ( <i>flat</i> )		
<b>Cable Screen Bonding:</b>	Bonded Both Ends		
<b>Power Duct Size:</b>	110mm SDR17.6 & 125mm HDPE SDR11		
<b>Seasonal Characteristics</b>	<i>Summer</i>	<i>Spring/Autumn</i>	<i>Winter</i>
<b>Ambient Temp (Soil)</b>	20°C	15°C	10°C
<b>Soil Thermal Resistivity</b>	1.2 K·m/W	1.0 K·m/W	1.0 K·m/W
<b>Backfill Thermal Resistivity</b>	1.0 K·m/W	1.0 K·m/W	0.85 K·m/W
<b>Bentonite Thermal Resistivity</b>	0.77 K·m/W		

**Table 2 - Cable Study General Parameters**

To be noted that only summer characteristics were considered as part of this ampacity study, as those represent the worst-case scenario for seasonal characteristics.

The cable ampacity ratings were calculated in accordance with the current edition of IEC 60287 for steady-state operation of cables, using the software Cableizer for modelling the several anticipated system configurations for this project. The cable systems were modelled to a maximum conductor temperature of 90°C.

Deviations to the results may be expected where the actual construction characteristics differ.

$$I_c = \frac{MVA}{\sqrt{3} * V_l}$$

# TECHNICAL NOTE 01



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## Cable Study Results

Appendix A presents a summary of the Cable Rating Results detailed below.

➤ **630mm<sup>2</sup> Al Cable - 38kV Standard Trefoil Trench (Depth 950mm) Design:**

A cable rating study was completed for a **SolidAl 630mm<sup>2</sup> AL XLPE (38kV) UGC** over a distance of 1km using the **standard trefoil trench design in 110mm ducts** as detailed in Appendix B. Using this arrangement, the circuit is capable of carrying a maximum full load current of **612.5A**, without exceeding the cables max insulative property of 90°C. Therefore, 630mm<sup>2</sup> Al XLPE (38kV) UGC when installed using the standard trefoil trench design can achieve the required maximum full load (35MW). In Winter operating conditions with this standard trench arrangement will have a maximum full load current of **692.1A** without exceeding the cables max insulative property of 90°C, achieving the required maximum full load (35 MW) under winter operating conditions. This will represent a maximum cable loading percentage of **91%**, in Summer, against the desired load of 35MW.

The results obtained are included below for reference in Table 3 below.

05-949 Kellystown 38kV UGC - 35MW												
Cable Rating Study Results												
Standard Trefoil 38kV Trench - SolidAl 630sq Al												
Rev00 [23.04.2024]												
Cable Rating Study Results												
Rating Sheet Ref	Season	Ambient Temp (°C)	Backfill (CBGM) Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrangement	Duct Depth (mm)	Required Amps (A)	Max Ampere Rating @ 90°C	MW Loading	Loading Capacity	Rating met
SolidAl_630 AL 950D Sum	Summer	20	1	1.2	Trefoil 110mm	Both Ends	950	559.8	612.5	38.3	91%	Yes
SolidAl_630 AL 950D Spr/Aut	Spring/Autumn	15	1	1.2	Trefoil 110mm	Both Ends	950	559.8	633.7	39.6	88%	Yes
SolidAl_630 AL 950D Winter	Winter	10	0.85	1	Trefoil 110mm	Both Ends	950	559.8	692.1	43.3	81%	Yes

Table 3 - Standard Trench Results - SolidAl 630mm<sup>2</sup> AL XLPE (38kV) UGC

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Project: Proposed Kellystown Wind Farm – 38kV Grid Connection	Ref: Rev0
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➤ **1000mm<sup>2</sup> Al Cable - 38kV Standard Trefoil Trench (Depth 950mm) Design:**

A cable rating study was completed for a **SolidAl 1000mm<sup>2</sup> AL XLPE (38kV) UGC** over a distance of 1km using the **standard trefoil trench design in 110mm ducts** as detailed in Appendix B. Using this arrangement, the circuit is capable of carrying a maximum full load current of **757.9A** without exceeding the cables max insulative property of 90°C. Therefore, 1000mm<sup>2</sup> Al XLPE (38kV) UGC when installed using the standard trefoil trench design is capable of achieving the required maximum full load (35 MW).

In Summer operating conditions with this standard trench arrangement will have a maximum full load current of **757.9A** without exceeding the cables max insulative property of 90°C. Therefore, 1000mm<sup>2</sup> Al XLPE (38kV) UGC is capable of achieving the required maximum full load (35MW) under Summer operating conditions. This will represent a maximum cable loading percentage of **86%** against the desired load of 35MW.

The results obtained are included below for reference in Table 4 below.

05-949 Kellystown 38kV UGC - 35MW												
Cable Rating Study Results												
Standard Trefoil 38kV Trench - SolidAl 1000sq Al												
Rev00 [23.04.2024]												
Cable Rating Study Results												
Rating Sheet Ref	Season	Ambient Temp (°C)	Backfill (CBGM) Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrangement	Duct Depth (mm)	Required Amps (A)	Max Ampere Rating @ 90°C	MW Loading	Loading Capacity	Rating met
SolidAl_1000 AL 950D Sum	Summer	20	1	1.2	Trefoil 110mm	Both Ends	950	559.8	757.9	40.7	86%	Yes
SolidAl_1000 AL 950D Spr/Aut	Spring/Autumn	15	1	1.2	Trefoil 110mm	Both Ends	950	559.8	813.3	50.9	69%	Yes
SolidAl_1000 AL 950D Winter	Winter	10	0.85	1	Trefoil 110mm	Both Ends	950	559.8	859.0	53.7	65%	Yes

**Table 4 - Standard Trench Results - SolidAl 1000mm<sup>2</sup> AL XLPE (38kV) UGC**

# TECHNICAL NOTE 01

Project: Proposed Kellystown Wind Farm – 38kV Grid Connection

Ref: Rev0

Section: Underground Cable Ampacity Study

Job No: 05-949

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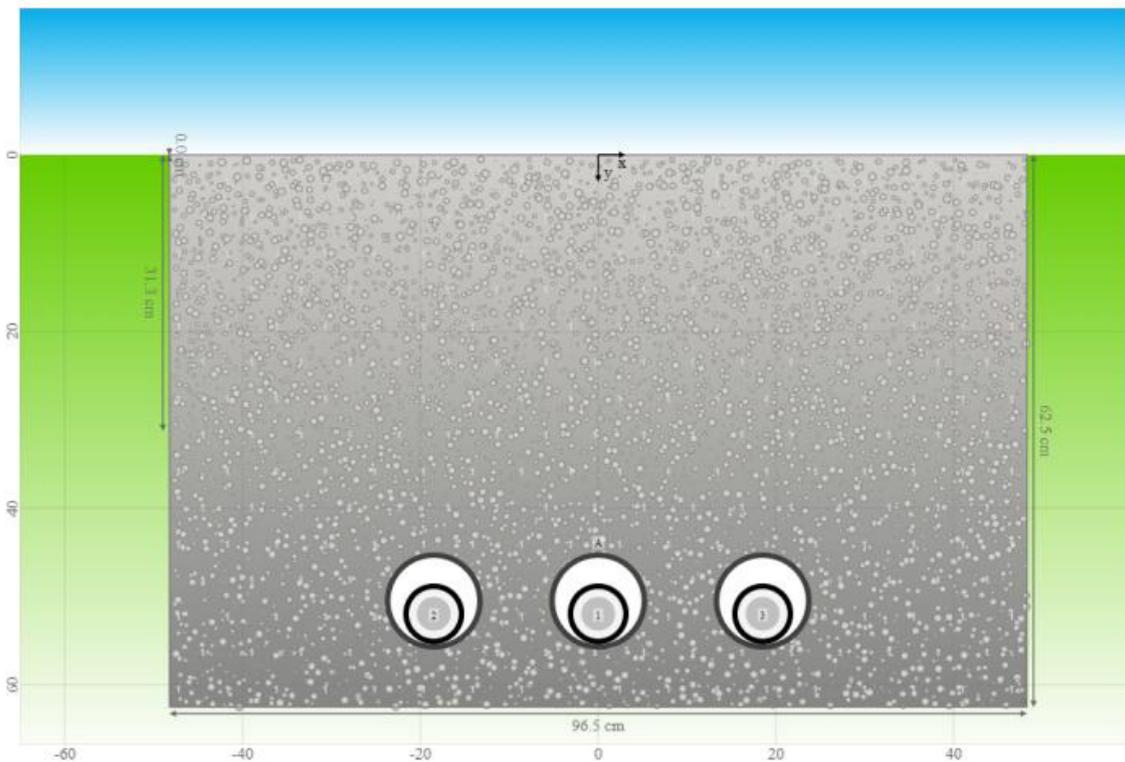
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➤ **1000mm<sup>2</sup> Al Cable - 38kV Flat Formation Trench (Depth 450mm) Design:**

A cable rating study was completed for a **SolidAl 1000mm<sup>2</sup> AL XLPE (38kV)** over a distance of 100m using the **Flat Formation Trench design in 110mm duct**. Using this arrangement, the circuit is capable of carrying a maximum full load current of **778A** without exceeding the cables max insulative property of 90°C. Therefore, 1000mm<sup>2</sup> Al XLPE (38kV) UGC when installed in a shallow, flat formation trench design is capable of achieving the required maximum full load (35.0MW). The loading capacity was found to be 72% see Table 5 below. The same study was carried on for a **SolidAl 630mm<sup>2</sup> AL XLPE (38kV) UGC** over a distance of 100m and the loading capacity was found to be 86%.



Following systems are active in the arrangement:

System	Object	Current $I_c$ [A]	max Temp. $\theta_c$   $\theta_e$ ( $\theta_{de}$ ) [°C]	Losses $W_{sys}$ [W/m]
System A	SolidAl 1000mm <sup>2</sup> Al XLPE (38kV)	778.0	90.0   81.3 (61.2)	120.0

**Figure 1: Cable Study Results – 38kV 1000mm<sup>2</sup> Al Flat Formation (450mm Depth)**

# TECHNICAL NOTE 01



Project: Proposed Kellystown Wind Farm – 38kV Grid Connection

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## 05-949 Kellystown 38kV UGC - 35MW



### Cable Rating Study Results

#### Flat Formation 38kV Trench

Rev00 [23.04.2024]

#### Cable Rating Study Results

Rating Sheet Ref	Season	Ambient Temp	Backfill (CBGM)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrange	Duct Depth	Required Amps (A)	Max Ampere	MW Loading	Loading Capacity	Rating met
38kV Standard Flat 630AL 450D Sum	Summer	20	1	1.2	Flat 110mm	Both Ends	450	559.8	651.1	40.7	86%	Yes
38kV Standard Flat 630AL 450D Spr	Spring/Autumn	15	1	1.2	Flat 110mm	Both Ends	450	559.8	673.0	42.1	83%	Yes
38kV Standard Flat 630AL 450D Win	Winter	10	0.85	1	Flat 110mm	Both Ends	450	559.8	723.1	45.2	77%	Yes
38kV Standard Flat 1000AL 450D Sum	Summer	20	1	1.2	Flat 110mm	Both Ends	450	559.8	778.0	48.6	72%	Yes
38kV Standard Flat 1000AL 450D Spr	Spring/Autumn	15	1	1.2	Flat 110mm	Both Ends	450	559.8	804.0	50.3	70%	Yes
38kV Standard Flat 1000AL 450D Win	Winter	10	0.85	1	Flat 110mm	Both Ends	450	559.8	866.7	54.2	65%	Yes

Table 5 – Flat Formation, 450mm depth, 38 KV Trench Results

# TECHNICAL NOTE 01



Project: Proposed Kellystown Wind Farm – 38kV Grid Connection

Ref: Rev0

Section: Underground Cable Ampacity Study

Job No: 05-949

➤ **630mm<sup>2</sup> AL XLPE 38kV Horizontal Directional Drill, Single Shot (Depth 4000mm)**

Pinch points were identified along the proposed UGC route with the requirement of Horizontal Directional Drill (HDD) to cross obstacles, warranting further assessment. An HDD cable rating study was completed for a **SolidAl 630mm<sup>2</sup> AL XLPE (38kV) UGC**, using a single shot HDD with a 355mm core with 125mm HDPE SDR11 ducts within this drill core, with bentonite surround. A maximum HDD depth of 4000mm has been assumed for this study; shallower depths will be more favourable.

Cable rating calculations were carried out under summer and winter conditions for these HDD simulations. Using **SolidAl 630mm<sup>2</sup> AL XLPE (38kV) UGC**, set to operate at the maximum temperature without exceeding the insulative property of the existing cable at 90°C showed that the current carrying capacity is **559.8A<sup>1</sup>** which results with this install arrangement achieving a result of **574.8A**. In summer conditions, this installation will achieve the required continuous current-carrying capacity of the conductor, with a 97% loading. In winter conditions, this HDD installation, has a current carrying capacity of **661.2A**, with a loading of 83%. The results obtained are included in Table 5 below.

<b>05-949 Kellystown 38kV UGC - 35MW</b>												
<b>HDD Cable Rating Study Results (Single Shot Trefoil)</b>												
<b>630mm<sup>2</sup> Al XLPE Cable</b>												
<b>Cable Rating Study Results</b>												
Rating Sheet Ref	Season	Ambient Temp (°C)	Bentonite Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrangement	Duct Depth (mm)	Required Amps (A)	Max Ampere Rating @ 90°C	MW Loading	Loading Capacity	Rating met
SolidAl 630 Al-HDD Trefoil 4000D-Summer	Summer	20	0.77	1.2	HDD 125mm HDPE	Both Ends	4000	559.8	574.8	35.9	97%	Yes
SolidAl 630 Al-HDD Trefoil 4000D-Spr/Aut	Spring/Autumn	15	0.77	1.2	HDD 125mm HDPE	Both Ends	4000	559.8	595.0	37.2	94%	Yes
SolidAl 630 Al-HDD Trefoil 4000D-Winter	Winter	10	0.77	1	HDD 125mm HDPE	Both Ends	4000	559.8	661.2	41.2	83%	Yes

**Table 6 - HDD Crossing Single Drill Core Results (630mm<sup>2</sup> AL XLPE (38kV) 4000mm Depth)**

<sup>1</sup> Rated Current formula = 
$$I_c = \frac{MVA}{\sqrt{3} * V_l}$$

# TECHNICAL NOTE 01

Project: Proposed Kellystown Wind Farm – 38kV Grid Connection

Ref: Rev0

Section: Underground Cable Ampacity Study

Job No: 05-949



## Systems

Following systems are active in the arrangement:

System	Object	Current [A] $I_c$	Temp. [°C] $\theta_c \mid \theta_e (\theta_{de})$	Losses [W/m] $W_{sys}$	Load $LF$
System A	SolidAl 630mm <sup>2</sup> Al XLPE (38kV)	1x 574.8	90.0   81.8 (77.2)	66.4	1.00

Figure 2 –Single Shot HDD Trefoil Formation Results Extract – Summer conditions

# TECHNICAL NOTE 01

Project: Proposed Kellystown Wind Farm – 38kV Grid Connection

Ref: Rev0

Section: Underground Cable Ampacity Study

Job No: 05-949

➤ **1000mm<sup>2</sup> AL XLPE 38kV Horizontal Directional Drill, Single Shot (Depth 4000mm)**

An HDD cable rating study was completed for a **SolidAL 1000mm<sup>2</sup> AL XLPE (38kV) UGC**, using a single shot HDD with a 355mm core with 125mm HDPE SDR11 ducts within this drill core, with bentonite surround. A maximum HDD depth of 4000mm has been assumed for this study.

Cable rating calculations were carried out under Summer, Spring/Autumn, and Winter conditions for these HDD simulations. Using **SolidAL 1000mm<sup>2</sup> AL XLPE (38kV) UGC**, set to operate at the maximum temperature without exceeding the insulative property of the existing cable at 90°C showed that the required current carrying capacity is **559.8A<sup>2</sup>** which results with this install arrangement achieving this with a result of **709.6A**. In summer conditions, this installation will achieve the required continuous current-carrying capacity of the conductor, at 79% loading.

In winter conditions, this HDD installation will achieve the required continuous current-carrying capacity of the conductor also. The current carrying capacity of the selected cable is **818.6A**, achieving 68% loading capacity.

The results obtained are included in Table 7.

<b>05-949 Kellystown 38kV UGC - 35MW</b>												
<b>HDD Cable Rating Study Results (Single Shot Trefoil)</b>												
<b>1000mm<sup>2</sup> AL XLPE Cable</b>												
<b>Cable Rating Study Results</b>												
Rating Sheet Ref	Season	Ambient Temp (°C)	Bentonite Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrangement	Duct Depth (mm)	Required Amps (A)	Max Ampere Rating @ 90°C	MW Loading	Loading Capacity	Rating met
SolidAL 1000 Al-HDD Trefoil 4000D-Summer	Summer	20	0.77	1.2	HDD 125mm HDPE	Both Ends	4000	559.8	709.6	44.4	79%	Yes
SolidAL 1000 Al-HDD Trefoil 4000D-Spr/Aut	Spring/Autumn	15	0.77	1.2	HDD 125mm HDPE	Both Ends	4000	559.8	734.6	45.9	76%	Yes
SolidAL 1000 Al-HDD Trefoil 4000D-Winter	Winter	10	0.77	1	HDD 125mm HDPE	Both Ends	4000	559.8	818.6	51.2	68%	Yes

**Table 7: HDD Crossing Single Drill Core Results (1000mm<sup>2</sup> AL XLPE (38kV) 4000mm Depth)**

<sup>2</sup> Rated Current formula = 
$$I_c = \frac{MVA}{\sqrt{3} * V_l}$$

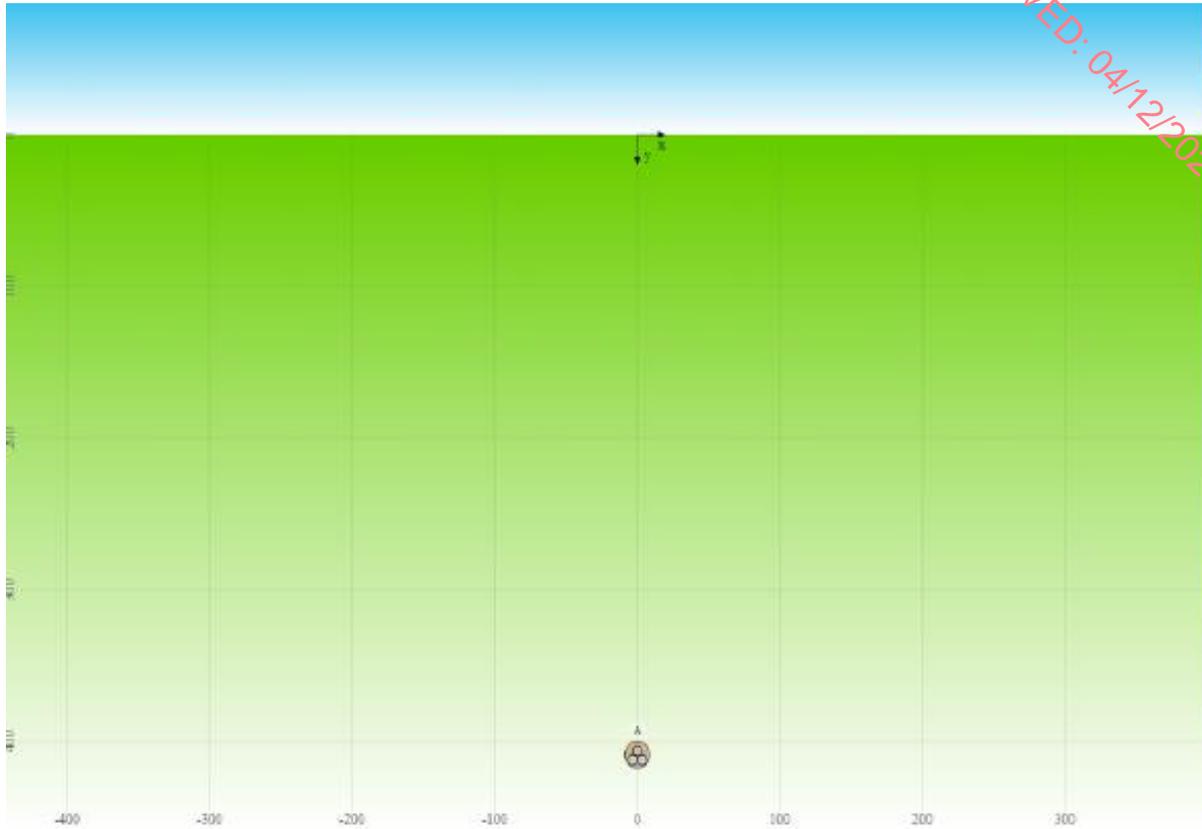
# TECHNICAL NOTE 01

Project: Proposed Kellystown Wind Farm – 38kV Grid Connection

Ref: Rev0

Section: Underground Cable Ampacity Study

Job No: 05-949



## Systems

Following systems are active in the arrangement:

System	Object	Current [A] $I_c$	Temp. [°C] $\theta_c$   $\theta_e$ ( $\theta_{de}$ )	Losses [W/m] $W_{sys}$	Load $LF$
System A	SolidAl 1000mm <sup>2</sup> Al XLPE (38kV)	1x 709.6	90.0   83.4 (79.3)	68.8	1.00

Figure 3: Triple Shot HDD Flat Formation Results Extract – Summer conditions

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Project: Proposed Kellystown Wind Farm – 38kV Grid Connection

Ref: Rev0

Section: Underground Cable Ampacity Study

Job No: 05-949

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## ➤ **Cable Rating Study Results Summary**

The Cable Rating Study completed have indicated that it should be possible to carry the maximum export capacity of the cable at 35MW on a standard 38kV single circuit **SolidAL 630mm<sup>2</sup> AL XLPE (38kV) UGC**. The Cable Rating Study completed have indicated that it should be possible to carry the maximum export capacity of the cable at 35MW on a standard 38kV single circuit **SolidAL 1000mm<sup>2</sup> AL XLPE (38kV) UGC** without exceeding the proposed recommended maximum conductor temperature of 90°C when using the proposed trench designs. Therefore, it is recommended that **SolidAL 630mm<sup>2</sup> AL XLPE (38kV) UGC** be employed as the most cost-effective solution, while achieving the 35MW maximum export capacity, for the Proposed Kellystown Windfarm.

All results at this stage are indicative only, further analysis will be required at the detailed design phase in order to accurately calculate the final loading on the cables. As part of the detailed design process, the number of existing service crossings will be identified on the route. The exact number of service crossings will need to be confirmed during construction as the service information provided by the utilities is indicative only. The size and depth of the services to be crossed is not known at this stage and will be confirmed during construction.

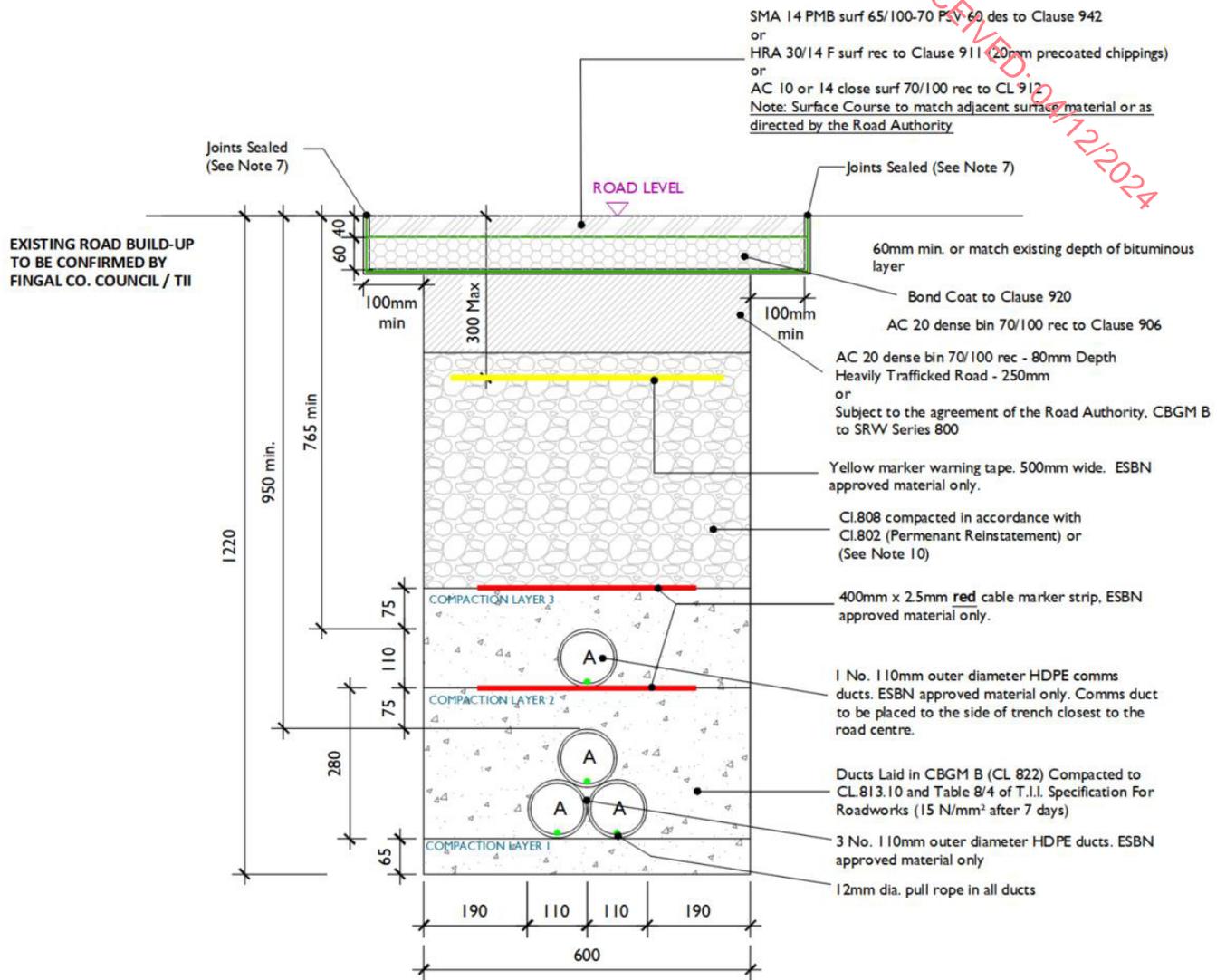
## Appendix A – Cable Rating Results Summary

RECEIVED: 04/12/2024



<b>05-949 Kellystown 38kV UGC - 35MW</b>												
<b>Cable Rating Study Results</b>												
Standard Trefoil 38kV Trench - SolidAl 630sq Al												
Rev00 [23.04.2024]												
<b>Cable Rating Study Results</b>												
Rating Sheet Ref	Season	Ambient Temp (°C)	Backfill (CBGM) Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrangement	Duct Depth (mm)	Required Amps (A)	Max Ampere Rating @ 90°C	MW Loading	Loading Capacity	Rating met
SolidAl_630 AL 950D Sum	Summer	20	1	1.2	Trefoil 110mm	Both Ends	950	559.8	612.5	38.3	91%	Yes
SolidAl_630 AL 950D Spr/Aut	Spring/Autumn	15	1	1.2	Trefoil 110mm	Both Ends	950	559.8	633.7	39.6	88%	Yes
SolidAl_630 AL 950D Winter	Winter	10	0.85	1	Trefoil 110mm	Both Ends	950	559.8	692.1	43.3	81%	Yes
<b>Cable Rating Study Results</b>												
Standard Trefoil 38kV Trench - SolidAl 1000sq Al												
Rev00 [23.04.2024]												
<b>Cable Rating Study Results</b>												
Rating Sheet Ref	Season	Ambient Temp (°C)	Backfill (CBGM) Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrangement	Duct Depth (mm)	Required Amps (A)	Max Ampere Rating @ 90°C	MW Loading	Loading Capacity	Rating met
SolidAl_1000 AL 950D Sum	Summer	20	1	1.2	Trefoil 110mm	Both Ends	950	559.8	757.9	40.7	86%	Yes
SolidAl_1000 AL 950D Spr/Aut	Spring/Autumn	15	1	1.2	Trefoil 110mm	Both Ends	950	559.8	813.3	50.9	69%	Yes
SolidAl_1000 AL 950D Winter	Winter	10	0.85	1	Trefoil 110mm	Both Ends	950	559.8	859.0	53.7	65%	Yes
<b>Cable Rating Study Results</b>												
Flat Formation 38kV Trench												
Rev00 [23.04.2024]												
<b>Cable Rating Study Results</b>												
Rating Sheet Ref	Season	Ambient Temp (°C)	Backfill (CBGM) Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrangement	Duct Depth (mm)	Required Amps (A)	Max Ampere Rating @ 90°C	MW Loading	Loading Capacity	Rating met
38kV Standard Flat 630AL 450D Sum	Summer	20	1	1.2	Flat 110mm	Both Ends	450	559.8	651.1	40.7	86%	Yes
38kV Standard Flat 630AL 450D Spr	Spring/Autumn	15	1	1.2	Flat 110mm	Both Ends	450	559.8	673.0	42.1	83%	Yes
38kV Standard Flat 630AL 450D Win	Winter	10	0.85	1	Flat 110mm	Both Ends	450	559.8	723.1	45.2	77%	Yes
38kV Standard Flat 1000AL 450D Sum	Summer	20	1	1.2	Flat 110mm	Both Ends	450	559.8	778.0	48.6	72%	Yes
38kV Standard Flat 1000AL 450D Spr	Spring/Autumn	15	1	1.2	Flat 110mm	Both Ends	450	559.8	804.0	50.3	70%	Yes
38kV Standard Flat 1000AL 450D Win	Winter	10	0.85	1	Flat 110mm	Both Ends	450	559.8	866.7	54.2	65%	Yes
<b>HDD Cable Rating Study Results (Single Shot Trefoil)</b>												
630mm <sup>2</sup> Al XLPE Cable												
Rev00 [23.04.2024]												
<b>Cable Rating Study Results</b>												
Rating Sheet Ref	Season	Ambient Temp (°C)	Bentonite Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrangement	Duct Depth (mm)	Required Amps (A)	Max Ampere Rating @ 90°C	MW Loading	Loading Capacity	Rating met
SolidAl 630 Al-HDD Trefoil 4000D-Summer	Summer	20	0.77	1.2	HDD 125mm HDPE	Both Ends	4000	559.8	574.8	35.9	97%	Yes
SolidAl 630 Al-HDD Trefoil 4000D-Spr/Aut	Spring/Autumn	15	0.77	1.2	HDD 125mm HDPE	Both Ends	4000	559.8	595.0	37.2	94%	Yes
SolidAl 630 Al-HDD Trefoil 4000D-Winter	Winter	10	0.77	1	HDD 125mm HDPE	Both Ends	4000	559.8	661.2	41.2	83%	Yes
<b>HDD Cable Rating Study Results (Single Shot Trefoil)</b>												
1000mm <sup>2</sup> Al XLPE Cable												
Rev00 [23.04.2024]												
<b>Cable Rating Study Results</b>												
Rating Sheet Ref	Season	Ambient Temp (°C)	Bentonite Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Bonding Arrangement	Duct Depth (mm)	Required Amps (A)	Max Ampere Rating @ 90°C	MW Loading	Loading Capacity	Rating met
SolidAl 1000 Al-HDD Trefoil 4000D-Summer	Summer	20	0.77	1.2	HDD 125mm HDPE	Both Ends	4000	559.8	709.6	44.4	79%	Yes
SolidAl 1000 Al-HDD Trefoil 4000D-Spr/Aut	Spring/Autumn	15	0.77	1.2	HDD 125mm HDPE	Both Ends	4000	559.8	734.6	45.9	76%	Yes
SolidAl 1000 Al-HDD Trefoil 4000D-Winter	Winter	10	0.77	1	HDD 125mm HDPE	Both Ends	4000	559.8	818.6	51.2	68%	Yes

## Appendix B – Standard 38kV Trench Design – Section through Public Road



# Kellystown - 38kV Grid Connection



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## Route Summary & Joint Bay Locations

Rev01 (29.05.2024)

Section From	Section To	Section Length	Bonding Arrangement	No. of Watercourses	Watercourses	No. of Bridges	Motorway	No. of Services Xing	Water	Sewer	ESB	Surface Water	Gas	Telecom	Comments
JB01(Drybridge)	JB-02	1050	Bonded Both Ends	-	-	-	-	5	3	-	1	-	-	1	
JB-02	JB-03	700	Bonded Both Ends	-	-	-	1	4	2				1	1	HDD under motorway
JB-03	JB-04	900	Bonded Both Ends	1	Bridge 1	1		4	2				1	1	HDD Water Under Bridge
JB-04	JB-05	840	Bonded Both Ends	-	-			1						1	
JB-05	JB-06	710	Bonded Both Ends	-	-			2			1			1	
JB-06	JB-07	970	Bonded Both Ends	1	Culvert 1			1						1	
JB-07	JB-08	980	Bonded Both Ends	-	-			4						4	
JB-08	JB-09	960	Bonded Both Ends	1	Culvert 2										
JB-09	JB-10	1060	Bonded Both Ends	-	-										
JB-10	JB-11	1050	Bonded Both Ends	1	Bridge 2	1									HDD
JB-11	JB-12	980	Bonded Both Ends	1	Culvert 3			1						1	
JB-12	JB-13	980	Bonded Both Ends	2	Culvert 4,5			5	1					4	HDD Culvert 4,5
JB-13	JB-14	1000	Bonded Both Ends	1	Bridge 3	1		1	1						HDD
JB-14	Kellystown SS	420	Bonded Both Ends	-	-										
<b>Total:</b>		<b>12,600</b>		<b>8</b>		<b>3</b>	<b>1</b>	<b>28</b>	<b>9</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>15</b>	