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CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

Appendix 3.3

Grid Connection Constructability Report

CONSTRUCTION METHODOLOGY

Ballinagree Windfarm - 110kV Underground Cable

Document No: 05843-R01-01

Revision:	Author:	Checked:	Date:	Notes:
00	NOC	DB	10.11.21	*Issued for Information*
01	NOC	GH	11.01.22	*Issued for Information*

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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 construction of the Ballinagree Wind Farm 110kV underground cable grid connection to the existing EirGrid Clashavoon 220kV Substation in Co. Cork. The grid connection will consist entirely of underground cabling (UGC) with the majority of the UGC to be installed within the public road network.

The UGC works will consist of the installation of 5 No. ducts in an excavated trench to accommodate 3 No. power cables, and 1 No. fibre communications cable to allow communications between the Ballinagree Wind Farm Substation and Clashavoon 220kV substation.

This document is intended to be used as an aid to understand the methodologies to be employed during construction and should be read in conjunction with all other specialist reports which accompany the Planning Application. 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 development.

2.0 110kV Underground Cable Route

The UGC route is approximately 11.307km in length and runs in a northerly direction from the existing Clashavoon 220kV Substation to Ballinagree Wind Farm substation location utilising an existing access track adjacent to Clashavoon 220kV Substation on the periphery of EirGrid property, the public road network, forestry access tracks and minimal sections of private land.

The exact location of the UGC within the site boundary is subject to minor modification following a further detailed assessment to be undertaken prior to construction and following consultation with EirGrid, Cork County Council and all other relevant stakeholders, having regard to all environmental protection measures outlined in the planning application and accompanying technical reports.

Below **(Figure 1)** which outlines the UGC route, with each section of the route being formulated in detail within Table 1.

This grid connection route is shown as an Overall Site Layout Plan in Drawing No. 05843-DR-001.

Figure 1 – Grid Connection Route Location (See Drawings 05843-DR-001/008)

Table 1 of this report summaries the route location features of the underground cable connection and route.

Table 1 – Approximate Route Location of Preliminary Design:			
Substation/Access Roads	**Public Roads**	**Private Land**	**Forestry Access Roads/WF**
244m	9,463m	120m	1,600m

Table 1: Clashavoon 220kV Substation to WF Substation – UGC Route Location Summary

Table 2 below separates the UGC route into a number of sections and describes the specific construction requirements of each individual section. All plant and equipment employed on the works will be subject to good site organisation and hygiene, particularly during construction activities.

Table 2 - Summary of 110kV Underground Cable Route	
Section	**Description**
Section 1 244m approx.	**UGC Route from EirGrid's Clashavoon 220kV Substation (110kV side) to Local Public Road** **(For reference see drawings 05843-DR-001 & 05843-DR-002)** The underground cable route exits Clashavoon 220kV Substation from the southeast side (110kV side) and heads in an easterly direction. The route runs parallel to the substation fence until it reaches the southeast corner of the substation. At this point the route turns in a northerly direction toward the junction of the substation entry road and the local public road. This section of the route is totally within EirGrid owned land until it meets the local public road. <u>Section 1 Features:</u> ▪ *1 No. Joint Bays and associated chambers* The joint bay will be located below ground and finished/reinstated to the required EirGrid specification. The joint bay will have an associated communication chamber and link box which will have a surface access hatch matching existing ground levels. Due to the high number of existing UGC circuits in the assessed location of joint bay 1 the final location can only be determined once consultation with EirGrid and detailed site investigation works have been carried out. The final position of the joint bay, link box and communication chamber will need to be agreed with EirGrid as part of the design approval process. ▪ *Multiple UGC Crossings* Third-party records show that the Ballinagree UGC Wind Farm route runs in Parallel or crosses with several existing HV UGC routes within Section 1. The exact location, depth and arrangement of the existing HV UGC and joint bays and associated chambers will need to be confirmed by detailed survey and site investigation works. It should be noted that there is the possibility that the proximity of the existing HV UGC route may have a mutual de-rating effect on both UGC circuits. The de-rating effect will be minimised by setting and maintaining a minimum separation distance between the cables. Additionally, it should be further noted that along the length of section 1 it will be necessary to cross the existing HV UGC route several times. Any crossing points will need to be identified by detailed survey and site investigation works. The scale of the de-rating effect will need to be considered by detailed design calculation and system modelling. The EirGrid preferred undercrossing method will be used where possible. Where undercrossing of the existing UGC routes is not possible an overcrossing method will be used. All UGC crossings will need to be agreed with EirGrid as part of the design approval process. The UGC crossings have been designed in-line with the EirGrid specifications. ▪ *Culvert Crossings* The UGC route will cross existing culverts using an undercrossing or overcrossing method which will be selected based on the cover available above the culvert. Where it is not possible to cross

Table 2 - Summary of 110kV Underground Cable Route	
Section	**Description**
	under an existing culvert while maintaining the culvert in place, the culvert may be replaced. Culvert crossings have been designed in-line with the EirGrid specifications.
Section 2 1,200m approx.	**UGC within the Local Public Road Network towards the Windfarm Substation** From section 1 the UGC route merges onto the local road which it follows in a north-westerly direction. The proposed Ballinagree UGC route will run in Parallel with another HV UGC route for the full length of section 2. **(For reference see drawings 05843-DR-001 & 05843-DR-002)** Section 2 Features: ▪ *1 No. Joint Bay and associated chambers* The joint bay will be located below ground and finished/reinstated to the required Cork County Council specification. All reinstatement works will be carried out in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. All Joint Bay infrastructure are to be installed within the corridor of the existing carriageway. The link boxes and communication chambers will also be installed in the road carriageways or verges were available. Road widening works may be required to facilitate this joint bay. The final position of the joint bay, link box and communication chamber will need to be agreed with EirGrid as part of the design approval process. ▪ *Culvert Crossings* The UGC will cross multiple existing culverts within section 2 using an undercrossing or overcrossing method which will be selected based on the cover available above the culvert. Culvert crossings have been designed in-line with the EirGrid specifications. Where it is not possible to cross under an existing culvert while maintaining the culvert in place, the culvert may be replaced. All reinstatement works will be carried to the required Cork County Council specification and in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. ▪ *Existing UGC Route Plus Associated Joint Bays and Chambers* Third-party records show that the proposed Ballinagree UGC Wind Farm route runs in parallel with an existing HV UGC route for approximately 1,200 meters. These records indicate that the existing HV UGC route has two joint bays and associated chambers within section 2. The exact location, depth and arrangement of the existing HV UGC and joint bays and associated chambers will need to be confirmed by detailed survey and site investigation works. It should be noted that there is the possibility that the proximity of the existing HV UGC route may have a mutual de-rating effect on both UGC circuits. The de-rating effect will be minimised by setting and maintaining a minimum separation distance between the cables. Additionally, it should be further noted that along the length of section 2 (1,200m parallel section) it may be necessary to cross the existing HV UGC route several times. Any crossing points will need to be identified by detailed survey and site investigation works. The scale of the

Table 2 - Summary of 110kV Underground Cable Route	
Section	**Description**
	de-rating effect will need to be considered by detailed design calculation and system modelling. The EirGrid preferred undercrossing method will be used where possible. Where undercrossing of the existing UGC routes is not possible an overcrossing method will be used. All UGC crossings will need to be agreed with EirGrid as part of the design approval process. The proposed UGC crossings have been designed in-line with the EirGrid specifications.
Section 3 4,344m approx.	**UGC Route within the Local Public Road Network Including Three Bridge Crossings** **(For reference see drawings 05843-DR-001, 002, 003, 004 & 005)** Section 3 starts at the road junction where the existing HV UGC turns right to follows the road north. The Ballinagree UGC route continues in the local road network in a north-westerly/northerly direction making several left and right hand turns to follow the public road network through. The route crosses three, three arch bridge crossing within section 3. <u>Section 3 Features:</u> ▪ *6 No. Joint Bays and associated chambers* These joint bays will be located below ground and finished/reinstated to the required Cork County Council specification. All reinstatement works will be carried out in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. The joint bays will have associated communication chambers and link boxes which will have a surface access hatch matching existing ground levels. All Joint Bay infrastructure are to be installed within the corridor of the existing carriageway. The link boxes and communication chambers will also be installed in the road carriageways or verges were available. Road widening works may be required to facilitate these joint bays, link boxes and communication chambers. The final positions of these joint bays, link boxes and communication chamber can only be decided once detailed site investigation works have been carried out. The final position of the joint bays, link boxes and communication chambers will need to be agreed with EirGrid as part of the design approval process. ▪ *Culvert Crossings* The UGC will cross existing culverts using an undercrossing or overcrossing method which will be selected based on the cover available above the culvert. Culvert crossings have been designed in-line with the EirGrid specifications. Where it is not possible to cross under an existing culvert while maintaining the culvert in place, the culvert may be replaced. ▪ *3 Bridges Crossings* There are three (3), three arch bridge crossing within section 3. 1. Clonaverick Bridge - Laney River – HDD 1 2. Awboy Bridge - Awboy River – HDD 2 3. Coppeleenbawn Bridge - Glashreagh River – HDD 3

Table 2 - Summary of 110kV Underground Cable Route	
Section	**Description**
	All three bridges are in the public road and has insufficient room to install the cable within the bridge deck to EirGrid specification (450mm cover to top of ducts). The design of these bridge is therefore inadequate to accommodate the works using a standard trench design. It is therefore proposed to horizontal directional drill (HDD) under each bridge (See Section 9). Initiating a drill from the launch site within private land on the northwest side of the Laney River (subject to landowner agreement) and reception within the local road network on the southern side of the watercourse. Two further HDD shots will be executed within the existing road corridor. Road widening works may be required to facilitate each individual HDD launch and reception site. The design and final location of the HDD launch/reception areas will need to be confirmed by a specialist drilling contractor following detailed site investigation works including bore holes. The total length of the proposed HDD will be approx. 40m – 100m. The HDD launch/reception pits will be reinstated with a transition coupler or transition chamber. All reinstatement works will be finished/reinstated to the required Cork County Council or landowners' specifications. All reinstatement works will in the public road will be carried out in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. The final position of each individual HDD and possible transition chambers will need to prior agreement with EirGrid as part of the design approval process.
Section 4 1,573m approx.	**UGC Route within the Local Public Road Network towards the Windfarm Substation** **(For reference see drawings 05843-DR-005 & 006)** From Section 3 the UGC route makes a left turn heading again in a north-westerly direct before turning right and remains within the local road network which it follows in a northerly direction. The Ballinagree UGC route will again run in Parallel with another HV UGC route for the full length of section 4. <u>Section 4 Features:</u> ▪ *2 No. Joint Bays and associated chambers* The Joint bays will be located below ground and finished/reinstated to the required Cork County Council specification. All reinstatement works will be carried out in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. Each joint bay will have an associated communication chamber and link box which will have a surface access hatch matching road/ground levels. All Joint Bay infrastructure are to be installed within the corridor of the existing carriageway. The link boxes and communication chambers will also be installed in the road carriageways or verges were available. Road widening works may be required to facilitate these joint bays. The final position of the joint bays, link boxes and communication chambers will need to be agreed with EirGrid as part of the design approval process.

Table 2 - Summary of 110kV Underground Cable Route	
Section	**Description**
	▪ *Culvert Crossings* In section 4 the UGC route will cross several existing culverts using an undercrossing or overcrossing method which will be selected based on the cover available above the culvert. Culvert crossings have been designed in-line with the EirGrid specifications. Where it is not possible to cross under an existing culvert while maintaining the culvert in place, the culvert may be replaced. All reinstatement works will be carried out to the required Cork County Council specification and in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. *1 Existing UGC Route* Third-party records indicate that the Ballinagree UGC Wind Farm route runs in parallel with an existing HV UGC route for the approximately 1,580 meters (the entire length of section 4). These records indicate that the existing HV UGC route does not include any joint bays or associated chambers within section 4. The records available indicate that the Parallel UGC route runs along the western side of the road and mainly in the verge. Again, the exact location, depth and arrangement of the existing HV UGC route will need to be confirmed by detailed survey and site investigation works. It should again be noted that there is the possibility that the proximity of the existing HV UGC route may have a mutual de-rating effect on both UGC's. The de-rating effect will be minimised by setting and maintaining a minimum separation distance between the cables. Again, it should be noted that along the length of section 4 (parallel section) it may be necessary to cross the existing UGC route at least once. The scale of the de-rating effect will need to be considered by detailed design calculation and system modelling. The EirGrid preferred undercrossing method will be used where possible. Where undercrossing of the existing UGC routes is not possible an overcrossing method will be used. All UGC crossing will need to be agreed with EirGrid as part of the design approval process. The UGC crossings have been designed in-line with the EirGrid specifications.
Section 5 2345m approx.	**The UGC Route Continues within the Local Public Road Network towards the Windfarm Substation** **(For reference see drawings 05843-DR-006 & 007)** From section 4 the UGC route makes a right turn and heads in a northerly direct before making a following a series of sharp left and righthand bend before arriving at the entry track to Ballinagree Wind Farm. The UGC route remains within the local road network for the whole of section 5. <u>Section 5 Features:</u> ▪ *3 Joint Bays and associated chambers*

Table 2 - Summary of 110kV Underground Cable Route	
Section	**Description**
	The Joint bays will be located below ground and finished/reinstated to the required Cork County Council specification. All reinstatement works will be carried out in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. Each joint bay will have an associated communication chamber and link box which will have a surface access hatch matching road/ground levels. All Joint Bay infrastructure are to be installed within the corridor of the existing carriageway. The link boxes and communication chambers will also be installed in the road carriageways or verges were available. It is proposed to install all joint bays within the corridor of the existing carriageway. The link boxes and communication chambers may be installed in the road verge. Road widening works may be required to facilitate these joint bays. The final position of the joint bays, link boxes and communication chambers will need to be agreed with EirGrid as part of the design approval process. ▪ *Culvert Crossings* Within section 5 the UGC route will again cross several existing culverts using an undercrossing or overcrossing method which will be selected based on the cover available above the culvert. One of the culverts (Culvert 16 – See 05843-DR-006) along this section the route will cross a large box culvert constructed of concrete and stone with a flat slab concrete roof. There is insufficient cover available in the road above the culvert to cross with a standard trench design. It is therefore a requirement to horizontal directional drill (HDD - 4) under this culvert. This can be executed by aligning the HDD within the existing road corridor to cross beneath the obstacle in the least intrusive manner. Some road widening works may be required to facilitate the HDD launch and reception site, this may include additional temporary works area within the adjacent private lands. The design and final location of the HDD launch/reception areas will need to be confirmed by a specialist drilling contractor following detailed site investigation works including bore holes. The total length of the HDD will be approx. 40m. The HDD launch/reception pits will be reinstated with a transition coupler or transition chamber. All reinstatement works will be finished/reinstated to the required Cork County Council or landowners' specifications. All reinstatement works will in the public road will be carried out in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. The final position of each individual HDD and possible transition chambers will need to prior agreement with EirGrid as part of the design approval process. The remaining culvert crossings have been designed in-line with the EirGrid specifications. Where it is not possible to cross under an existing culvert while maintaining the culvert in place, the culvert may be replaced. All reinstatement works will be carried out to the required Cork County Council specification and in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. EirGrid's preferred undercrossing method will be used where possible. Where undercrossing of the existing UGC routes is not possible an overcrossing method will be used. All UGC crossing will need to be agreed with EirGrid as part of the design approval process. The UGC crossings have been designed in-line with the EirGrid specifications.

Table 2 - Summary of 110kV Underground Cable Route	
Section	**Description**
Section 6 1600m approx.	**The Final section of the UGC Route turns off The Local Public Road Network and enters the forester access road until reaching the new Ballinagree Windfarm Substation** **(For reference see drawings 05843-DR-007 & 008)** <u>Section 6 Features:</u> ▪ *2 No. Joint Bays and associated chambers* The Joint bays will be located below ground and finished/reinstated to the required landowner specification. Each joint bay will have an associated communication chamber and link box which will have a surface access hatch matching road/ground levels. All Joint Bay infrastructure are to be installed within the corridor of the existing carriageway. The link boxes and communication chambers will also be installed in the access track. Track widening works may be required to facilitate these joint bays. The final position of the joint bays, link boxes and communication chambers will need to be agreed with EirGrid as part of the design approval process. ▪ *Culvert Crossings* In section 6 the UGC route will again cross several existing culverts using an undercrossing or overcrossing method which will be selected based on the cover available above the culvert. Culvert crossings have been designed in-line with the EirGrid specifications. Where it is not possible to cross under an existing culvert while maintaining the culvert in place, the culvert may be replaced. All reinstatement works will be carried out to the required landowner specification. ▪ *UGC Entry Point to Ballinagree Wind Farm Substation* The final entry point and position of the UGC route will be within the new Ballinagree Substation where the cable will transition from the ducted UGC route through a sand pit before rising vertically up to the cable sealing ends. The final location of the route will to be determined by the client in consultation and agreement with EirGrid as part of the design approval process.
Note: The precise location of the cable route may be subject to change as result of existing services/utility locations, ground conditions and any environmental constraints.	

3.0 Preliminary Site Investigations

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

The following items may be carried out for the grid connection cable route:

- Slit trenches at locations of service crossings (Full road/track width).

- Trial holes along the route to ascertain ground conditions and thermal resistivity of the soil.
- Trial holes at all joint bay positions to ascertain ground conditions and thermal resistivity of the soil.
- Boreholes at HDD locations to ascertain ground conditions.

Traffic Management – Single lane Closure with Stop/Go system in place as required.

Equipment:

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

4.0 Access Routes to Work Area

The majority of the underground cable will be installed within the public road network and existing access tracks and will therefore be accessed via the existing road network and access points. Where the cable route is located on private lands, contractor(s) will be required to utilise the local public road network in the vicinity of the work area and from there utilise existing access points, where appropriate.

A detailed Traffic Management Plan will need to be prepared, and agreed with Cork County Council, prior to the commencement of construction. Some work areas will require a road closure where it is not possible to safely implement a Stop/Go system. Where road closures are necessary, a suitable diversion will be implemented using appropriate signage, following consultation with Cork County Council.

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 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.

5.0 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 Cork County Council. All work on public roads will be subject to the approval of a road opening license application. The contractor will prepare detailed traffic management plans 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. The UGC will be usually installed in 100m sections, and no more than 100m will be excavated without the majority of the previous section being reinstated.

All construction vehicles will be parked within the works area so as not to cause additional obstruction or inconvenience to road users or 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.

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

6.0 Road Opening Licence

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

7.0 Construction Hours

Standard working hours for construction will be 8.00am to 8.00pm Monday to Friday and 8.00am to 6.00pm on Saturday (if required), with no works on Sundays or Bank Holidays except in exceptional circumstances or in the event of an emergency. All site personnel will be required to wear project notification labelling on high visibility vests and head protection so that they can be easily identified by all workers on-site.

8.0 UGC Construction Methodology

The UGC will consist of 3 No. 160mm diameter HDPE power cable ducts and 2 No. 125mm diameter HDPE communications duct (plus a 63mm Earth Continuity Conductor Duct between Clashavoon 220kV Substation and Joint Bay 1) to be installed in an excavated trench, The standard trench is 600mm wide by 1,250mm deep, with variations on this design to adapt to bridge crossings, culvert crossings, service crossings and watercourse crossings, etc. The power cable ducts will accommodate 1 No. power cables per duct. The communications duct will accommodate a fibre cable to allow communications between the Ballinagree Wind Farm substation and Clashavoon 220kV substation. The ducts will be installed, and the trench reinstated in accordance with the landowner or Cork County Council specifications, the electrical cabling/fibre cable is then pulled through the installed ducts in sections between joint bays. Construction methodologies implemented and materials used will ensure that the UGC is installed in accordance with the requirements and specifications of EirGrid.

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 included within the EIAR and as required by planning conditions where relevant;
- All existing underground services along the UGC route shall be confirmed prior to the commencement of construction works;
- At watercourse crossings, the contractor will be required to adhere to the environmental control measures outlined within the EIAR, the detailed Construction Environmental Management Plan (CEMP) and best practice construction methodologies;
- Where the cable route intersects with culverts, the culvert will remain in place (where possible) and the ducting will be installed either above or below the culvert to provide minimum separation distances in accordance with EirGrid and Irish Water specifications;
- In the event that culverts require removal for ducting installation, a suitable method of damming the water source and pumping the water around the work area would be set out in a method statement and agreed with the relevant stakeholders. Once the ducts are installed the culvert will be reinstated to match existing levels and dimensions. If works of this nature are required, the contractor will liaise with Inland Fisheries Ireland in advance of works;
- Traffic management measures will be implemented in accordance with those included in the EIAR, and a detailed Traffic Management Plan will be prepared and agreed with Cork County Council;
- 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 trench will be opened at any one time. The second 100m will only be excavated once the majority of reinstatement has been completed on the first;
- The excavation, installation and reinstatement process will take on average of 1 no. day to complete a 100m section;
- Where the cable is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together;
- Following the installation of ducting, pulling the cable will take approximately 1 no. day between each joint bay, with the jointing of cables taking approximately 1 week per joint bay location.

Figure 2 – Example of 110kV Underground Duct Installation

8.2 Ducting Installation Methodology

For the trenching and ducting works the following step by step methodology will apply for the standard trefoil trench design:

1. Grade, smooth and trim trench floor when the required 1,250mm depth and 600mm width have been obtained.
2. Place bedding layer of Cement Bound Granular Mixture B (CBGM B) material in accordance with the specification and compact it so that the compacted thickness is as per the drawings.
3. Lay the bottom row of ducts in trefoil formation as detailed on the design drawings. Use spacers as appropriate to establish horizontal duct spacing. Fit a secure cap / bung to the end of each duct run to prevent the ingress of dirt or water.
4. Carefully surround and cover ducts with CBGM B in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
5. Place cable protection strips on compacted CBGM B directly over the ducts.
6. Lay the top row of ducts onto the freshly compacted CBGM B including the 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.
7. Carefully surround and cover ducts with CBGM B material in accordance with the drawings and thoroughly compact without damaging ducts.
8. Place red cable protection strip on top of compacted CBGM B over each set of ducts as shown on the drawings.
9. Place and thoroughly compact CBGM B material or Clause 804 backfill or soil backfill as specified and place warning tape at the depth shown on the drawings.

10. For concrete and asphalt/bitmac road sections, carry out immediate temporary/permanent reinstatement in accordance with the specification and to the approval of the local authority and/or private landowners, unless otherwise agreed with local authorities *(Figure 3).*

11. For unsurfaced/grass sections, backfill with suitable excavated material to ground level leaving at least 100mm 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).*

12. Clean and test the ducts in accordance with the specification by pulling through a brush and mandrel. Install 12mm polypropylene draw rope in each duct and seal all ducts using robust duct end seals fitted with rope attachment eyes in preparation for cable installation at a later date. All the works should be witnessed by EirGrid Clerk of Works (CoW) as required.

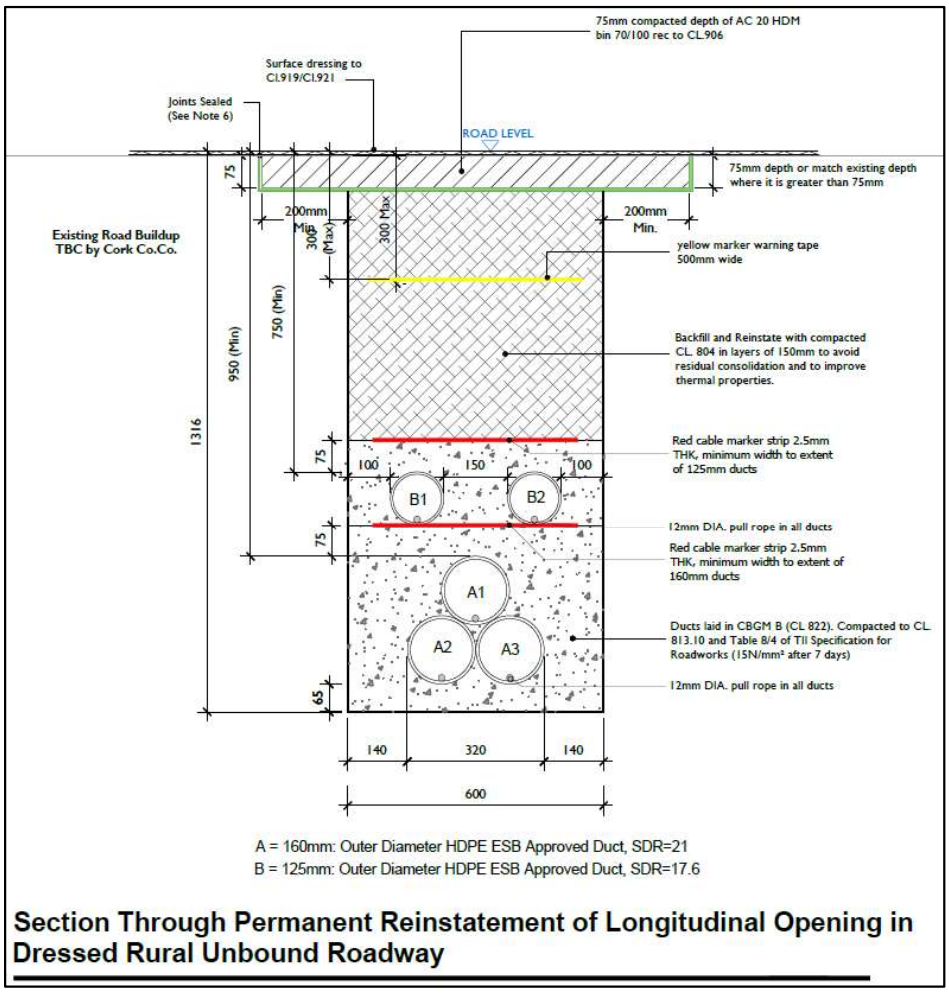

Figure 3 – 110kV Trefoil Trench in Rural Roadway

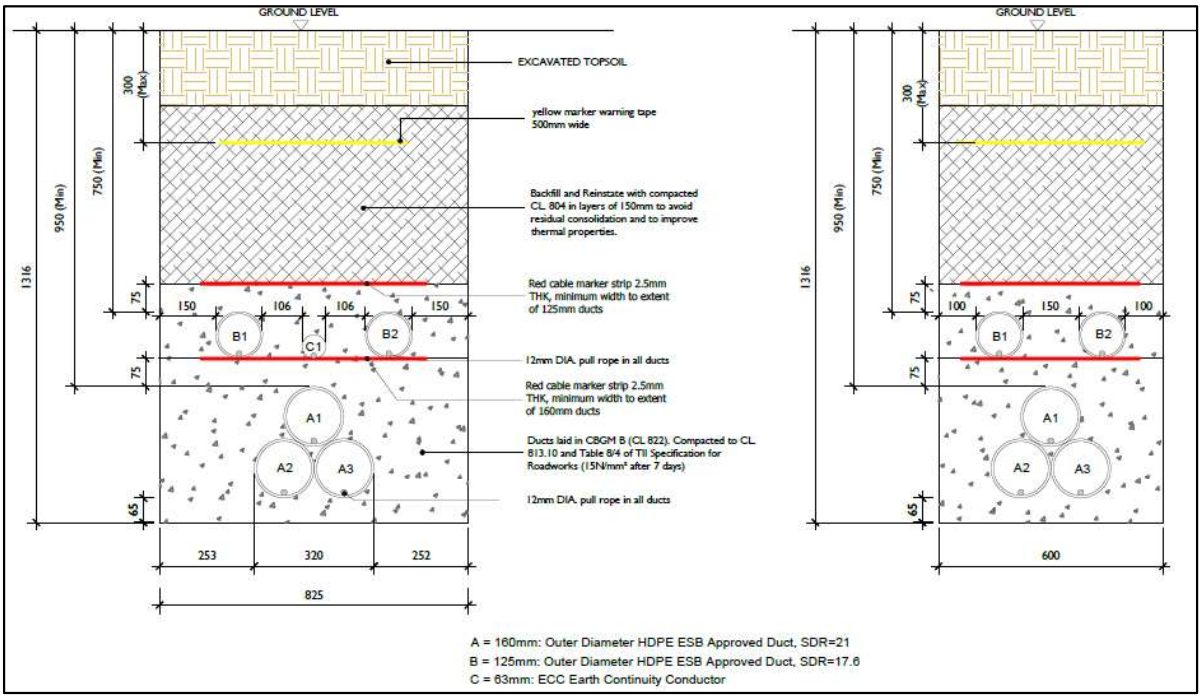

Figure 4 - Trench in Off Road Section

Equipment:

- 2-3 General Operatives;
- 1 Excavator Operator;
- 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;
- 160mm & 125mm diameter HDPE ducting;
- Temporary Surface Reinstatement Materials;

8.2.1 UGC Installation on Public Road

The majority of the 110kV route is located within public road carriages and where applicable the trench will be installed in the non-trafficked strip between the wheel marks on the road. The cable will be micro-sited based on the presence of exiting utilities and the nature of the road and the adjoining terrain. It is preferable to excavate a trench within the middle of the lane, or the middle of the roadway to reduce load on the cable.

8.2.2 UGC Installation on Forestry Tracks

Where the cable is installed in forestry tracks the location where the cable is laid will depend on several factors such as; width of track, bends along the track and crossings. Where the track needs to be widened, stone will be brought in to build up the area to the same level of the track. The excess material from the track will be used elsewhere on reinstatement works.

8.3 Surface Cable Markers & 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 EirGrid standards.

Marker posts will be used on non-roadway routes to delineate the cable route and joint bay positions. Corrosion proof aluminium triangular danger sign, with 700mm base, and with centred lightning symbol, on engineering grade fluorescent yellow background shall be installed in adequately sized concrete foundations. Marker post shall also be placed in the event that burial depth is not standard. Siting of marker posts to be agreed with EirGrid as part of the detailed design process *(Figure 5)*.

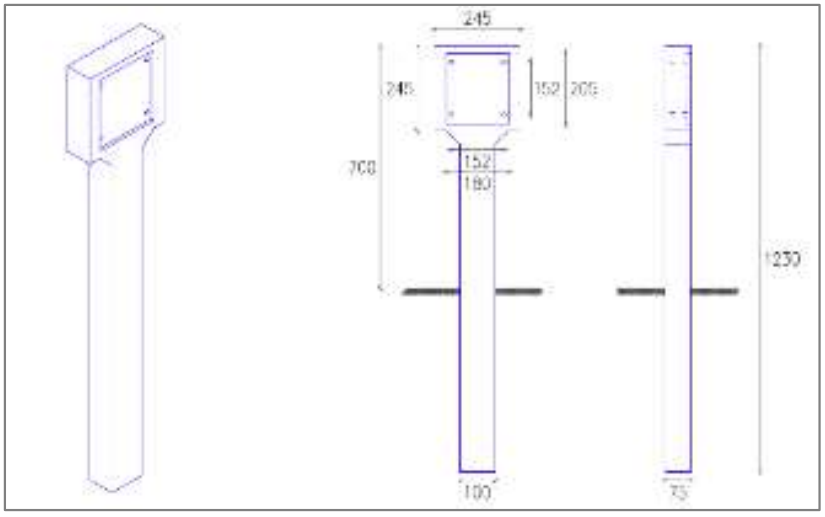

Figure 5 - EirGrid Marker Posts Example

8.4 Managing Excess Material from Trench

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

8.5 Storage of Plant and Machinery

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

8.6 Joint Bays and Associated Chambers

Joints Bays are to be installed along the UGC route to facilitate the jointing of 3 No. lengths of UGC (see Appendix A, Route Summary for distances between each joint bay). Joint bays are approximately 2.5m x 6m x 1.75m 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 the Ballinagree Wind Farm substation and the existing 110kV substation at Clashavoon. Earth Sheath Link Chambers are also required at every joint bay along the cable route. Earth Sheath Links are used for earthing and bonding cable sheaths of underground power cables, so that the circulating currents and induced voltages are eliminated or reduced. Earth Sheath Link Chambers and Communication Chambers are located in close proximity to Joint bays. Earth Sheath Link Chambers and Communication Chambers will be pre-cast concrete structures with an access cover at finished surface level.

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

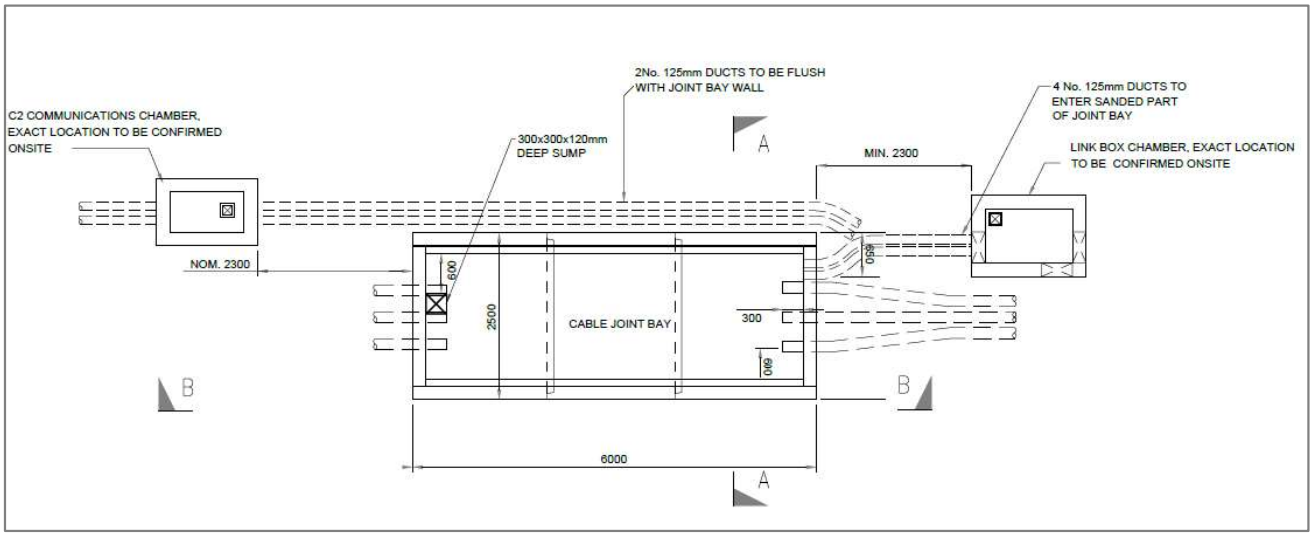

Figure 6 –110kV Joint Bay Plan Layout

8.7 Joint Bay Construction and Cable Installation

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

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

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

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

1. The contractor will excavate a pit for joint bay construction, including for a sump in one corner.

2. Grade and smooth floor; then lay a 50mm depth of thick sand for pre-cast concrete construction on 200mm thick Clause 804 granular material.

3. Place pre-cast concrete sections on sand bedding. *(Figure 7)*

Figure 7 – Example of Joint bay under construction (pre-cast)

4. Where joint bays are located under the road surface the joint bay will be backfilled with compacted layers of Clause 804 and the road surface temporarily reinstated as specified by the local authority.

5. Precast concrete covers may be used as temporary reinstatement of joint bays at off road locations. These covers are placed over the constructed joint bay and are then removed at the cable installation stage of the project.

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

7. The cable is supplied in pre-ordered lengths on large cable drums *(Figure 8).* Installing "one section" of cable normally involves pulling three individual conductors into three separate ducts. The cable pulling winch must be set at a predetermined cut off pulling tension as specified by the designer. The cable will be connected to the winch rope using approved suitably sized and rated cable pulling stocking and swivel or the pulling head fitted by the cable manufacturer**.** A sponge may also be secured to the winch rope to disperse lubricant through the duct. Lubrication is also applied to the cable in the joint bay before it enters the duct.

Figure 8 - HV cable pulling procedure (Drum set-up example)

8. Once the "two sections" of cable (total of 6 conductors) are pulled into the joint bay, a jointing container is positioned over the joint bay and the cable jointing procedure is carried out in this controlled environment. *(Figure 9)*

Figure 9 - HV cable jointing container

9. Please note that where the cable is to be installed in steep sections of the route the cable may have to be clamped/cleated within the joint bay's either side of the steep section to avoid and future damage caused by the UGC creeping downhill.

10. Following the completion of jointing and duct sealing works in the joint bay, place, and thoroughly compact cement-bound sand in approximately 200mm layers to the level of the cable joint base to provide vertical support. Install additional layers of cement-bound sand and compact each layer until the cement-bound sand is level with the top of the joint. Install an additional 100mm cement-bound sand layer. Install cable protection strip. Backfill with cement-bound sand to a depth of 250mm below surface and carry out permanent reinstatement including placement of warning tape at 400mm depth below finished surface.

Equipment:

- 2-3 General Operatives
- 1 Excavator Operator
- 360˚ tracked excavator (13 ton normally, 22 ton for rock breaker)
- 1 no. tracked dumper or tractor and trailer

Materials:

- Sand for pipe bedding
- Clause 804 Material
- 160mm diameter HDPE ducting;
- 125mm diameter HDPE ducting;
- 63mm ECC Duct – (Clashavoon 220 Substation to Joint Bay 1)
- Precast Joint Bay Chamber Units
- Link Boxes & C2 Communication Chambers (precast)

9.0 Horizontal Direction Drilling (HDD)

Horizontal Direction 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 thee bridges and one culvert 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.

Detailed site investigation works will be completed at each of the HDD locations to confirm ground conditions. This information will be obtained by completing boreholes at each location, the results from the borehole data will be used to design the HDD and crossing depths. A bespoke design will be prepared for each HDD crossing by a specialist drilling contractor. Each individual HDD design will be subject to prior EirGrid review and approval. As part of each HDD design an Outline Frac-Out Mitigation Plan will be prepared by the contractor which will detail the measures which will be implemented to prevent, contain, control and stop any frac-out. A sample 'HDD outline Frac-Out Mitigation Plan' is shown in Appendix B of this report.

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 ESB Networks, EirGrid and Cork County Council.
13. A transition coupler or transition chamber will be installed at either side of the obstacles following the horizontal directional drilling as per EirGrid requirements, this will join the HDD ducts to the standard ducts.

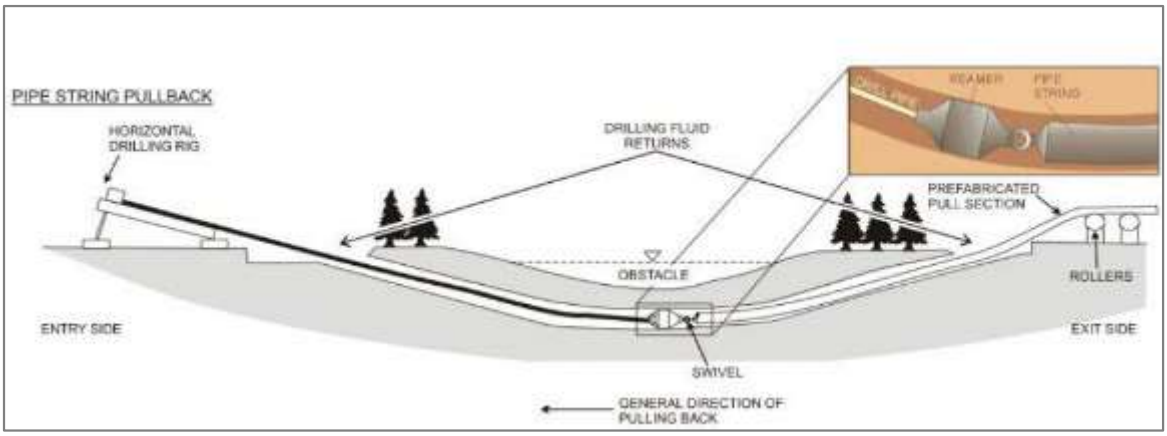

Figure 10 - Example of HDD Installation

10.0 Watercourse Damming and Reinstatement Methodology

Sections of trenching and ducting will involve instream works at numerous culvert crossing locations in order to install cabling. To facilitate the works, these watercourses will be dammed and the water diverted over or around the works using either a flume pipe or a diversion channel. Following the completion of works at the watercourse, the dam will be removed and the watercourse reinstated.

Duration: 1-2 Days per location

Personnel, Machinery & Equipment:

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

Materials:

- Pipe culvert
- Box culvert
- Cable ducting and trenching backfill
- Sand bags
- Water pump
- Geotextile membrane
- Straw bales

Standard Methods - Dam & Flume Work:

1. The flume pipe(s) will be set out on the bed of the existing stream.

2. A dam will be constructed using sand bags and suitable clay material around the flume pipe(s) and across the stream so that all the flows are diverted through the pipe(s).

3. Silt traps, such as geotextile membrane, straw bales etc. will be placed downstream of the in-stream trenching location prior to construction, to minimise silt loss.

4. The ducting installation works will be carried out in the dry stream bed and under/around the flume pipe(s). If required, a temporary sump will be established and used to collect any additional water. This water will be removed by pumping to a percolation area if the soil is not saturated, otherwise a settlement tank will be used to remove any solids from the de-watering.

Standard Methods - Dam & Divert Work:

1. A suitable channel for the stream will be excavated adjacent to the original channel.
   Bedding stone will be placed on the bed of the new channel.

2. A dam will be constructed using sandbags and suitable clay material across the stream so that the flow is diverted down the new channel.

3. Silt traps, such as geotextile membrane, straw bales etc. will be placed downstream of the in-river trenching location prior to construction, to minimise silt loss.

4. The trench will be excavated in the dry stream bed. If required, a temporary sump will be established and used to collect any additional water. This water will be removed by pumping to a percolation area if the soil is not saturated, otherwise a settlement tank will be used to remove any solids from the de-watering.

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

1. Following the completion of works, the stream bed will be reinstated with original or similar material and the spawning gravels replaced under the supervision of an aquatic ecologist.

2. Once the stream bed is appropriately re-instated the dam and the flume pipe(s) will be removed thus restoring the stream to its original condition.

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

1. Following the installation of the cable ducts, the stream bed will be reinstated with original or similar material and the spawning gravels replaced under the supervision of an aquatic ecologist.

2. Once the stream bed is appropriately reinstated, the dam will be removed thus restoring the stream to its original alignment.

3. The temporary channel will then be reinstated with the previously excavated material.

11.0 Replacement of Existing Culverts

The grid connection route extends approximately 11.307km mainly along local roads and an unpaved forestry access road. There are currently nineteen known culverts along the route. Of these culverts, most appear to be

either concrete pipe, HDPE twinwall pipe or stone construction, most of which are on the public road. Where there is insufficient cover over the culvert, it will be necessary to trench under the culvert. It should be again noted that the EirGrid preferred method of crossing third party services/culverts is undercrossing. For stone culverts there is a high probability that the culvert would collapse sending stream water into the trench. To avoid this occurring, stone culverts with insufficient cover will be identified and replaced prior to trenching works. The following approach will be taken:

1. Works will be supervised by the ECoW and / or the project aquatic ecologist who will liaise with IFI and National Parks and Wildlife Service (NPWS) prior to works commencing. The ECoW will also monitor surface water quality downstream of the works in accordance with the surface water monitoring programme and will have the authority to cease any works should the monitoring identify unacceptable water quality conditions.

2. Any works within watercourses that are subject to fish habitat (indicated in the EIAR at least of "Medium" sensitivity), will be avoided between Oct 1st and April 30th as per IFI and Loughs Agency guidelines.

3. All plant and equipment will be serviced and cleaned before entry to site to limit risk of oil spillage and for biosecurity.

4. Where temporary fluming or flow diversion are in situ, in a watercourse frequented by salmon or trout, (at least medium sensitivity) all fish within the designated area will be subject to fish rescue and translocation downstream by a fisheries biologist. Fish rescue will be conducted under Section 14 authorisation (DCCAE/ IFI) or Section 69 authorisation (Loughs Agency) where appropriate.

5. Works will be carried out in dry weather with low flows in the streams with forecast for dry weather for the duration of the works – approximately 2 days.

6. Machinery used will stay on the public road; machinery will not be permitted to enter the stream channel.

7. The road edge adjacent to the watercourse will be lined with sandbags and silt fences (multiple fences recommended) as appropriate to prevent runoff from the trenching works reaching the stream. The design of these multiple features shall also allow for the safe removal of accumulated silt away from the channel, particularly through staged removal of the most contaminated upper fence before the lower ones, and the removal of the final fence only when it is clear of any silt

8. Clean sandbags will be used to dam flows on the upstream side of the culvert. Sandbags will be placed by hand at a suitable location to take advantage of any natural pool but set back from the works to permit unhindered excavation of the existing culvert.

9. A second sandbag dam will be placed on the downstream side of the culvert to prevent backflow into the works and contain any groundwater seepage that is likely to be turbid.

10. Sandbagging requires careful attention to detail if it is to be effective. All bags must be laid neck uppermost and seams aligned. Bags must not be overfilled or they will not tamp together or will burst with ease. Additional bags will be filled ready to raise freeboard of dams.

11. Flume placement for temporary flow diversion or permanent replacement of culverts will follow guidelines issued by IFI and CIRIA to ensure that fish passage is not impeded.

12. If topography permits, the water will be piped over the road by gravity flow, otherwise, it will be pumped. Discharge will be via break tank or similar approved storage onto a splash-plate or rip-rap (gabion basket) to dissipate energy and avoid scour or erosion of the stream bend or banks. The pump will be filled with a screen, so fish aren't drawn into the pump intake.

13. The use of pump sumps will be considered within the dammed area. These will be lined to prevent scouring. The intention is to intercept clean groundwater ingress and pump it out rather than allowing it to get silted in the works area by segregating off areas.

14. Any spoil generated will be removed to designated safe area clear of the flood plain. Some of this spoil will be saturated and will require bunding and sheeting over.

15. If bank material needs to be removed it will be stored separately and reinstated according.

16. The ducting will be advanced passed the culvert and the existing culvert will be excavated 'in the dry' and a new culvert, sized for a 100-year rainstorm event, will be installed with appropriate gradient, headworks and outfall. A precast concrete culvert, concrete pipe or HPDE pipe will be used. Culverts will be embedded to at least 300mm below the existing stream bed to ensure backwatering. Culverts will avoid a significant change in gradient (i.e. >3%). After embedding, replacement culverts will be filled with clean washed gravels and cobbles to replace lost habitat and facilitate fish movement.

17. Dry stone headworks will be placed at the culvert intake and discharge and the stream bed adjacent to the works will be reinstated at the direction of the project aquatic ecologist.

18. The ECoW will determine the quality of any water trapped between the two dams – visual inspection and turbidity meter. If this water is clean it will be left in situ. If it is not clean, it will be removed from the works area prior to removal of the dams. If required, dewatering of the works area prior to dam removal will be undertaken by pumping from the stream bed to either a) the cable trench for percolation or b) taken back to the wind farm site for treatment at an existing settlement pond or c) treatment using a Siltbuster. The most efficient method will depend on the volume of water present and the available percolation.

19. The upstream dam will then be removed to permit flow though the new culvert. This will be done in phases, so a large volume of water isn't released at once. The downstream dam will be removed in a similar manner.

12.0 Relocation of Existing Services

In order to facilitate the installation of the underground cable, it may be necessary to relocate existing underground services such as water mains or existing cables. In advance of any construction activity, the contractor will undertake detailed surveys and scans of the 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.

13.0 Watercourse Crossings

The grid connection cable route contains 3 No. bridge watercourse crossings and one large culvert crossing which will be completed using horizontal directional drilling (HDD) (refer to Section 9 above for further details). Where the cable route intersects with existing watercourses, a detailed construction method statement will

need to be prepared by the Contractor prior to the commencement of construction and is to be approved by the Local Authority and relevant environmental agencies.

A number of other minor watercourses crossing locations have been noted along the cable route, i.e. culverts, pipe drains and minor field drains. Crossing of these existing culverts will be as per undercrossing or an overcrossing methods, depending on the depth of the culvert or using open trenching. A detailed site survey of all culverts will need to be completed as part of the next phase of the project prior to construction. The culvert crossing methods are detailed in *Figures 11* and *12*.

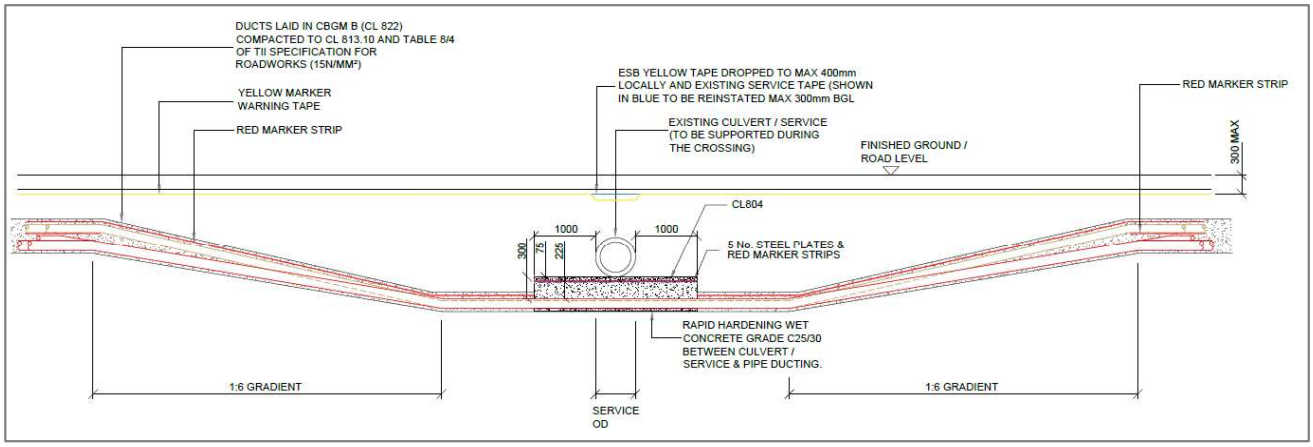

Figure 11 – 110kV UGC Culvert Undercrossing

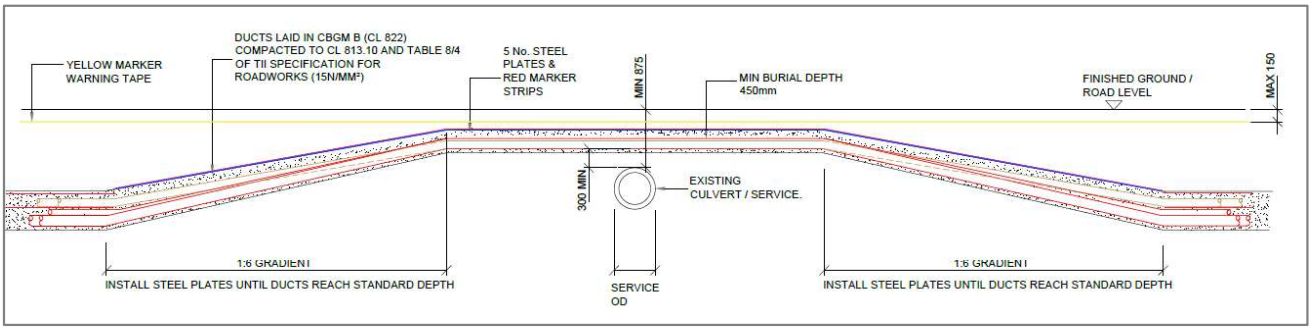

Figure 12 – 110kV UGC Culvert Overcrossing

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.

14.0 HV Underground Cable (UGC) Crossings & Parallel Runs

As mentioned in **Table 2** above there are several locations where the Ballinagree UGC route will have to cross other existing HV UGC route. These crossing and parallel runs occur in **Sections 1**, **2**, and **4** (see Table 2 for details)**.** Each individual crossing and parallel run will need to be individually access on a case-by-case basis. Site investigation works along with detailed surveying techniques and consultation with EirGrid will be required to determine the locations depths and configurations and ratings of the existing

UGC routes. Once these details are determined then cable rating studies and system modelling can be carried out to determine how best to proceed with the UGC route design in these areas.

It bears repeating that there is the high probability that the proximity (both in parallel and in crossing) of the existing HV UGC routes may well have a mutual de-rating effect on both UGC circuits. The de-rating effect will be minimised by setting and maintaining a minimum separation distance between the cables. The scale of the de-rating effect will need to be considered by detailed design calculation and system modelling. The EirGrid preferred undercrossing method will be used where possible. A crossing method can be seen in *Figure 13* below. Where undercrossing of the existing UGC routes is not possible an overcrossing method will be used. All UGC crossings will need to be agreed with EirGrid as part of the design approval process. The UGC crossings have been designed in-line with the EirGrid specifications.

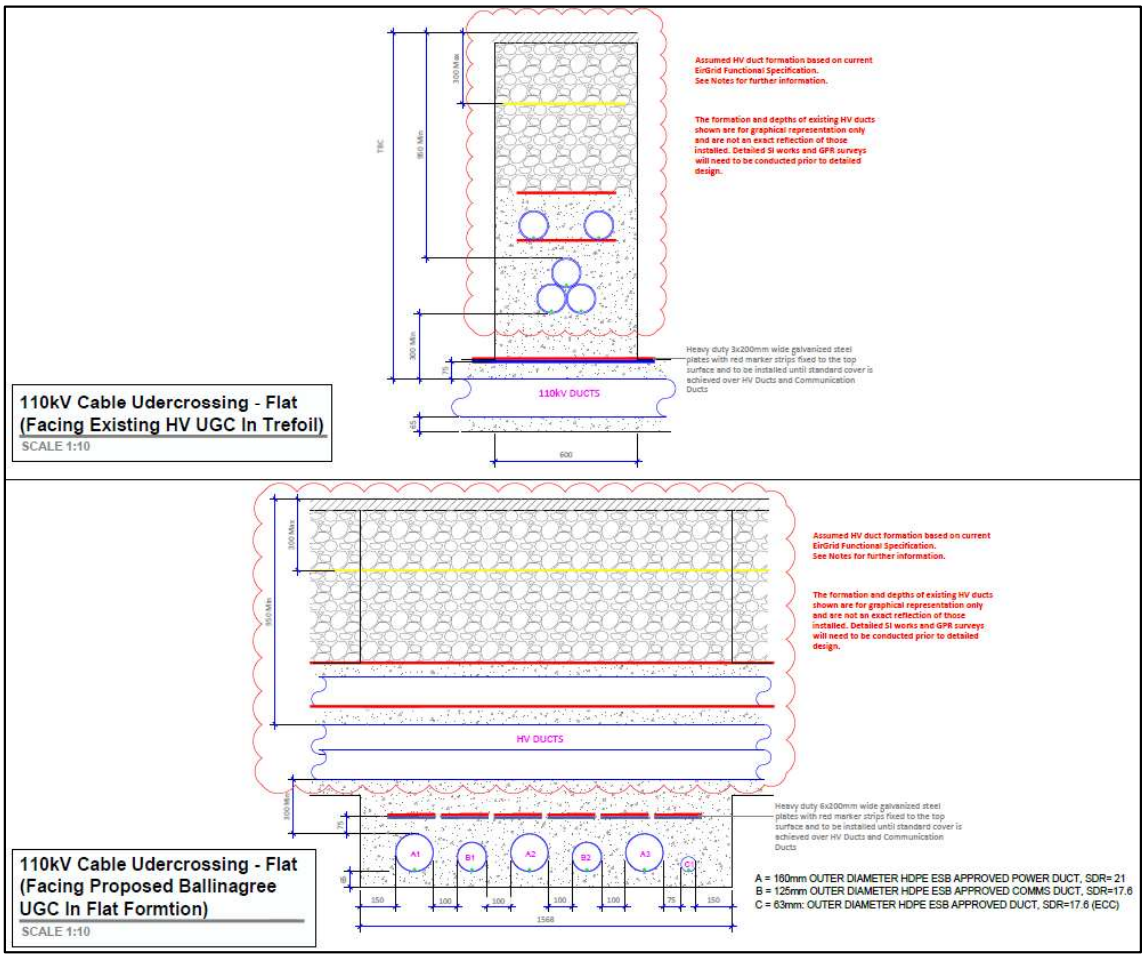

Figure 13 – Example of 110kV UGC Cable Undercrossing in Access Track

15.0 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 in consultation with the landowner and in line with any relevant measures outlined in the planning application, CEMP and planning conditions.

16.0 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 Outline Construction Methodology, environmental protection measures included within the planning application, measures within the CEMP, and the guidance documents and best practice 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 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 pocket book*. (C762) 4th edition. CIRIA;
- CIRIA *Environmental Good Practice on Site (fourth edition) (C741) 2015*.

The 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 Ballinagree 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 considered 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 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, with the Contractor required to prepare a contingency plan for before and after such events;
- The contractor will carry out visual examinations of local watercourses from the 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 concrete contaminated water run-off will not be allowed to enter any watercourses. Any pouring of concrete (delivered to site ready mixed) will only be carried out in dry weather. Washout of concrete trucks shall be strictly confined to a designated and controlled wash-out area within the Wind Farm site; remote from watercourses, drainage channels and other surface water features;
- A designated trained operator experienced in working with concrete will be employed during the concrete pouring phase;
- Concrete waste water can be pumped into a skip to settle out; settled solids will need to be appropriately disposed of off-site;
- Wash-down water from exposed concrete surfaces, will be trapped to allow sediment to settle out and reach neutral pH before clarified water is released to the drain system or allowed to percolate into the ground;
- Where dust suppression is considered to be required by the Contractor, such requirements and methodology shall be subject to the agreement with the Ecological Clerk of Works;
- 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 waste water 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.

17.0 Invasive Species Best Practice Measures

Invasive species can be introduced into a location by contaminated plant, machinery and equipment which 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.

18.0 Waste Management

All waste arising during the construction phase will be managed and disposed of in a way that ensures the provisions of the Waste Management Act 1996 and associated amendments and regulations and the Waste Management Plan. Soil will be reinstated into trenches where possible. In the event, there is excess material with no defined purpose, it will be transported to an authorised soil recovery site.

Appendix A – Route Summary

Section From	*Section To*	*Section Length (m)*	*Bonding Arrangement*	*No. of Watercourses*	*Watercourses*	*No. of Bridges*	*Bridges*	*Location Drawing Ref.*
Clashavoon SS	JB-01	230	Single point Bonded	2	C1, C2 Existing Surface Water (EXS) Substation infrastructure	-	-	05843-DR-002
JB-01	JB-02	830	Cross-bonded	5	C3, C4, C5, C6, C7	-	-	05843-DR-002/003
JB-02	JB-03	809	Cross-bonded	3	C8, C9, C10	-	-	
JB-03	JB-04	837	Cross-bonded	1	C11	-	-	
JB-04	JB-05	692	Cross-bonded	1	C12	-	-	05843-DR-003/004
JB-05	JB-06	720	Cross-bonded	1	B1 - Clonavrick Bridge, Laney River HDD	1	B1	
JB-06	JB-07	727	Cross-bonded	0		-	-	
JB-07	JB-08	822	Cross-bonded	1	B2 - Awboy Bridge over River Awboy - HDD	1	B2	05843-DR-004/005/006
JB-08	JB-09	794	Cross-bonded	2	B3 - Coppeleenbawn Bridge - River Glashreagh - HDD, C13	1	B3	
JB-09	JB-10	795	Cross-bonded	2	C14, C15	-	-	
JB-10	JB-11	648	Cross-bonded	0		-	-	05843-DR-006/007
JB-11	JB-12	675	Cross-bonded	1	C16 - Concrete culvert 1300mm D x 1900mm W 200mm slab, 450mm cover	-	-	
JB-12	JB-13	653	Cross-bonded	1	C18	-	-	
JB-13	JB-14	683	Cross-bonded	0		-	-	05843-DR-007/008
JB-14	JB-15	692	Cross-bonded	1	C19	-	-	
JB-15	Ballinagree SS	700	Cross-bonded	1	C20	-	-	
	Total:	**11,307**		**22**		**3**		

Appendix B – Sample HDD Outline Frac-Out Mitigation Plan

HDD Outline Frac-Out Mitigation Plan

All HDD personnel to be briefed and fully conversant with this **Frac-Out Mitigation Plan** prior to works commencing. There are four stages to the management of a frac-out which will be implemented as follows: -

1) Prevention **2) Containment** **3) Control** **4) Stop**

Methods for Mitigating Hydro-Fracture

1 Prevention

A hydrofracture or 'frac-out' is the unintentional return of drilling fluids to the surface during HDD. A frac-out occurs when the down hole mud pressure exceeds the overburden pressure (i.e. shallow or loose sections of the bore), or the fluid finds a preferential seepage pathway (such as fault lines and fractures, infrastructure or loose material). These fractures can be natural or induced by over-pressurising the formation. Most frac-outs are usually minor, within works easements and close to the bore entry or exit.

Drilling fluid is comprised primarily of water and approximately 1 to 3% bentonite, a naturally occurring clay mineral, so it is, in most circumstances, a non-toxic, benign fluid, except when suspended within a water body where it can harm ecology. The risk of inadvertent fluid returns should be reduced through competent design and good practices.

Annular fluid pressures are minimised by constant monitoring of the drilling fluid parameters.

- The Fluids Technician will monitor drill fluid density, viscosity and solids content on a regular basis, **(half-hourly)**, to ensure that the fluid does not increase in viscosity, requiring additional pressure to maintain mobility.
- The Driller will monitor the drill fluid pressures, volumes, viscosities and densities of mud being pumped through the bore. Any increases in pump pressure will be investigated immediately to prevent the risk of pressure build up within the annulus.
- The Fluids Technician will monitor active fluid tank volumes and account for any unexpected changes (The drill fluid is designed to allow water loss in porous formations in order to build filter cake).
- The bore hole will be reamed on a regular basis to keep the annulus clear. Rates of Penetration and circulated cuttings volumes will be monitored to ensure that drilled cuttings are being flushed from the bore and are not building up creating pressure restrictions.
- Annular fluid velocity will be kept below critical velocity to prevent eddying and subsequent erosion caused by turbulent flow. When drilling clay based formations (which may be present), inhibitors may be used to prevent the absorption of water and subsequent swelling of the formations.
- A **Frac-Watch** programme will be operated at all times whilst circulating, particularly when drilling past potential pathways
- The **Frac-Watch** programme will ensure that the ground surface above the drilling path will be inspected throughout the HDD process. Spotters will be responsible for the monitoring (numbers dependant on drill length and location topography etc.)

HDD drilling fluid returns to be monitored. Risk of hydro-fracture to be mitigated through monitoring and HDD fluid selection. Methods of monitoring include: -

Operational (This will be undertaken throughout HDD process)

- *Full briefing of personnel prior to HDD operation (Mitigation Plan)*
- *Personnel will be assigned to specific tasks and be fully conversant with procedures in Mitigation Plan*
- *Follow best drilling practices (HDD Design)*
- *Monitor & control mud weights*

- *Maintain effective fluid properties*
- *Monitor pressures on HDD rig*
- **Frac-Watch** - *Visual monitoring of returns at both launch and reception pits*
- **Frac-Watch** - *Spotters to be deployed*
- **Frac-Watch** - *Spotters to have two-way radios, along with launch and reception teams (close monitoring and direct communication ensures swift reaction)*
- **Frac-Watch** – Driller to inform spotters of progress of drill so that they know location of drill head/reamer (i.e. Joint 1, 2, 3.etc.)

2 Containment

Contingencies are in place to deal with potential frac-outs when drilling operations commence. If a frac-out occurs, drilling operation to be suspended temporarily and assessment of location and severity to be carried out.

a. The rig and pumps will immediately be shut off

b. The drilling assembly will be pulled off bottom to reduce annular pressures

c. Once shut down procedure is complete, the frac-out will be contained by all site personnel as-quickly-as possible by any one of the measures listed below where applicable.

Physical (This will be undertaken if a frac-out occurs)

The following is to be stored at the **Entry Site** and **Exit Site**.

- Sandbags – use to contain sediment, deploy at source. Frac-out may occur some distance from the bore path. Sand Bags will be available to control drill fluid at surface
- 1 x roll of Polyethylene
- Tractor & bowser
- Pumps

d. Client Site Manager to be notified as-soon-as possible.

3 Control

The freshwater based, bentonite suspension, drill fluid systems utilised are, essentially, low viscosity grouts. In most cases, the fracture pathways will quickly seal up. Frac-out is likely to indicate that the bore hole requires reaming to reduce the pressure required to return drill fluid to surface.

Once the frac-out has been contained a swab-trip may be sufficient to prevent further frac-out and re-establishment of fluid returns. Lost Circulation Material (LCM) drill fluid additives will be available to seal fractures in the formation.

After an assessment has been conducted following a frac-out the following control measures should be implemented as follows: -

a) Re-Circulation Attempt (This will be undertaken if a frac-out occurs)

- The pilot bore or reaming operation will be retracted away from the frac-out to try and re-establish fluid returns. This may require the complete extraction of the drill string and a re-drill if necessary.

b) Mechanical (This will be undertaken if a frac-out occurs)

This will be carried out via fluid mixing system and pumped down drill string to frac-out.

- Physical plugging by Loss of Circulation Material (LCM), Enviro Formfill to be utilised as-soon-as possible to manufacturer's specification.

4 Stop Procedure (If sections 1, 2, & 3 are unsuccessful)

If any of the measures outlined in sections 1, 2, & 3 are unsuccessful then drilling operation will be suspended.

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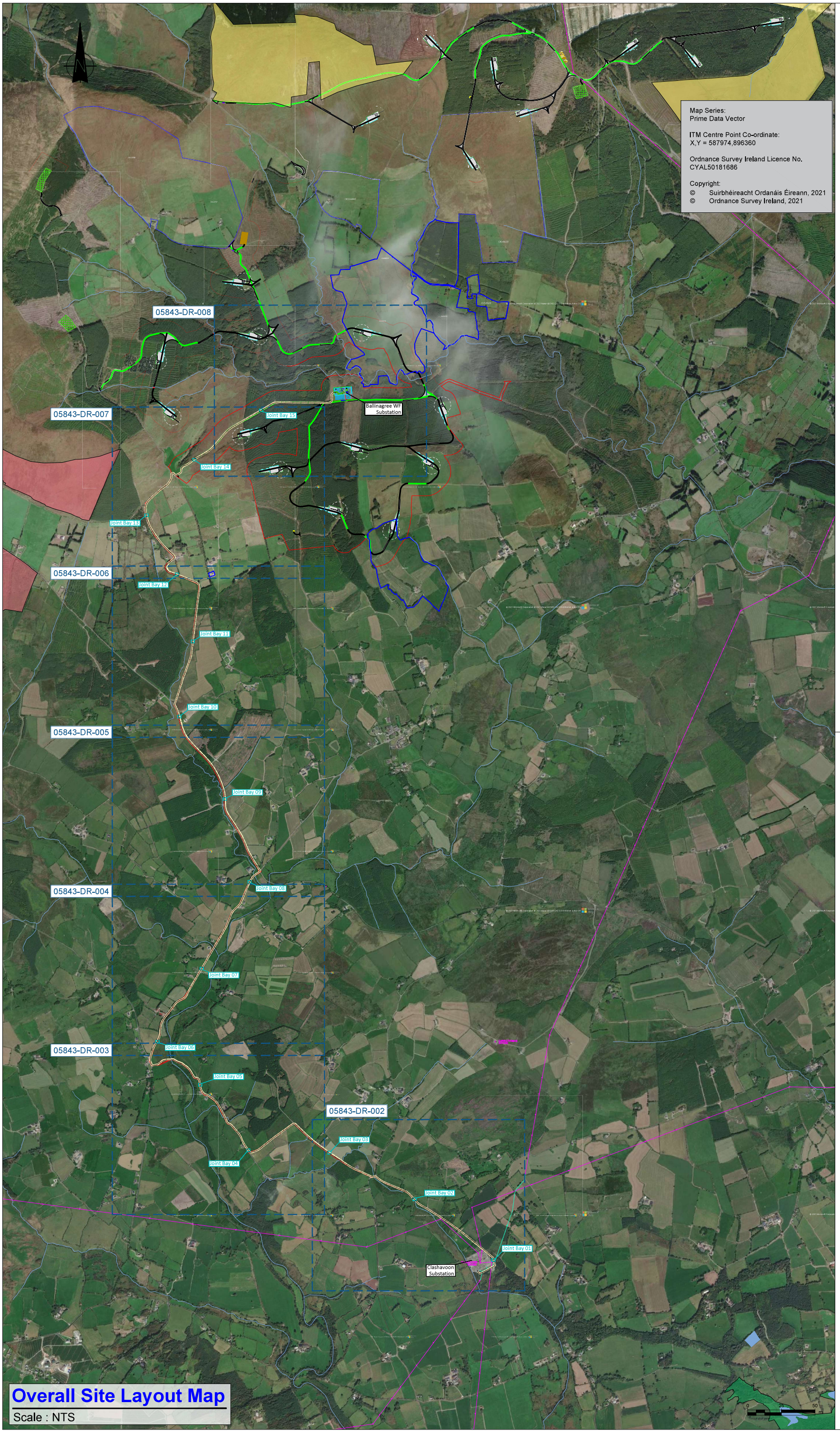

LEGEND: -

- Proposed 110kV UGC Route (11.307km)
- Existing Rivers & Streams
- Existing ESB OHL & UGC HV Network
- Special area of Conservation
- Natural Heritage Areas
- Proposed Natural Heritage Areas
- Proposed Red Line Boundary

NOTES: -

- This drawing is to be used only for the purpose of the planning application and is subject to detailed design.
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- Position of link boxes and comms chambers is to be agreed onsite with EirGrid/ESB.
- Other services may be encountered on the route.

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PROJECT NUMBER

05-843

SHEET TITLE

Overall Site Layout Map

SHEET NUMBER

05843-DR-001

ISO A1 594mm x 841mm

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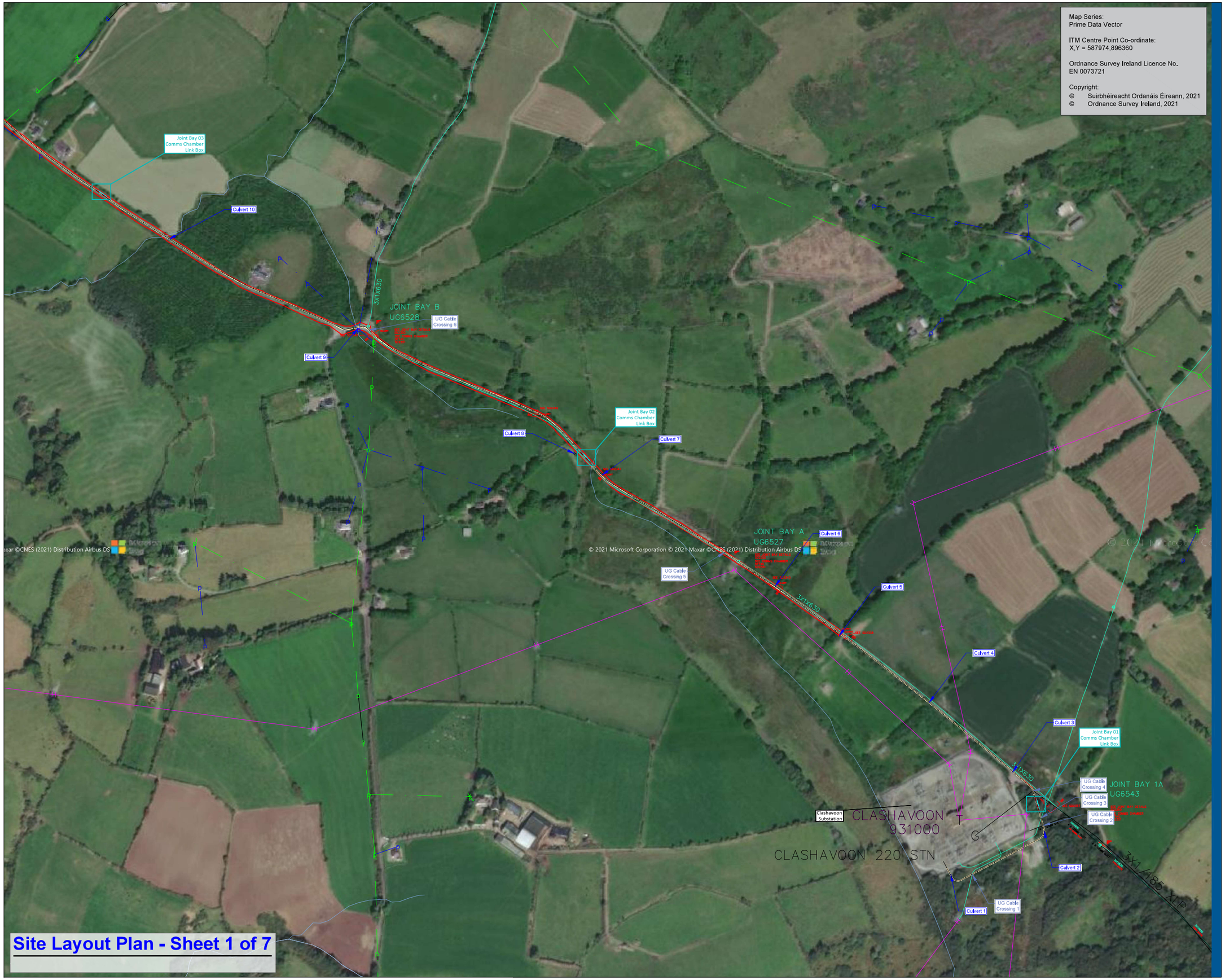

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- Other services may be encountered on the route.

LEGEND: -

- Proposed 110kV UGC Route (11.307km)
- Existing Rivers & Streams
- Existing ESB OHL & UGC HV Network
- Existing ESB OHL MV & LV Network
- Existing Surface Water
- Proposed Red Line Boundary

PROGRESS PRINT

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I/R	DATE	DESCRIPTION
F01	07.01.22	Issued for Information
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05-843

SHEET TITLE

Site Layout Plan -
Sheet 1 of 7

SHEET NUMBER

05843-DR-002

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- Position of HDD launch/reception shown points are indicative only and will be subject to site investigation works and detailed design.

LEGEND: -

Proposed 110kV UGC Route (11.307km)
Existing Rivers & Streams
Existing ESB OHL MV & LV Network
Proposed Red Line Boundary

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I/R	DATE	DESCRIPTION
F01	07.01.22	Issued for Information
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05-843

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Site Layout Plan -
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LEGEND: -

- Proposed 110kV UGC Route (11.307km)
- Existing Rivers & Streams
- Existing ESB OHL MV & LV Network
- Proposed Red Line Boundary

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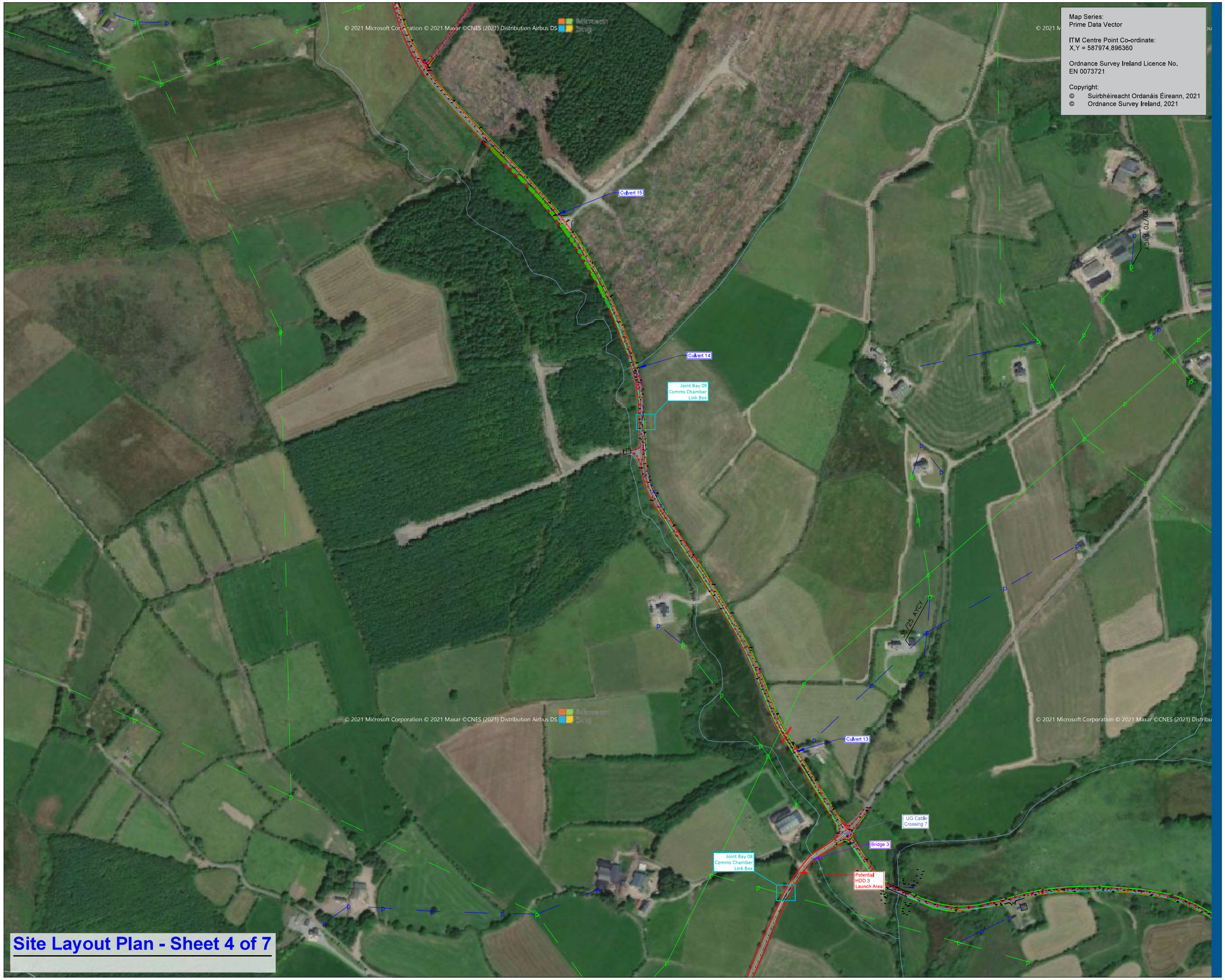

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LEGEND: -

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Existing Rivers & Streams
Existing ESB OHL MV & LV Network
Proposed Red Line Boundary

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LEGEND: -

- Proposed 110kV UGC Route (11.307km)
- Existing Rivers & Streams
- Existing ESB OHL MV & LV Network
- Landowner Folio Boundary
- Proposed Red Line Boundary

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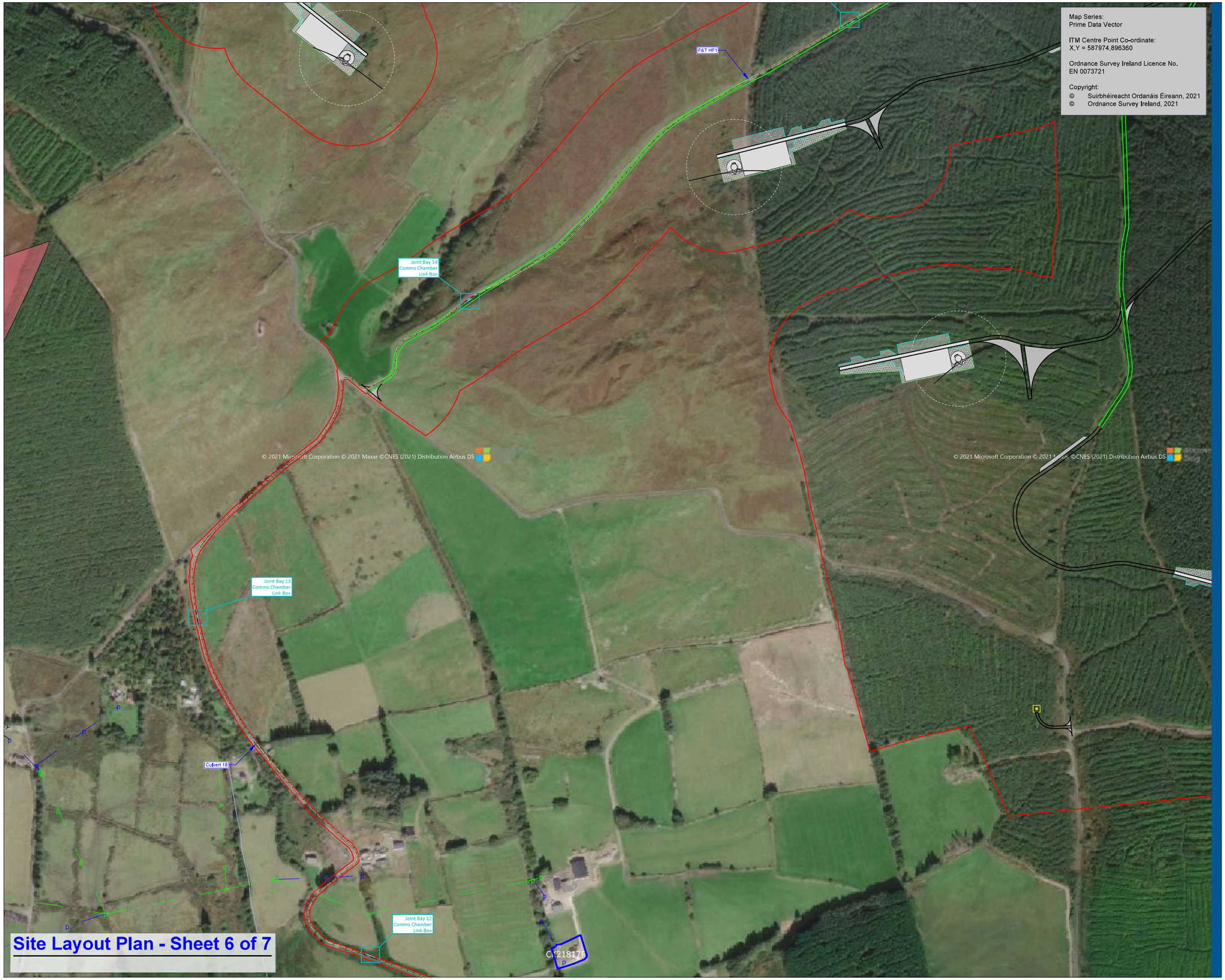

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LEGEND: -

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- Existing Rivers & Streams
- Existing ESB OHL & UGC HV Network
- Existing ESB OHL MV & LV Network
- Landowner Folio Boundary
- Special area of Conservation
- Proposed Red Line Boundary

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Joint Bay 15
Comms Chamber
Link Box

F&T HF1

F&T HF2

Ballinagree WF
Substation

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- Proposed Red Line Boundary

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