



Awel y Môr Offshore Wind Farm

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.Technical Note: Electro-Magnetic Fields

Awel y Môr Offshore Windfarm

4th June 2021

Summary

This note has been prepared by SLR Consulting Ltd (SLR) and is provided to inform consultees of the approach the Awel y Mor Offshore Wind Farm (AyM OWF), proposes to take with regard to the assessment of Electro-Magnetic Fields (EMF) within the Preliminary Environmental Information Report (PEIR) and Environmental Statement (ES).

The Purpose of this note is to provide an update on the selection of a preferred corridor for the transmission infrastructure and to seek agreement from Public Health Wales (PHW), Public Health England (PHE) and Denbighshire County Council (DCC) for the proposed approach and preliminary findings to the assessment of EMF.

In line with NPS EN-5 (DECC, 2011), the electrical infrastructure will be designed to comply with current guidelines on levels of public exposure and design of electrical infrastructure. It is also important to note that the project have made an active design decision to bury all electrical cable infrastructure.

As set out below, the selected Onshore Export Cable Corridor does not contain any residential properties and all transmission infrastructure will be placed underground. As ground-level magnetic fields from underground cables fall much more rapidly with distance than those from a corresponding overhead line, the AyM OWF Onshore Export Cable Corridor estimated levels are not anticipated to exceed guidance levels established by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). As the onshore transmission elements of the AyM OWF are anticipated to be compliant with ICNIRP guidelines, and hence with Public Health England recommendations and Government policy, the anticipated effect of EMF is predicted to be negligible.

Project Background

In February 2021 RWE announced a preferred corridor for the transmission infrastructure associated with the AyM OWF. Prior to the selection of a preferred route, the project had considered a number of landfall, cable routing and substation siting options.

Taking on board valuable feedback received during public consultation in November 2020 along with technical and environmental studies and statutory stakeholder consultation, RWE has been able to select a preferred corridor for the transmission infrastructure. This is the route within which AYM OWF's electricity cables and substation would be located.

The Preferred route would start at the offshore wind farm out at sea and end at the substation near St Asaph business park where the electricity would feed into the National Grid. The eastern offshore cable corridor which runs between the existing Gwynt y Môr and Rhyl Flats cables has been selected. These cables would meet the land east of Rhyl and travel west of Rhuddlan and then south to St Asaph. The preferred substation zone is located west of the National Grid's existing 400kV substation at St Asaph.

EIA Scoping and Consultation

A Formal request for an EIA Scoping Opinion was provided to the Planning Inspectorate (PINS), on the 11 June 2020, with a subsequent Scoping Opinion provided in July 2020 by the Inspectorate on behalf of the Secretary of State in respect of the Proposed Development. EIA Scoping was undertaken at a stage when the landfall, cable route and substation were undetermined and so an opinion was sought on the basis of an onshore Search Area.

The onshore Search Area extended from Prestatyn in the east to Penrhyn Bay in the west and extended south to include St Asaph.

Although the location of transmission infrastructure was not determined, the EIA Scoping Request made reference to International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines and, through project design, committed to comply with current guidelines on levels of public exposure and design of electrical infrastructure. As such, the EIA Scoping Request proposed that the impact would be of negligible magnitude and would not result in significant effects in EIA terms such that it was intended to scope the onshore impact of EMF during operation of the AyM OWF out of further consideration within the EIA.

In response, PINS did not consider that sufficient evidence had been provided within the Scoping Request to support scoping these matters out from the assessment. PINS advised that the Applicant should make effort to agree the approach to the assessment with relevant consultation bodies ensuring that the assessment is both proportionate and robust.

The proposed approach to the assessment of EMF was discussed during the Human Environment Expert Topic Group (ETG), meeting on the 29th September 2020. During the meeting it was confirmed that a technical note would be provided against the final preferred route with a focus on EMF with reference to ICNIRP guidelines with an aim to scope EMF out of assessment within the EIA.

This note responds to this advice from PINS and sets out the proposed approach to assessment in order to seek agreement from PHW), PHE and DCC.

Policy and Guidance

There are no statutory regulations in the UK with regard to exposure to EMF. However, in 2004 the UK Government adopted guidelines published in 1998 by the International Commission on Non-Ionizing Radiation Protection (ICNIRP, 1998) in accordance with the terms of the 1999 EU Council recommendation on limiting public exposure to EMF (EU, 1999). The criteria establish acceptable limits for exposure of the public to EMF that adopt a precautionary approach taking into account various scenarios and potentially more vulnerable groups (such as infants).

Whilst there are no statutory regulations in the UK that limit the exposure of people to power-frequency EMF, responsibility for implementing appropriate measures for the protection of the public lies with the UK Government, who have a clear policy, restated in October 2009 (Department of Health, 2009) and incorporated in NPS EN-5 (DECC, 2011), on the exposure limits and other policies they expect to see applied. It is important to note however that whilst reference is made to EN-5 insofar as it relates to electrical infrastructure the AyM OWF project has been actively designed to avoid overhead lines and the associated effects by committing to underground all electrical cable infrastructure. Practical details on EMF exposure limits, appropriate design of electrical infrastructure and how the policy is to be implemented are contained in Codes of Practice (see below) agreed between industry and Government. This guidance is referenced by Public Health England within its position paper on 'NSIP Planning Statement on Electromagnetic fields', which has also been adopted by Public Health Wales:

- Power Lines: Demonstrating compliance with EMF public exposure guidelines – a Voluntary Code of Practice (DECC, March 2012a);
- Optimum Phasing of high voltage double-circuit Power Lines – a Voluntary Code of Practice (DECC, 2012b); and
- Power Lines: Control of microshocks and other indirect effects of public exposure to electric fields - a Voluntary Code of Practice (DECC, July 2013).

Government, in turn, acts on the scientific advice from Public Health England, which has responsibility for advising on non-ionising radiation protection, including power frequency fields.

The ICNIRP guidance, to which the UK Government policy follows, outlines two categories of public exposure levels, 'reference levels' and 'basic restriction' levels. The ICNIRP 'reference levels' for the public are:

- 100 microteslas (μT) for magnetic fields; and
- 5 kilovolts (kV) per metre for electric fields.

While the ICNIRP 'basic restriction' for levels of public exposure are higher at:

- 360 μT for magnetic fields; and
- 9 kV per metre for electric fields.

In the ICNIRP guidelines and the EU Recommendation, the actual limit is the basic restriction. The reference levels are not limits, but are guides to when detailed investigation of compliance with the actual limit, the basic restriction, is required. If the reference level is not exceeded, the basic restriction cannot be exceeded and no further investigation is needed. If the reference level is exceeded, the basic restriction may or may not be exceeded.

If the fields produced by an item of equipment are lower than 9 kV/m and 360 μT , the fields corresponding to the ICNIRP basic restriction, it is compliant with the ICNIRP guidelines and hence with Public Health England recommendations and Government policy. If the fields are greater than these values, it is still compliant with Government policy if the land use falls outside the residential and other uses specified in the Code of Practice (DECC, 2012a) and it may still be compliant if the fields are non- uniform.

Onshore Export Cable Corridor

Following the selection of a preferred route in Feb 2021, RWE has continued to optimise the cable routing proposals and has identified an Onshore Export Cable Corridor (onshore ECC). The ECC is approximately 100m wide and runs from landfall southwards to the proposed substation near St Asaph business park. From the proposed substation the ECC continues south eastwards and connects the proposed substation to the existing 400kV National Grid substation which is located to the south of St Asaph Business Park.

A series of PDF mapsheets showing the landfall location, onshore ECC and substation locations are provided alongside this note.

The landfall location for AyM OWF is proposed to be between Rhyl and Prestatyn. The landfall denotes the location where the offshore cables are brought ashore and jointed to the onshore cables within Transition Joint Bays that would be located either within land formally designated as Rhyl Golf club, or to the south of the Railway (North Wales Coast Line).

The ECC will comprise approximately 14km of underground cable, connecting the Transition joint Bays to the proposed substation, that will comprise of 1 or 2 circuits with a voltage rating of up to 400KV. Each circuit will consist of 3 onshore power cables (one power core for each phase), each approximately 150 mm in diameter. The power cables will be installed in individual lengths varying from c.500 m to c.1000 m and then jointed. Each circuit will typically have three main ducts, one for each electrical cable. In addition, each circuit will include communications cables and an earth cable.

The cable circuits will be buried with a minimum Depth of Burial (DOB) from the original ground level to the top of the duct of 0.6m and a maximum DOB of 1.64m. In many places along the ECC, a trenchless technique such as Horizontal Directional Drilling (HDD) will be used to pass beneath features such as roads, watercourses and large woodlands. HDD depth is typically 20m. HDD will be used to pass beneath the Robin Hood Holiday Park caravan site that is located near the Landfall.

The cable circuits will be separated from each other to prevent heat build-up which increases resistivity in the cables and reduces transmission efficiency. Each circuit will typically be installed in individual trenches with a typical separation distance of 3.5 m centre-to-centre (separation distance is dependent on cable depth and

surrounding ground conditions). For the purpose of this technical note, it is assumed that the cable circuits could be located anywhere within the 100m ECC.

In line with NPS EN-5 (DECC, 2011), the electrical infrastructure will be designed to comply with current guidelines on levels of public exposure and design of electrical infrastructure. It is also important to note that the project have made an active design decision to bury all electrical cable infrastructure.

Potential Receptors

In routing the ECC, RWE has sought to avoid residential properties and there are no residential properties located within the 100m wide ECC. Table 1 lists the residential properties within 50m of the ECC:

Table 1 – Residential properties within 50m of the ECC

Receptor	Grid Reference	Distance to ECC	Observations
Bryn Celyn Collages	303155, 379702	43m	
Bryn y Wal Children’s Home	302848, 379393	37m	
Cwbr-bach	302520, 379319	16m	ECC will be via HDD at this point so cable will be at greater depth
Plas Lorna Care Home	302594, 379213	6m	ECC will be via HDD at this point so cable will be at greater depth
Glanywern	301669, 376430	33m	ECC will be via HDD at this point so cable will be at greater depth
Faenol-Bropor Farmhouse	301292, 374778	12m	
Gwelfryn	300648, 373886	37m	

In addition, the ECC includes areas of the Robin Hood Holiday park which comprises static caravans next to the landfall area. Although within the ECC, it is proposed to use HDD in order to pass beneath the caravan park at a depth of 10 to 20m below ground level. The ECC also intersects with a number of Public Rights of Way.

The nearest residential property to the proposed substation is approximately 350m to the south west (Gwelfryn).

Consideration of potential impacts

The transport of electricity through the cables has the potential to emit a localised electromagnetic radiation which could potentially affect public health depending on vulnerability, levels of EMF and exposure time.

All onshore infrastructure built as part of AyM OWF will comply with the government guidelines on electromagnetic radiation emission. The following section sets out how maximum magnetic field values are all below the ‘reference levels’ and significantly below the ‘basic restriction’ of the ICNIRP guidance exposure levels.

Studies on human health impacts caused by exposure to electromagnetic radiation suggest there may be an increased risk of Alzheimer’s disease and childhood leukaemia due to higher than usual magnetic field exposures in homes, some of which are near to large above ground powerlines. However, the balance of evidence is towards no effects and there is no known mechanism or clear experimental evidence to explain how these effects might happen (Public Health England, 2013).

Electric fields depend on the operating voltage of the equipment producing them and are measured in V/m (volts per metre). The operating voltage of most equipment is a relatively constant value. Electric fields are shielded by most common building materials, trees, and fences, and diminish rapidly with distance from the source.

As a consequence of their design, some types of equipment do not produce an external electric field. This applies to underground cables and gas insulated switchgear (GIS), which are enclosed in a metal sheath (a protective metal layer within the cable) and have solid metal enclosures respectively.

As the ECC will comprise underground cables, it is proposed to scope out the consideration of potential impacts from electric fields from further assessment.

Magnetic fields are measured in μT (microtesla) and depend on the electrical currents flowing, which vary according to the electrical power requirements at any given time. They are not significantly shielded by most common building materials or trees but do diminish rapidly with distance from the source.

The strength of the magnetic field decreases rapidly horizontally and vertically with distance from source. Objects such as trees, buildings and earth will reduce the strength further still.

National Grid provides the following information with regards the magnetic fields for buried underground cables and substation via the website:



The website provides maximum and typical magnetic field value for 400kV underground cables at a point 1m above ground levels for three main types of underground cable:

- Trough: the separate cores of the cable are in a concrete trough, typically only 0.3 m or less below ground, but also only 0.15 m apart
- Direct buried: the separate cores of the cable are laid directly in the ground, typically 1 m below ground and 0.3-0.5 m apart
- Tunnel: the cable is carried in a tunnel typically 20 m below ground

The AyM OWF ECC will utilise a combination of direct buried cable and Tunnel (HDD) cable.

The maximum magnetic field that is typically produced by a single circuit direct buried underground 400kV HVAC cable is estimated at 96.17 μT directly over the cable, dropping to 13.05 μT at 5m from the cable centreline, and further to 3.58 μT at 10m from the cable centreline. These maximum magnetic field values are all below the 'reference levels' and significantly below the 'basic restriction' of the ICNIRP guidance exposure levels.

The typical magnetic field values for a 400kV Direct buried underground cable are considerably lower at 24.06 μT directly over the cable, dropping to 3.26 μT at 5m from the cable centreline, and further to 0.9 μT at 10m from the cable centreline. The typical magnetic field values are significantly below both the 'reference levels' and the 'basic restriction' of the ICNIRP guidance exposure levels.

The nearest residential receptor will be at least 12m from the edge of the ECC. As the anticipated magnetic field levels are lower than 9 kV/m and 360 μT , the fields corresponding to the ICNIRP basic restriction, the AyM OWF ECC is compliant with the ICNIRP guidelines and hence with Public Health England recommendations and UK Government policy.

Alternative data sources also indicate that magnetic field strength from a typical 400 kV cable buried at 1 m below ground would be over 30 μT at ground level directly over the cable, falling to 10 μT at 2 m above the ground (lower for lower voltages) (ICF, 2003).

¹ Accessed 5th April 2021

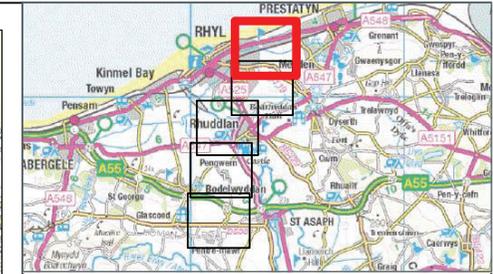
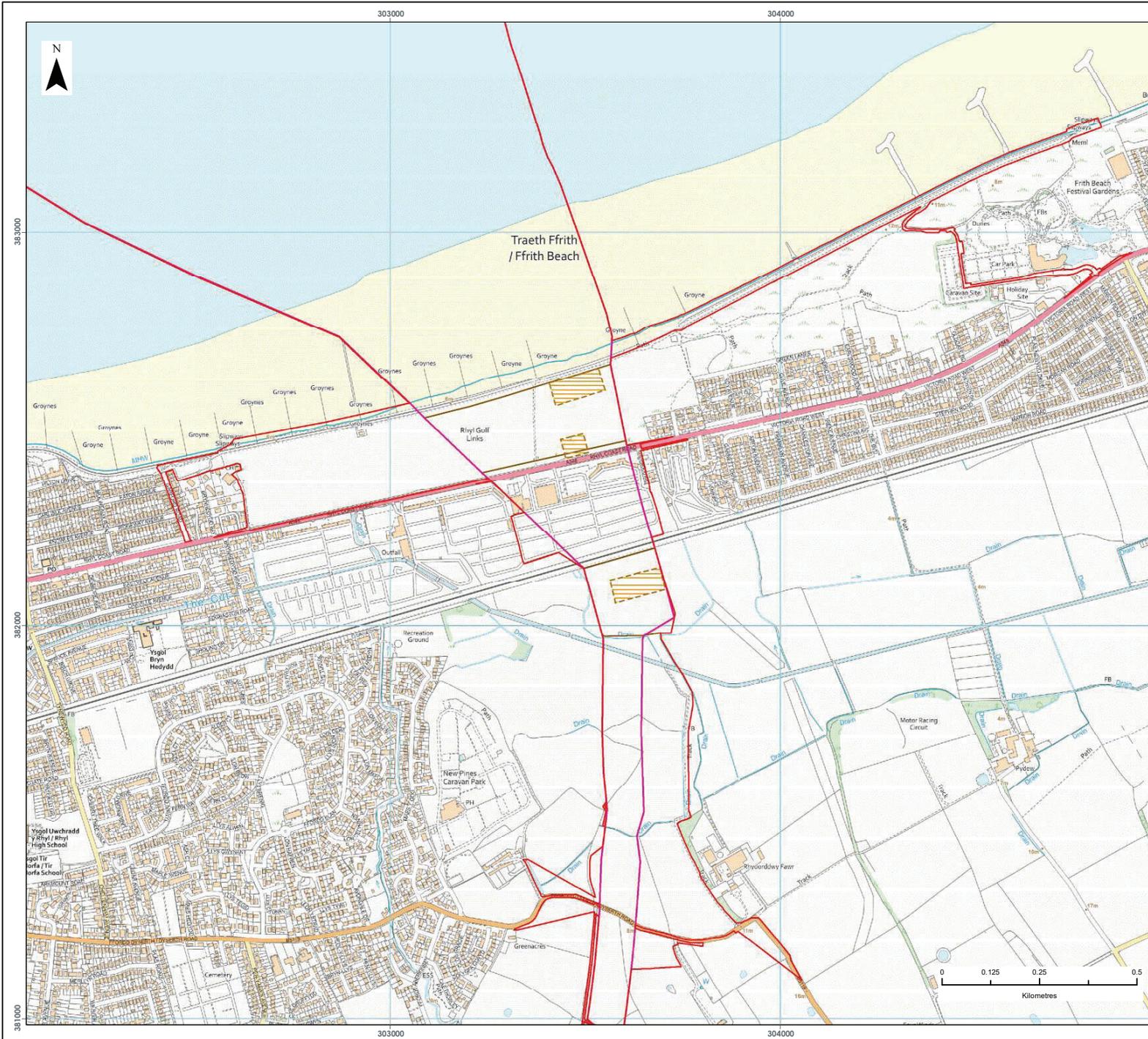
With regard to caravan users at the Robin Hood holiday Park, the cables will be installed via HDD at an anticipated depth of 10 to 20m below ground level. As such, the conductors cannot be approached closely by members of the public, and the magnetic field at the surface is much reduced, lower than an equivalent overhead line and often lower than background fields from other sources.

Fields from substations are usually measured rather than calculated. Calculations are not usually feasible because of the complex geometry of the current paths within a substation. At the perimeter fence of a large, high-voltage substation, the highest fields are invariably produced by overhead lines or underground cables entering the substation. Away from these lines and cables, the field would normally be below 1µT. The nearest residential receptor to the substation zone is 350m to the south west.

In conclusion, all infrastructure built will comply with the government guidelines on electromagnetic radiation emission (ICNIRP, 1998; DECC, 2012a; DECC, 2012b; ENA, 2017). The embedded mitigation in place as well as no conclusive scientific evidence relating EMF and certain health effects leads to the magnitude of impact to be deemed as Negligible.

References

- Department of Energy and Climate Change (DECC) (2011), 'National Policy Statement (NPS) for Electricity Network Infrastructure (EN-5)'.
- Department of Health (2009), 'Government response to the stakeholder advisory group on extremely low frequency electric and magnetic fields (ELF EMFs) (SAGE) recommendations'.
- Department of Energy and Climate Change (DECC) (2012a), 'Power Lines: Demonstrating compliance with EMF public exposure guidelines – a Voluntary Code of Practice (document dated March 2012 replacing document with the same title dated February 2011)'.
- Department of Energy and Climate Change (DECC) (2012b), 'Optimum Phasing of high voltage double-circuit Power Lines – a Voluntary Code of Practice'.
- Department of Energy and Climate Change (DECC) (2013), 'Power Lines: Control of microshocks and other indirect effects of public exposure to electric fields – a Voluntary Code of Practice'
- ICF Consulting Ltd (2003) Overview of the Potential for Undergrounding the Electricity Networks in Europe. Prepared for the DG TREN/ European Commission.
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- International Commission on Non-Ionizing Radiation Protection (ICNIRP) (1998), 'Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)'. *Health Phys*, 74: 494-522.
- Energy Networks Association (ENA) (2017), EMFs The Facts. [Accessed: May 2018].



LEGEND

- Red Line Boundary
- Proposed Onshore Export Cable Corridor 100m
- Proposed Horizontal Direction Drilling Compound

Data Source:
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PROJECT TITLE:
AWEL Y MÔR OFFSHORE WINDFARM

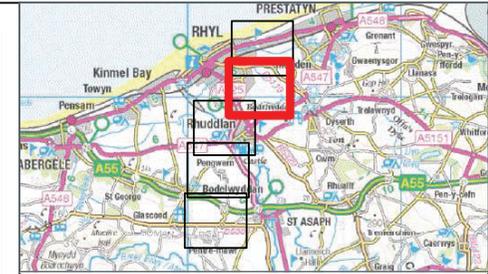
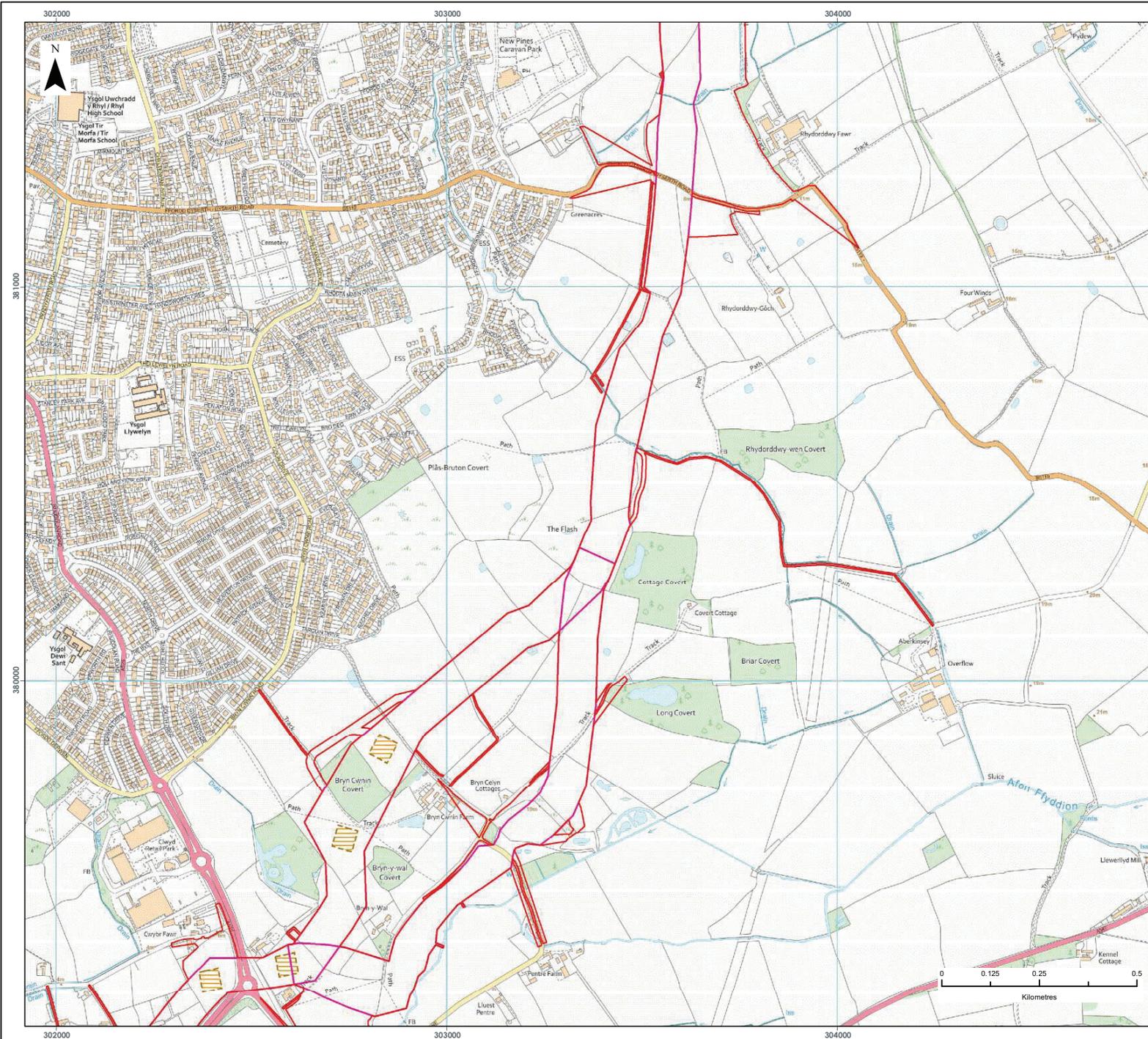
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**ONSHORE
INFRASTRUCTURE OVERVIEW**

VER	DATE	REMARKS	Drawn	Checked
1	05/05/2021	Draft	JRS	MF

FIGURE NUMBER:
1
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SCALE: 1:10,000 PLOT SIZE: A3 DATUM: ODN COORDINATE SYSTEM: British National Grid

Ffwrn Wyrnt Alltraeth
AWEL Y MÔR
Offshore Wind Farm



LEGEND

- Red Line Boundary
- Proposed Onshore Export Cable Corridor 100m
- Proposed Horizontal Direction Drilling Compound

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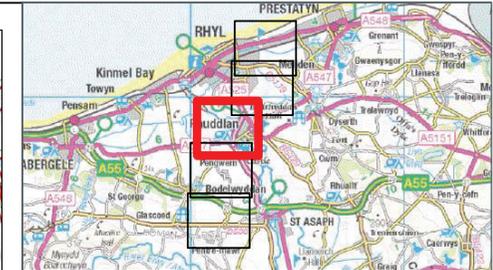
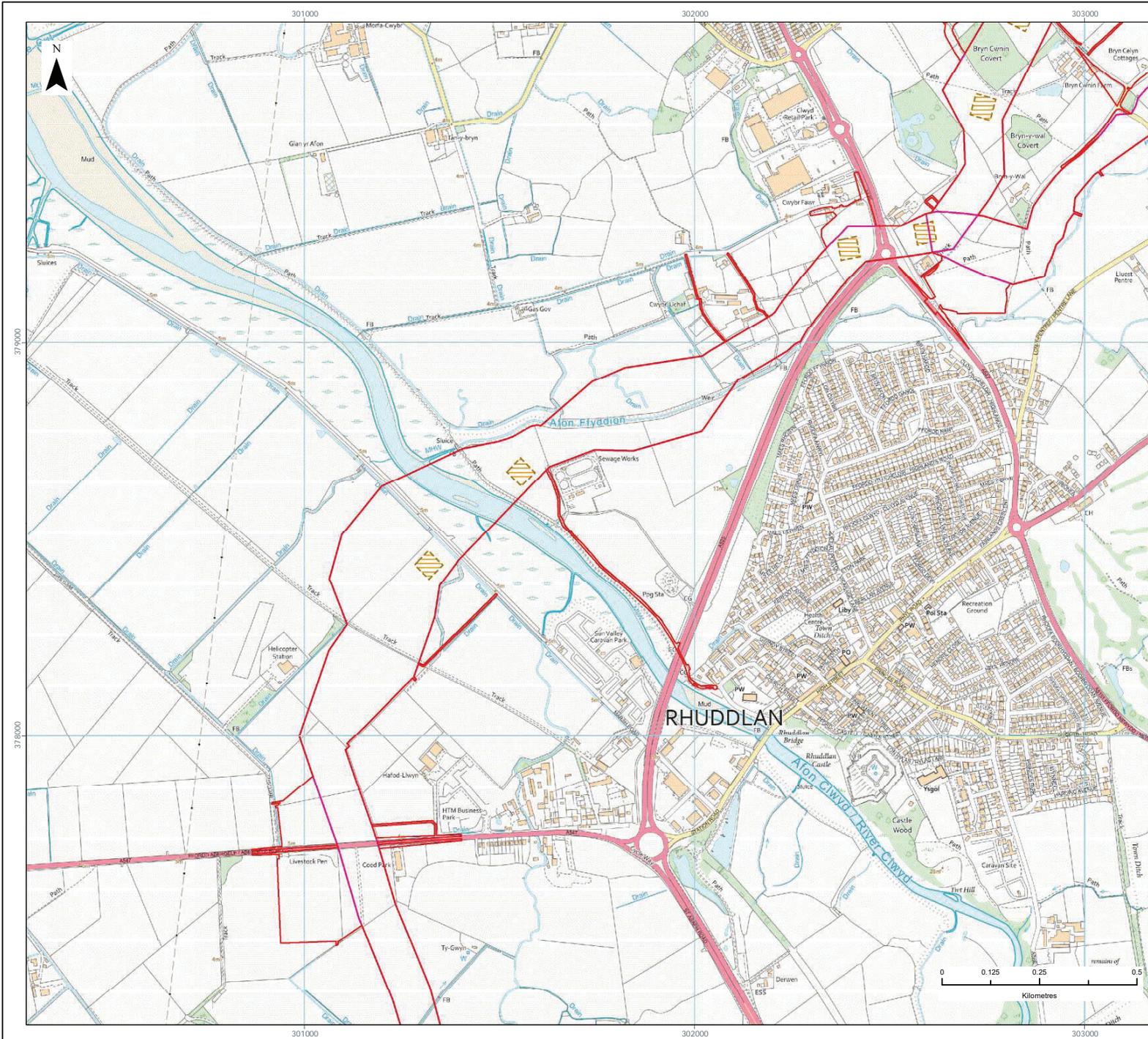
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**ONSHORE
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FIGURE NUMBER:
 1

SCALE: 1:10,000 PLOT SIZE: A3 DATUM: ODN COORDINATE SYSTEM: British National Grid

Ffwrn: Wyrnt Alltraeth
AWEL Y MÔR
 Offshore Wind Farm



- LEGEND**
- Red Line Boundary
 - Proposed Onshore Export Cable Corridor 100m
 - Proposed Horizontal Direction Drilling Compound

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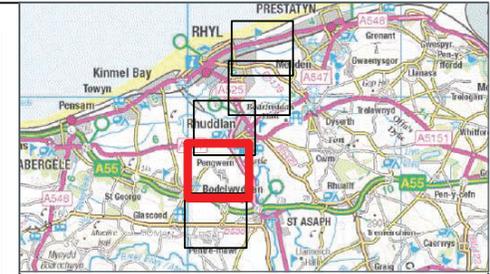
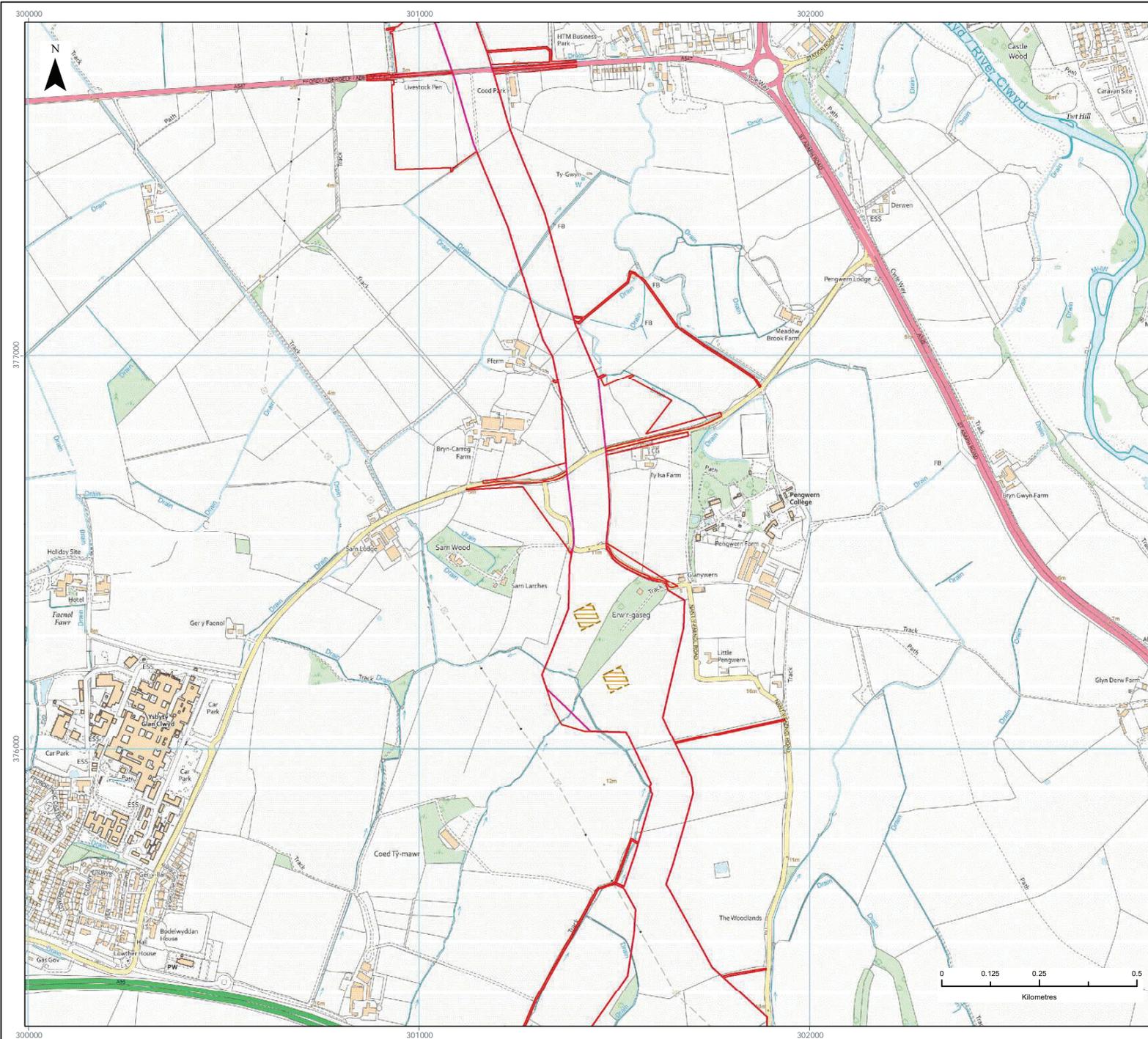
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FIGURE NUMBER:
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SCALE: 1:10,000 PLOT SIZE: A3 DATUM: ODN COORDINATE SYSTEM: British National Grid





LEGEND

- Red Line Boundary
- Proposed Onshore Export Cable Corridor 100m
- Proposed Horizontal Direction Drilling Compound

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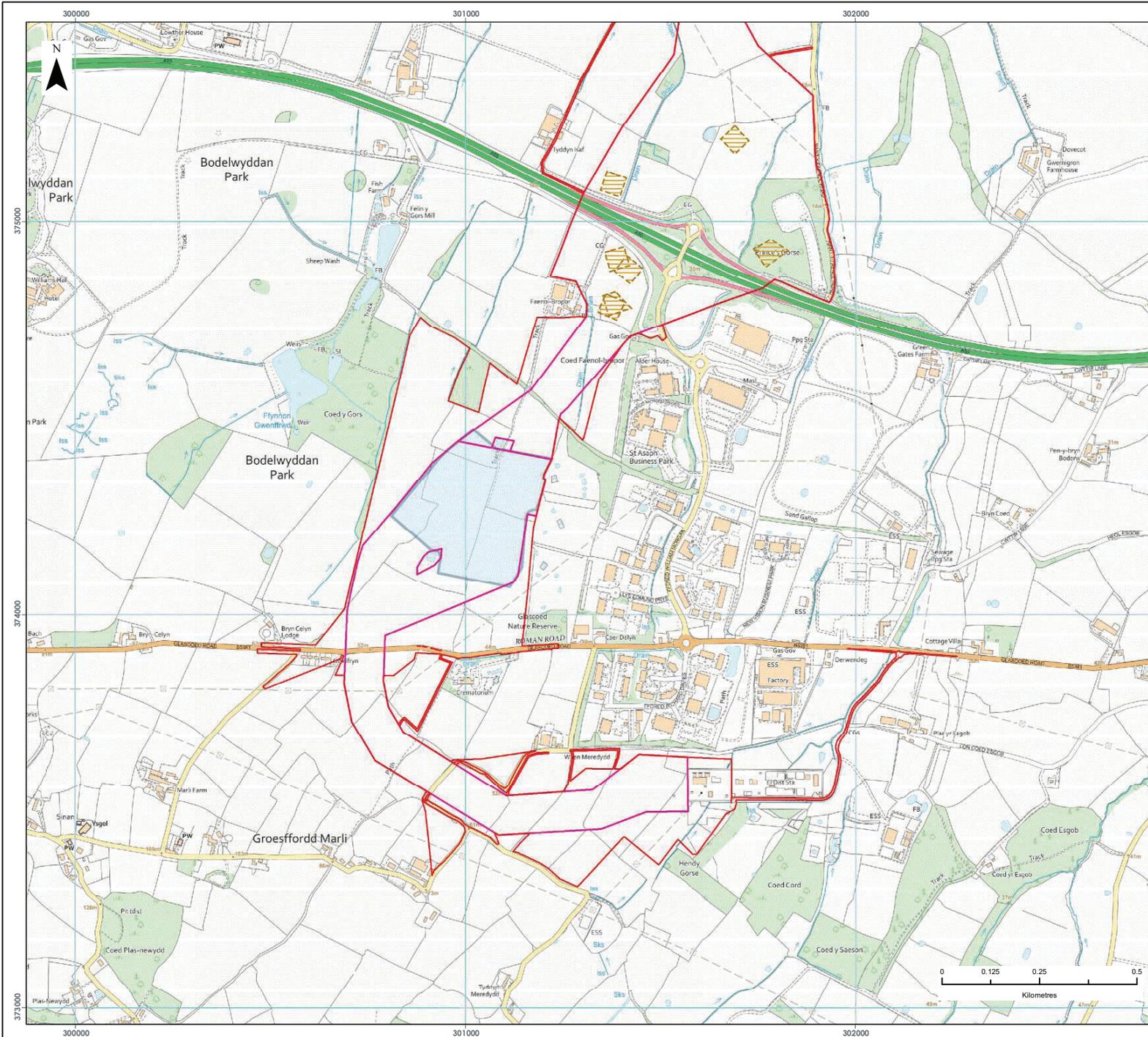
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**ONSHORE
INFRASTRUCTURE OVERVIEW**

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FIGURE NUMBER:
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SCALE: 1:10,000	PLOT SIZE: A3	DATUM: ODN	COORDINATE SYSTEM: British National Grid
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Ffwrn Wyrnt Alltraeth
AWEL Y MÔR
Offshore Wind Farm



LEGEND

- Red Line Boundary
- Proposed Onshore Export Cable Corridor 100m
- Proposed Horizontal Direction Drilling Compound
- Proposed Substation Zone

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INFRASTRUCTURE OVERVIEW**

VER	DATE	REMARKS	Drawn	Checked
1	05/05/2021	Draft	JRS	MF

FIGURE NUMBER:
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SCALE: 1:10,000 PLOT SIZE: A3 DATUM: ODN COORDINATE SYSTEM: British National Grid

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