Sure Partners Limited

ARKLOW BANK WIND PARK PHASE 2 **ONSHORE GRID INFRASTRUCTURE**

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

VOLUME II

Chapter 4 Consideration of Alternatives

ARUP

sse Renewables

Contents

4 Consideration of Alternatives

4.1 Introduction

This chapter describes the reasonable alternatives studied by the Developer, which are relevant to the proposed development and its specific characteristics and provides an indication of the main reasons for the option chosen, taking into account the effects of the proposed development on the environment.

In order to develop the Arklow Bank Wind Park (ABWP) Phase 2 (the Project), it is necessary to connect the offshore export infrastructure to the National Electricity Transmission Network (NETN). Other than not progressing the Project, there is no alternative to the provision of onshore grid infrastructure (OGI) to connect to the NETN. Hence, the assessment of alternatives is a consideration of alternative locations, configurations and designs for the OGI. It should also be noted that the alternatives studied are constrained by the options permitted under the extant Foreshore Lease for the Arklow Bank Wind Park.

This chapter of the EIAR has been prepared in accordance with Article 5(1)(d) and Part 2 of Annex IV of the EIA Directive which identifies that the following is required in the EIAR:

"A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."

This chapter has therefore been structured to describe the following reasonable alternatives that have been considered:

- The do-nothing scenario;
- Alternative locations for the proposed development, in terms of:
  - Landfall
  - Connection from landfall to a new 220kV onshore substation
  - 220kV onshore substation
  - Connection to NETN; and
- Alternatives in terms of project design, technology, size and scale for the proposed development, under the same headings as above.

4.2 Project Objectives

The Developer, Sure Partners Limited (SPL), objectives for the proposed development are as follows:

- to provide connection of the ABWP Phase 2 Offshore Infrastructure to the NETN;
- to deliver a technically feasible proposed development;
- to deliver an economically viable proposed development;
- to deliver the proposed development in an environmentally sustainable manner within the constraints of technical feasibility and economic viability; and
- to acquire land and wayleaves by agreement where possible.

4.3 Do-Nothing

The do-nothing scenario refers to what would happen if the proposed development was not implemented and the Arklow Bank Wind Park remained at the Phase 1 current installed capacity.

The Arklow Bank Wind Park Phase 2 will support a maximum export capacity (MEC) of 520MW of renewable electricity generation. This supports the objectives of the EU Green Deal as it will create additional renewable energy supply in Ireland helping to meet EU, National and Regional plans and targets, refer to **Chapter 2** *Policy Context*.

The proposed development complies with these objectives by providing the connection to the NETN for a development that will assist in the decarbonisation of energy generation in Ireland. The proposed development will facilitate the development of a new source of renewable energy that will reduce reliance on fossil fuels (and associated energy related greenhouse gas emissions) and improve security of supply.

The proposed development aligns with the actions and targets set out in the Programme for Government (2020) regarding the need for investment in renewable energy, specifically marine renewable energy.

If Arklow Bank Wind Park is to stay at its current (Phase 1) capacity there will be no change to this existing situation and the Arklow Bank Wind Park Phase 2 (enabled by the proposed development) will not contribute to Ireland's progress towards reaching EU, National and Regional planning objectives or in helping to meet its renewable energy and decarbonisation targets, including in particular, the targets in the Climate Action Plan.

In terms of environmental effects, the 'do-nothing' scenario would avoid the potential negative effects associated with the proposed development. This includes, in particular, the potential construction stage effects such as effects on biodiversity, noise and vibration, traffic and transportation, land and soils, archaeology and architectural heritage, landscape and visual and population and human health.

It would also avoid potential operational effects on aspects such as landscape and visual, noise and vibration and population and human health. These negative effects on the environment are considered to be outweighed by the environmental benefits, outlined above.

The environmental effects of the 'do-nothing' scenario are compared with the effects of the proposed development in the assessment chapters (**Chapters 7 to 19)**.

The 'do-nothing' scenario does not meet the project objectives and consequently was not the chosen alternative.

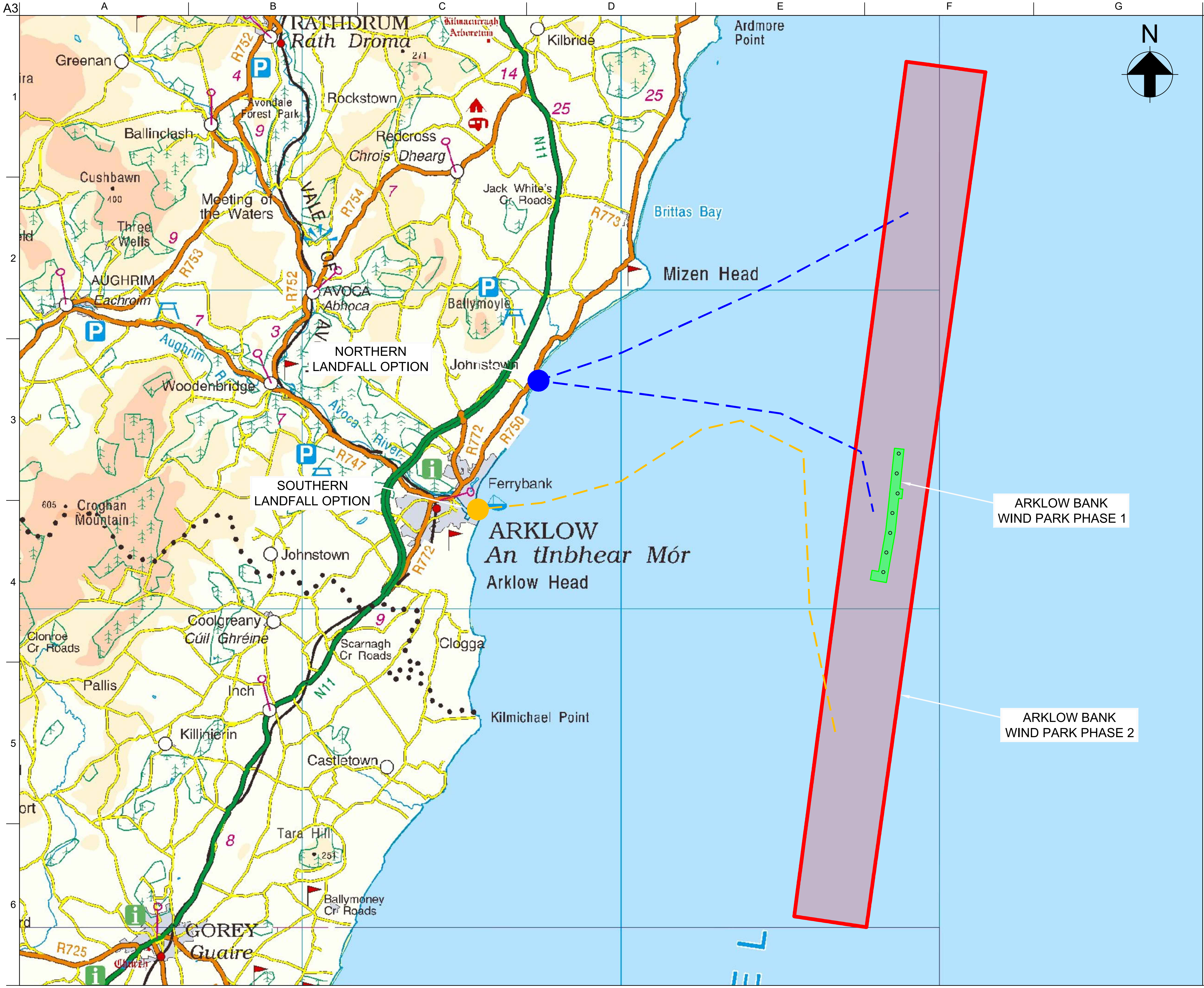
4.4 Landfall Alternatives

To connect the power generated by the offshore wind park, it is necessary to bring cables circuits onshore and connect to the NETN. The point at which the offshore export cable circuits come onshore (the landfall) is a key component in the overall proposed development.

Alternative locations, within the constraints of the routes consented under the existing Foreshore Lease, and alternative construction methods were considered for the landfall. In the context of the consideration of location alternatives described below, the 'landfall' is the location, at which the cable circuits come ashore and are joined to the onshore cable circuits (i.e. between the high water mark (HWM) to the onshore/offshore cable transition).

4.4.1 Alternative Landfall Locations

The offshore export cable circuit will comprise of 2 no. 220kV cables, connecting the offshore infrastructure to the NETN. **Figure 4.1** below shows the location of the three consented (Foreshore Lease) offshore export cable routes.



LEGEND:

ARKLOW BANK WIND PARK PHASE 1

ARKLOW BANK WIND PARK PHASE 2

OFFSHORE CABLE ROUTE NORTHERN OPTION

OFFSHORE CABLE ROUTE SOUTHERN OPTION

LANDFALL NORTHERN OPTION

LANDFALL SOUTHERN OPTION

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Rev	Date	By	Chkd	Appd

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Client
Sure Partners Limited

Project Title
Arklow Bank Wind Park
Phase 2
Onshore Grid Infrastructure

Drawing Title
Location of Consented
(Foreshore Lease)
Offshore Grid Cable Routes

Scale at A3 NTS

Role Civil

Suitability For Information

Arup Job No 271715-00

Rev D1

Name
Figure 4.1

Do not scale

The routes consented under the existing Foreshore Lease and the construction requirements constrained the consideration of alternatives locations for the landfall.

To minimise the landfall horizontal directional drilling (HDD) length, the landfall should be as close as practicable to the high water mark (HWM). To enable construction, regardless of the actual construction method chosen, the minimum requirements for the landfall are:

- there has to be sufficient space onshore, close to the landfall, for construction equipment, storage of plant and cable drums, and facilities for the workforce;
- there has to be access to the road network and a feasible route away from the landfall site for the onshore cable; and
- the land must be available for lease or purchase at a reasonable price.

Two potential cable landfall locations were identified, termed the ‘northern’ and ‘southern’ landfalls. It is noted that two of the consented offshore export cable routes terminate in the vicinity of the northern landfall.

Description of the Northern Landfall Location

The northern landfall location is in the townland of Johnstown North approximately 4.5km northeast of Arklow, close to Ennereilly Beach, Co Wicklow. The landfall area in this location consists of undulating pasture fields located behind sea cliffs, approximately 10m in height, which rise above a steeply sloping shingle beach. The landfall site extends to the highwater mark (HWM), which forms the boundary with the foreshore.

At this potential landfall location, a suitable area for the proposed site compound was identified. The proposed site compound will be located in a field on undulating agricultural land located behind the cliffs, to the west of the R750 single track road. There was insufficient space for the landfall construction compound to the east of the R750 road, at this location. The northern landfall location is shown in **Figure 4.2**.

The landfall is at an elevation of approximately 15mOD (above Ordnance Datum). Access is provided by means of a gate, directly off the R750 which is a single-track road of around 5 to 8m in width. A pond is located in the north western corner. The foreshore, located below the cliffs, comprises of sand and shingle storm beach deposits which overlie steeply dipping foliated metamorphic rocks. The rock outcrops at isolated locations on the foreshore and forms the cliffs which bound the foreshore to the west.

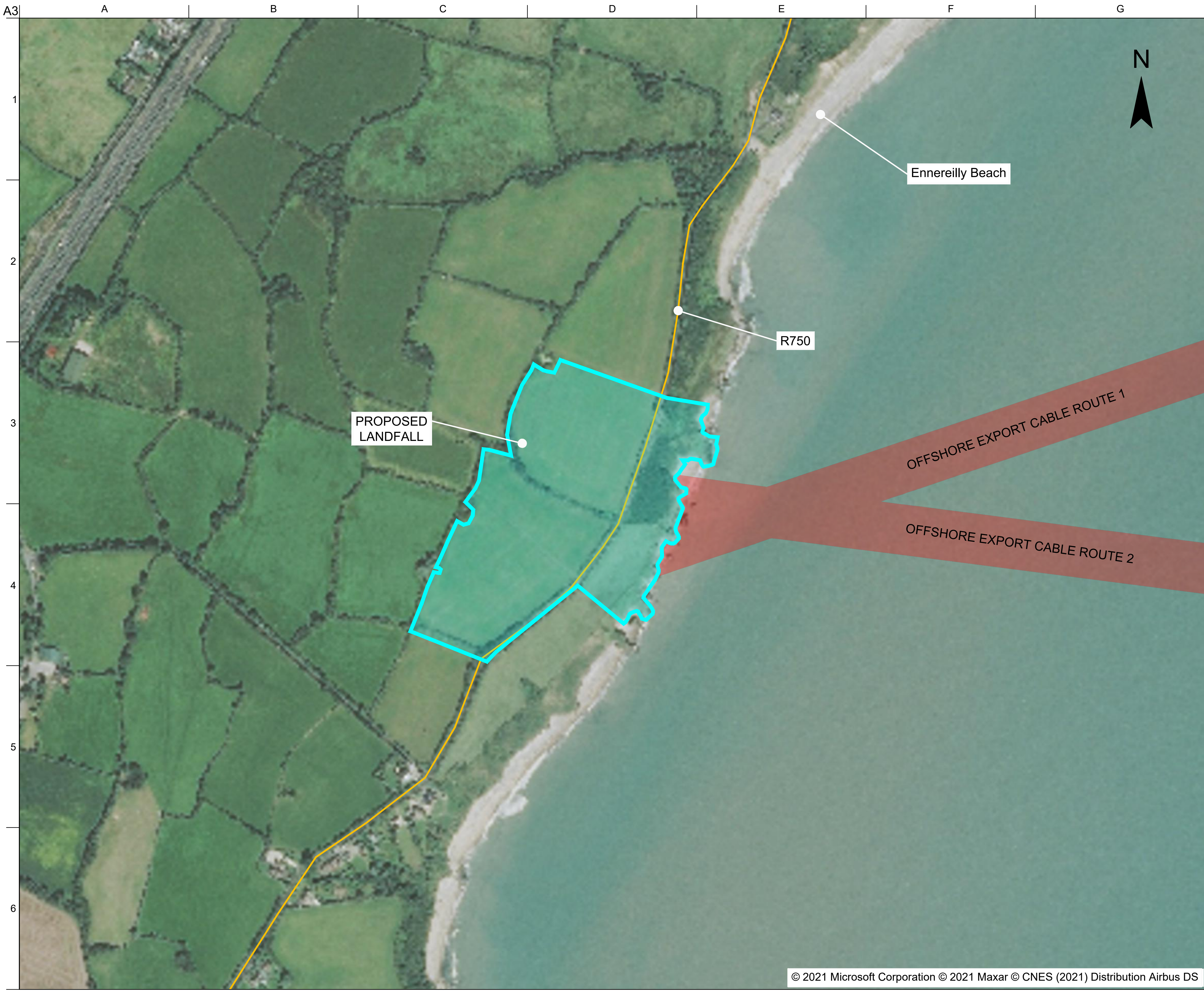
Technical Appraisal of the Northern Landfall

A cable landfall feasibility study was undertaken by the Developer to determine suitable cable landfall construction methods through a process of options appraisal. This preliminary appraisal was based on technical and environmental considerations, with the primary objective being to establish the most appropriate cable landing technique for each landfall site, and offer a recommendation on the preferred site, mainly from a technical viewpoint.

The feasibility study identified a number of potential technical constraints associated with the northern landfall site option. These technical constraints include:

- the bedrock is expected to consist of slate, phyllite and schist with bands of siltstone, granite and orthoquartzite. The granite and orthoquartzite will likely result in hard drilling or excavation;
- the bedrock is recorded to dip steeply towards the south at between 70° and 88° and as with any schistose rock the foliation plane presents a plane of weakness;
- approximately 300m and 700m offshore there are two faults running approximately north to south which again present a possible plane of weakness; and
- there is a significant level difference between the cliff tops and the foreshore; this is approximately 9m to the top of the cliff line and 14m to the site compound level.

As the site has not been previously developed, there is also the potential risk of unknown hazards or historical use. Given the agricultural use and undulating topography, it is considered that this risk is low at the northern landfall location.



LEGEND:

PROPOSED LANDFALL

OFFSHORE EXPORT CABLE ROUTE

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Project Title
Arklow Bank Wind Park
Phase 2
Onshore Grid Infrastructure

Drawing Title
Northern Landfall Location

Scale at A3: 1:5,000
Role: Civil
Suitability: For Information
Arup Job No: **271715-00**
Rev: **D1**
Name

Figure 4.2

Do not scale

Southern Landfall Location

The southern landfall option is located within the town of Arklow on a parcel of land to the north of the Avoca River, adjacent to the coastline with the Irish Sea which is formed by a coastal erosion protection embankment at this location.

Having initially looked at three discrete site locations close together in this general area, two were subsequently discounted, as they were the subject of planning applications (now consented) and unlikely to be available for purchase, one for the proposed Arklow Wastewater Treatment Plant and one for a commercial development (3 storey office building and ancillary infrastructure). In respect of the latter, this would also require a cable route alignment outside the existing Foreshore Lease area, introducing additional consenting issues/risk.

One of the site options (now proposed for Arklow Wastewater Treatment Plant) is in made ground, with potential contamination issues related to its historical use as a wallboard manufacturing site and as a munition's factory. The second site option (now proposed for commercial development) is to the north of the proposed wastewater treatment plant site and is also a brownfield site, with potential contamination issues.

The remaining southern landfall site option was an existing large, open, and flat public amenity area occupied by a public running track and with an existing access route, located in the north-eastern part of the town.

The southern cable landfall site option is located approximately 400m to the northeast of Arklow town centre and to the north of the Avoca River. The site is bordered by the Irish Sea to the east, with a prominent coastal erosion protection embankment forming the coastline at the site location. It is located on an area of flat playing fields used as a running track, which sits behind and to the west of the coastal erosion revetment. Access is directly from Seaview Avenue which forms the northern site boundary.

The site location is shown in **Figure 4.3**.

LEGEND:

PROPOSED LANDFALL OPTIONS

OFFSHORE EXPORT CABLE ROUTE

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Drawing Title
Southern Landfall Location

Scale at A3 1:5,000

Role Civil

Suitability For Information

Arup Job No **271715-00**

Rev **D1**

Name
Figure 4.3

Do not scale

Technical Appraisal of the Southern Landfall

The feasibility study identified a number of potential technical and environmental constraints which would need to be considered in the detailed design of the cable landfall. These constraints include:

- as the site was part of the Kynoch Munitions Factory, with an associated chemical works, there is a moderate potential that pockets of contamination may exist on site;
- the site has an existing running track and the area is used as a public space. This needs to be considered in the context of the proposed works and impacts on same;
- the export cable from the Arklow Bank Wind Park Phase 1 runs below the coastal erosion protection revetment in this area;
- the outfall pipeline for the consented Wastewater Treatment Plant (WwTP), located immediately south of the site area, (planning reference PL27.302556 needs to be considered as this may conflict with the proposed offshore export cable route alignment;
- from available information, the depth of superficial deposits, above the bedrock, is likely to be significant (>20 m). Further work would be needed to establish the nature of ground conditions both onshore and offshore, including depth to bedrock and dip direction of the rock;
- approximately 270m and 560m offshore there are two faults running approximately north to south. These present locations where there may be a sudden variance in the depth to rock, and possible planes of weakness associated with fault brecciation, with a risk of ‘frac-out’ of drilling fluids or choking and collapse of the bore profile in weak and broken rock;
- there are four groundwater extraction boreholes indicated to be within 2km of the site, however their specific locations are not provided. A detailed hydrogeological assessment may be required in order to ascertain the risks of aquifer contamination as a result of the proposed works, should this option progress;
- the site area has flooded in the past and this could not be discounted during the site works phase therefore, a detailed Flood Risk Assessment would be required if this option were to progress;
- due to the historical adjacent site uses, the site area is considered to be at medium risk of Unexploded Ordnance (UXO) contamination and mitigation measures must therefore be in place during any phase of construction works; and
- observations made during the walkover survey highlight a number of failures in the existing coastal embankment, comprising localised slippages and wash out. It seems likely that this is as a result of storm damage, and it is noted that the coast at this location fronts the open sea. As a result, there is considered a high potential for sediment mobilisation and scour during storm events.

Comparison of Environmental Effects of Landfall Options

A desktop comparison of likely environmental effects associated with each landfall, was also carried out. The comparison of environmental effects is summarised in **Table 4.1** below.

Table 4.1 Landfall Location Options - Comparison of Likely Environmental Effects

Environmental Aspect	Northern Landfall	Southern Landfall
Population and Human Health	The northern landfall option is in a rural location, with a small number of houses/sensitive receptors in the vicinity. Far fewer residents, businesses and road users would be disrupted during the construction phase.	The southern landfall is located in the north-eastern part of Arklow town, with considerable residential development in close proximity. The proposed site is also a running track and amenity area which would be closed to the public during landfall construction. Construction of the onshore cable from the southern landfall to the new substation would require construction through the streets of Arklow town, with consequent disruption, inconvenience and potential nuisance from noise and dust to residents and businesses, potential disruption to traffic and road users with full or partial closures of streets for the duration of the construction phase.
Biodiversity	The site is farmland and is of low ecological significance. The Buckroney-Brittas Dunes and Fen, a Special Area of Conservation (and proposed Natural Heritage Area, pNHA), is located approximately 320m north of northern landfall option and then extends north for a distance of around 8.50km. With the implementation of standard mitigation measures it is considered that potential effects on this site can be avoided.	The southern option does not appear to have any significant biodiversity constraints, although there is likely to be usage of the amenity pond, to the north of the site, by birds. There are also two pNHAs in the vicinity of the southern landfall option, being Arklow Town Marsh pNHA (c. 0.8 km to the northwest) and Arklow Sand Dunes pNHA (c. 1.8km to the northeast).
Archaeology & Architectural Heritage	There are no significant archaeological or architectural heritage records in close proximity to the site. Notwithstanding, there is the potential for undiscovered finds at the site, which is undeveloped.	There are no significant archaeological or architectural heritage records in close proximity to the site. There is the potential for undiscovered finds at the site, albeit the potential is considered higher at the southern landfall option, given its location in proximity to the historical settlement of Arklow.
Noise & Vibration	There is the potential for noise effects during construction. There are few sensitive receptors. Given the rural location, the background noise would be lower.	There is the potential for noise effects during construction. There are many sensitive receptors in close proximity, background noise may be relatively high, given the more urban location.

Environmental Aspect	Northern Landfall	Southern Landfall
Air Quality & Climate	There are likely to be air quality effects – dust and vehicle and plant emissions - during construction. There are few sensitive receptors in close proximity. The landfall site is adjacent to the coastline, with the risk of coastal flooding, which could be exacerbated by climate change. However, the elevation of the northern landfall option means this risk is very low.	There are likely to be air quality effects – dust and vehicle and plant emissions - during construction. There are a number of sensitive receptors in close proximity. The landfall site is adjacent to the coastline, introduces the risk of coastal flooding, which could be exacerbated by climate change. However, the southern landfall option is protected by a sea defence revetment.
Land and Soils	The northern landfall option is in agricultural use, and therefore the risk of contamination is likely to be low. The site would be returned to agricultural use, after construction, with restrictions on the type of future uses in close proximity to the cable.	The southern site is comprised primarily of made ground. The historical use of the site means there is the potential for ground contamination, as well as unexploded ordnance. After construction, there would be restrictions on the type of future uses in close proximity to the cable.
Water	There is no history of flooding of the site.	The site is known to have flooded in the past and a detailed flood risk assessment will be required to determine the risk of flooding at this location. The coastal revetment in this location is also in poor condition.
Landscape and Visual	The site is located within an Area of Outstanding Beauty, as designated by the Wicklow County Development Plan. There is also a scenic route (R750 Wicklow to Arklow) in close vicinity. There will be temporary effects on landscape during the construction phase. There will only be an access road and minor above ground structures (manholes, marker posts) in the operational phase and therefore no significant landscape and visual effects are considered likely.	The site has no landscape designation. There will be temporary effects on landscape during the construction phase. There will only be an access road and minor above ground structures (manholes, marker posts) in the operational phase and therefore no significant landscape and visual effects are considered likely.

Conclusion of Consideration of Landfall Location Options

Having considered the two options for the landfall location through a multi-criteria assessment, including an assessment of potential environmental effects, as detailed above, it is considered that the northern landfall location is preferable to the southern landfall location, both from a technical and an environmental perspective.

In particular, the southern landfall location has the disadvantage that the offshore export cable route runs along the route of the existing offshore export cable (for the Arklow Bank Wind Park Phase 1) and conflicts with the consented outfall for the Arklow Wastewater Treatment Plant. In addition, given that the proposed cable route alignment is outside the existing Foreshore Lease area, consent issues/risks would also arise. The onshore cable from this location would be difficult to construct through the urban centre of Arklow town due to existing services, the need for traffic management, etc. There is a significant potential for contaminated land associated with the southern landfall site given the brownfield nature of the site. There are significant constraints relating to the geology and hydrogeology at the southern landfall site including uncertainties pertaining to ground conditions onshore and offshore.

Construction of the southern landfall has the potential to have a significant impact on the local population, users of the amenity area and businesses during construction phase. There would be disruption to traffic and potential noise and dust nuisance.

In contrast, the northern landfall, does offer distinct advantages in terms of its rural location, the low risk of contamination at the landfall site and as evidenced in Table 4.1, the low numbers of sensitive receptors and lower potential for significant environmental effects, in comparison to the southern landfall option. While the northern landfall is in relatively close proximity to a Natura site (Buckroney-Brittas Dunes and Fen area cSAC), it is considered that, with standard mitigation measures, potential effects can be avoided.

Consequently, the northern location was brought forward as the preferred location for the landfall and the southern landfall option was excluded from further consideration.

4.4.2 Alternative Landfall Construction Methods

There were four different construction methods considered for the landfall associated with the proposed development. These methods are as follows:

- Open Cut-Trench involves:
    - removing the surface material,
    - excavating from the surface down to the required trench depth, through the overburden and rock
    - supporting the trench sides, if necessary, depending on ground conditions,
    - installing the cables and cable surround materials,

  - backfilling with appropriate materials, including installing marker tapes, as required, and
  - reinstating the surface material.
- Horizontal Directional Drilling (HDD) is a technique whereby a hole is drilled from land under any coastal features such as cliffs, dune systems or sensitive features, to a point a suitable distance offshore, ensuring environmental constraints are avoided. HDD involves pushing a steerable rotating boring head, supported by a drilling fluid, through the ground. When the pilot bore is completed it is enlarged to the required diameter by pulling a reamer back towards the drilling machine and pulling the duct into place. A pipe will be inserted into the drilled hole, the pipe will then be used as a duct into which the cables are installed.
- Direct Pipe is a proprietary method developed by Herrenknecht whereby a Micro-Tunnel Boring Machine (MTBM), which has cutting wheels and high-pressure jetting nozzles, is launched from an excavated launch pit onshore. A steel casing is attached to the MTBM, and the whole assembly then jacked seawards by hydraulic rams located within the launch pit. The arisings generated by the MTBM are then passed back along the casing annulus, suspended in drilling mud, and processed through shakers and screeners, located onshore, for disposal, with the drilling muds recycled. The casing forms the permanent ducting through which the cabling will be installed at a later date.
- Micro Tunnelling (pipe jacking) involves a similar method to that described above for the Direct Pipe proprietary method. However, this non-proprietary method may require intermediate thrust jacking stations along the bored tunnel route.

Comparison of Landfall Construction Methods

Table 4.2 summarises the comparison of options with regard to reasonable alternative construction methods at the northern landfall.

Table 4.2 Options Appraisal of Landfall Construction Methods

Option	Advantages	Disadvantages
Micro-tunnelling / pipe jacking	Suitable for geological conditions Accuracy of installation operations Speed of installation operations Minimum impact to environment Pre-Cast Concrete sections installed with the advancing tunnel drive providing immediate shoring support Suitable for installation below groundwater level	Typically, cannot be curved when drill length <1km Typical maximum single drive of 300m to 500m (intermediate thrust jacking stations may be required) Relatively expensive Temporary sheet piles required for Launch and Reception Pits
Open-cut Trench	Accuracy of installation operations Relatively Low Cost when compared to trenchless techniques	Steep cliffs (approximately 9m high) in conjunction with an exposed location susceptible to stormy sea conditions will preclude the use of open cut trenching This option should be discounted from further consideration
Horizontal Directional Drilling (HDD)	Suitable ground conditions Minimum impact to environment Accuracy of installation operations Speed of installation operations Continuous monitoring and control during the operations	Additional space required for stringing out / laydown if required Minor earthworks cut and fill required to create level area at proposed entry compound
Direct Pipe	Suitable ground conditions. Minimum impact to environment Accuracy of installation operations Speed of installation operations	Insufficient bending radii to account for topography / need to pass below cliff line Temporary sheet piles required for Launch and Reception Pits Disposal of potentially contaminated arisings

Table 4.2 considers four typical construction methods for the cable landfall.

Due to the ground conditions expected at the site, the Direct Pipe method has been discounted as there is insufficient bending radii to account for the topography at the site, because the cable would pass below the cliff line.

Micro-tunnelling has also been discounted as it cannot be guaranteed that intermediate thrust jacking stations would not be required and, due to there being limited bending radii on a tunnel of this length, and the exit point would be at depth and therefore require a significant retrieval pits to be formed offshore.

Open cut trenching is technically possible, but the risks associated, and temporary works requirements involved in working on the foreshore deem the technique less advisable. The horizontal directional drill option is technically feasible.

Consequently, only two of the methods were deemed to be technically feasible at this location, and as such, were considered to be reasonable alternatives.

Comparison of Environmental Effects

Table 4.3 presents a comparison of the environmental effects of the reasonable landfall construction methodologies. These are temporary construction impacts. Once operational, the landfall would have no potential environmental effects.

Table 4.3 Environmental effects of Landfall Construction Method Alternatives

Environmental Aspect	Open cut	Horizontal Directional Drilling
Population and Human Health	The cable trench would cross the road and construction of it disrupt road users.	No potential significant effect
Biodiversity	Cutting a trench through the cliff and beach would disturb the habitats and species. Further, due to the proximity of the site to the Buckroney-Brittas Dune and Fen cSAC, there is the potential for silt, from open cut trenching in the inter-tidal area, to affect.	HDD does not include any disturbance to the cliff and beach which would have a direct disturbance effect on the habitats and species. The drilling operations may have noise, vibration impacts on species in the vicinity. Far less silt arising from the HDD operation, reduced potential to affect the SAC.
Archaeology & Architectural Heritage	Potential to affect any unknown archaeology in the intertidal and shallow subtidal areas.	The HDD would be beneath the zone of archaeological potential except for the relatively small footprint at the entry and exit points.
Noise & Vibration	Potential for noise and vibration effects, particularly when cutting trench through rock cliff face.	Potential for noise and vibration effects from the drilling rig.
Air Quality & Climate	Potential for air quality and climate impacts.	Potential for air quality and climate impacts from plant, but less potential for dust emissions as the HDD entry point would have a smaller footprint that an open cut trench.

Environmental Aspect	Open cut	Horizontal Directional Drilling
Land and Soils	Open cut would have a greater temporary impact on land and soil as the trench would cause a larger disturbance of the ground.	Apart from the entry and exit points, the HDD would have minimal impact on land and soils.
Water	The open cut would create silt which has the potential to affect water quality.	HDD would give rise to minimal silt. There could be some discharge of drilling fluid at the exit point under the sea, as well as the possibility of frac-out along the bore. The drilling mud will be non-toxic (bentonite) and will not have a negative effect on water quality.
Landscape and Visual	Temporary impact of construction plant. The open cut trench through the cliff face would be a permanent visual impact from the sea looking onshore, which would be difficult to mitigate. However, there are very few receptors at this vantage point.	Temporary impact of construction plant. Once construction is complete there would not be a significant impact.

The comparison of environmental effects indicates that the open cut method is less preferable in terms of potential significant environmental effects, with regards to most parameters. There is also the greater potential for significant effects on the nearby Natura site (Buckroney Brittas Dunes and Fen cSAC) from an open cut trenching methodology.

Conclusion

In terms of technical feasibility and in consideration of the likely environmental effects, the Horizontal Directional Drilling (‘HDD’) methodology is determined as the favoured technique for the cable landfall at the Northern Site.

On technical grounds therefore, the northern landfall option, using a method of horizontal directional drilling, is the preferred option for the cable landfall.

4.4.3 Northern Landfall HDD Configurations for Offshore Export Cable Route Options

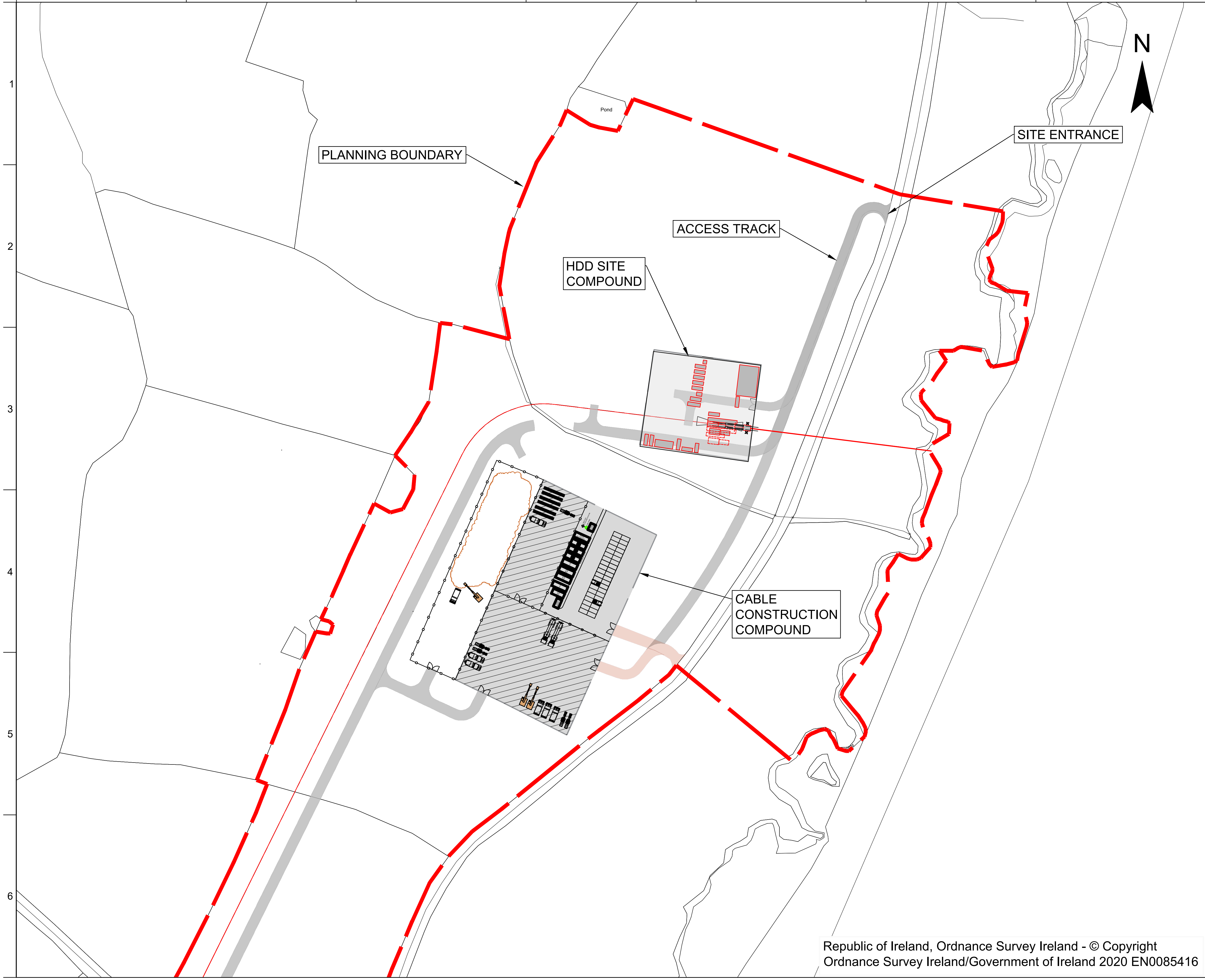
Having established the preferred landfall location (northern landfall) and the preferred construction methodology (HDD), it was then necessary to consider the configuration of the offshore export cable routes as they come onshore, together with the choice of compound location, layouts, etc to accommodate same.

There are two consented (Foreshore Lease) offshore export cable routes associated with the northern landfall, one or both of which may be used. To provide the Developer with the required flexibility, both grid cable route options (and the associated onshore HDD configurations) were considered and have been brought forward for assessment in this EIAR.

The HDD compound areas are located within an undulating agricultural field to the west of the R750 road and will be accessed directly from the R750. The HDD compound location primarily aligned for Offshore Export Cable Route Option 1 is shown in **Figure 4.4** and the HDD compound location primarily aligned for Offshore Export Cable Route Option 2 is shown in **Figure 4.5**. Only one HDD compound will be used for the HDD operations, even in the case where both offshore export cable routes are used (i.e. one offshore export cable circuit on each export cable route). Whichever site is chosen for the HDD compound at construction stage, the other site will be utilised for a temporary cable construction compound. Both options, as outlined above, are assessed within this EIAR.

Conclusion

The preferred offshore export cable route option and hence the preferred HDD compound area has not yet been determined at this stage. Therefore, both landfall configurations as illustrated in **Figure 4.4** and **Figure 4.5** are being assessed in this EIAR to allow flexibility to the Developer to select the optimum offshore cable route(s). There will only be one landfall configuration utilised and thus only one landfall HDD compound, however, the final decision will be made by the Developer in consultation with the contractor prior to construction.



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Phase 2
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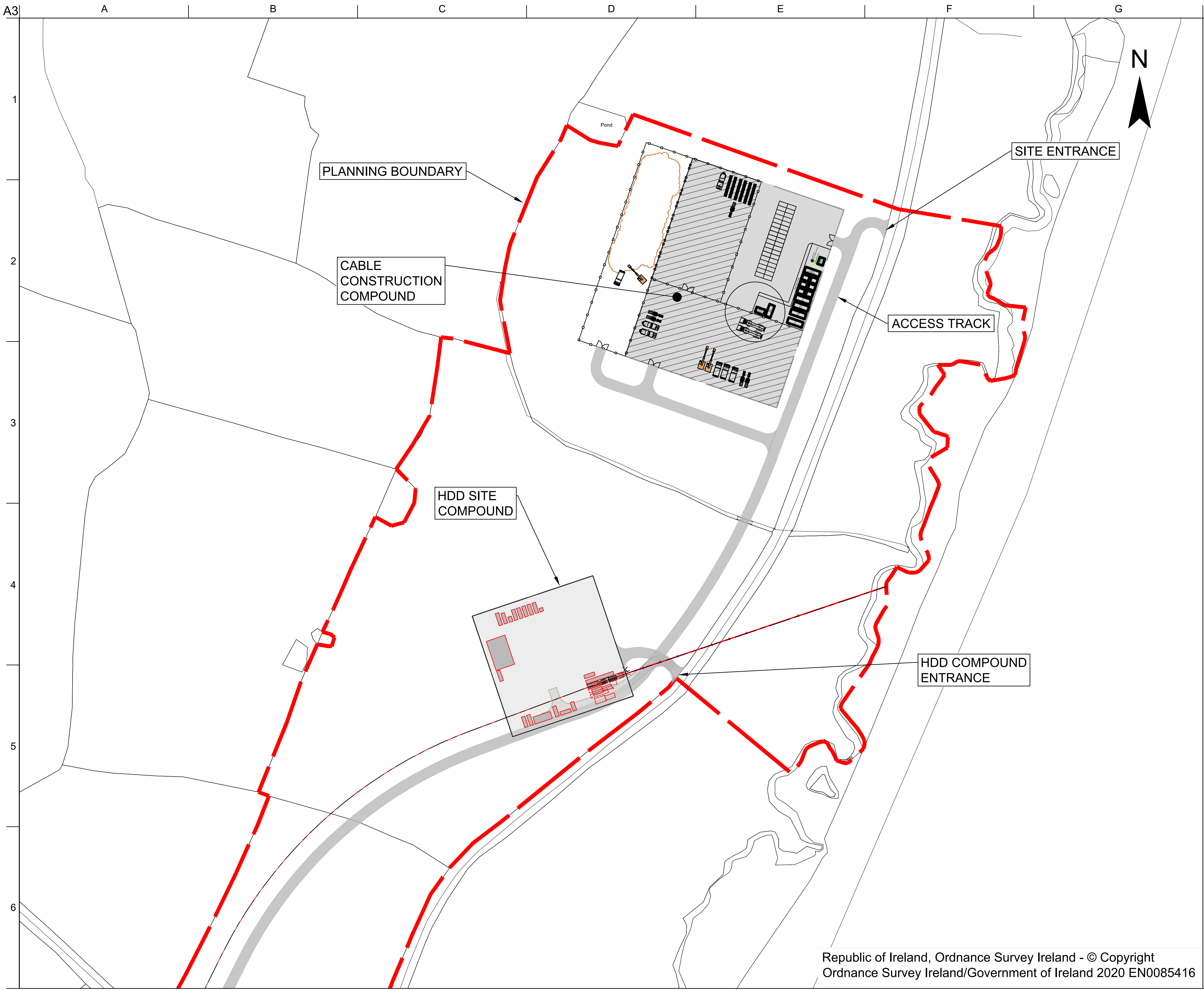
Drawing Title
Typical Landfall Temporary
Compound Arrangement Option 1

Scale at A3: 1:2,000
Role: Civil
Suitability: For Information
Arup Job No: 271715-00
Rev: D1
Name
Figure 4.4

A3
Do not scale



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Arklow Bank Wind Park
Phase 2
Onshore Grid Infrastructure

Drawing Title
Typical Landfall Temporary Compound Arrangement Option 2

Scale at A3: 1:2,000

Role: Civil

Suitability: For Information

Arup Job No: **271715-00**

Rev: **D1**

Name

Figure 4.5

Do not scale

4.5 Substation Alternatives

Alternatives were considered with regard to the proposed 220kV onshore substation, particularly in respect of the substation configurations, the connection to the NETN and the location of the substation site.

As all of these alternatives are inter-related, these alternatives were considered in parallel, before a decision on the preferred substation design was made.

4.5.1 Substation Configurations and Connection to the Transmission Network

Configurations

A preliminary screening exercise was undertaken for the Developer in June 2019. Two technologies for the onshore substation were assessed in this report; Air Insulated Switchgear (AIS) and Gas Insulated Switchgear (GIS). A brief outline of these technologies is provided below:

- AIS - this technology has busbars and terminations open to the air and utilises air to insulate the substation equipment. This requires insulation co-ordination with minimum phase to earth clearance distances of over 4 meters (m) which is achieved using steel lattice structure supports, and post insulation, to mount HV equipment which maintains required clearance distances.
- GIS - this technology utilises Sulphur Hexaflouride gas (SF6) to insulate all exposed high voltage components or conductors. This minimises the electrical clearance distances for 220kV to a fraction of the clearance distance required for AIS. Consequently, a substantially reduced footprint (see **Figure 4.7 - Figure 4.10**) can be achieved in comparison to AIS. A significant portion of GIS substations can also be housed in a building to reduce the potential visual and noise impacts.

Both AIS and GIS technologies are used extensively throughout Ireland and the UK and each offers unique advantages, the favourability of one technology over another depends on site specific constraints.

The key disadvantage of AIS is the significantly larger footprint required, but this technology offers advantages in terms of cost, maintainability and future expansion over GIS. The key attribute that GIS offers relates to space saving and the ability to house the equipment which offers a distinct advantage with regards to noise abatement for example. This reduced land take does however require an increase of infrastructure height.

Comparison of the Environmental Effects of AIS and GIS substation Technology

Table 4.4 presents the comparison of the environmental effects of the AIS and GIS substation technology.

Table 4.4 Comparison of Environmental Effects of AIS and GIS Substation Technology

Environmental Aspect	AIS Substation	GIS Substation
Population and Human Health	Design to international codes, no significant potential effect	Design to international codes, no significant potential effect
Biodiversity	AIS has a larger footprint so would have a more significant effect on biodiversity if the site was of ecological value	GIS has a smaller footprint so would have a less significant effect on biodiversity if the site was of ecological value
Archaeology & Architectural Heritage	AIS has a larger footprint so would have a more significant effect on archaeology if the site was of archaeological significance	GIS has a smaller footprint so would have a less significant effect on archaeology if the site was of archaeological significance
Noise & Vibration	Greater noise impacts, as no shielding	Less noise impact as noisy equipment abatement by building enclosure
Air Quality & Climate	Same potential impact on air quality	Same potential impact on air quality. GIS utilises Sulphur Hexaflouride gas which is a potent greenhouse gas. Design to international codes ensures risk of a release minimised
Land and Soils	AIS has a larger footprint so would have a more significant effect on land and soil	GIS has a smaller footprint so would have a less significant effect on land and soil
Water	Minimal potential for impact on water	Minimal potential for impact on water
Landscape and Visual	Requires lightning protection monopoles 30m in height which could have a significant visual impact in certain settings	Relatively large building, which could have a significant visual impact in certain settings

The decision on whether AIS or GIS technology is used, is interdependent with the substation site selection process.

Connection to the National Electricity Transmission Network (NETN)

The substation must connect to the NETN to transmit the power from the offshore wind farm.

A preliminary screening exercise assessed potential connection options to the NETN which constrained substation location options. Three methods to connect the new substation to the existing 220kV NETN were considered including:

- Type 1 – ‘Across the Fence’ Connection;
- Type 2 - ‘Tail-Fed’ Connection; and
- Type 3 - ‘Loop-In’ Connection.

The Type 1 connection comprises a connection directly to an existing NETN substation, requiring the new substation to be on an adjacent site. Type 2 and Type 3 connections would comprise (within one overall site) an additional compound, referred to as the transmission compound, containing additional infrastructure for the connection to the NETN and therefore would require a larger footprint.

AIS and GIS technology were considered for the transmission compound of the new substation but only GIS technology was considered for the connection compound based on the area constraints of the identified sites when environmental constraints were factored in. An AIS substation for the transmission compound was only considered at locations where the land folio was of sufficient size.

Type 1 - ‘Across the Fence’ Connection:

This option is applicable for a potential substation connection within c. 500 metres of the existing Arklow 220kV substation. This option would require a footprint of approximately 30,000m^2, as shown in **Figure 4.6.**

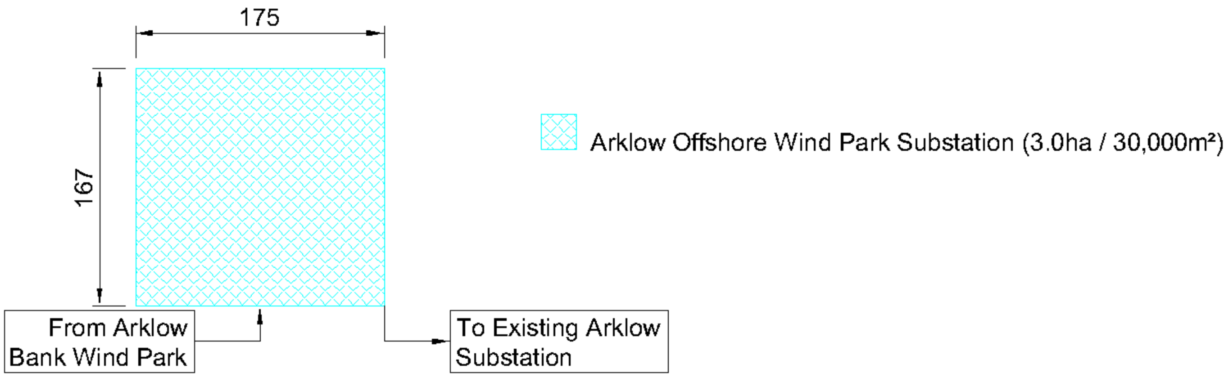


Figure 4.6 "Across the Fence" Connection

Type 2 – ‘Tail- Fed’ Connection:

This option is applicable for potential connection options between the landfall and the existing Arklow substation (at a distance greater than 500m from the existing substation). A ‘Tail-Fed’ configuration requires both a transmission and connection compound within the overall substation site as outlined above, and as shown in **Figure 4.7** and **Figure 4.8** respectively.

In addition to the area required for the connection compound (30,000 m^2 as above), the transmission compound of the new substation site would require an additional footprint of approximately 21,500m^2 (AIS) or approximately 6,000 m^2 (GIS). Therefore, a total area of 36,000m^2 to 51,500m^2 would be required for this option.

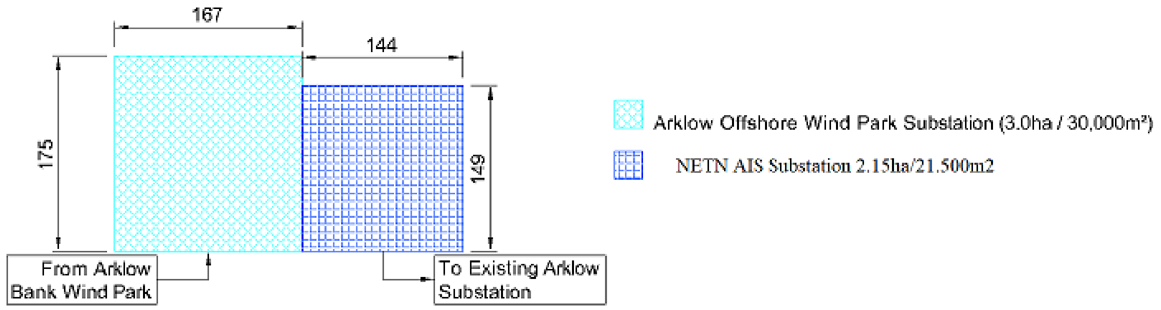


Figure 4.7 Proposed "Tail-Fed" Connection AIS Option

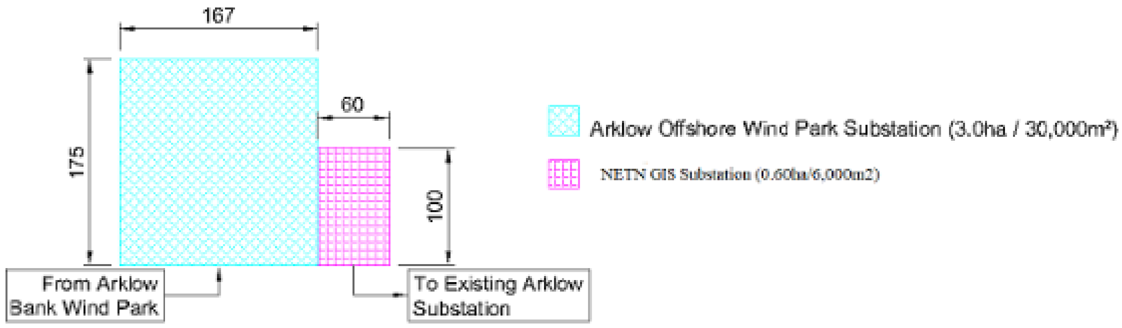


Figure 4.8 Proposed "Tail-Fed" Connection GIS Option

Type 3 – 'Loop-In' Connection:

This option is applicable for potential locations where there is an existing 220kV Overhead (OH) line traversing the area. As with the tail fed option, the loop-in option also requires both a transmission and connection compound within the overall substation site. Either AIS or GIS technology could be used for the 'Loop-In' connection, as shown in **Figure 4.9** and **Figure 4.10**, respectively.

Type 3 options require an additional area of approximately 37,500m^2 for the transmission compound (AIS) or 6,000m^2 (GIS). Therefore, a total area of 36,000m^2 to 67,500m^2 would be required for this option.

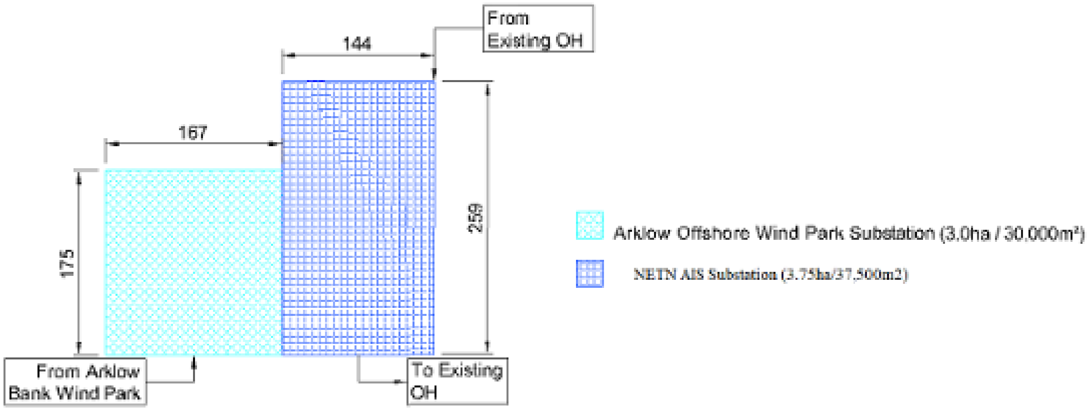


Figure 4.9 Proposed "Loop-In" Connection AIS Option

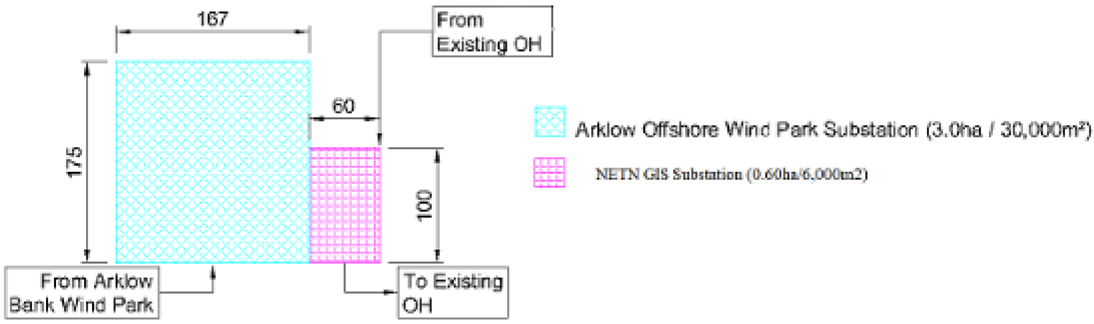


Figure 4.10 Proposed "Loop-In" Connection GIS Option

As a preliminary screening exercise, land parcels and indicative cable routes were identified, on the basis that they avoided significant engineering and environmental constraints where feasible, in the general Arklow area. Three of the land parcels facilitated 'across the fence' connections. There were four potential 'loop-in' and four potential 'tail-fed' options. A preliminary comparison was undertaken of the land parcels within each category, using a ranking matrix and a broad range of assessment criteria, including environmental considerations, as detailed below. It should be noted that, at this preliminary stage, the technical feasibility of the land parcels or cable routes, and the availability of the land parcels was not assessed.

The ranking scores were 0, 1, 3 and 5, from lowest level of constraint to highest level of constraint.

Table 4.4 Technical and Environmental Comparison of Substation Land Parcels

Land Parcel	AF1 Killiniskyduff (West)	AF2 (Coolboy) South	AF3 Killiniskyduff (South)	LI1 Coolboy (North)	LI2 Carrycole	LI3 Templemichael	LI4 Shelton Abbey	TA1 Johnstown North	TA2 Seabank	TA3 Ballymoney	TA4 Ballyrichard
Land Ownership	1	1	1	3	1	1	0	0	0	1	1
Buildings	1	1	3	0	5	5	0	0	5	0	0
Designations (Ecological, Archaeological)	5	1	0	0	0	5	0	0	0	0	0
Landscape Character	1	1	1	1	1	1	1	3	3	3	1
Current Land Use	1	1	1	1	1	1	5	1	1	1	1
Land Use Zoning	3	5	3	3	3	3	1	3	3	3	3
Flood Risk	0	1	3	3	0	1	5	0	0	0	0
Topography	0	3	3	1	5	3	0	5	1	1	3
Road Network & Access	0	3	1	5	3	0	0	5	5	5	5
Watercourses	1	1	5	1	0	5	5	3	5	5	0
Utilities	5	3	0	3	0	0	5	1	5	0	5
Ground Conditions	1	1	1	1	5	5	3	5	1	1	5
Health & Safety	3	3	3	5	5	5	5	3	5	3	3
Total	22	25	25	27	29	35	30	29	34	23	27

Following on from the preliminary screening exercise, the Developer conducted a series of studies and consultations with EirGrid on the three NETN connection methods. EirGrid completed an East Coast Generation Study, Grid Feasibility Study, Grid Stability Report and a Load Flow Report assessing the impact of the three NETN connection methods on the wider NETN. The Grid Feasibility Study findings determined that the ‘across the fence’ connection to the existing Arklow 220kV substation would require a significant full station outage to extend the existing switchgear, which EirGrid indicated may not be possible. Consequently, this connection option and the three land parcels, which depended on it, were discounted. The results from the EirGrid Stability and Load Flow Studies determined that the ‘tail fed’ and ‘loop in’ connections were feasible, with a ‘loop in’ connection being preferred as minimal works and outages are required at the existing 220kV Substation for this type of connection.

The Developer’s consultations with the landowners of the remaining land parcels focussed on specific sites within the identified land parcels. Arising out of these discussions four sites were identified as potentially available for acquisition, and these were subjected to a more detailed evaluation, as described in **Section 4.5.2**. Other sites, which were not available for acquisition, were not considered to be reasonable alternatives.

Conclusion

As detailed above, while both AIS and GIS technologies were considered for the transmission compound of the new substation (depending on the constraints of the final selected site), only GIS technology was brought forward for the connection compound, based on both the physical and environmental constraints associated with the potential sites identified in the preliminary screening exercise .

As the ‘across the fence’ option for connection to the NETN was ruled out on technical feasibility grounds, this option was not taken forward for further evaluation. Both the ‘tail fed’ and ‘loop in’ options were considered technically feasible and four sites, associated with these connection options, were brought forward for further assessment.

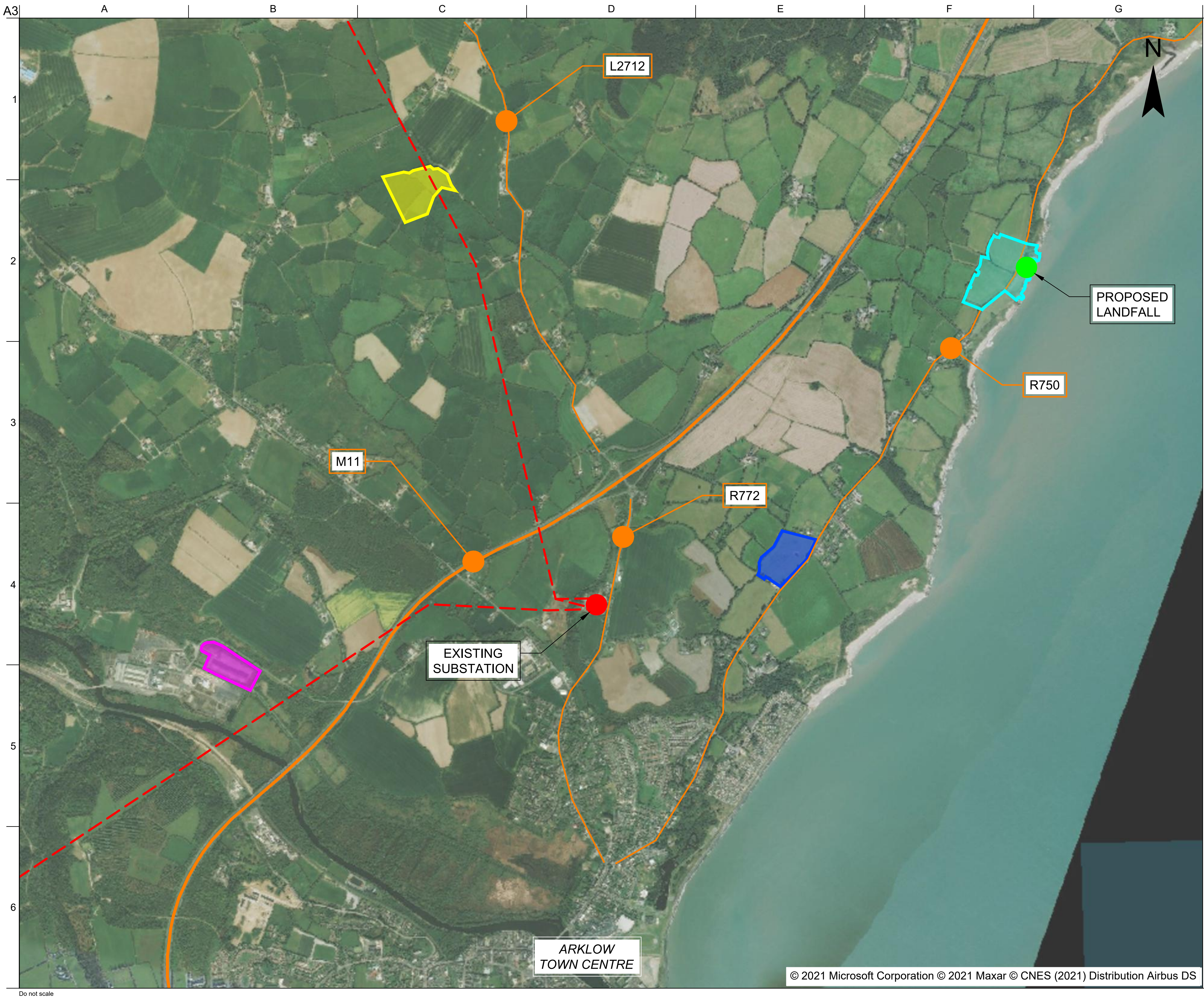
4.5.2 Substation Site Selection

In January 2020 Arup prepared a Site Appraisal Report on the four potential sites for the new Arklow Bank Wind Park Phase 2 220kV substation (sites shown in **Figure 4.11**). These sites were identified from previous studies as detailed in **Section 4.5.1**.

The four sites were subject to a detailed evaluation, including site surveys, to determine the site most suited for the proposed substation. The shortlisted sites were:

- Site A – Carrycole, situated approximately 4.9km north of Arklow Town in an agricultural setting with an approximate area of up to 6.4 hectares. The site is situated in an agricultural setting and the surroundings are used for arable land.

- Site B – Shelton Abbey, situated approximately 2.1km north of Arklow Town. It is a brownfield site, approximately up to 4 hectares in area, located in an industrial setting as part of the Avoca River Business Park. The site consists entirely of made ground, with the exception of a Right of Way along the southern boundary, which consists of a mixture of soil and gravel. This land parcel makes up the northern portion of a larger site occupied by Irish Fertiliser Industries (IFI) up until 2003.
- Site C – Johnstown North, situated approximately 5.3km north-east of Arklow harbour with an area of approximately up to 7.3 hectares. The current use of the site is primarily grazing. The site lies to the east of the M11.
- Site D – Seabank, situated in an agricultural setting approximately 3.1km north of Arklow Town with an area of approximately up to 5.5 hectares. This site is also primarily used for grazing. This site is located in the townland of Seabank to the east of the M11. There are several buildings including a nursing home within close proximity to the site.



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Project Title
Arklow Bank Wind Park
Phase 2
Onshore Grid Infrastructure

Drawing Title
Proposed Substation Site Options

Scale at A3: 1:20,000
Role: Civil
Suitability: For Information
Arup Job No: **271715-00**
Rev: **D1**
Name: **Figure 4.11**

Assessment Criteria

The assessment criteria used to assess the potential substation sites included the following:

- site history and current land-use;
- engineering appraisal including topography and constructability, access and services and infrastructure;
- land use zoning;
- ecology, including proximity of potential substation sites to ecological designated areas and hydrogeological sensitive areas were evaluated;
- landscape and visual;
- noise, including proximity to sensitive receptors;
- soils, geology and hydrogeology;
- hydrology and flooding, including proximity to watercourses;
- archaeology and cultural heritage, including proximity to recorded sites and monuments; and
- proposed developments with planning permission in the vicinity.

Following the individual assessment of each site under the above criteria, a relative scoring system was applied across the four site options to identify the most favourable option, which was recommended for further assessment, as shown in **Table 4.5**.

Table 4.5 Appraisal Scoring System

Category	Score
Major Disadvantage	1
Disadvantage	2
Neutral	3
Advantage	4
Major Advantage	5

A summary of each site is provided below, with the overall scoring of each site presented in **Table 4.6**.

Advantages and Disadvantages

Site A – Carrycole:

The site location is shown in **Figure 4.12**.

Site A has two significant disadvantages, including:

- a 1km road would have to be constructed to access the site from the public road which, itself, would have to be upgraded for construction traffic; and
- earthworks required to create a level platform. As rock is expected close to the surface, there would be a significant quantity of rock excavation. This would have the potential for re-use, covering a portion of the site, however it would add significant cost to the development. There are deeper drift deposits also expected.

Site A has five other less significant disadvantages:

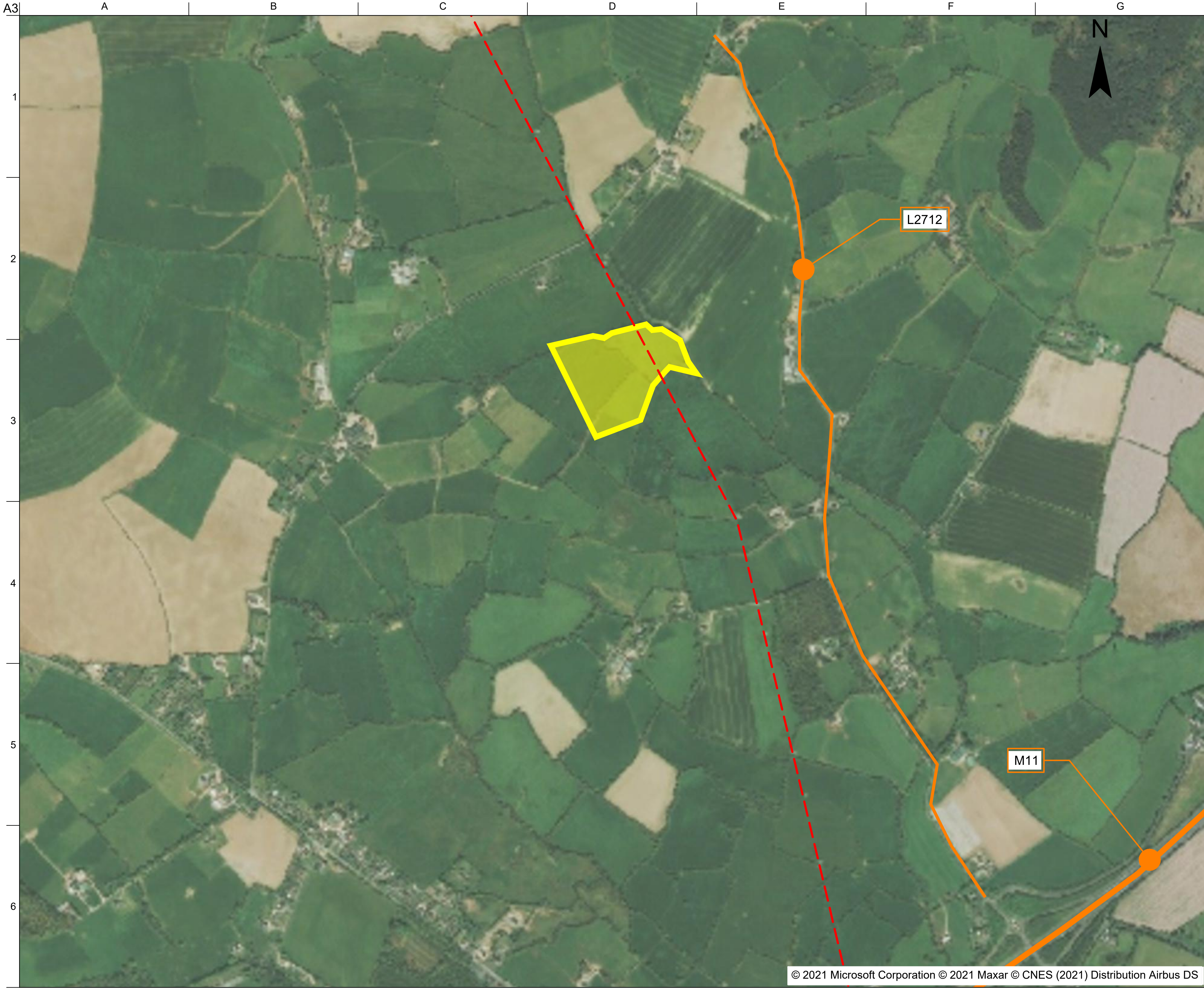
- there is the potential for unknown archaeology, including fulacht fiadh (cooking pit site dating from the Bronze Age) close to the stream;
- development on the site could disturb birds and mammals, potentially including otter and kingfisher and impact on the water quality in the Templerainy Stream;
- the zoning is open countryside – rural area, so it would be necessary to justify locating the substation on the site, specifically that "*scenic value, heritage value and/or environmental / ecological / conservation quality of the area is protected"*. However, there is precedent for solar farm, commercial and industrial developments in similar settings nearby;
- the site sits in a valley which is overlooked by a number of houses, farm-houses and farmyards on the local road to the north of the site and on the surrounding hills overlooking the site; and
- there are currently no services/utilities to the site.

Site A has three advantages:

- there is sufficient area available for the substation;
- there are no sensitive noise receptors in the immediate vicinity of the site; and
- although, from limited data, there is a potential for flooding close to the stream within the site boundary, the balance of earthworks can be used to form a platform. The large volume of site won rock will reduce impact to local environment. It will also reduce construction traffic as there would be reduced importation of aggregate.

Site A has the major advantage of the 220kV OHLs (Overhead Lines) crossing the site.

A substation on Site A would be connected to the NETN by a 'Loop-in' connection.



LEGEND:

PROPOSED SUBSTATION SITE A

EXISTING 220kV OVERHEAD CABLE

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Arklow Bank Wind Park
Phase 2
Onshore Grid Infrastructure

Drawing Title
Proposed Substation Site A
Carrycole Location

Scale at A3: 1:10,000

Role: Civil

Suitability: For Information

Arup Job No: **271715-00**

Rev: **D1**

Name: **Figure 4.12**

Do not scale

Site B – Shelton Abbey:

The site location is shown in **Figure 4.13**.

Site B has one major disadvantage:

- in terms of flooding risk, the site is almost entirely defended from the 0.1% AEP event (annual exceedance potential) with the exception of the possible flood route upstream of the site. Flood protection up to the 0.1% AEP event can be achieved for the site behind the flood defence embankment by raising the embankment locally where low areas are identified.

Site B has four other less significant disadvantages:

- the site is restricted in area which may present challenges for later expansion, if required;
- there is up to 3m of fill on the site, so piled foundations will be required for buildings and heavy items of equipment. As a brownfield site, there is a greater potential for encountering and having to deal with contaminated soil;
- when compared with Site A, the 220kV OHL is located to the east, outside of the site, rather than crossing it, but this is a very minor issue, given the close proximity of the OHL to the site; and
- the existing surface water drainage incorporates over-pumping and attenuation, which needs to be fully understood to appreciate if any work is required for operation or maintenance.

Site B has the advantage that the site is level, with the only earthworks required to raise the platform level if required.

Site B has a number of major advantages:

- it is zoned for employment and planning permission was given for a data centre;
- the site already has a number of industrial activities present. As such the character of the noise environment will not be significantly changed by the addition of the substation;
- the visual impact of a development, which complies with the zoning, on this site is deemed acceptable in the County Development Plan;
- all services/utilities are on site;
- the road infrastructure appears suitable for this type of development, although if this option is taken forward, this will need to be confirmed by swept path analysis for horizontal and vertical clearance for overhead lines;
- the site is not ecologically sensitive; and
- the potential for archaeological remains is low given the disturbed nature of the site.

A substation on Site B would be connected to the NETN by a 'Loop-in' connection.

A3

A	B	C	D	E	F	G

LEGEND:

PROPOSED SUBSTATION SITE B

EXISTING 220kV OVERHEAD CABLE

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Project Title
Arklow Bank Wind Park
Phase 2
Onshore Grid Infrastructure

Drawing Title
Proposed Substation Site B
Shelton Abbey Location

Scale at A3 1:10,000

Role Civil

Suitability For Information

Arup Job No **271715-00**

Rev **D1**

Name
Figure 4.13

Do not scale

<u>Site C – Johnstown North:</u>

The site location is shown in **Figure 4.14**.

Site C has two significant disadvantages:

- the site is in an Area of Outstanding Natural Beauty (AONB). Protected views and prospects in this area do not rule out development. However, it would be necessary to demonstrate the development is not visible, or visible but not intrusive, when viewed from M11 towards the sea; and
- the site is located in close proximity to an SAC (400m away) therefore the area has a higher sensitivity with greater potential for the existence of sensitive receptors that could be affected by environmental impacts and disruption.

Site C has six other less significant disadvantages:

- the zoning is open countryside – rural area, so it would be necessary to justify locating the substation on the site, specifically that "*scenic value, heritage value and/or environmental / ecological / conservation quality of the area is protected"*. However, there is precedent for solar farm development in the vicinity of the site;
- earthworks would be required to create a level platform which would increase the associated development costs;
- there are no services/utilities on the site;
- the road network is narrow which means that construction traffic will require appropriate traffic management and planning;
- ten noise sensitive properties within 500m, however there is existing noise from the M11 nearby; and
- moderate to high potential for the survival of archaeological remains beneath the ground surface.

Site C has three advantages:

- there is sufficient area available for the substation and it is close to the offshore export cable landfall;
- there is a low risk of flooding; and
- although there is limited data, there is no indication that the ground conditions are not suitable.

A substation on Site C would be connected to the NETN by a 'Tail-fed' connection.

A3 | A | B | C | D | E | F | G

1
2
3
4
5
6

LEGEND:

PROPOSED SUBSTATION SITE C

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Drawing Title
Proposed Substation Site C
Johnstown North Location

Scale at A3: 1:10,000
Role: Civil
Suitability: For Information
Arup Job No: **271715-00**
Rev: **D1**
Name
Figure 4.14

Do not scale

Site D - Seabank

The site location is shown in **Figure 4.15**.

Site D has two major disadvantages:

- the site is in an AONB. Protected views and prospects in this area do not rule out development, however, it would be necessary to demonstrate the site is not visible, or visible but not intrusive, from the M11 towards the sea; and
- there are more than 30 noise sensitive properties within 500m, some as close as 15m to the site.

Site D has six less significant disadvantages:

- the zoning is open countryside – rural area, so it would be necessary to justify locating the substation on the site, specifically that "*scenic value, heritage value and/or environmental / ecological / conservation quality of the area is protected"*. However, there is precedent for development of solar farms previously;
- the site is relatively limited in size to accommodate the substation, civil works, access and construction compound requirements;
- earthworks would be required to create a level platform which would increase the associated development costs;
- there are no services/utilities on the site;
- the road network is narrow and construction may cause disruption; and
- there is moderate to high potential for the survival of archaeological remains beneath the ground surface.

Site D has four advantages:

- low risk of flooding;
- although there is limited data, there is no indication that the ground conditions are not suitable;
- the site is not ecologically sensitive; and
- for a tail-fed connection to Arklow Substation, the distance is relatively short.

A substation on Site D would be connected to the NETN by a 'Tail-fed' connection.

A3

A	B	C	D	E	F	G

LEGEND:

PROPOSED SUBSTATION SITE D

EXISTING 220kV OVERHEAD CABLE

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Arklow Bank Wind Park
Phase 2
Onshore Grid Infrastructure

Drawing Title
Proposed Substation Site D
Seabank Location

Scale at A3 1:10,000

Role Civil

Suitability For Information

Arup Job No **271715-00**

Rev **D1**

Name

Figure 4.15

Do not scale

A summary of the scoring given to each site relative to the assessment criteria is shown in **Table 4.6**.

Table 4.6 Summary of Site Scoring

	Site A - Carrycole	Site B – Shelton Abbey	Site C – Johnstown North	Site D - Seabank
Site Area	4	2	4	2
Grid Connection	5	2	4	5
Access	1	5	2	2
Earthworks	1	4	2	2
Zoning	2	5	2	2
Services	2	5	2	2
Ecology	2	5	1	5
Landscape and Visual	2	5	1	1
Noise	4	5	4	1
Ground Conditions	1	2	4	4
Flooding	4	1	5	5
Archaeology	2	5	2	2
Overall Score	**30**	**46**	**33**	**33**

Conclusion

A site assessment was conducted for four potential substation sites in which the advantages and disadvantages of the four sites were compared.

The preferred site, on the basis of the detailed evaluation undertaken, for the proposed 220kV substation was Site B, the Shelton Abbey site. This site was selected as it offered distinct advantages in that it is a level, brownfield site with many existing services and utilities already available in an easily accessible industrial setting. The site is zoned for employment and is not considered particularly sensitive from a noise, biodiversity or archaeology perspective.

Overall, Site B has the most advantages and the least disadvantages and thus is the selected site for the proposed substation.

4.5.3 Substation Site Remediation Alternatives

While the proposed substation site is currently covered by asphalt, the site history (the site is the north western portion of a larger site that was previously an Irish Fertiliser Industries (IFI) fertiliser manufacturing facility) as well as recent site investigations indicate that some fertiliser by-product material from the manufacturing facility is present on the site.

The manufacturing plant was located to the south of the substation site. The records available on the Environmental Protection Agency (EPA) files indicate that the substation site was used for the outdoor storage of materials. No process plant or equipment were located on the site. Process wastes were disposed of in a landfill, which is now capped, to the east and south-east of the substation site.

As the substation site is not within the licence boundary of the existing licence area (Register Number: P0031-02), there are no obligations under the licence, relevant to the proposed development. The proposed substation site will however, require site remediation, prior to commencing the construction of the above ground structures.

The previous site history, together with the historical and recent ground investigations and soil testing carried out at the proposed substation site, provided the basis for an assessment of options for the site remediation strategy. In order to inform the decision process, Arup prepared a remedial strategy assessment. Five remediation options were considered as part of this assessment, as detailed below. The preferred option and the four alternative options are shown in **Figure 4.16**.

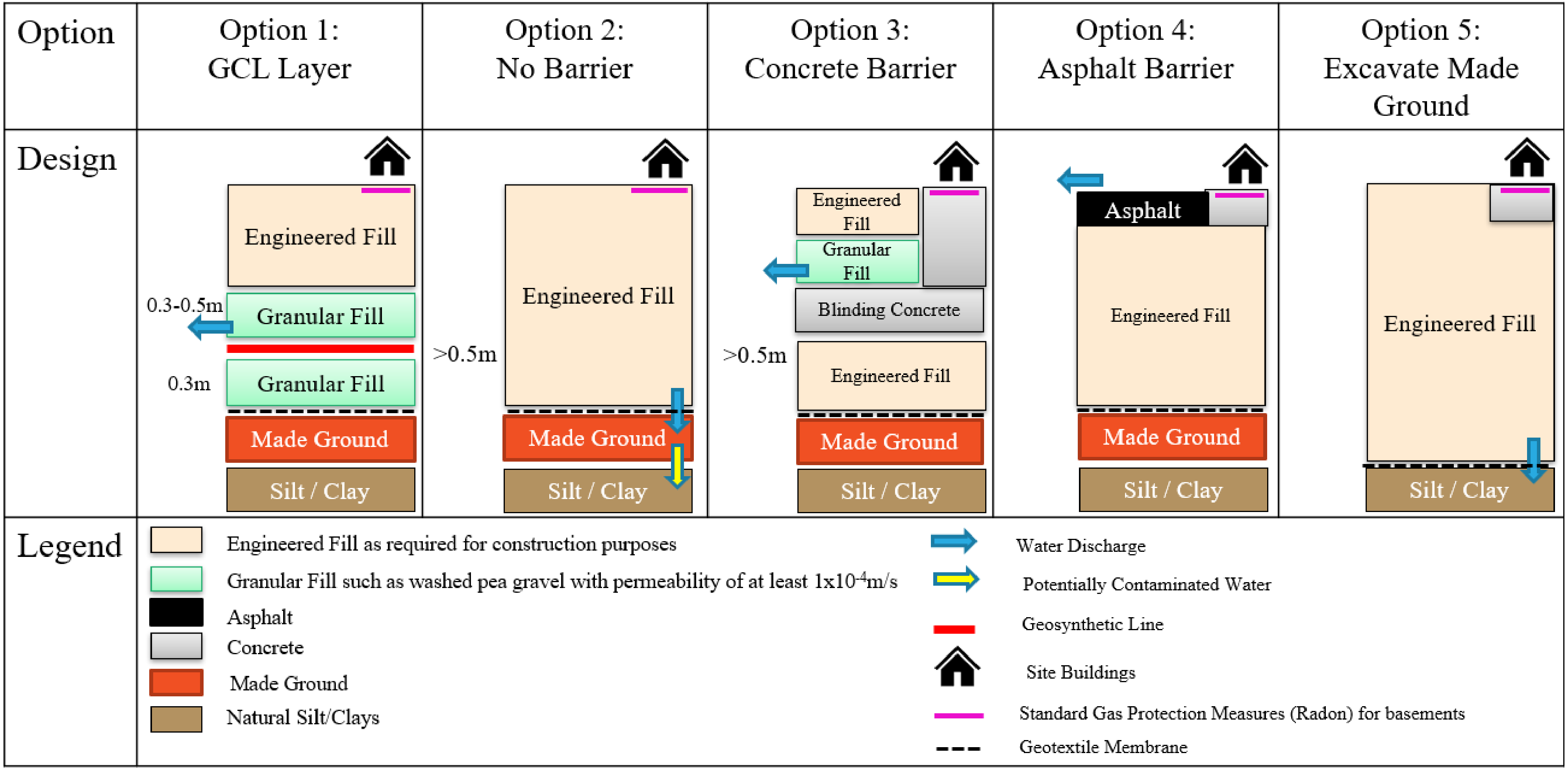

Figure 4.16 Substation Site Remediation Options

Each of the options considered is outlined below, with an assessment of the potential effects of each option in terms of technical and environmental aspects, also outlined.

4.5.3.1 Option 1

This option is to cap the Made Ground with a geosynthetic clay liner (GCL) barrier layer to minimise the percolation of rainwater through the contaminated material which will minimise leachate generation, act as a gas barrier and also form a physical barrier for site users to prevent dermal contact with the hazardous Made Ground during site operation. The remedial measures will be designed to facilitate the buried services for the proposed development, and any future buried services.

4.5.3.2 Option 2

This option represents the Do-Nothing option, with respect to groundwater protection and includes the removal of the asphalt from the Made Ground, regularisation of the Made Ground surface and then backfilling the site to the required platform level with a uniform engineered fill, the composition of which will vary depending on construction and engineering requirements.

This would result in a potential increase in rainfall percolation moving through the Made Ground material and leaching of contaminants. Therefore, this option would represent a negative impact on the receiving environment and is not recommended.

4.5.3.3 Option 3

This option includes the use of a blinding concrete layer as the barrier layer in place of the GCL barrier. This option includes the same site preparation with regards to removing existing asphalt and regularising/compacting the Made Ground followed with the placement of the lower granular layer to provide a sub-base. At this point the piling is completed and the piles are allowed to extend up to the required elevation. The site is then entirely covered with blinding concrete which will flow around the piles and create an impermeable barrier. The site is then completed as required with hardcore fill, buildings or roads.

This option is not preferred as the blinding concrete is prone to shrinkage cracking and is not a water-tight layer and does not confirm to EPA Landfill Manuals (2000) guidance on barriers.

4.5.3.4 Option 4

This option omits the use of a buried barrier layer and includes for the site to be entirely covered by asphalt outside the buildings and infrastructure. The asphalt would be integrated with a kerb and gully system connected to the surface water drainage network such that all rainfall on site would be collected and discharged.

This option is not preferred as the asphalt might at some stage in the future need to be excavated to allow for repair, upgrade or alteration of buried services, this would mean that there is no barrier during these works and the quality of the reinstatement would need to be confirmed in each instance.

In addition, this would mean the granular fill under the site could not be used for rainfall attenuation and additional storm attenuation capacity would need to be provided on site as part of the drainage design.

4.5.3.5 Option 5

This option includes the excavation of all Made Ground and contaminated soils from the site. This would therefore remove the source of contamination. The site would subsequently be built up to platform level with engineered fill as required for construction and engineering purposes. There is no requirement for any liner or additional measures.

Due to the hazardous waste classification of the Made Ground, this option would require the material to be exported to Belgium or Denmark as Ireland does not have a suitable facility for material of this type. In addition to the significant cost implication for appropriate disposal, there are associated negative environmental effects in terms of resource and waste management, noise, traffic and transportation, air quality etc..

This option is also in contravention with the United Nations (UN) Sustainable Development Goals (SDGs), in particular SDG No. 12: Ensure Sustainable Consumption and Production Patterns. Upon excavation some of the Made Ground would become a hazardous waste and its disposal abroad would contravene the following targets from the UNs comprehensive plan of action for every area in which human impact on the environment, Agenda 21, and in particular, Chapter 20 of that publication, in respect of:

- preventing or minimizing the generation of hazardous wastes as part of an overall integrated cleaner production approach; and
- eliminating, or reducing to a minimum, transboundary movements of hazardous waste.

4.5.3.6 Conclusion

Option 2 would result in a potential increase in rainfall percolation moving through the made ground material and leaching of contaminants. Therefore, this option would represent a negative impact on the receiving environment (particularly groundwater, soils, biodiversity) and is not recommended.

Option 3 is not preferred as the blinding concrete is prone to shrinkage cracking and is not a water-tight layer, which would not provide enough protection against contamination of groundwater. It also does not confirm to EPA guidance as detailed above.

Option 4 is not preferred as the asphalt may at some stage in the future need to be excavated to allow for repair, upgrade or alteration of buried services, this would mean that there is no barrier during these works and the quality of the reinstatement would need to be confirmed in each instance.

In addition, this would mean the granular fill under the site could not be used for rainfall attenuation and additional storm attenuation capacity would need to be provided on site as part of the drainage design.

The quality of the reinstatement would need to be confirmed in each instance.

Option 5 is not preferred as due to the hazardous waste classification of the made ground associated with this option. There would be significant environmental effects at the construction stage associated with excavating and moving the hazardous material and it would represent a significant additional cost.

The GCL liner option (Option 1) is the preferred option as the GCL liner minimises any risk of contamination of groundwater, with the environmental effects during the maintenance of buried services considered to be not significant.

4.5.4 Overall Conclusions on Substation Alternatives

Following a detailed evaluation of reasonable alternative connections to the NETN, substation configurations (AIS and GIS) and substation locations, which included environmental consideration of all alternatives considered, the preferred solution was as follows:

- the Shelton Abbey site was selected as the preferred substation site location;
- given the selected substation site, the connection to the NETN will be via ‘loop in’ connection, which from consultation with EirGrid, is the preferred connection method, from a technical perspective;
- given the physical constraints of the selected substation site, GIS technology will be used for the substation (for both the transmission and connection compounds); and
- the GCL liner was chosen for remediation of the substation site.

4.6 Cable Route Alternatives

The onshore cable (2 no. 220kV Alternating Current (AC cable circuits)) will run from the proposed landfall at Johnstown North, to the proposed 220kV substation at Shelton Abbey.

Both overhead lines and underground cables would be technically feasible to connect the offshore infrastructure to the national electricity transmission network (NETN). However, given the objectives of the coastal Area of Outstanding Natural Beauty (AONB) designation, in addition to public opposition to overhead lines, an early decision was taken to disregard an overhead grid connection option and therefore only underground cable route options were considered for the proposed development.

4.6.1 Cable Routing Philosophy

The approach to cable routing for this project is to traverse cross-country (off-road) where possible, to minimise disruption to traffic and to avoid in so far as possible, areas of congested utilities and proximity to residential areas. It is intended, where cables traverse agricultural or greenfield land, that cable corridors will follow field boundaries where feasible.

For some sections, where following the boundary would result in longer cable runs or would produce excessive cable bends, a more direct route will be selected. The cable route lands will be returned to agriculture use post construction. Routes with fewer crossings of roads and watercourses are preferable (where no significant other environmental constraints are identified) due to the potential difficulties these crossings could pose during construction. Routes with fewer individual landholdings were also preferred as this should reduce the requirements in terms of wayleaves.

To inform the cable route selection process, Arup prepared a Cable Route Appraisal Report.

The cable route appraisal comprised a detailed desktop study and site walkovers, to determine the optimum cable route, from a technical and environmental perspective. The constraints and potential impacts of the various routes and route combinations were compared in the assessment, which was undertaken in three phases, as follows:

- Phase 1 – Desktop comparator assessment between northern (north of M11) and southern (south of M11) route options;
- Phase 2 – Desktop assessment of various potential route combinations associated with the southern route options;
- Phase 3 – Survey and Ground truthing of Route Combinations 1 and 2; and
- Phase 4 – Further Engineering Assessment and Landowner Negotiations.

A number of initial route options were proposed by the Developer. These included potential routes to the south (Southern Routes) and to the north (Northern Routes) of the M11 with a number of possible variants to these routes, as described below and shown in **Figure 4.17**.

LEGEND:

- PROPOSED LANDFALL
- PROPOSED SUBSTATION LOCATION
- EMERGING PREFERRED CABLE ROUTE
- LANDFALL CABLE ROUTE NORTHERN OPTION
- LANDFALL CABLE ROUTE SOUTHERN OPTION
- OTHER CABLE ROUTE OPTIONS ASSESSED

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Arklow Bank Wind Park
Phase 2
Onshore Grid Infrastructure

Drawing Title
Cable Route Options Assessment

Scale at A3: 1:20,000
Role: Civil
Suitability: For Information
Arup Job No: **271715-00**
Rev: **D1**
Name: **Figure 4.17**

Do not scale

Northern Routes

Proposed cable route 2A (as shown in *yellow* in **Figure 4.18**) originates at the landfall site location in Johnstown North and initially heads south-west through agricultural lands, directly adjacent to the R750 for 200m before crossing the L95115 and changing to a north westerly direction towards the M11. The route then crosses the M11 and two roads (one by-road between the L95115 and R772 east of the M11 and the R772 on the western side of the M11). The route continues north west from Arklow Rugby Club, through agricultural lands, where possible, close to field boundaries, for a distance of c. 2000m until the route reaches Ballinclea. The route then runs around the northern boundary of the proposed solar park (Planning Ref: 171440). From this point the route continues in a westerly direction, crossing the L2172, before continuing in a southerly direction for c. 1000m until the route reaches Carrycole. The route then continues in a south easterly direction through agricultural lands, close to the field boundaries where possible for a distance of c. 1000m until the route reaches Coolboy. From here the route travels in a south westerly direction through agricultural lands east of the Coillte forest, crossing the L2180 Beech Road and continuing adjacent to the M11 through farmlands for c. 300m where it crosses Shelton Abbey Road. When the route reaches Kilbride it continues in a westerly direction, crossing the L6179 Kilbride Road at the entrance to Avoca River Business Park to make its way through agricultural lands to the proposed Shelton Abbey substation connection. At the approach to the substation site, the route may (marginally) cross into the historic landfill area for approximately 50m.

Proposed cable route 2B (as shown in *orange* in **Figure 4.18**) diverges from cable route 2A at Ballinclea, and continues in a north westerly direction through arable lands for a distance of c. 700m, before crossing the L2172. After the L2172 crossing, the route continues in a south westerly direction through agricultural lands for a distance of c. 700m running parallel to the Avoca Old Cemetery.

Proposed cable route 2C (as shown in *red* in **Figure 4.18**) diverges from cable route 2A in farmland at Carrycole. The route continues in a south westerly direction towards Raheen, through farmlands along the field boundaries where possible for a distance of c. 1000m. At Raheen, the route crosses the local Templemichael/Ballinakill public road and the L2180 Beech Road. It passes through a residential ribbon development area at Raheen before continuing in a southerly direction through farmlands, crossing two local roads adjacent to the woodland area at Shelton Abbey. The route then passes through a local GAA grounds for c. 200m. The route then continues through agricultural lands for c. 800m to the proposed Shelton Abbey substation connection.

A3

LEGEND:

- PROPOSED LANDFALL
- PROPOSED SUBSTATION LOCATION OPTION
- PROPOSED CABLE ROUTE OPTION 2A
- PROPOSED CABLE ROUTE OPTION 2B
- PROPOSED CABLE ROUTE OPTION 2C

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Northern Routes
2A, 2B and 2C

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Role: Civil
Suitability: For Information

Arup Job No	Rev
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Name
Figure 4.18

Do not scale

Southern Routes

Proposed cable route 1A (as shown in *light blue* in **Figure 4.19**) originates at the landfall site location in Johnstown North and initially heads south-west, crossing a minor road, the L95115, then running in fields adjacent to the R750 in agricultural lands, for c. 1000m until it reaches Ballymoney.

From this point the route continues in a westerly direction through agricultural land, close to field boundaries, for c. 1700m. The route then crosses the Dublin Road (R772) and passes north of the existing Arklow Substation and from this point continues in a southerly direction for c. 500m until it crosses the L2180 Beech Road and the Kilbride Industrial Estate.

From here the route changes to a westerly direction, for a distance of c. 2000m, crossing the M11 and passing again through agricultural lands in a south-westerly direction until it crosses the Shelton Abbey Road and finally the L6179 Kilbride Road at the entrance to the Avoca River Business Park before arriving at the proposed Shelton Abbey substation.

Proposed cable route 1B (as shown in *medium green* in **Figure 4.19**) diverges from cable route 1A at Ballymoney. It continues in a southerly direction, adjacent to the R750 through agricultural lands for c. 800m until it reaches west of Seabank. From this point the route continues in a south westerly direction passing through agricultural lands, in close proximity to some residential properties in Killiniskyduff, for a distance of c. 1500m through agricultural fields. The route crosses the R772 Dublin Road in Killiniskyduff, passing south of the existing Arklow substation and continues, again through agricultural lands, until it crosses the L2180 Beech Road at the Kilbride Industrial Estate where it re-joins route 1A.

Proposed cable route 1C (as shown in *light green* in **Figure 4.19**) diverges from cable route 1A at the north west side of Kilbride Industrial Estate. It continues in a westerly direction for c. 300m before turning in a southerly direction through agricultural lands, near the field boundaries, adjacent to the M11 for c. 400m where it crosses the L6179 Kilbride Road and continues south for c. 400m. At Ballyraine Lower the route continues in a north westerly direction through grazing lands, passing under the M11 and continuing to the proposed Shelton Abbey substation using a Right of Way.

A3

LEGEND:

PROPOSED LANDFALL

PROPOSED SUBSTATION LOCATION OPTION

PROPOSED CABLE ROUTE OPTION 1A

PROPOSED CABLE ROUTE OPTION 1B

PROPOSED CABLE ROUTE OPTION 1C

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Southern Routes
1A, 1B and 1C

Scale at A3: 1:20,000

Role: Civil

Suitability: For Information

Arup Job No: **271715-00**

Rev: **D1**

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Figure 4.19

Do not scale

Assessment Criteria (Phase 1 & 2)

All potential cable routes were assessed against a number of criteria to firstly determine whether the northern or southern options were preferred.

The assessment criteria were as follows:

- land use considerations (the historic and current land-use as well as the length of each route option was considered);
- land use zoning;
- engineering appraisal;
- topography and constructability;
- access;
- services and infrastructure;
- ecology;
- designations – proximity of potential cable routes to ecological designated areas and hydrogeological sensitive areas were evaluated;
- records and potential for protected species along the routes were also considered;
- soils, geology and hydrogeology;
- depth to bedrock and aquifer vulnerability was noted for potential cable routes;
- hydrology and flooding;
- archaeology and cultural heritage;
- proposed developments with planning permission;
- consented developments were identified within a 500m corridor of the potential cable routes to highlight the potential cumulative effects from the combined developments;
- existing developments in the vicinity were examined to identify any constraints; and
- residential, commercial and public amenities in proximity to the cable route which have the potential for nuisance or loss of amenity.

Phase 1 Assessment

The Phase 1 assessment focussed on a 100m corridor, 50m either side of the proposed route, (unless stated otherwise) and comprised a comparator assessment between the alternative southern and northern route options.

Based on the Phase 1 evaluation of the northern and southern route options, it is considered that, with regard to the criteria as outlined above, the southern route options are preferable to the northern route options.

In particular, given the more direct and shorter route length for the southern route options, the technical and environmental constraints (in terms of the assessment criteria) are fewer for these options and the potential impacts are less (mainly by virtue of a shorter route).

The northern route options negotiate steep and undulating topography. Geological Survey Ireland (GSI) mapping also shows a swathe of the northern routes may encounter shallow bedrock. Traversing this terrain will therefore increase total length of cable and will also likely present challenges during the construction phase. The southern route is generally a flat route which will likely present less challenges in terms of construction.

The southern route options, although more urban in nature, provide more suitable road access to sections of the cable route. There are, however, more utility and service crossings associated with the southern route options as well as more potential for disruption to sensitive receptors during the construction phase. Consideration will need to be given to the potential disruption and noise from construction activities along the southern route options.

Given all of the above, the southern route options were considered to be more suitable and were progressed to the Phase 2 evaluation, where a more detailed assessment was carried out.

Phase 2 Assessment

The Phase 2 assessment looked in more detail at the various potential route combinations associated with the southern route options.

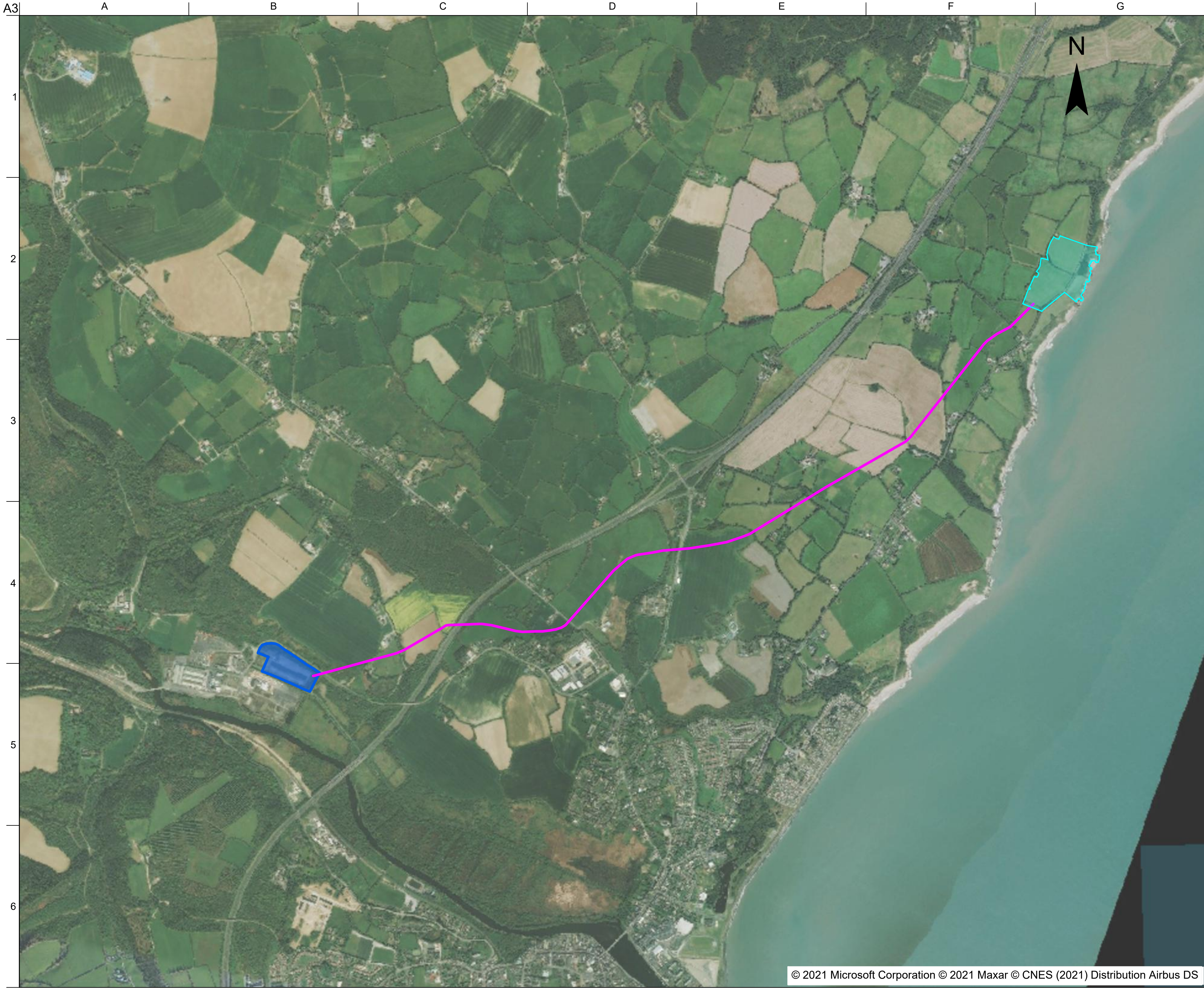
Following Phase 1, a detailed desktop assessment of the preferred southern route options and the potential route variations was carried out. This was to map relevant constraints and highlight specific advantages and disadvantages between the route options and identify a final preferred route. The desktop assessment looked at a corridor of up to 100m.

There were six route combinations of the three main southern route options assessed. These are shown in **Figure 4.20** - **Figure 4.25** below.

These route combinations were as follows:

- Route Combination 1, as shown in **Figure 4.20**, follows the main southern route in its entirety, as described previously in this section (**Section 4.6.1**). The total route length is c. 4700m.
- Route Combination 2, as shown in **Figure 4.21**, follows Route 1A for a distance of c. 1000m, then diverges to alternative Route 1B for a further 2400m, before re-joining Route 1A and continuing to the proposed substation. The total route length is 4900m. The route sections are described previously in this section (**Section 4.6.1**).
- Route Combination 3, as shown in **Figure 4.23** follows Route 1A for the first c. 3500m, then diverges to Route 1C for a further c. 1700m to the proposed substation at Shelton Abbey. The total route length is c. 5200m. The route sections are described previously in this section (**Section 4.6.1**).

- Route Combination 4, as shown in **Figure 4.23**, follows Route 1A for the first c. 3900m, then diverges to Route 2A for a distance of c. 850m until it reaches the proposed substation at Shelton Abbey. The total route length is c. 4800m. The route sections are described previously in this section (**Section 4.6.1**).
- Route Combination 5, as shown in **Figure 4.24**, follows Route 1A for c. 1000m, then diverges to Route 1B for a distance of c. 2400m, before re-joining route 1A until it diverges again to Route 2A for a distance of c. 900m until it reaches the proposed substation at Shelton Abbey. The total route length is c. 5000m. The route sections are described previously in this section (**Section 4.6.1**).
- Route Combination 6, as shown in **Figure 4.25**, follows Route 1A for c. 1000m, then diverges to Route 1B for a distance of c. 2400m, before re-joining route 1A until it diverges again to Route 1C for a distance of c. 700m until it reaches the proposed substation at Shelton Abbey. The total route length is c. 5400 m. The route sections are described previously in this section (**Section 4.6.1**).



LEGEND:

PROPOSED LANDFALL

PROPOSED SUBSTATION LOCATION OPTION

PROPOSED CABLE ROUTE COMBINATION 1

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Project Title
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Phase 2
Onshore Grid Infrastructure

Drawing Title
Route Combination 1

Scale at A3 1:20,000

Role Civil

Suitability For Information

Arup Job No 271715-00

Rev D1

Name
Figure 4.20

Do not scale

A3 A B C D E F G

LEGEND:

PROPOSED LANDFALL

PROPOSED SUBSTATION LOCATION OPTION

PROPOSED CABLE ROUTE COMBINATION 2

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Project Title
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Drawing Title
Route Combination 2

Scale at A3: 1:20,000
Role: Civil
Suitability: For Information
Arup Job No: 271715-00
Rev: D1
Name
Figure 4.21

Do not scale

A3

LEGEND:

- PROPOSED LANDFALL
- PROPOSED SUBSTATION LOCATION OPTION
- PROPOSED CABLE ROUTE COMBINATION 3

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Drawing Title
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Role Civil

Suitability For Information

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Name
Figure 4.22

Do not scale

LEGEND:

PROPOSED LANDFALL

PROPOSED SUBSTATION LOCATION OPTION

PROPOSED CABLE ROUTE COMBINATION 4

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Drawing Title
Route Combination 4

Scale at A3 1:20,000

Role Civil

Suitability For Information

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Name
Figure 4.23

A3

LEGEND:

PROPOSED LANDFALL

PROPOSED SUBSTATION LOCATION OPTION

PROPOSED CABLE ROUTE COMBINATION 5

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Project Title
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Drawing Title
Route Combination 5

Scale at A3 1:20,000

Role Civil

Suitability For Information

Arup Job No **271715-00**

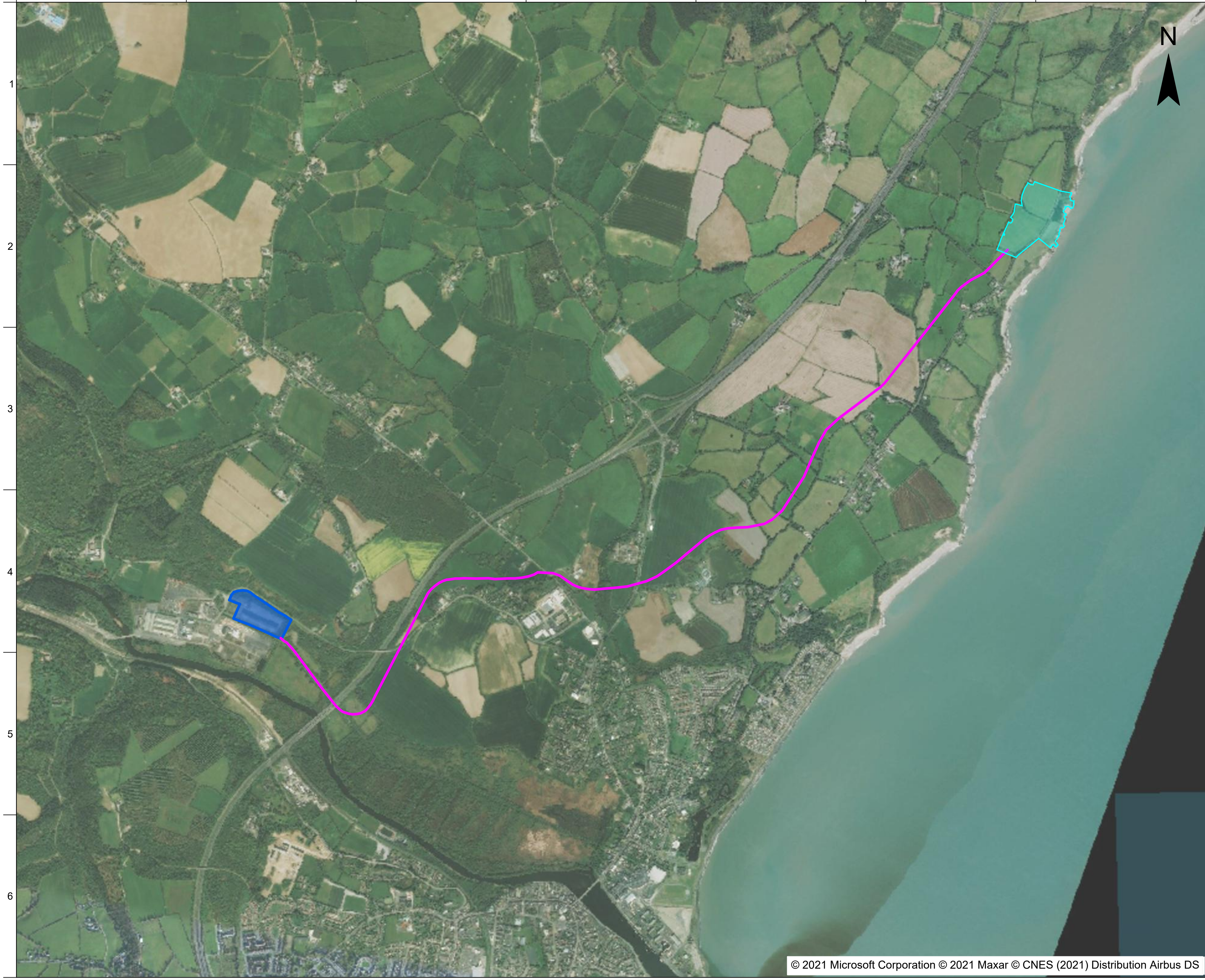
Rev **D1**

Name

Figure 4.24

Do not scale

A3



LEGEND:

PROPOSED LANDFALL

PROPOSED SUBSTATION LOCATION OPTION

PROPOSED CABLE ROUTE COMBINATION 6

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Project Title
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Drawing Title
Route Cobination 6

Scale at A3: 1:20,000

Role: For Information

Suitability: Draft

Arup Job No: **271715-00**

Rev: **D1**

Name

Figure 4.25

Do not scale

Following the detailed, individual assessment of each of the southern route options under the assessment criteria previously described, a commentary of the environmental impacts relative to each route combination was given across the six route combinations to identify the most favourable option or combination which is recommended for further assessment, see **Table 4.8**. A black, red, amber or green (BRAG) rating (as defined below in **Table 4.7**) is assigned for each route combination based on the following:

Table 4.7 BRAG Definitions

Development is definitively excluded along the route, and it is not foreseeable that this level of constraint will reduce.	B
There is a significant consenting/development risk across most of the proposed route. A significant level of mitigation would be required to reduce risks to acceptable levels.	R
Consenting/development risks remain for all or part of the route but could be made acceptable with further assessment and mitigation.	A
Effects are considered to be unlikely, not significant, or easily avoided using standard mitigation/best practice.	G

Table 4.8 Route Combination BRAG Assessment

Combination No.	Comments (environmental impact and constraints relative to the other route combinations)	BRAG
1	This was found to be a reasonable alternative option as it is the shortest most direct route. The topography, ground conditions, flood risk and access make this route favourable for construction. Although the risk of disruptions to traffic and utilities is slightly higher than the other routes it is still primarily through agricultural fields in which the disruptions are not major. The archaeology and ecology are not significantly different from the other routes.	
2	This was found to be another reasonable alternative option, similar to Route Combination. 1. The topography, ground conditions and flood risk make this route favourable for construction. 1B has the best accessibility in comparison to the other route sections. 1B does add 200m to the overall length. The risk of disruptions to traffic and utilities is slightly higher than the other routes, but similar to Route Combination 1, it is still primarily through agricultural fields in which the disruptions are not major. The archaeology and ecology are not significantly different from the other routes.	
3	The divergence to Route 1C adds some potential difficulties during the construction phase to this combination. The ground conditions and flood risk are more challenging for construction for this route section. The historic landfill site may also bring additional	

Combination No.	Comments (environmental impact and constraints relative to the other route combinations)	BRAG
	difficulties during construction. The divergence to 1C adds 500m to the overall length. The archaeology and topography are not significantly different to the other routes; however the church, graveyard and mausoleum are noteworthy constraints east of chainage 4000m. There is the potential for impacts on the Avoca River which is considered an important aquatic habitat and on the Arklow Town Marsh which is considered to be of national value.	
4	There is very little difference between this option and Route Combination 1. The only difference is at the divergence to Route 2A which is further south than 1A for this section of the route and there is a short section of 2A close on approach to the substation site which enters the historic landfill. However, for the most part, both routes remain within the same agricultural lands so there is little difference in environmental constraints. It would be advisable to avoid the landfill section if possible. Consideration must also be given to the change from route 1A to 2A to avoid sharp bends and potentially a longer crossing of the M11. There is very little difference in the archaeology and ecology between this option and Route Combination 1.	
5	There is very little difference between this option and Route Combination 2. There is a short section of 2A close on approach to the substation site which enters the historic landfill. However, for the most part, both routes remain within the same agricultural lands so there is little difference in environmental constraints. It would be advisable to avoid the landfill section if possible. Consideration must also be given to the change from route 1A to 2A to avoid sharp bends and potentially a longer crossing of the M11. There is very little difference in the archaeology and ecology between this option and Route Combination 2.	
6	This route is similar to Route Combination 2 with a divergence to Route 1C which adds some potential challenges for this combination. The ground conditions and flood risk are more challenging for construction for the 1C route section. The historic landfill site may bring significant risks and potential difficulties during construction. The divergences to 1B and 1C adds 700m to the overall length. There are 1-2 less water and road crossings than other route sections which would be favourable however the potential for difficulties outweighs this. The close proximity to the Arklow Marsh pNHA and Avoca River may present challenge in terms of ecology.	

Combination No.	Comments (environmental impact and constraints relative to the other route combinations)	BRAG
	The archaeology and topography are not significantly different to the other routes.	

The results of the Phase 2 desktop study show that Route Combinations 1 and 2 had the most advantages and the least disadvantages of the options assessed and were recommended for further consideration.

From the Phase 2 analysis it was concluded that, in order of preference, the reasonable alternative options at this point are summarised in **Table 4.9** as follows:

Table 4.9 Phase 2 Route Ranking

Combination No.	Southern Cable Options			
	Length (km)	No. of Public Road Crossings	No. of Private Road Crossings	No. of Watercourse Crossings
1	4.7	6	1	8
2	4.9	6	1	8
4	4.8	4	2	7
5	5.0	6	2	8
3	5.2	6	2	8
6	5.4	4	2	7

There are some minor differences between these Route Combinations including, the route lengths with Route Combination no. 2 and no. 5 being slightly longer than no.1 and no. 4 and Route Combination no.2 and no.5 having the better accessibility than combinations no. 1 and no. 4.

Route Combination no. 3 and no. 6 were ruled out at this stage, primarily due to the likely challenges posed during the construction phase. There are potential difficulties associated with unfavourable ground conditions, flood risk and most significantly from the historic landfill site (EPA Licence Register: P0031-02) that section 1C traverses.

Having excluded these two route options, there is no significant differentiator between the remaining Route Combination no.'s 1, 2, 4 and 5 at this stage.

Combination no. 1 and no. 2 are considered slightly preferable to Combination no. 4 and 5, largely on the basis that the latter options would require a longer and therefore more challenging crossing of the M11.

Phase 3 Assessment

To enable the final route selection, it was necessary to ground truth by site walkovers and survey, Route Combinations 1 and 2. This survey and ground truthing exercise was carried out by technical specialists in order to identify the emerging preferred option. Other factors that came into consideration in this respect, were cost, consultation with stakeholders such as landowners, Wicklow County Council (accessibility), national road authorities (M11 crossing), utility providers and state agencies.

A number of site walkovers (by technical specialists) of the two emerging preferred cable route options took place between May, June and July 2020. These included engineering and geotechnical walkovers, ecological walkovers and surveys, and archaeological walkovers.

The purpose of these walkovers and surveys was to ground truth the constraints highlighted in the Phase 2 Detailed Desktop Assessment and to identify any additional constraints which were not captured during the desktop assessment of these two options in order to select an emerging preferred cable route.

A summary of the findings of the ground truthing exercise is presented below:

Route Combination 1:

- Geotechnical Walkover – Overall, of the surveyed cable route, some constraints were identified such as elevation changes, stream crossings and road crossings which could subsequently be mitigated during the design development phase. The nature of the topography along the cable route will need consideration during design and it is noted there are significant changes in elevation at two locations. For several constraints such as the R772 crossing, Templerainy Stream, M11 motorway crossing and several OHLs entering the Arklow substation, directional drilling may be considered as a mitigation option.
- Ecological Walkover – Habitat and bird surveys were carried out on 21 May, 18 June, 21 July and 30 July 2020 to identify the habitats, flora and fauna present at the site. Overall, this route will impact on common agricultural habitats with some moderate quality hedgerows/treelines and a small section of woodland. No signs of other protected mammals were recorded. Although there is likely to be bat activity along hedgerows and streams, no trees likely to be of significant value for roosting bats were recorded. No veteran trees will be impacted. Based on the ecological surveys carried out to inform the route selection, no significant ecological constraints were identified.
- Archaeological Walkover – Surveys along accessible areas of the route were focused primarily on identifying any previously unrecorded Areas of Archaeological Potential (AAPs). In addition, the route crosses six townland boundaries. Overall, the route contains ten AAPs. Based on the surveys carried out to inform the route selection, no significant archaeological constraints were identified.

Route Combination 2:

Geotechnical Walkover – Overall, there were some constraints identified along this cable route such as elevation changes and road crossings which can be mitigated during the design process. The nature of the topography along the cable route will need consideration during design and it is noted that, while not as steep as Combination 1, there is one significant change in elevation along the route. There are several constraints located along this route such as the R772 crossing, Templerainy Steam, broadleaf woodland and several OHLs entering the Arklow substation.

Ecological Walkover – Habitat with bird surveys were carried out on 18 June, 21 July and 30 July 2020 to identify the habitats, flora and fauna present at the site. Overall, this route will impact on common agricultural habitats with some moderate quality hedgerows/treelines. A small area of woodland which is of value at a local level will be crossed. Based on the surveys carried out to inform route selection, no significant ecological constraints were identified.

Archaeological Walkover - Surveys carried out along accessible areas of the route were focused primarily on identifying any previously unrecorded Areas of Archaeological Potential (AAPs). In addition, the route crosses two townland boundaries. No previously unknown archaeological features were identified along the route during the inspection. Overall, this route contains eight AAPs. Based on the surveys carried out to inform route selection, no significant archaeological constraints were identified.

A summary of the environmental considerations associated with each of the preferred route options is summarised in **Table 4.10**.

Table 4.10 Summary of Preferred Route Options

Route Combination	1	2
Cable Route Length (km)	5.0	5.2
No. Landowners	~15	~16
Land Use	Agricultural with some single residential dwellings, mixed land use, some urban and industrial areas nearby (employment, commercial, residential)	Agricultural with some single residential dwellings, mixed land use, some urban and industrial areas nearby (employment, commercial, residential) Woodland to the south west of the existing Arklow substation.
Topography	Undulating topography ranging between approximately 10mOD at the Substation site to 20mOD at the proposed landfall site. Along the route there are topographic highs of up to approximately 40mOD and topographic lows of approximately 20mOD Noteworthy changes in topography west of R772.	Undulating topography ranging between approximately 10mOD at the Substation site to 20mOD at the proposed landfall site. Along the route there are topographic highs of up to approximately 40mOD and topographic lows of approximately 20mOD Noteworthy changes in topography west of R772.
Access	Direct access via R772, L2180 and L6179	Direct access via R772, L2180 and L6179
No. of road crossings	6 public (incl. 1 motorway) 1 private	6 public (incl. 1 motorway) 1 private
Utilities	220kV Overhead Line (crossed under lines entering and exiting Arklow Substation and west of the M11 on approach to substation site) 110kV and 38kV Overhead Lines MV/LV Overhead Lines Gas mains along R772	220kV Overhead Line (crossed under lines west of M11 on approach to substation site) 110kV and 38kV Overhead Lines MV/ LV Overhead Lines Gas mains along R772 Interactions with existing utilities within R772 and its verges. Telecom within R772 to east.

Route Combination	**1**	**2**
	Interactions with existing utilities within R772 and its verges. Telecom within R772 to east.	
Zoning	Agricultural, Mixed, Urban (residential, commercial) Employment (LAP 2018)	Agricultural, Mixed, Urban (residential, commercial) Employment (LAP 2018)
Environmentally Designated Sites within 1km of route	Buckroney-Brittas Dunes and Fen cSAC and pNHA (000729) 930m north of landfall Arklow Town Marsh pNHA (1931) 650m southeast of route on L6179 Kilbride Road	Buckroney-Brittas Dunes and Fen cSAC and pNHA (000729) 930m north of landfall Arklow Sand Dunes pNHA (1746) 700m southeast of route at Seabank Arklow Town Marsh pNHA (1931) 650m southeast of route on L6170 Kilbride Road
Ecology	Johnstown North and South, Templerainy Stream are all noted by IFI to be salmonid with populations of Brown Trout. Templerainy Stream may be used by otter and potentially Kingfishers.	Johnstown North and South, Templerainy Stream are all noted by IFI to be salmonid with populations of Brown Trout. Templerainy Stream may be used by otter and potentially Kingfishers. Pond with newt potential at Killiniskyduff, east of R772.
Ground Conditions and Geology	Subsoil: Sandstone and shale clayey till (Lower Palaeozoic) with matrix of Irish Sea Basin origin Alluvium deposits expected at watercourse crossings Bedrock: The landfall and northern section of the cable route is mainly underlain by the folded and faulted dark blue grey slates, phyllites and schists (Maulin Formation) which is seen to outcrop along the foreshore. The substation and southern section of the cable route (from approximately Johnstown South Stream southwards) is underlain by dark grey slate with pale sandstones (Kilmacrea Formation).	Subsoil: Sandstone and shale clayey till (Lower Palaeozoic) with matrix of Irish Sea Basin origin Alluvium deposits expected at watercourse crossings Soft, wet ground noted on route between Ballymoney and Seabank Bedrock: The landfall and northern section of the cable route is mainly underlain by the folded and faulted dark blue grey slates, phyllites and schists (Maulin Formation) which is seen to outcrop along the foreshore. The substation and southern section of the cable route (from approximately Johnstown South Stream southwards) is

Route Combination	**1**	**2**
		underlain by dark grey slate with pale sandstones (Kilmacrea Formation).
Watercourse crossings	8 EPA Watercourses: 3no. identified with permanent water (Johnstown North, Templerainy and Kilbride Streams) All others noted as dry during surveys	8 EPA Watercourses: 3no. identified with permanent water (Johnstown North, Templerainy and Kilbride Streams) All others noted as dry during surveys
Road and Watercourse Crossing Considerations	For Johnstown North Stream, the crossing strategy may need further ecological survey and technical assessment given the undulating topography and Johnstown North Stream. For the Templerainy Steam, it is recommended to consider trenchless crossing techniques in order to avoid a number of constraints such as R772, Templerainy Stream, steep topography, existing overhead lines and underground utilities including gas mains. At the Kilbride Stream, the crossing strategy may need further ecological survey and technical assessment. The route crosses the M11 motorway which may require Horizontal Directional Drilling. Further technical assessment is required to determine most suitable crossing methodology. All other crossings are deemed to be suitable for open cut techniques with suitable construction management and reinstatement post construction.	For Johnstown North Stream, the crossing strategy may need further ecological survey and technical assessment given the undulating topography and Johnstown North Stream. For the Templerainy Steam, it is recommended to consider trenchless crossing techniques in order to avoid a number of constraints such as R772, Templerainy Stream, steep topography, existing overhead lines and underground utilities including gas mains. At the Kilbride Stream, the crossing strategy may need further ecological survey and technical assessment as it runs close to the steam, bridge and also crosses a private and public road (L2180). The route crosses the M11 motorway which may require Horizontal Directional Drilling. Further technical assessment is required to determine most suitable crossing methodology. All other crossings are deemed to be suitable for open cut techniques with suitable construction management and reinstatement post construction.
Flood Risk (Refer to CFRAM Mapping)	Most of the route has no fluvial flood risk, minor sections of route within flood risk zone near watercourses.	Most of the route has no fluvial flood risk, minor sections of route within flood risk zone near watercourses.

Route Combination	**1**	**2**
Archaeology and Cultural Heritage Designated Sites within 50m either side of route	No SMRs within corridor	SMR Site: Ring Ditch (SMR no. WI040-047) buffer on edge of corridor
No. of proposed developments within 50m either side of route	No proposed developments within corridor	No proposed developments within corridor
No. of residential developments within 50m either side of route	Residential dwellings and yard along Beech Road (L2180)	Residential dwelling and farmyard north along Beech Road (L2180) Single residential dwelling south of route along Beech Road (L2180) Residential dwellings and yard along Beech Road (L2180)
No. of commercial developments within 50m either side of route	No commercial developments within corridor	Kilbride Industrial Estate south of route, however outside of corridor
No. of Amenities within 50m either side of route	No amenities identified	No amenities identified

Conclusion

The constraints and potential effects of the possible routes and route combinations have been identified and compared as part of a multi-criteria route options appraisal. The results of the Phase 1 desktop study show that the southern route options are preferred to the northern route options, and thus the southern options were investigated in more detail in the next Phase of the study. The results of the Phase 2 desktop study show that Route Combinations 1 and 2 have the most advantages and the least disadvantages of the options assessed and were recommended for further consideration.

Following the Phase 3 ground truthing and survey exercise in respect of Route Combinations 1 and 2, the findings of the Cable Route Options Appraisal were that both routes are suitable options, particularly in respect of environmental constraints considered in the assessment.

Phase 4 Assessment

Further detailed engineering and technical assessment of the road and water crossings was undertaken. The Developer also engaged in further landowner and stakeholder consultation, following which, the final preferred cable route option was selected as shown in **Figure 4.26.** Further information can be found in **Chapter 5** *Description of Development.*

LEGEND:

- PROPOSED LANDFALL
- PROPOSED SUBSTATION
- FINAL CABLE ROUTE
- M11 HDD CROSSING OPTION

D1	11.02.21	SB	EO'G	MW
Rev	Date	By	Chkd	Appd

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Client
Sure Partners Limited

Project Title
Arklow Bank Wind Park
Phase 2
Onshore Grid Infrastructure

Drawing Title
Final Route

Scale at A3 1:20,000
Role Civil
Suitability For Information
Arup Job No 271715-00
Rev D1
Name
Figure 4.26

Do not scale

4.6.2 Alternative Cable Route Construction Methods

For the majority of the cable route, open cut trench construction methods are proposed, given that the route is predominantly through agricultural land. The only reasonable alternatives considered relate to road and stream crossings, where HDD crossings were considered for particular crossing locations, dependent on the characteristics of the crossing. Full details of the crossing methodology is provided in **Chapter 6** *Construction Strategy*.

4.7 National Electricity Transmission Network Alternatives

The alternative connection methods to the National Electricity Transmission Network (NETN) are discussed under **Section 4.5**, with a 'loop in' connection chosen as the preferred option. Changes in the alignment of the existing 220kV overhead lines are required to accommodate this connection, including new/replacement towers. In considering the preferred location of these new/replacement towers, the primary consideration was ensuring that it minimised the change from the existing alignment/locations.

4.8 Decommissioning Alternatives

4.8.1 Substation Decommissioning Alternatives

The normal asset life of a substation is circa 50 years but may be extended beyond this. When the proposed development reaches the end of its useful life, a decision will be made to either refurbish or replace the asset, or it will be decommissioned. If decommissioned, all buildings and above ground structures on the substation site will be removed. **Table 4.11** below provides a comparison of environmental effects associated with the various alternatives which may be considered.

Table 4.11 Comparison of Substation Decommissioning Options

	Refurbish	Replace	Decommission
Population	Disruption to residents and road users during refurbishment works	Disruption to residents and road users during demolition and replacement works	Demolition works will be disruptive, but less so than replacement. Visual impact reduced
Traffic	Additional traffic, disruption to traffic when works underway	Additional traffic, disruption to traffic when works underway	Additional traffic, disruption to traffic when works underway
Noise	Noise emissions from works, noise emissions from operation	Noise emissions from works, noise emissions from operation	Noise emissions from works, no operational noise emissions
Emissions to Air	Emissions to air from construction works	Emissions to air from construction works	Emissions to air from demolition works

	Refurbish	Replace	Decommission
Resources and Waste	Consumption of resources for works; some construction waste	Consumption of resources for works; some construction waste; possible materials recovery	Consumption of resources for demolition works, demolition waste produced; possible materials recovery

All of these options are viable options for the asset at the end of its asset life and therefore have been considered in the EIAR.

4.8.2 Cable Decommissioning Alternatives

It is likely that the cables will remain in-situ when the project ceases operation. The removal of the cables would require excavation of the trench at frequent intervals, cutting of the cables, setting up a winch and extracting the cables. The recovered cable would be cut into lengths short enough to fit on a truck. This operation would cause disruption to residents and traffic, emissions of noise and dust, generation of waste and consumption of energy. Therefore, there would be more environmental impact in removing the cables than can be justified by the recycle value of cable material and it is standard industry practice to leave the cables in situ. While this does avoid the disruption, it does mean that recovery of the cable materials would not be possible. The environmental effects of the options are compared qualitatively in **Table 4.12**.

Table 4.12 Comparison of Cable Decommissioning Options

	Leave Cables in Place	Remove Cables
Population	No disruption to residents and road users	Disruption to residents and road users
Traffic	No traffic effects	Additional traffic, disruption to traffic when works underway
Noise	No noise emissions	Noise emissions from works
Emissions to Air	No emissions to air	Emissions to air from works
Resources and Waste	No consumption of fuel etc; no recovery of cable materials	Consumption of resources for works; recovery of cable materials

4.8.3 Overhead Loop-In Decommissioning Alternatives

If the substation is refurbished or replaced, then it is likely that no changes will be required to the overhead line loop-in and it will remain in place. If however, the substation is decommissioned, then there will be minor changes to the overhead line, to reinstate the existing Lodgewood-Arklow-Carrickmines 220kV line.

This would be subject to consultation with EirGrid at the appropriate time but is likely to require one new tower adjacent to the substation site as well as necessary re-stringing of overhead line.

4.9 Conclusion

The purpose of the proposed development is to connect the power generated from the Arklow Bank Offshore Wind Park Phase 2, to the NETN and comprises onshore grid infrastructure, requiring the selection of a suitable:

- Landfall
- Substation (and associated NETN connection)
- Onshore cable route

The consideration of alternatives was somewhat constrained. The landfall choice for example, was constrained by the consented offshore export cable routes (Foreshore Lease). The NETN connection, and therefore the substation location, was also constrained by the existing transmission network in the vicinity of the proposed development.

Working within these constraints, the Developer identified, through a number of studies, the reasonable alternatives which could be considered for the proposed development. A detailed technical and environmental assessment was undertaken to identify the preferred solution for the proposed development, resulting in a robust solution being brought forward for assessment in the EIAR.

4.10 References

EPA (2000) *Landfill Manuals. Landfill Site Design. Environmental Protection Agency, Ireland*