3. CONSIDERATION OF REASONABLE ALTERNATIVES

3.1 Introduction

Article 5(1)(d) of Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification) as amended by Directive 2014/52/EU (the EIA Directive) requires that the EIAR prepared by the developer contains *"a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment."*

Article 5(1)(f) of the EIA Directive requires that the EIAR contains *"any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected."*

Annex IV of the EIA Directive states that the information provided in an Environmental Impact Assessment Report (EIAR) should include 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."*

As detailed in Section 1.2.2 in Chapter 1 Introduction, for the purposes of this EIAR, the various project components are described using the following references: 'Proposed Development', 'the Site', 'Wind Farm Site' and 'Grid Connection'.

This section of the EIAR contains a description of the reasonable alternatives that were studied by the developer, which are relevant to the Proposed Development and its specific characteristics, in terms of site location and other renewable energy technologies as well as site layout incorporating size and scale of the project, connection to the national grid and transport route options to the site. This section also outlines the design considerations in relation to the wind farm, including the associated substation, construction compound and borrow pits. It provides an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.

The consideration of alternatives is an effective means of avoiding environmental impacts. As set out in the '*Guidelines on The Information to be Contained in Environmental Impact Assessment Reports' (Environmental Protection Agency, 2022),* the presentation and consideration of reasonable alternatives investigated is an important part of the overall Environmental Impact Assessment (EIA) process.

Hierarchy

EIA is concerned with projects. The Environmental Protection Agency's guidelines (EPA, 2022) state that in some instances neither the applicant nor the competent authority can be realistically expected to examine options that have already been previously determined by a higher authority, such as a national plan or regional programme for infrastructure.

Non-environmental Factors

EIA is confined to the potential significant environmental effects that influence consideration of alternatives. However, other non-environmental factors may have equal or overriding importance

to the developer of a project, for example project economics, land availability, engineering feasibility or planning considerations.

Site-specific Issues

The EPA guidelines state that the consideration of alternatives also needs to be set within the parameters of the availability of the land, i.e., the site may be the only suitable land available to the developer, or the need for the project to accommodate demands or opportunities that are site-specific. Such considerations should be on the basis of alternatives within a site, for example design and layout.

3.1.2 Methodology

The EU Guidance Document (EU, 2017) on the preparation of EIAR outlines the requirements of the EIA Directive and states that, in order to address the assessment of reasonable alternatives, the Developer needs to provide the following:

- A description of the reasonable alternatives studied; and
- An indication of the main reasons for selecting the chosen option with regards to their environmental impacts.

There is limited European and National guidance on what constitutes a 'reasonable alternative', however, the EU Guidance Document (EU, 2017) states that reasonable alternatives "*must be relevant to the proposed project and its specific characteristics, and resources should only be spent assessing these alternatives*".

The guidance also acknowledges that "*the selection of alternatives is limited in terms of feasibility. On the one hand, an alternative should not be ruled out simply because it would cause inconvenience or cost to the Developer. At the same time, if an alternative is very expensive or technically or legally difficult, it would be unreasonable to consider it to be a feasible alternative*".

The EPA Guidelines (EPA, 2022) state that "*It is generally sufficient to provide a broad description of each main alternative and the key issues associated with each, showing how environmental considerations were taken into account is deciding on the selected option. A detailed assessment (or 'mini-EIA') of each alternative is not required.*"

Consequently, taking consideration of the legislation and guidance requirements into account, this chapter addresses alternatives under the following headings:

- 'Do Nothing' Alternative;
- Alternative Site Locations;
- Alternative Renewable Energy Technologies;
- Alternative Turbine Numbers and Turbine Models;
- Alternative Turbine Layouts and Development Design;
- Alternative Design of Ancillary Structures;
- Alternative Grid Connection Route Options;
- Alternative Transport Route and Site Access; and
- Alternative Mitigation Measures.

Each of these is addressed in the following sections.

When considering a wind farm development, given the intrinsic link between layout and design, the two will be considered together in this chapter.

While environmental considerations have been at the core of the decision-making process for all of the project processes and infrastructure components, it should be noted that the majority of alternative options considered under the headings listed above are unlikely to have had significantly, greater environmental effects than the chosen option.

3.2 'Do-Nothing' Alternative

Article IV, Part 3 of the EIA Directive states that the EIAR should include "*an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge."* This is referred to as the "do-nothing" alternative. EU guidance (EU, 2017) states that this should involve the assessment of "*an outline of what is likely to happen to the environment should the Project not be implemented – the so-called 'do-nothing' scenario.*"

An alternative land-use option to the development of a renewable energy project at the Proposed Development site would be to leave the site as it is, with no changes made to existing land-use practices of coniferous forestry, biodiversity areas under Coillte management and third party lands currently being used for agricultural and forestry on the Wind Farm Site; public road corridor and coniferous forestry along the Grid Connection. In doing so, the environmental effects in terms of emissions are likely to be neutral however, the opportunity to capture the available renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment, local authority development contributions, rates and investment in the local area would also be lost. Also, the proposed amenity walkway would not be constructed and therefore this recreational opportunity would be lost. On the basis of the positive environmental effects arising from the project, when compared to the do-nothing alternative, the do–nothing alternative was not the chosen option.

The existing surrounding land uses can and will continue in conjunction with this Proposed Development.

A comparison of the potential environmental effects of the 'Do-Nothing' Alternative when compared against the chosen option of developing a renewable energy project at this site are presented in Table 3-1 below.

Table 3-1 Comparison of environmental effects when compared against the chosen option of developing a renewable energy project (the Proposed Development.

Environmental Consideration	'Do Nothing' Alternative	Developing a renewable energy project (Chosen option)
Population & Human Health (incl. Shadow Flicker)	No increase in local employment and no long-term financial contributions towards the local community. No potential for shadow flicker and noise to affect sensitive receptors.	Approximately 80-100 jobs could be created during the construction, operation, and decommissioning phases of the Proposed Development. Based on the assessment detailed in Chapter 5 and the mitigation measures proposed, there will be no significant effects related to

Environmental Consideration	'Do Nothing' Alternative	Developing a renewable energy project (Chosen option)
		shadow flicker and noise from the Proposed Development.
Biodiversity & Ornithology	No habitat loss No potential for collision risk for birds and bats	As detailed in Chapter 6, the development has been designed to avoid or mitigate impacts on biodiversity. As detailed in the Bat Report in Appendix 6-2 of this EIAR, taking into consideration the sensitive design of the project, the proposed best practice and adaptive mitigation measures, significant residual effects on bats are not anticipated. As detailed in Chapter 7, the Collision Risk Assessment (CRA) indicates that the impact of the Proposed Development on birds corresponds to a Low to Very Low effect significance.
Land, Soils & Geology	No excavation of large volumes of peat and spoil.	As detailed in the assessment in Chapter 8, there is no loss of peat, subsoil or bedrock as a result of the Proposed Development. Peat and subsoil will be relocated within the site.
Geotechnical/Peat Stability	Neutral	The findings of the Peat Stability Assessment Report indicate that the site has an acceptable margin of safety, a low risk of peat failure and is suitable for the Proposed Development.
Water (Hydrology & Hydrogeology)	Neutral	No significant effects on surface water or groundwater quality will occur.
Air & Climate	Will not provide the opportunity for an overall increase in air quality or significant reduction of greenhouse gasses. Will not assist	As detailed in the assessment in Chapter 11, over the proposed 35-year lifetime of the Proposed Development,

Environmental Consideration	'Do Nothing' Alternative	Developing a renewable energy project (Chosen option)
	in achieving the renewable energy targets set out in the Climate Action Plan.	60,489 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation. The minimum tonnage of carbon dioxide that could be saved by the Proposed Development is 47,887 tonnes per annum.
Noise & Vibration	No potential for noise impacts on nearby sensitive receptors.	Based on the assessment detailed in Chapter 12 and the mitigation measures proposed, there will be no significant effects on sensitive receptors due to an increase in noise levels from the Proposed Development during the construction, operational and decommissioning phases.
Cultural Heritage & Archaeology	No potential for impacts on unrecorded, subsurface archaeology.	As detailed in the assessment in Chapter 13, the significance of direct effects on Cultural Heritage (archaeology, architecture and cultural heritage) will be Not Significant. The significance of indirect effects on Cultural Heritage (archaeology, architecture and cultural heritage) will be Imperceptible to Moderate.
Landscape & Visual	No potential for landscape and visual impacts.	As detailed in the assessment in Chapter 14, the lack of nearby highly sensitive landscape and visual receptors, and the strategic siting of infrastructure will mitigate any potential for significant landscape and visual effects.
Material Assets	No additional traffic generated, or accommodation works carried out on the local road network and therefore no direct or indirect effects on roads and traffic.	As detailed in Chapter 15, there will be a temporary negative slight impact on traffic volumes during the construction phase of the Proposed Development. A

Environmental Consideration	'Do Nothing' Alternative	Developing a renewable energy project (Chosen option)
	No potential for effects on telecommunications, aviation or waste management services.	detailed Traffic Management Plan incorporating all the mitigation measures will be agreed with the roads authority prior to construction works commencing on site. Results from the telecom operator consultations and desktop survey analysis indicate that the 9-turbine layout will not impact any of the Telecom Operator radio networks. The findings of the Aviation Summary Report concludes that with the assessment outcomes and mitigation measures, the residual effects are not significant.

3.3 Alternative Site Locations

3.3.1 Strategic Site Screening

FuturEnergy Ireland (FEI) undertook a detailed screening process in 2014 and again in 2017, through Geographical Information Spatial (GIS) software, using a number of criteria and stages to assess the potential of a large number of possible sites, on lands within Coillte's stewardship (c. 441,000 hectares), suitable to accommodate a wind energy development. The GIS database drew upon a wide array of key spatial datasets such as forestry data, ordnance survey land data, house location data, transport, existing wind energy and grid infrastructure data and environmental data such as ecological designations, landscape designations and wind energy strategy designations available at the time.

The following is a summary of the methodology used in the screening process. The screening process included the following phases:

- Phase 1 – Initial Screening
- Phase 2 – Proximity to National Grid
- Phase 3 – Screening

3.3.2 Phase 1 – Initial Screening

This initial stage in the selection process discounted lands that were not available for development under a number of criteria, as follows:

- Committed Lands for other developments.

- Millennium Sites (This is a Coillte environmental designation – these sites were planted and managed for provision of a tree for every household in the country as part of the Millennium tree planting project).
- Life Site (This is a Coillte environmental designation – these former forested sites were cleared and are managed for biodiversity).
- Wild Nephin Properties (This is a Coillte designation. Since 2014 these properties have been incorporated into National parks).
- Farm Partnerships and Leased Lands.
- National Parks.
- Natura 2000 and Nationally Designated Sites ((Special Areas of Conservation (SAC), candidate SACs, Special Protection Areas (SPA), candidate SPAs, Natural Heritage Areas (NHA), Proposed Natural Heritage Areas (pNHA)).

Lands where the average wind speed at 80 metres above ground level is less than 7 m/s and, therefore, potentially not suitable for a commercially viable wind energy development were also discounted at this stage. Similarly sites with a contiguous area of less than 300 hectares were discounted.

In addition, the relevant local authority's County Development Plan (CDP), Renewable Energy Strategy (RES), and Wind Energy Strategy (WES) in place at the time (2014 and 2017) were reviewed, and further analysis did not proceed where the policy context was not supportive of wind farm development. In this regard, areas were not brought forward for further analysis if they were not identified as being at least "open for consideration" for wind farm development.

3.3.3 Phase 2 – Proximity to National Grid

The electricity transmission system is the backbone of the nation's power system, efficiently delivering large amounts of power from where it is generated to where it is needed. As part of the site selection process, it was necessary to consider the potential for grid connection, including in terms of distance to potential connection nodes and the grid capacity at the nodes, in the local area, to accommodate the connection.

3.3.4 Phase 3 – Screening

As part of the next stage of screening, the following were considered when screening out lands from further analysis:

- Sensitive Amenity or Scenic Areas designation in CDPs (at the time of the screening process).
- Tourist areas/sites/trails.
- Lands utilised for other wind farm developments.
- Telecommunications masts and links.
- Sensitive habitat/species of bird.
- Land Ownership title Issues.
- Relatively high residential density in vicinity.
- Unfavourable slopes and ground conditions.

3.3.5 Results of the Screening Process

A screening process was conducted across the country in 2014 and again in 2017 which identified a number of suitable sites, which were then taken forward for detailed assessment. As these sites have all been brought forward to planning (or are in that process), and are subject to EIA, a description of the reasonable alternatives studied which are relevant to each project and its specific characteristics, together with an indication of the main reasons for selecting the chosen option with

regards to their environmental impacts, are provided in the EIAR accompanying the applications for same.

Sites that emerged from the 2014 site selection process outlined above, for which planning applications have been submitted are as follows:

- Croagh, County Leitrim;
- Carrownagowan, County Clare;
- Glenard, County Donegal;
- Bottlehill (Coom), County Cork; and
- Castlebanny, County Kilkenny.

As such, a description of the reasonable alternatives studied which are relevant to each project and its specific characteristics, together with an indication of the main reasons for selecting the chosen option with regard to their environmental impacts, is provided in the EIAR accompanying the planning application for each project.

In 2017, Coillte once again examined the lands under its stewardship for candidate sites for wind energy development using the same site selection process as described above, but this time, reducing the required contiguous site area from 300ha to 50ha.

The proposed sites that emerged from this process are as follows:

- Ballinagree Co. Cork;
- Croaghaun, Co. Carlow;
- Gortyrahilly, Co. Cork;
- Inchamore Co. Cork; and
- Lissinagroagh, Co. Leitrim.

Similar to the sites which emerged in 2014; these sites which emerged in 2017 are projects in their own right which are/will be subject to EIA.

As such, a description of the reasonable alternatives studied which are relevant to each project and its specific characteristics, together with an indication of the main reasons for selecting the chosen option with regards to their environmental impacts, is/will be provided in the EIAR accompanying the applications for same.

As stated above, Coillte conducted two reviews of its land in recent years in which it examined candidate sites for wind energy development. However, as also stated above FEI continuously assesses lands for wind opportunities and other sites also emerge periodically.

This site was not brought forward under the 2014 or 2017 screening processes, due to the need to further investigate the potential impact of a wind farm project on aviation at this location. On completion of a more detailed review of this issue, it was concluded that this site was deemed suitable for wind farm development, as demonstrated in the aviation section of the Material Assets chapter of this EIAR.

In our continuous review of the portfolio, other sites which have also emerged are as follows:

- Cummeennabuddoge wind farm
- Scart Mountain wind farm

Each are projects in their own right which are/will be subject to EIA. As such a description of the reasonable alternatives studied which are relevant to each project and its specific characteristics, together with an indication of the main reasons for selecting the chosen option with regards to

their environmental impacts has/ will been / will be provided in the EIAR accompanying the applications for same.

It should be noted that FEI continuously assess lands for wind opportunities, on its own and in conjunction with other developers. Sites previously identified or not progressed for various reasons, including local county development wind designations or commercial viability, have been and will be brought forward as circumstances evolve. Such circumstances may include an increased national ambition for onshore wind development, changes on foot of cyclical review/updates to local wind energy policies in county development plans, or third party lands becoming available and resulting in new commercial opportunities/joint venture projects. Such sites are not considered alternatives to this site.

3.3.6 Suitability of the Candidate Site

Knockshanvo, as a candidate site, was further examined under the following headings in order to confirm its suitability for wind energy development.

- Planning Policy
- Proximity of Existing Grid Infrastructure
- Designated Sites
- Average Wind Speeds
- Population Density

It should be noted, the Applicant considered the potential for wind farm development on adjoining lands and necessary set-backs have been respected. The Applicant confirmed there was deemed no development potential on some surrounding lands and in those circumstances overall turbine locations on the site are maximized to meet climate targets.

3.3.6.1 Planning Policy

The Clare County Development Plan 2023 – 2029 (CDP) was formally adopted by Elected Members of Clare County Council on March 9th, 2023. The CDP officially came into effect on April 20th, 2023. The CDP provides overall guidance for the proper planning and development of County Clare through the use of supporting policies and objectives.

The CDP recognises its position in supporting the delivery of meaningful action on climate change. Climate action is thus an important strategic objective of the CDP, with aims to achieve decarbonisation and climate resilience as a county. This has been reflected in Chapter 2, in addition to other climate action and renewable energy related objectives introduced throughout the CDP.

The significance of climate change and the need for continued support / investment within renewable energy generation as part of the county's adaption strategy is captured within the strategic objective of the CDP's Climate Action Chapter:

> *Goal II: A county that is resilient to climate change, plans for and adapts to climate change and flood risk, is the national leader in renewable energy generation, facilitates a low carbon future, supports energy efficiency and conservation and enables the decarbonisation of our lifestyles and economy.*

The Interim Wind Energy Strategy (WES) for County Clare 2023-2029 was published in April 2023 and is incorporated into the CDP as Volume 6. The WES has been developed as a planning framework to support the implementation of wind developments in the county.

As the initial WES was published in 2017, it was developed to meet the policies and objectives of the Clare County Development Plan 2017-2023. Within the preface of the 2017- 2023 WES it states:

> *"Circular PL20-13, dated 20th December 2013, in the cyclical review of a Development Plan it is advised that, until the national policy review processes have concluded in relation to the Wind Energy Development Guidelines and the Renewable energy Export Policy and Development Framework, local authorities should defer amending their existing Development Plan policies and should instead operate their existing Development Plan policies and objectives until the completion of these processes and further advice is issued."*

The WES 2023-2029 highlights 11 Strategic objectives that outline the overall rationale behind the strategy, with the aim of contributing to national legally binding targets while also capitalising on those opportunities associated with the generation and harnessing of wind energy in a sustainable matter. A key objective being:

> *"To promote economic development through wind energy and other renewables in the County, underpinning the need for energy security, the promotion and establishment of a low carbon economy and the development of green business within the County."*

Lands classified under the WES have been developed for wind farm developments based on specific objectives. The definitions of the on-shore wind energy classifications, as per the WES are outlined below –

'Strategic Areas' are considered to be highly suitable for wind energy developments and are of strategic importance due to key factors which include:

- Wind resource;
- Access to grid;
- Distance from properties; and
- Outside any Natura 2000 sites.

'Acceptable in Principle' are areas considered suitable for Wind Energy developments due to key factors which include:

- Sufficient wind speeds;
- Access to grid network; and
- Established patterns of inquiries.

'Open to Consideration' areas are evaluated on a case-by-case basis subject to:

- Viable wind speeds;
- Environmental resources and constraints; and
- Cumulative impacts.

'Not Normally Permissible' areas are not, in principle, considered as suitable locations for Wind Energy developments due to sensitivity arising from:

- Landscapes;
- Ecological resources;
- Recreational; and/ or
- Cultural and Built Heritage resources.

The Wind Farm Site is located within an area designated primarily as a *'Strategic Area'* with the site also partially located within an area which is designated as *'Acceptable in Principle'* (AIP).

Strategic areas are considered suitable for wind farm development with good/excellent wind resources, access to grid, distance from properties and location outside designated sites. A target of minimum 400MW from these areas is identified in the WES. AIP areas are also considered suitable for wind farm development with sufficient wind speeds, access to grid and established patterns of inquiries. A target of minimum 150MW from these areas is identified in the WES. However, the Local Authority will assess each application for wind development in line with existing planning policy, objectives and legislation.

Further details on Planning Policy and the range of other provisions within the CDP that support the provision of renewable energy, including the objectives are listed in Section 2.4.4 of Chapter 2 of this EIAR.

3.3.6.2 Existing Grid Infrastructure

The Wind Farm Site is located within relatively close proximity (c. 10km) of 2 no. existing electrical substations and therefore a wind energy development at this location has multiple options for connection to the national electricity grid. The 110kV Ardnacrusha electrical substation is located approximately 7.7km south of the candidate site boundary at its closest point. The 110kV Drumline electrical substation is located approximately 10km southwest of the Wind Farm Site boundary. The preferred Grid Connection route option includes for underground 110kV electrical cabling from the proposed onsite 110kV electrical substation within the Wind Farm Site to the Ardnacrusha 110kV electrical substation. The underground cable route measures approximately 9.2 km in length, located within existing forestry tracks and the public road corridor.

3.3.6.3 Designated Sites

There are no Natura 2000 or nationally designated sites located within the Proposed Development boundary. The nearest Natura 2000 site, i.e., Special Area of Conservation (SAC) or Special Protection Area (SPA), to the candidate site is Danes Hole, Poulnalecka SAC, located approximately 380m north of the candidate site boundary. The nearest SPAs are the River Shannon and River Fergus Estuaries SPA and Lough Derg (Shannon) SPA, located approximately 4.9km south and 10.8km northeast of the candidate site, respectively. Gortacullin Bog Natural Heritage Area (NHA) is located immediately adjacent to the northern Proposed Development boundary.

3.3.6.4 Average Wind Speeds

The Irish Wind Atlas produced by Sustainable Energy Authority of Ireland (SEAI) shows average wind speeds for the country. With the upland nature of the landscape, the Wind Atlas shows that wind speeds on the Wind Farm Site range from 7.5m/s to 9.25m/s at a 100m elevation. Such wind speeds indicate that this site is viable for commercial wind energy development.

3.3.6.5 Population Density

The applicants sought to identify an area with a relatively low population density. Having reviewed the settlement patterns in the vicinity, the study area has emerged as suitable to accommodate the Proposed Development. The population density of the Population Study Area as described in Chapter 5: Population and Human Health of this EIAR is 24.22 persons per square kilometre. This is significantly lower than the average national population density of 73.27 persons per square kilometre. Further to this, the closest dwelling to the Proposed Development is located 751m east of the nearest turbine. This meets the requirements as set out in the '*Draft Revised Wind Energy Development Guidelines December 2019*' (Department of Housing, Local Government and Heritage, 2019) for a setback distance from occupied dwellings of 4 times tip height from a turbine (i.e., 751m in the case of the maximum proposed tip height for this

Proposed Development). Although not adopted, the developer has applied the setback in this instance as it is considered best practice. There are 15 no. residential properties located within 1km of the proposed turbines.

3.3.6.6 Summary

The Knockshanvo site is located within an existing commercial forestry property which allows the site to take advantage of existing access roads. This, when combined with the relatively close proximity of the existing 110kV Ardnacrusha electrical substation and 110kV Drumline electrical substation, and associated electricity transmission infrastructure, further highlights the suitability of the site as it can make further sustainable use of these established items of infrastructure.

The Knockshanvo site does not overlap with any environmental designations and is also located in an area with a very low population density, relative to the national average, with viable annual wind speeds.

The purpose of the site screening exercise outlined in Section 3.3.1, above, was to identify areas within Coillte's nationwide portfolio, sites that would be capable of accommodating a renewable energy development while minimising the potential for adverse impact on the environment. In order to satisfy this requirement, significant landholdings that would yield a sufficient viable area for the siting of each element of the Proposed Development was required (i.e., sites with contiguous areas as described in Stage 1 of the screening process).

While the outcome of the site screening process has identified the site of the Proposed Development as a suitable location for a renewable energy development of the nature proposed, it does not preclude other sites within Coillte's portfolio being brought forward for consideration in the future.

3.4 Alternative Renewable Energy Technologies

Both onshore and offshore wind energy development will be required to ensure Ireland reaches the target set in the Climate Action Plan to source 80 per cent of our electricity from renewable energy by 2030. It is not a case of 'either' 'or'. When considering other renewable energy technologies in the area, the Applicant considered commercial solar energy production as an alternative on the Wind Farm Site. Knockshanvo Wind Farm (and all sites) was included in this screening but due to the undulating nature of the site coupled with the presence of adverse soil conditions for solar, it wasn't deemed viable.

Commercial solar energy production is the harnessing and conversion of sunlight into electricity using photovoltaic (PV) arrays (panels). Solar PVs have a smaller capacity factor than wind farms. The capacity factor of solar PV panels in the southwest of Ireland is approximately 10%[1], compared to the capacity factor of the Wind Farm Site of 36%[2]. As discussed in Section 4.2.1 in Chapter 4 of this EIAR, the potential installed capacity of the Wind Farm Site will range from a minimum of 51.3 MW up to a maximum 64.8 MW, and therefore has the potential to produce between 161,780 MWh and 204,353 MWh of electricity per year, which is sufficient to supply between approximately 38,519 and 48,656 Irish households with electricity per year. A solar PV array with the same potential installed capacity would produce between 44,939 MWh and 56,765 MWh of electricity per year, or an electricity supply for between approximately 10,700 and 13,515 Irish households per year.

[1] *Teagasc, Solar PV. Available at: https://www.teagasc.ie/rural-economy/rural-development/energy/technologies/solar-pv/*
[2] *EirGrid, 2022 Enduring Connection Policy 2.2 Constraints Report for Solar and Wind ECP-2-2-Solar-and-Wind-Constraints-Report-Area-D-v1.0.pdf (eirgridgroup.com)*
The Proposed Development is located within the D wind region for Ireland with an associated 2020 capacity factor of 36%.

In order to supply the same number of households with electricity per year as the Wind Farm Site, a solar PV array would require a potential installed capacity of between 184.7 MW and 233.3 MW, thus requiring a development footprint approximately 8 times the Wind Farm Site (At 0.7ha per MW for Solar PV, to achieve the same electricity output as the Wind Farm, between 129ha and 163ha would be required. Average taken to given approximately 8 times the development footprint). In addition, as described in Table 3-2 below, a solar development, of this scale, would have a higher potential environmental effect on Hydrology and Hydrogeology, Traffic and Transport (construction phase) and Biodiversity and Birds (habitat loss, glint and glare) at the site. A comparison of the potential environmental effects of the development of such a solar PV array against the chosen option of developing wind turbines at the Wind Farm Site is presented in Table 3-2 below.

Table 3-2 Comparison of environmental effects when compared against the chosen option (wind turbines)

Environmental Consideration	Solar PV Array	Wind Turbines (Chosen option)
Population & Human Health (incl. Shadow Flicker)	No potential for shadow flicker to affect sensitive receptors. Potential for glint and glare impacts on local road users and residential receptors.	Based on the assessment detailed in Chapter 5 and the mitigation measures proposed, there will be no significant effects related to shadow flicker from the Proposed Development. No potential for glint and glare impacts on local receptors.
Biodiversity & Ornithology	Larger development footprint would result in greater habitat loss. No potential for collision risk for birds or bats. Potential for glint and glare impacts on birds.	As detailed in Chapter 6, the development has been designed to avoid or mitigate impacts on biodiversity. As detailed in the Bat Report in Appendix 6-2 of this EIAR, taking into consideration the sensitive design of the project, the proposed best practice and adaptive mitigation measures, significant residual effects on bats are not anticipated. As detailed in Chapter 7, the Collision Risk Assessment (CRA) indicated that the impact of the Proposed Development on birds corresponds to a Low to Very Low effect significance. No potential for glint and glare impacts on birds.
Land, Soils & Geology	Shallower excavations involved in solar PV array developments	As detailed in the assessment in Chapter 8, no significant

Environmental Consideration	Solar PV Array	Wind Turbines (Chosen option)
	would result in reduced volume of spoil to be excavated.	effects on soils and subsoils will occur.
Geotechnical/Peat Stability	Shallower excavations involved in solar PV array developments would decrease the potential for peat instability.	The findings of the Peat Stability Assessment Report indicate that the site has an acceptable margin of safety, a low risk of peat failure and is suitable for the Proposed Development.
Hydrology & Hydrogeology	A solar PV array development would require a significantly larger area of forestry to be permanently felled and replaced with renewable energy development therefore increasing the potential for silt laden runoff to enter receiving watercourses. Shallower excavations involved in solar PV array developments would result in reduced volume of spoil to be excavated, therefore reducing the potential for silt-laden runoff to enter receiving waterbodies.	As detailed in the assessment in Chapter 9, no significant effects on surface water or groundwater quality will occur.
Air & Climate	Solar PV array technology would result in a longer carbon payback period.	As detailed in the assessment in Chapter 11, over the proposed 35-year lifetime of the Proposed Development, 60,489 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation. The minimum tonnage of carbon dioxide that could be saved by the Proposed Development is 47,887 tonnes per annum.
Noise & Vibration	Less potential for noise impacts on nearby sensitive receptors.	Based on the assessment detailed in Chapter 12 and the mitigation measures proposed, there will be no significant effects on sensitive receptors due to an increase in noise levels from the Proposed Development during the construction, operational and decommissioning phases.

Environmental Consideration	Solar PV Array	Wind Turbines (Chosen option)
Cultural Heritage & Archaeology	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.	As detailed in the assessment in Chapter 13, the significance of direct effects on Cultural Heritage (archaeology, architecture and cultural heritage) will be Not Significant. The significance of indirect effects on Cultural Heritage (archaeology, architecture and cultural heritage) will be Imperceptible to Moderate.
Landscape & Visual	Potentially less visible from surrounding area due to screening from forestry and topography.	As detailed in the assessment in Chapter 14, the lack of nearby highly sensitive landscape and visual receptors, and the strategic siting of infrastructure will mitigate any potential for significant landscape and visual effects.
Material Assets	Potential for greater traffic volumes on the external road network during construction phase due to the number of solar panels required to achieve the same output. Less potential for effects on telecommunications, aviation or waste management services.	As detailed in Chapter 15, there will be a temporary negative slight impact on traffic volumes during the construction phase of the Proposed Development. A detailed Traffic Management Plan incorporating all the mitigation measures will be agreed with the roads authority prior to construction works commencing on site. Results from the telecom operator consultations and desktop survey analysis indicate that the 9-turbine layout will not impact any of the Telecom Operator radio networks. The findings of the Aviation Summary Report concludes that with the assessment outcomes and mitigation measures, the residual effects are not significant.

For the reasons set out above, the proposal for a wind energy renewable energy development at the Wind Farm Site was considered to be the most efficient method of electricity production with a smaller development footprint and a lower potential for significant environmental effects than a solar energy development with the equivalent electricity supply capacity.

3.5 Alternative Turbine Numbers and Turbine Sizes

The proposed wind turbines, for the purpose of the assessments within this EIAR, will each have a potential power output in the 5.7 to 7.2 megawatt (MW) range. It is proposed to install 9 turbines at the site which could achieve a minimum output of 51.3 MW and a maximum output of 64.8 MW. Such a wind farm could also be achieved on the proposed Wind Farm Site by using smaller turbine technology (for example 2.5 MW machines). However, this would necessitate the installation of between 21 no. and 26 no. turbines to achieve a similar output range. Furthermore, the use of smaller turbines would not make efficient use of the wind resource available having regard to the nature of the Wind Farm Site.

A larger number of smaller turbines would result in the wind farm occupying a greater footprint within the site, with a larger amount of supporting infrastructure being required (i.e., roads etc.) and increasing the potential for negative environmental effects to occur.

The proposed wind turbines to be installed on the site will have a ground-to-blade tip height between 179.5m and 185m, a hub height between 102.5m and 110.5m, and a rotor diameter between 149m and 163m (blade length between 74.5m and 81.5m). The proposed number of turbines takes account of all site constraints and the distances to be maintained between turbines and features such as roads and houses, while maximising the wind energy potential of the Wind Farm Site. The 9-turbine layout selected for the Proposed Development has the smallest development footprint of the other alternative considered, while still achieving the optimum output at a more consistent level than would be achievable using different turbines.

The use of alternative smaller turbines at this site would not be appropriate as they would fail to make the most efficient use of the wind resource passing over the site. Furthermore, the increased use of materials, excavation and movement of peat and increase in visual effect associated with a larger number of smaller turbines would result in a higher level of negative environmental effects than the chosen option.

A comparison of the potential environmental effects of the installation of a larger number of smaller wind turbines when compared against the chosen option of installing a smaller number of taller wind turbines on the Wind Farm Site are presented in Table 3-3 below.

Table 3-3 Comparison of environmental effects when compared against the chosen option (larger wind turbines)

Environmental Consideration	21 no. to 26 no. Turbine Layout	9 no. turbine layout (Chosen option)
Population & Human Health (incl. Shadow Flicker)	Likely potential for increased shadow flicker impacts on nearby sensitive receptors due to the increased number of turbines.	Based on the assessment detailed in Chapter 5 and the mitigation measures proposed, there will be no significant effects related to shadow flicker from the Proposed Development.

Environmental Consideration	21 no. to 26 no. Turbine Layout	9 no. turbine layout (Chosen option)
Biodiversity & Ornithology	Larger development footprint would result in greater habitat loss and potential for displacement.	Smaller footprint would result in less habitat being lost. As detailed in Chapter 6, the development has been designed to avoid or mitigate impacts on biodiversity. As detailed in Chapter 7, the Collision Risk Assessment (CRA) indicated that the impact of the Proposed Development on birds corresponds to a Low to Very Low effect significance.
Land, Soils & Geology	Larger development footprint would result in greater volumes of peat and spoil to be excavated and managed.	Smaller footprint would result in smaller volume of soils to be excavated and managed. As detailed in the assessment in Chapter 8, no significant effects on soils and subsoils will occur.
Geotechnical/Peat Stability	Neutral	The findings of the Peat Stability Assessment Report indicate that the site has an acceptable margin of safety, a low risk of peat failure and is suitable for the Proposed Development.
Water (Hydrology and Hydrogeology)	Larger development footprint, therefore, increasing the potential for silt laden runoff to enter receiving watercourses.	Smaller footprint would result in less potential for silt-laden run-off to enter a watercourse. As detailed in the assessment in Chapter 9, no significant effects on surface water or groundwater quality will occur.
Air & Climate	Increased potential for vehicle emissions and dust emissions due to an increased volume of construction material and turbine component deliveries to the site.	A smaller footprint would result in less dust and vehicle emissions during the construction phase. As detailed in the assessment in Chapter 11, over the proposed 35-year lifetime of the Proposed Development,

Environmental Consideration	21 no. to 26 no. Turbine Layout	9 no. turbine layout (Chosen option)
		60,489 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation. The minimum tonnage of carbon dioxide that could be saved by the Proposed Development is 47,887 tonnes per annum.
Noise & Vibration	Potential for increased noise levels at nearby sensitive receptors due to reduced separation distance between residential dwellings and turbine locations.	Potential for less noise impacts on nearby sensitive receptors during the construction, operational and decommissioning phases. Based on the assessment detailed in Chapter 12 and the mitigation measures proposed, there will be no significant effects on sensitive receptors due to an increase in noise levels from the Proposed Development during the construction, operational and decommissioning phases.
Cultural Heritage & Archaeology	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.	As detailed in the assessment in Chapter 13, the significance of direct effects on Cultural Heritage (archaeology, architecture and cultural heritage) will be Not Significant. The significance of indirect effects on Cultural Heritage (archaeology, architecture and cultural heritage) will be Imperceptible to Moderate.
Landscape & Visual	A larger number of turbines would have a greater landscape and visual impact.	As detailed in the assessment in Chapter 14, the lack of nearby highly sensitive landscape and visual receptors, and the strategic siting of infrastructure will mitigate any potential for significant landscape and visual effects.

Environmental Consideration	21 no. to 26 no. Turbine Layout	9 no. turbine layout (Chosen option)
Material Assets	Potential for greater traffic volumes during construction phase due to larger development footprint and requirement for more construction materials and turbine components. Greater potential for effects on telecommunications, aviation or waste management services.	Less traffic volumes due to smaller footprint and less component deliveries. As detailed in Chapter 15, there will be a temporary negative slight impact on traffic volumes during the construction phase of the Proposed Development. A detailed Traffic Management Plan incorporating all the mitigation measures will be agreed with the roads authority prior to construction works commencing on site. Results from the telecom operator consultations and desktop survey analysis indicate that the 9-turbine layout will not impact any of the Telecom Operator radio networks. The findings of the Aviation Summary Report concludes that with the assessment outcomes and mitigation measures, the residual effects are not significant.

For the reasons set out above, the proposal for fewer, but taller turbines at the Wind Farm Site was considered to be the most efficient method of electricity production, with a smaller development footprint and a lower potential for significant environmental effects than the alternative proposal of a larger number of smaller turbines.

3.6 Alternative Turbine Layout and Development Design

The design of the Wind Farm Site has been an informed and collaborative process from the outset, involving the designers, developers, engineers, environmental, ecological, hydrological and geotechnical, archaeological specialists and traffic consultants. The design process has also taken account of the recommendations and comments of the relevant statutory and non-statutory organisations, near neighbours / the local community and local authorities as detailed in Section 2.6 of Chapter 2.

The aim of the process being to reduce the potential for environmental effects while designing a project capable of being constructed and viable.

Throughout the preparation of the EIAR, the layout of the Wind Farm Site has been revised and refined to take account of the findings of all site investigations, baseline assessments and external feedback received from the local community, which have brought the design from its first initial layout to the current proposed layout.

3.6.1 Detailed Constraints Mapping

The design and layout of the Proposed Development follows the recommendations and guidelines set out in the '*Wind Energy Development Guidelines'* (Department of the Environment, Heritage and Local Government, 2006) (the Guidelines) and the '*Best Practice Guidelines for the Irish Wind Energy Industry'* (Irish Wind Energy Association, 2012).

The *'Wind Energy Development Guidelines'* (DoEHLG, 2006) were subject to a targeted review 2013. Currently, the proposed changes to the development management standards associated with onshore wind energy developments are outlined in the Draft Revised Wind Energy Development Guidelines, December 2019 (draft Guidelines). A consultation process in relation to the draft Guidelines closed on 19th February 2020. The proposed changes presented in the draft Guidelines give certain focus on the setback distance from residential properties (four times the proposed maximum tip height), along with shadow flicker and noise requirements relative to sensitive receptors. At time of writing, the draft Guidelines have not yet been adopted, and the relevant guidelines for the purposes of section 28 of the Planning and Development Act 2000, as amended, remain those issued in 2006.

An initial 18 no. turbine layout was proposed following a preliminary desk-based constraints assessment. A more detailed constraints mapping exercise was then carried out to inform the final proposed turbine layout.

The detailed constraints mapping process involved the placing of buffers (separation distance) around different types of constraints so as to identify clearly the areas within which no development works will take place. The size of the buffer zone for each constraint has been assigned using standards presented in the documents listed above. The constraints maps for the site encompasses the following constraints and associated buffers:

- Residential dwellings plus a minimum 750 metre buffer (meeting the requirement of 4 x maximum tip height separation distance as required by the draft Guidelines. Although not adopted, the developer has applied the setback in this instance as it is considered best practice.) (Refer to Chapter 5 Population and Human Health of EIAR);
- Designated sites plus 100 metre buffer (Refer to Chapter 6 Biodiversity of EIAR);
- A 750m Biodiversity Exclusion Zone buffers (Refer to Chapter 7 Ornithology of EIAR);
- Rivers and streams plus 50 metre buffer (Refer to Chapter 9 Hydrology & Hydrogeology of EIAR);
- Recorded Archaeological Sites and Monuments/Protected Structures plus 50 metre buffer (Refer to Chapter 14 Cultural Heritage of the EIAR);
- Telecommunication Links plus operator specific buffer (Refer to Chapter 15 Material Assets of EIAR).

Facilitators at the site build on the existing advantages and include the following:

- Available lands for development;
- Good wind resource; and
- Existing access points and general accessibility of all areas of the site due to existing forestry road infrastructure.

For clarity, the constraints map is presented in two parts. Environmental constraints are presented in Figure 3-1a, and the physical (telecommunications and other infrastructure) and residential constraints are presented in Figure 3-1b. The inclusion of the detailed, combined constraints on a map of the EIAR Study Boundary allows for a viable area to be identified as shown in Figure 3-1c.

The final proposed turbine layout was then developed to take account of all the constraints mentioned above including their associated buffer zones and the separation distance required between them.

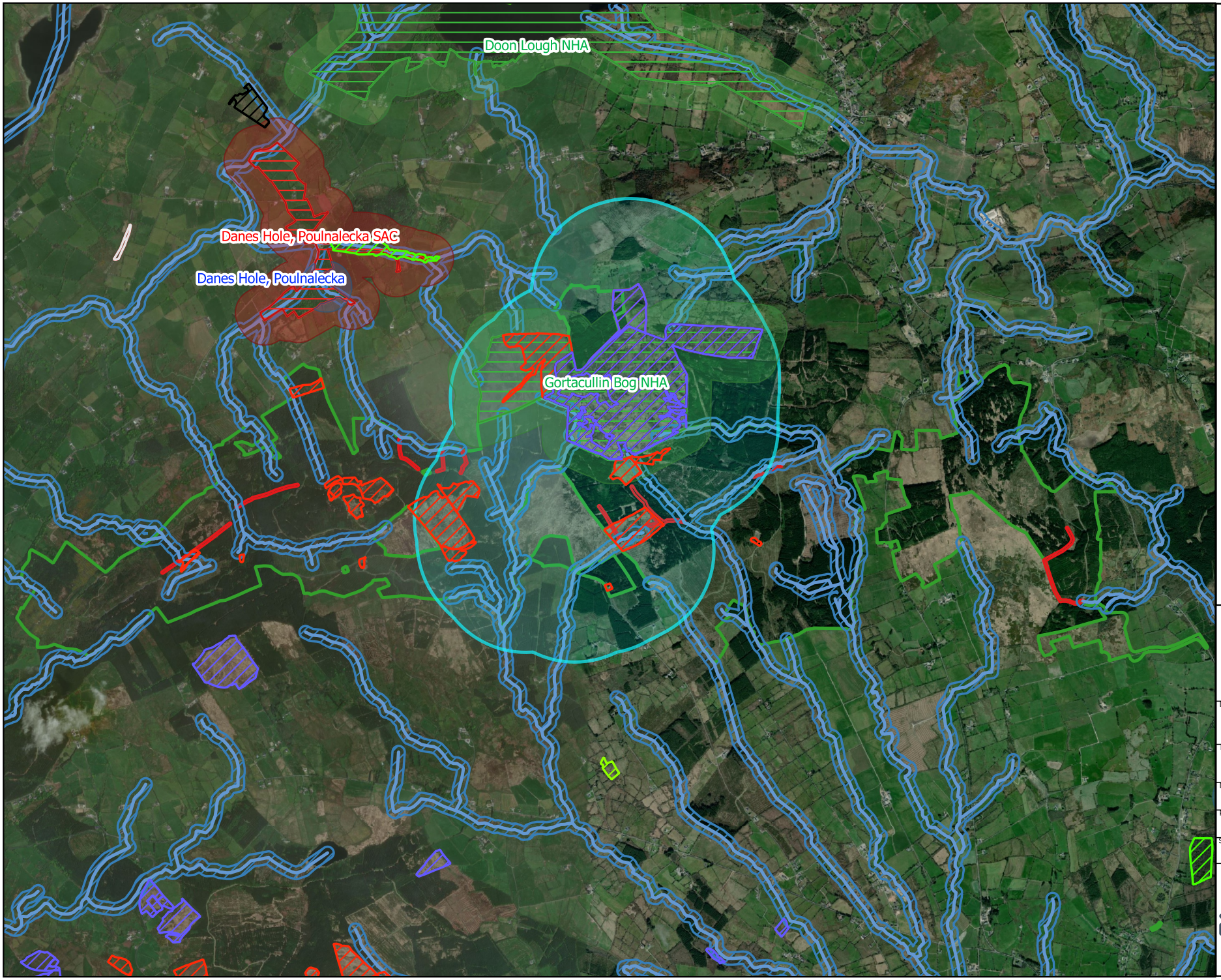
Following the mapping of all known constraints described above, detailed site investigations were carried out by the project team. The ecological assessment of the site encompassed habitat mapping and extensive surveying of birds and other fauna. These assessments, as described in Chapters 6 Biodiversity and Chapter 7 Ornithology of this EIAR, informed the decision on the siting of turbines and the carrying out of any development works, such as the construction of roads. The hydrological and geotechnical investigations of the site examined the proposed locations for turbines, roads and other components of the Proposed Development, such as the substation, borrow pits and the construction compounds. Where specific areas were deemed as being unsuitable (e.g., due to sensitive habitat, unmapped watercourse, poor ground conditions) for the siting of turbines or roads, etc., alternative infrastructure locations within the Wind Farm site were proposed and assessed, taking into account the areas that were already ruled out of consideration. The turbine layout for the Wind Farm Site was also informed by wind data and the results of noise and shadow flicker assessments as they became available.

3.6.2 Turbine Layout

The final proposed turbine layout takes account of all site constraints and the distances to be maintained between turbines and from houses, roads, etc. The layout is based on a combination of the results of all site investigations and surveys that have been carried out during the EIAR process, the community engagement process that began in 2022 (Refer to Appendix 2-3 of this EIAR) and the scoping with statutory and non-statutory consultees (refer to Section 2.6 of this EIAR). As information regarding the site of the Wind Farm Site was compiled and assessed, the proposed layout has been revised and amended to take account of the physical constraints of the site and the requirement for buffer zones and availability of land as well as cumulative impacts.

The selection of turbine number and layout has also had regard to wind-take, noise and shadow flicker effects and the separation distance between turbines. The EIAR and Wind Farm Site design process was an iterative process, where findings at each stage of the assessment were used to further refine the turbine layout, always with the intention of minimising the potential for environmental impacts.

The initial turbine layout comprised 18 no. turbines, however the proposed 9-turbine layout was refined following feedback from the project team, landowners, neighbours and the need to ensure sufficient separation distances are maintained for on-site constraints. The Wind Farm Site went through 8 no. separate iterations. Due to their similarities, all 8 no. turbine layout iterations have not been included, but Figure 3-2 to Figure 3-4 below gives an indication of how the design of the turbine layout evolved during the design process.



Map Legend

- Wind Farm Site
- Watercourses
- 50m Watercourse Buffer
- 10m Drain Buffer

Protected Areas

- Special Area of Conservation (SAC)
- Proposed Natural Heritage Area (pNHA)
- Natural Heritage Area (NHA)

200m Buffer of Protected Areas

- SAC Buffer
- pNHA Buffer
- NHA Buffer

Article 17 Habitats

- Active Blanket Bog
- Alkaline Fens
- Cladium Fen
- Dry Heath
- Molinia Meadows
- Old Oak Woodlands
- Wet Heath
- Biodiversity Exclusion Zone

N

Drawing Title
Environmental Constraints Map

Project Title
Knockshanvo Wind Farm

Drawn By	Checked By
SD	EOS
Project No.	**Drawing No.**
200513	Figure 3-1a
Scale	**Date**
1:40,000	2024-08-01

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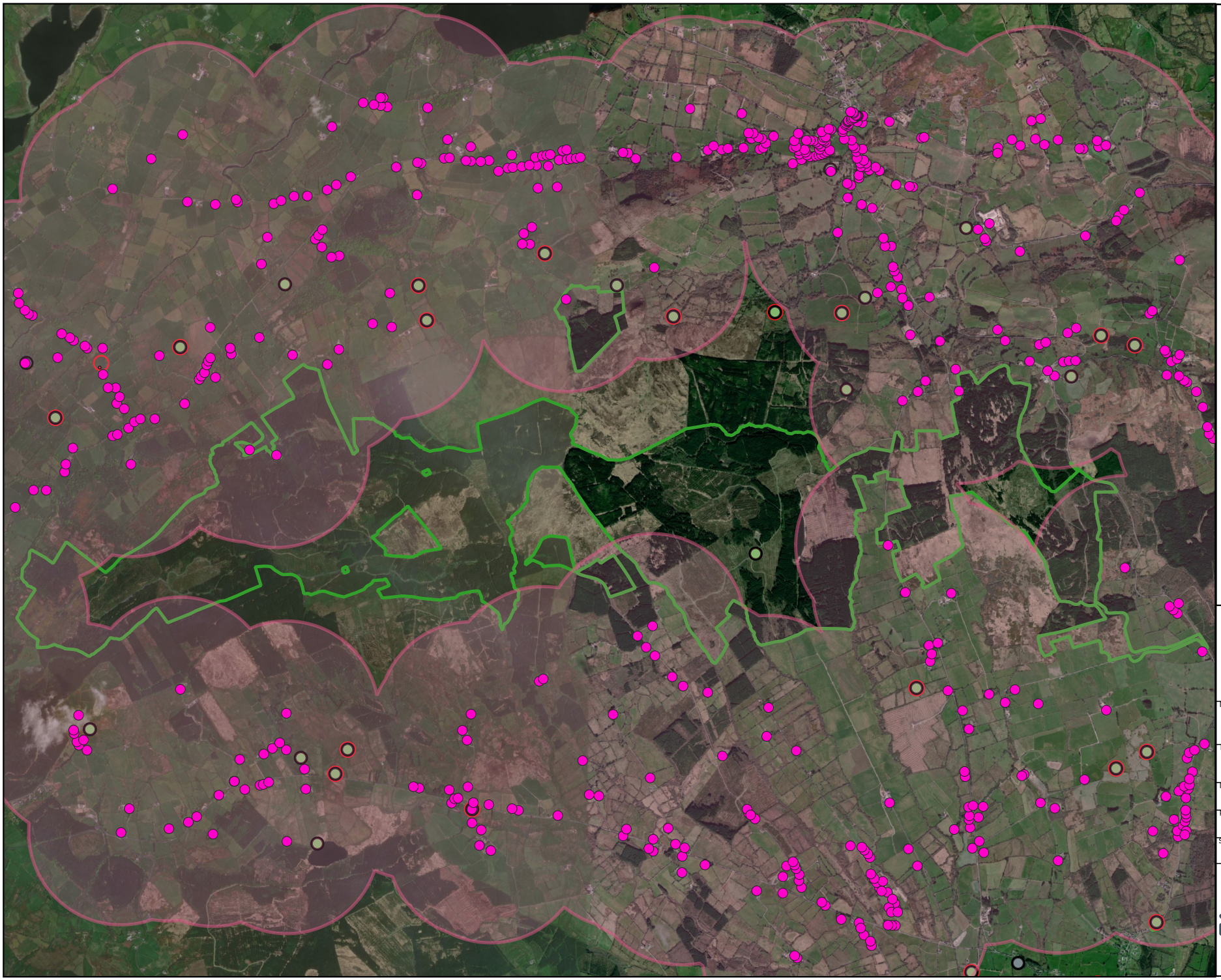
Map Legend
Wind Farm Site
Dwellings within 3km of proposed turbines
750m Dwelling Buffer
National Inventory of Architectural Heritage (NIAH) Sites
National Monuments
50m National Monuments and NIAH Sites Buffer
Site and Monutments Record (SMR) Zone
Telecommunications
ENet Link
100m ENet Link Buffer
Vodafone Link
100m Vodafone Link Buffer
ESB Link
250m ESB Link Buffer
ESB 458MHz Link
330m ESB 458MHz Link Buffer
2rn Fresnel Zone Buffer
25m Overhead Line Buffer
N
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Drawing Title
Physical and Residential Constraints Map
Project Title
Knockshanvo Wind Farm
Drawn By
SD
Checked By
EOS
Project No.
200513
Drawing No.
Figure 3-1b
Scale
1:40,000
Date
2024-08-01
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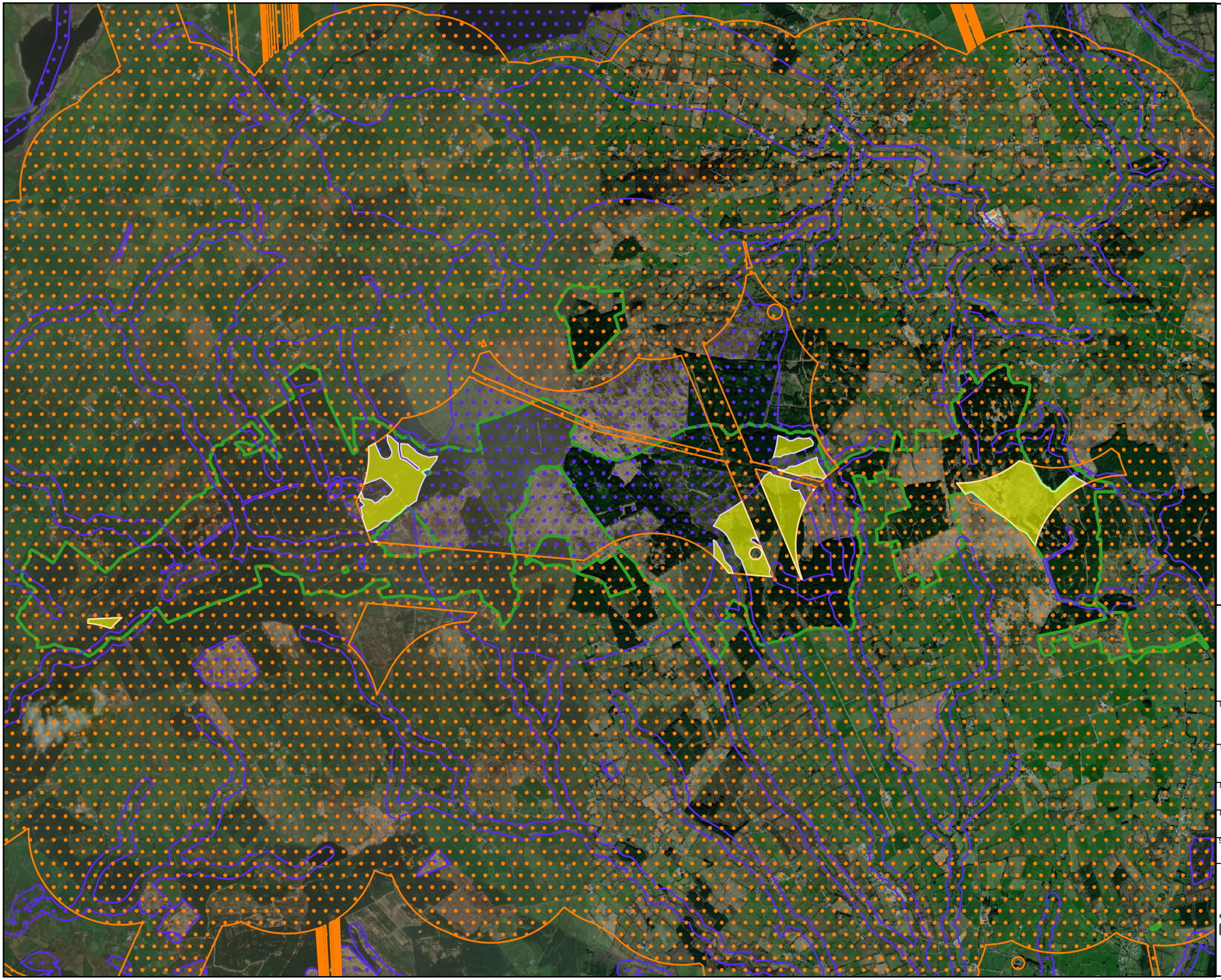

Map Legend

- Wind Farm Site
- All Environmental Constraints
- All Physical Constraints
- Remaining Viable Area

N

Drawing Title

Combined Constraints and Viabloe Area Map

Project Title

Knockshanvo Wind Farm

Drawn By	Checked By
SD	EOS
Project No.	**Drawing No.**
200513	Figure 3-1c
Scale	**Date**
1:40,000	2024-08-01

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Map Legend

- Wind Farm Site
- Proposed Turbine Layout Iteration No. 1 [18 no. turbines]

N

Drawing Title
Proposed Turbine Layout Iteration No. 1 (18 no. Turbines)

Project Title
Knockshanvo Wind Farm

Drawn By	Checked By
SD	EOS
Project No.	Drawing No.
200513	Figure 3-2
Scale	Date
1:45,000	2024-08-01

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Map Legend

- Wind Farm Site
- Proposed Turbine Layout Iteration No. 2 [9 no. turbines]

N

Drawing Title
Proposed Turbine Layout Iteration No. 2 (9 no. Turbines)

Project Title
Knockshanvo Wind Farm

Drawn By	Checked By
SD	EOS
Project No.	Drawing No.
200513	Figure 3-3
Scale	Date
1:45,000	2024-08-01

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Map Legend

- Wind Farm Site
- Proposed Turbine Layout [9 no. turbines]

N

Drawing Title
Final Proposed Turbine Layout (9 no. Turbines)

Project Title
Knockshanvo Wind Farm

Drawn By	Checked By
SD	EOS
Project No.	Drawing No.
200513	Figure 3-4
Scale	Date
1:45,000	2024-08-01

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3.6.2.1.1 Proposed Turbine Layout Iteration No. 1

There were a number of reviews of the specific locations of the various turbines during the optimisation of the site layout. The preliminary desk-based constraints assessment identified a potentially developable area suitable for approximately 18 no. turbines. This initial turbine layout, shown in Figure 3-2, occupied the potentially developable area within the EIAR Site Boundary as defined in Section 1.2.2 of Chapter 1, however the proposed turbine layout was refined following the identification of ecological/ornithological, hydrological, telecommunications and dwelling constraints after the initial site walkovers, and feedback from the project team.

3.6.2.1.2 Proposed Turbine Layout Iteration No. 2

Following the application of ornithological, telecommunication, dwelling and aviation buffers, Proposed Turbine Layout Iteration No. 2, shown in Figure 3-3 above, reduced the Wind Farm Site to 9 no. turbines. This layout maximised the efficient use of the wind resource and potential power output of the site while maintaining the necessary setbacks from residential dwellings, designated sites and neighbouring wind energy developments.

3.6.2.1.3 Final Proposed Turbine Layout

Following detailed constraints mapping exercises, environmental site walkovers, and feedback from the project team, the 9 no. turbine design (i.e. Iteration No. 2) was taken forward and refined further. Turbines nos. 01, 03, 08, and 09 were moved in Iteration No. 3 to avoid ecological, geological, and hydrological constraints. Turbines nos. 01, 03, 04 and 06 were moved in Iteration No. 4 to avoid ecological, hydrological and design constraints. Turbines nos. 01, 05 and 06 were microsited in Iteration No. 5 to avoid geotechnical constraints. Turbine no. 02 was moved in Iteration No. 6 to avoid design constraints. Turbine nos. 02 and 03 were moved in Iteration No. 7 to avoid geotechnical constraints.

Turbines nos. 01 and 05 were micro-sited approximately 7m and 12m south, respectively, to avoid watercourse buffers. Turbine no. 02 was moved approximately 60m southeast to avoid dwelling buffers, which resulted in the relocation of Turbine no. 03, approximately 45m south in order to maintain an adequate distance between turbines on-site.

The final proposed turbine layout takes account of all site constraints (ecology, ornithology, geology, hydrology, cultural heritage, telecommunications and aviation, and design constraints (setback distance from dwellings and third-party lands/infrastructure and distances between turbines on-site). The layout also takes account of the results of all site investigations and baseline assessments that have been carried out during the EIAR process. The final turbine layout that is the subject of this planning applications is shown in Figure 3-4 above.

A comparison of the potential environmental effects of the Iteration No. 1 and Iteration No. 2 against the final proposed turbine layout are presented in Table 3-4 below.

Table 3-4 Comparison of environmental effects Iteration No. 1 and Iteration No. 2 when compared against the chosen option (final proposed turbine layout 9 no. turbines.)

Environmental Consideration	Proposed Turbine Layout Iteration No. 1 (18 no. turbines)	Proposed Turbine Layout Iteration No. 2 (9 no. turbines)	Final Proposed Turbine Layout (9 no. turbines) (Chosen option)
Population & Human Health	Likely potential for increased shadow flicker impacts on	Likely potential for increased shadow flicker impacts on	Potential for reduced shadow flicker impacts on nearby sensitive receptors

Environmental Consideration	Proposed Turbine Layout Iteration No. 1 (18 no. turbines)	Proposed Turbine Layout Iteration No. 2 (9 no. turbines)	Final Proposed Turbine Layout (9 no. turbines) (Chosen option)
(incl. Shadow Flicker)	nearby sensitive receptors due to the increased number of turbines	nearby sensitive receptors due to shorter separation distances between turbines and dwellings.	due to the reduced number of turbines Based on the assessment detailed in Chapter 5 and the mitigation measures proposed, there will be no significant effects related to shadow flicker from the Proposed Development.
Biodiversity & Ornithology	Larger development footprint would result in greater potential habitat loss. Greater potential impact on identified sensitive ecological receptors.	Iteration No. 2 would result in greater habitat loss.	As detailed in Chapter 6, the development has been designed to avoid or mitigate impacts on biodiversity. As detailed in Chapter 7, the Collision Risk Assessment (CRA) indicated that the impact of the Proposed Development on birds corresponds to a Low to Very Low effect significance.
Land, Soils & Geology	Larger development footprint would have meant a greater volume of peat and spoil volumes to be excavated or crushed stone to be extracted for construction.	Neutral	Smaller footprint would result in smaller volume of soils to be excavated and managed. As detailed in the assessment in Chapter 8, no significant effects on soils and subsoils will occur.
Geotechnical/Peat Stability	Neutral	Iteration No. 2 has greater ground slope constraints.	There is a low risk of peat failure (at the site) as a result of the Proposed Development.
Water (Hydrology and Hydrogeology)	Larger footprint would result in a greater potential for silt-laden runoff to enter natural watercourses within and around the site.	Greater potential for silt-laden runoff to enter natural watercourses within and around the site due to the encroachment of watercourse	The final proposed turbine layout would result in less potential for silt-laden run-off to enter a watercourse. As detailed in the assessment in Chapter 9, no significant effects on

Environmental Consideration	Proposed Turbine Layout Iteration No. 1 (18 no. turbines)	Proposed Turbine Layout Iteration No. 2 (9 no. turbines)	Final Proposed Turbine Layout (9 no. turbines) (Chosen option)
		buffers from turbines no. 1 and 5.	surface water or groundwater quality will occur.
Air & Climate	Increased potential for vehicle emissions and dust emissions due to an increased volume of construction material and turbine component deliveries to the site.	Neutral	A smaller footprint would result in less dust and vehicle emissions during the construction phase. As detailed in the assessment in Chapter 11, over the proposed 35-year lifetime of the Proposed Development, 60,489 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation. The minimum tonnage of carbon dioxide that could be saved by the Proposed Development is 47,887 tonnes per annum.
Noise & Vibration	A larger number of turbines could have a greater noise impact on sensitive receptors.	Likely potential for greater noise impacts on nearby sensitive receptors due to shorter separation distances between turbines and dwellings.	Based on the assessment detailed in Chapter 12 and the mitigation measures proposed, there will be no significant effects on sensitive receptors due to an increase in noise levels from the Proposed Development during the construction, operational and decommissioning phases.
Cultural Heritage & Archaeology	Neutral	Neutral	Neutral
Landscape & Visual	A larger number of turbines could have a greater visual impact on the surrounding landscape.	Neutral	As detailed in the assessment in Chapter 14, the lack of nearby highly sensitive landscape and visual receptors, and the strategic siting of infrastructure will mitigate any potential for significant landscape and visual effects.

Environmental Consideration	Proposed Turbine Layout Iteration No. 1 (18 no. turbines)	Proposed Turbine Layout Iteration No. 2 (9 no. turbines)	Final Proposed Turbine Layout (9 no. turbines) (Chosen option)
Material Assets	A larger project footprint would result in additional site entrances and a larger impact on material assets. Greater potential for effects on telecommunications, aviation or waste management services.	Neutral	Less traffic volumes due to smaller footprint and less component deliveries. As detailed in Chapter 15, there will be a temporary negative slight impact on traffic volumes during the construction phase of the Proposed Development. A detailed Traffic Management Plan incorporating all the mitigation measures will be agreed with the roads authority prior to construction works commencing on site. Results from the telecom operator consultations and desktop survey analysis indicate that the 9-turbine layout will not impact any of the Telecom Operator radio networks. The findings of the Aviation Summary Report concludes that with the assessment outcomes and mitigation measures, the residual effects are not significant.

For the reasons set out above, the Final Proposed Turbine Layout at the Wind Farm Site was considered to be the most efficient method of electricity production with the lesser potential for significant environmental effects than Layout Iteration No. 1 and No. 2.

3.6.3 Road Layout

Access tracks are required onsite in order to enable transport of infrastructure and construction materials within the Wind Farm Site. Such tracks must be of a gradient and width sufficient to allow safe movement of equipment and vehicles. It was decided at an early stage during the design of the Wind Farm Site that maximum possible use would be made of existing roadways and tracks, where available and where possible, to minimise the potential for impacts by using new roads as an alternative.

As the overall Wind Farm Site layout was finalised, the most suitable routes between each component of the development were identified, taking into account the extensive network of existing roads and the physical constraints of the Wind Farm Site. Locations were identified where upgrading of the existing road would be required and where new roads are to be constructed, in order to ensure suitable access to and linkages between the various project elements, and efficient movement around the Wind Farm Site.

An alternative option to making maximum use of the existing road network within the Wind Farm Site would be to construct an entirely new road network, having no regard to existing roads or tracks. This approach was not favourable, as it would create the potential for additional significant environmental effects to occur in relation to land, soils and geology (increased excavation and aggregate requirements), hydrology (increased number of new watercourse crossings) and biodiversity (increased habitat loss).

A comparison of the potential environmental effects of constructing an entirely new road network when compared against maximising the use of the existing road network is presented in Table 3-5 below.

Table 3-5 Comparison of environmental effects when compared against the chosen option (maximising the use if the existing road network)

Environmental Consideration	Entirely New Road Network	Use and Upgrade of Existing Roads (Chosen option)
Population & Human Health	Potential for increased impacts on residential amenity due to increased disturbance during the construction stage.	The road upgrades will have potentially less of an impact on population and human health.
Biodiversity & Ornithology	Larger, new development footprint would result in greater habitat loss.	Smaller footprint due to road widening would result in less habitat being lost.
Land, Soils & Geology	Larger, new development footprint would result in greater volumes of peat and spoil to be excavated and stored. Larger volume of stone required from on-site borrow pit and off-site quarries for road construction.	Smaller volume of soils to be excavated and managed.
Geotechnical/Peat Stability	Potential increase in cut and fill volumes.	Neutral
Water (Hydrology and Hydrogeology)	Larger, new development footprint and increased number of new watercourse crossings, therefore, increasing the potential for silt laden runoff to enter receiving watercourses.	Less potential for silt-laden run-off to enter a watercourse.
Air & Climate	Potential for greater dust emissions due to the requirement of an	Potential for less dust and vehicle emissions during the

Environmental Consideration	Entirely New Road Network	Use and Upgrade of Existing Roads (Chosen option)
	increased volume of stone from the on-site borrow pit and off-site quarries. Potential for greater vehicular emissions due to and increased volume of construction traffic.	construction of the road upgrades.
Noise & Vibration	Potential for increased noise impacts on nearby sensitive receptors during the construction of the new roads.	Potential for less noise impacts on nearby sensitive receptors during the construction of the road upgrades.
Cultural Heritage & Archaeology	Larger, new development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.	Neutral
Landscape & Visual	Neutral	Neutral - There is no material environmental effect difference between both options considered.
Material Assets	Potential for greater traffic volumes during construction phase due to larger, new development footprint and requirement for more construction materials. Greater potential for effects on waste management services.	Less traffic volumes due to road upgrades. Less potential for effects on waste management services.

For the reasons set out above, the proposal for the use and upgrade of existing roads at the Wind Farm Site was considered to be the most efficient method of developing a renewable energy project with the lesser potential for significant environmental effects.

3.7 Alternative Design of Ancillary Structures

The ancillary infrastructure required for the Proposed Development includes temporary construction compounds, grid connection, on-site electrical substation, transport route, borrow pits, and temporary transition compound.

3.7.1 Construction Compounds

The 3 no. proposed construction compounds will be used for staff facilities the storage of all construction materials, plant and some turbine components. The use of multiple temporary construction compounds was deemed preferable to the alternative of a single large compound at the site for a number of reasons. Principally, it will facilitate more efficient construction practices

and will result in shorter distances for traffic movements within the site during construction. As a result, vehicle emissions and the potential for dust arising will be reduced.

A comparison of the potential environmental effects of constructing a single, large construction compound when compared against constructing multiple, smaller compounds is presented in Table 3-6 below.

Table 3-6 Comparison of environmental effects when compared against the chosen option (multiple construction compounds)

Environmental Consideration	Single Large Construction Compound	Multiple (3 no.) Construction Compounds (Chosen option)
Population & Human Health	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site which could have adverse health effects.	Potential for lower vehicular and dust emissions from shorter distance of traffic movements within the site.
Biodiversity & Ornithology	Neutral	Potential for greater habitat loss due to the larger development footprint.
Land, Soils & Geology	Neutral	Neutral
Geotechnical/Peat Stability	Neutral	Neutral
Water (Hydrology & Hydrogeology)	Neutral	Neutral
Air & Climate	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site.	Potential for lower vehicular and dust emissions from shorter distance of traffic movements within the site.
Noise & Vibration	Potential for increased noise impacts on nearby sensitive receptors due to longer distance of traffic movements within the site.	Potential for smaller noise impacts on nearby sensitive receptors due to shorter distance of traffic movements within the site.
Cultural Heritage & Archaeology	Neutral	Neutral
Landscape & Visual	Neutral	Neutral
Material Assets	Less efficient construction practices due to longer movements of construction vehicles, plant and materials within the site. Neutral in terms of impact on waste management services.	More efficient construction practices due to shorter movements of construction vehicles, plant and materials within the site.

Environmental Consideration	Single Large Construction Compound	Multiple (3 no.) Construction Compounds (Chosen option)
		Neutral in terms of impact on waste management services.

For the reasons set out above, the proposal for the use of multiple construction compounds at the Wind Farm Site was considered to be the most efficient method of developing a renewable energy project with the lesser potential for significant environmental effects.

3.7.2 Borrow Pit

The majority of material required for the construction of access roads and turbine bases will be obtained from the 5 no. proposed borrow pit onsite which will be located approximately 110m southeast of Turbine No. 1, approximately 750m northwest of Turbine No. 4, approximately 260m southeast of Turbine No. 4, approximately 160m west of Turbine No. 6, and approximately 240m east of Turbine No. 9. The use of onsite borrow pits represents an efficient use of existing onsite resources. It eliminates the need to transport large volumes of construction materials along the local public road network to the site. The locations for the borrow pits was identified taking into account the site characteristics, including topography, ground conditions, habitat type and surface water features.

An alternative to using on-site borrow pits was the option of sourcing all stone and hardcore materials from a licensed quarry or quarries in the vicinity of the site. The movement of the volume of material required for the construction of 9 no. turbine wind farm would result in a significant increase in construction traffic and heavy loads, in combination with a potential for an increase in noise and dust emissions along the haul routes and was therefore considered a less preferable option. The cost of importing the required volume of crushed stone was also a factor in choosing to obtain stone from an on-site borrow pits.

A comparison of the potential environmental effects when comparing the sourcing of stone from local, off-site quarries against the chosen option (on-site borrow pits) is presented in Table 3-7 below.

Table 3-7 Comparison of environmental effects when compared against the chosen option.

Environmental Consideration	Sourcing all stone from local, off-site quarries	Obtaining material from 5 no. Borrow Pits (Chosen option)
Population & Human Health	Potential for increased vehicular, noise and dust emissions from increased traffic movements, due to the volume of rock to be transported to the site along the public road network, which could be a nuisance to local residents along the haul route.	Potential for lower vehicular, noise and dust emissions from fewer traffic movements to/from offsite quarries.
Biodiversity & Ornithology	Potential increase in habitat loss as there would be no on-site borrow	5 no. borrow pits are located within conifer forestry. The

Environmental Consideration	Sourcing all stone from local, off-site quarries	Obtaining material from 5 no. Borrow Pits (Chosen option)
	pit and, therefore, additional peat repository areas would be required within the site.	borrow pits will be reinstated with peat and spoil.
Land, Soils & Geology	Slight reduction in peat and spoil to be excavated, however, additional peat placement areas would be required as an on-site borrow pit would not be available for the placement of excavated peat and spoil.	Slight increase in peat and spoil volumes, however, on-site borrow pits will be used for peat and spoil repository.
Geotechnical	Increased potential for peat instability as additional peat repository areas would be required for the placement of excavated peat and spoil.	The findings of the Peat Stability Assessment Report indicate that there is a low risk of peat failure at the 5 no. borrow pit locations.
Water	Increased potential for silt laden runoff to enter watercourses due to additional peat repository areas being required within the site.	Decreased potential for silt laden runoff to enter watercourses due to the avoidance of additional peat repository areas being required within the site. As detailed in the assessment in Chapter 9, no significant effects on surface water or groundwater quality will occur.
Air & Climate	Potential for increased vehicular and dust emissions from increased traffic movements within the site, due to the volume of rock to be excavated.	Lower vehicular and dust emissions from fewer traffic movements within the site.
Noise & Vibration	Reduced potential for noise and vibration effects on local sensitive receptors as no large-scale rock breaking or blasting required within the site. Increased potential for noise and vibration effects on sensitive receptors along haul routes due to volume of traffic required to transport the volume of crushed stone needed for the construction of the Proposed Development.	Increased potential for noise and vibration effects on local sensitive receptors due to large-scale rock breaking and blasting required within the site. However, decreased potential for noise and vibration effects on sensitive receptors along haul routes due to the availability of crushed stone within the site.
Cultural Heritage & Archaeology	Slightly smaller development footprint would reduce the potential for impacts on unrecorded, subsurface	Slightly larger development footprint would increase the potential for impacts on

Environmental Consideration	Sourcing all stone from local, off-site quarries	Obtaining material from 5 no. Borrow Pits (Chosen option)
	archaeology. However, there would be a requirement for additional peat repository areas within the site with a potential for impacts on unrecorded, subsurface archaeology.	unrecorded, subsurface archaeology.
Landscape & Visual	Reduced landscape and visual effects as no open rock face would be visible from certain viewpoints.	Increased landscape and visual effects.
Material Assets	Significantly higher traffic volumes on the public road network during construction phase due to the volume of crushed stone required to be transported to the site. Neutral in terms of impact on waste management services.	Significantly lower traffic volumes on the public road network during construction phase due to the volume of crushed stone available onsite. Neutral in terms of impact on waste management services.

For the reasons set out above, the proposal of obtaining materials from multiple borrow pits at the Wind Farm Site was considered to be the most efficient method of developing a renewable energy project with the lesser potential for significant environmental effects.

3.8 Alternative Grid Connection Route Options

3.8.1 Proposed Grid Connection

The Wind Farm Site will connect to the national grid via underground 110kV electrical cabling, located primarily within the public road corridor. Underground medium voltage electrical cables will transmit the power output from each wind turbine to the proposed onsite 110kV electrical substation, and from there to the existing Ardnacrusha 110 kV electrical substation, via an underground 110kV electrical cabling route, measuring approximately 9.2 km in length.

A key consideration in determining the grid connection method for a proposed wind energy development is whether the cabling is undergrounded or run as an overhead line. While overhead lines (OHL) are less expensive and allow for easier repairs when required, underground cables (UGC) will have no visual impact. For this reason, it was considered that underground cables would be a preferable alternative to overhead lines. Although not adopted the draft Wind Energy Guidelines 2019 also indicate that underground cables are the preferred option for connection of a wind energy development to the national grid.

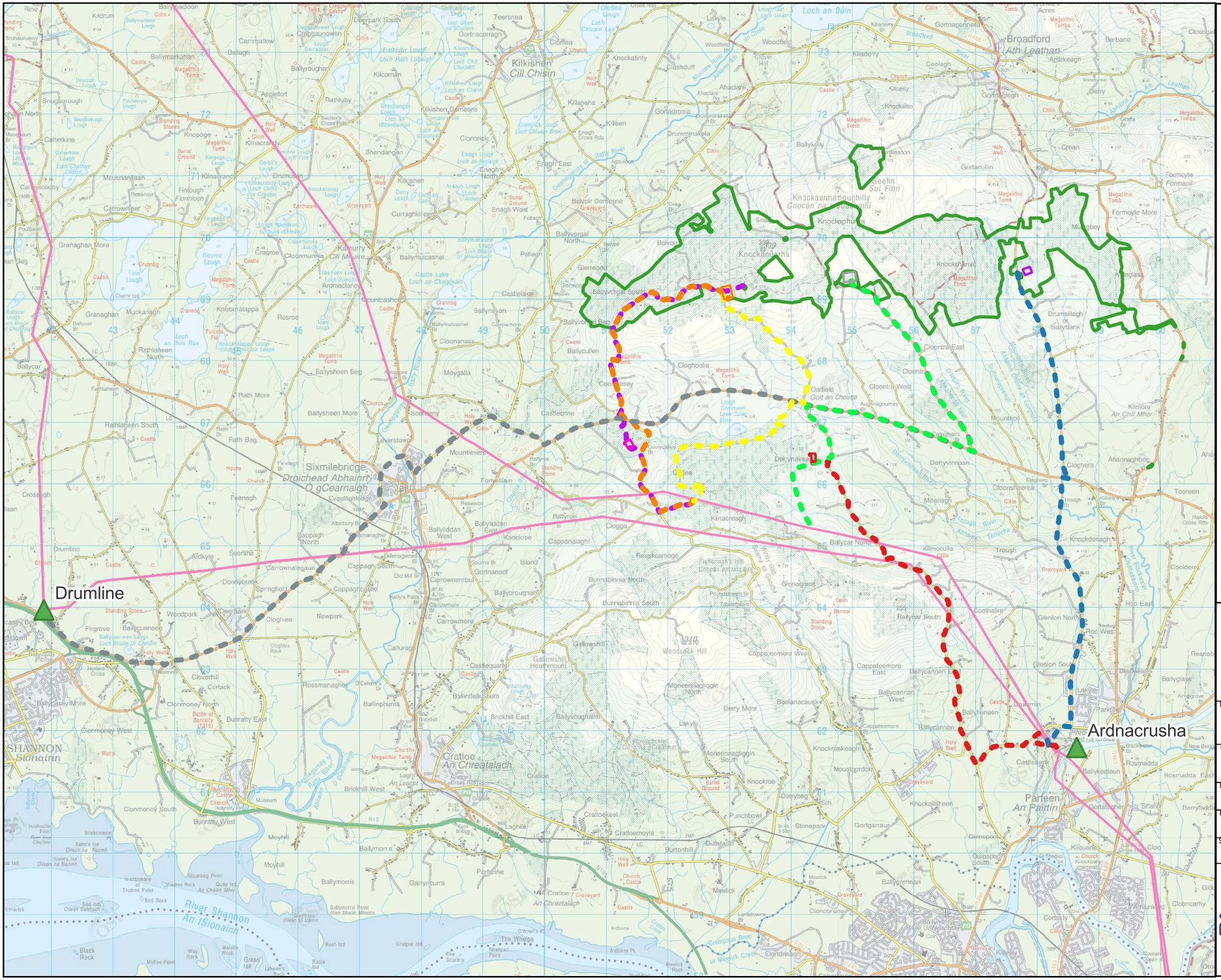
The output of the wind farm is such that it needs to connect to a 110kV electrical substation. There are 2 no. existing 110kV electrical substations located within 10km of the Wind Farm Site (at its closest point), namely:

- Ardnacrusha 110kV Electrical Substation
- Drumline 110kV Electrical Substation

Therefore, underground grid connection cabling routes to these existing substations were considered and assessed in order to determine which route would be brought forward as the Grid Connection route to be assessed as part of the overall Wind Farm Site project within the EIAR. 7 no. routes were originally considered by TLI Group (Appendix 4-5), as shown in Figure 3-5a, before refining this to 2 no. reasonable alternative Grid Connection route options following the assessment of key factors such as length, number of landowners, cost effectiveness, etc., as shown in Figure 3-5b below.

The preferred Grid Connection route (Grid Route Option 5) is a single circuit UGC route connecting an onsite substation in the east of the Wind Farm Site to the existing Ardnacrusha 110kV substation. The Ardnacrusha substation is located approximately 7.7km south of the onsite substation. The UGC route runs within the public local road networks, existing access tracks, private forestry access tracks and private lands. There is a total of 7 no. identified watercourse and existing culvert/drain crossings along this UGC route; 2 no. of which are EPA/OSI mapped crossings, and the remaining are classified as culverts over minor channels or manmade drains. The cabling route measures approximately 9.2 km in length.

The alternative option for the Grid Connection route (Grid Route Option 6) is a double circuit UGC route connecting an onsite substation in the west of the Wind Farm Site to the Ennis/Ardnacrusha 110kV OHL via loop-in. The Ennis/Ardnacrusha 110kV OHL is located approximately 3.3km south of the proposed onsite substation. This Grid Connection option utilises large sections of Coillte-owned plantations and access tracks, with a minimum of 2 no. third-party landowners required to access the public road network. This option would also require the construction of 1 no. new watercourse crossing. In total, the cabling route measures approximately 6.8km in length.



Map Legend

Wind Farm Site

Existing 110kV Overhead Line

Existing 110kV Electrical Substations

Grid Connection Route Options

- Grid Route Option 1
- Grid Route Option 2
- Grid Route Option 3
- Grid Route Option 4
- Grid Route Option 5
- Grid Route Option 6
- Grid Route Option 7

Onsite 110kV Electrical Substation Options

- Sub 1
- Sub 2
- Sub 3
- Sub 4
- Sub 5

Drawing Title: Initially Considered Grid Connection Routes

Project Title: Knockshanvo Wind Farm

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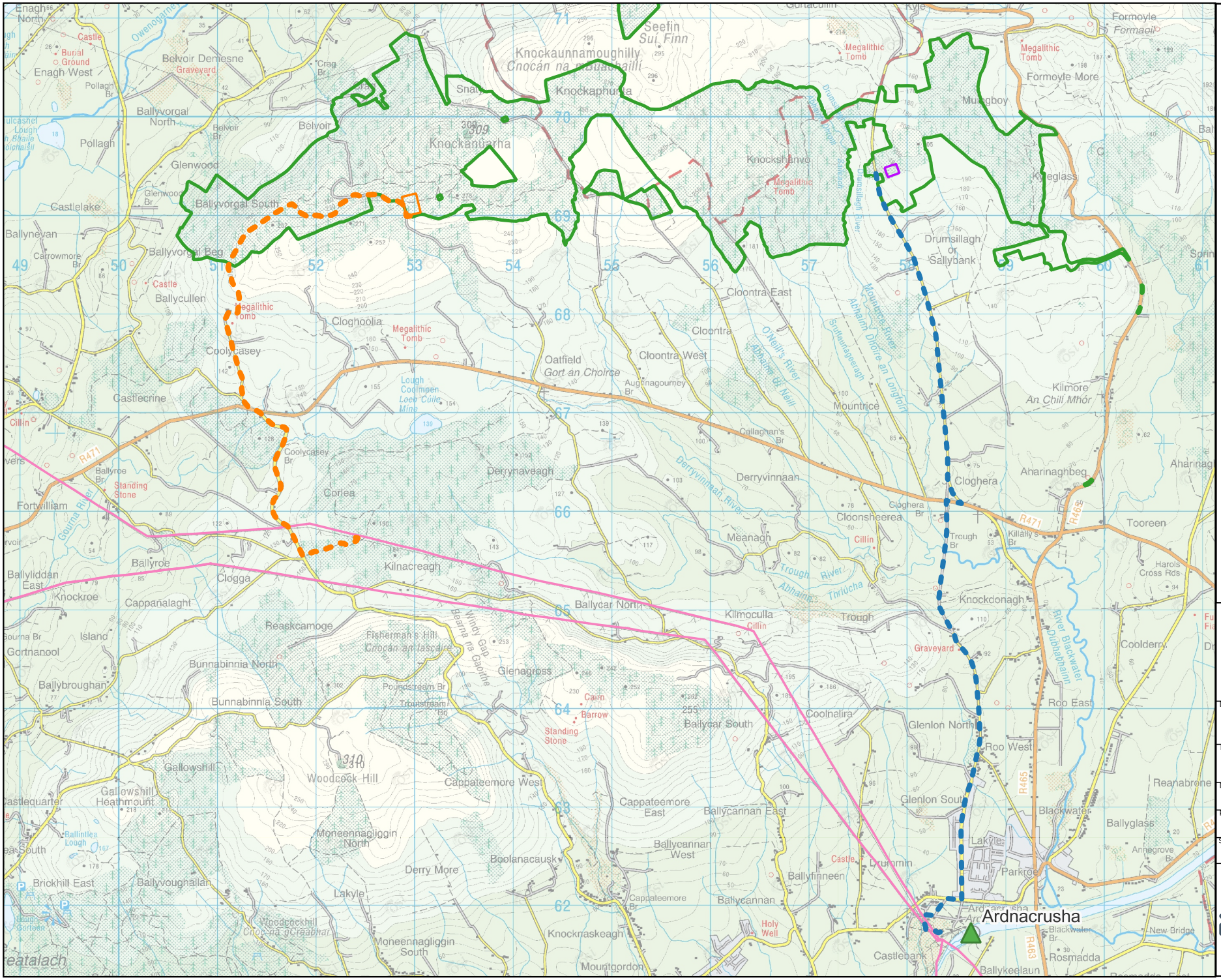

Map Legend

Wind Farm Site

Existing 110kV Overhead Line

Existing 110kV Electrical Substations

Grid Connection Route Options

Grid Route Option 5

Grid Route Option 6

Onsite 110kV Electrical Substation Options

Sub 1

Sub 4

Drawing Title

Alternatively Considered Grid Connection Routes

Project Title

Knockshanvo Wind Farm

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Based on the environmental considerations outlined above, the preferred Grid Connection route (Grid Route Option 5) to Ardnacrusha was selected as it is located within the public road corridor and forestry tracks for the entirety of the route, thus reducing the development footprint, the volumes of peat and spoil to be excavated and manged, and minimising habitat loss, when compared to the alternative option. The preferred Grid Connection route (Grid Route Option 5) also requires no new watercourse crossings, which reduces the potential for silt-laden water to enter natural watercourses, when compared to the alternative Grid Connection route option.

A comparison of the potential environmental effects of the alternative OHL loop in UGC grid connection (Grid Route Option 6) with the chosen UGC to Ardnacrusha (Grid Route Option 5)is presented in Table 3-8 below.

Table 3-8 Comparison of environmental effects of the Grid Connection route options

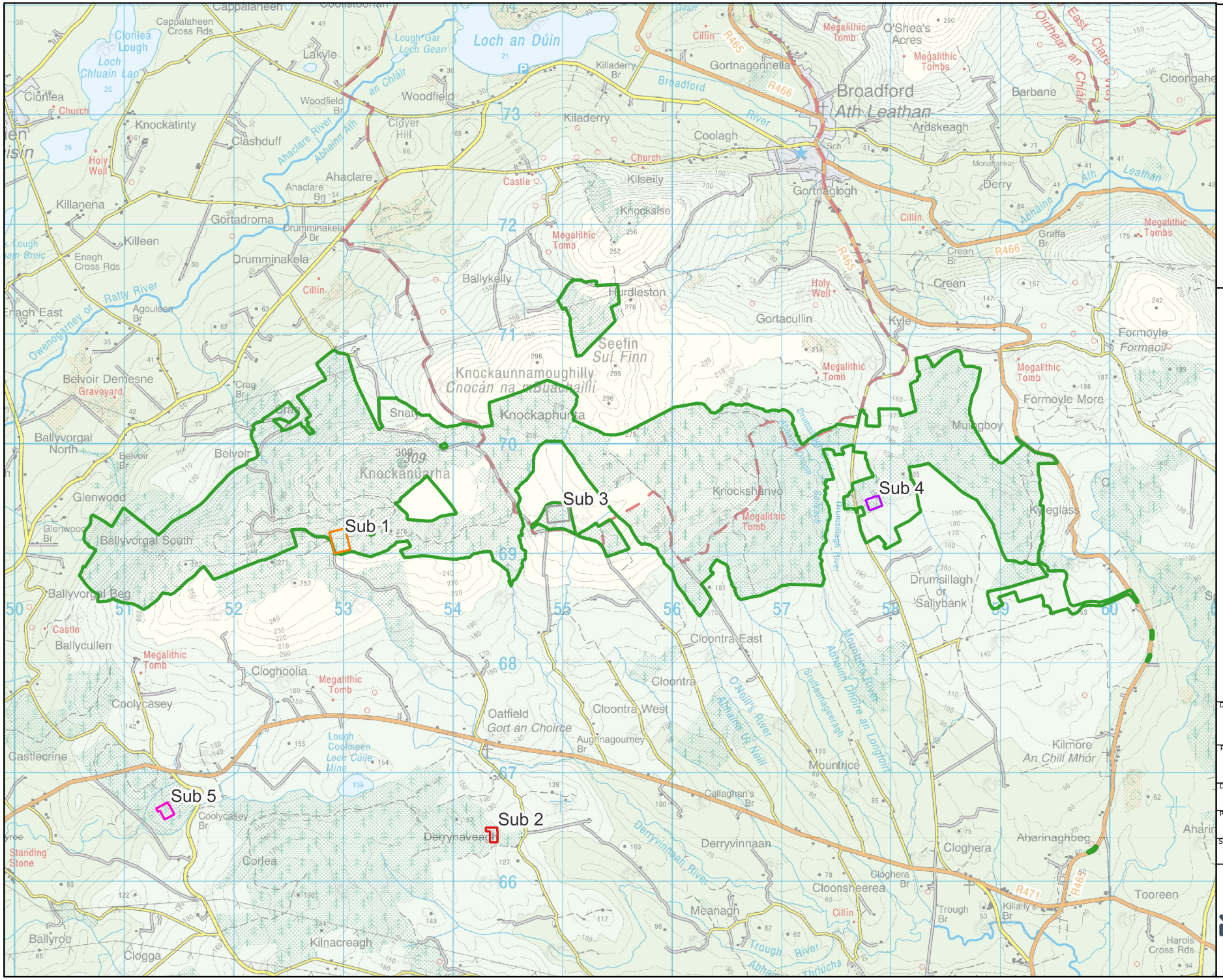
Environmental Consideration	UGC to Ennis/Ardnacrusha 110kV OHL Loop-In (Grid Route Option 6)	UGC to Ardnacrusha 110kV Substation (Grid Route Option 5) (Chosen option)
Population & Human Health	The route passes by fewer residential dwellings and therefore, there is less potential for nuisances for local residents to occur in relation to dust emissions from vehicle movements and excavations which could have adverse health effects.	There are more residential dwellings along this route, however, given the transient nature of the works, the impact of nuisances for local residents from dust emissions from vehicle movements and excavations during the construction stage will be temporary in nature.
Biodiversity & Ornithology	Increased habitat loss due to the requirement to construct new lengths of roads where the cable route is proposed 'off-road'. A double circuit UGC is required with 2m minimum spacing between circuits. This is a larger footprint than a single circuit cable trench and can be more difficult to situate in narrow roads already containing services. The associated substation location is not feasible due to ecological constraints.	Less habitat loss due to the presence of the cable predominantly in the public road corridor.
Land, Soils & Geology	Increased volume of peat, spoil and asphalt to be excavated due to the requirement for new roads along certain sections of the route. A double circuit UGC is required with 2m minimum spacing between circuits. This is a larger footprint than a single circuit cable trench and can be more difficult to situate in narrow roads already containing services.	Smaller volume of peat, spoil and asphalt to be excavated due to the presence of the cable predominantly in the public road corridor.
Geotechnical	Neutral	Neutral

Environmental Consideration	UGC to Ennis/Ardnacrusha 110kV OHL Loop-In (Grid Route Option 6)	UGC to Ardnacrusha 110kV Substation (Grid Route Option 5) (Chosen option)
Water	Requires the construction of 1 no. open river crossing which increases the potential for silt-laden runoff and hydrocarbons to enter receiving watercourses.	The cable is predominantly in the public road corridor and requires no open river crossings, minimising the potential for silt-laden runoff and hydrocarbons to enter receiving watercourses.
Air & Climate	Larger development footprint would increase the potential for impacts on air and climate.	Smaller development footprint with lower potential for impacts on air and climate.
Noise & Vibration	The route passes by fewer residential dwellings and therefore, there is potential for less noise impacts on nearby sensitive receptors.	The route passes by more residential dwellings and therefore, there is potential for slightly greater noise impacts on nearby sensitive receptors.
Cultural Heritage & Archaeology	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.	The use of the existing public road network for the majority of the Grid Connection route would reduce the potential for impacts on unrecorded, subsurface archaeology.
Landscape & Visual	Neutral	Neutral
Material Assets	Potential for greater traffic volumes during the construction phase due to greater development footprint. Greater potential for effects on waste management services.	Smaller traffic volumes during the construction phase due to the smaller development footprint. Less potential for effects on waste management services.

For the reasons set out above, the proposal to develop an UGC to Ardnacrusha 110kV Substation was considered to be the most efficient method of electricity production with the lesser potential for significant environmental effects.

3.8.2 Proposed 110kV Electrical Substation

The selection of the location of the on-site substation has had regard to the constraints of the site, outlined in Section 3.6.1 above. Ease of access, ensuring a suitable setback from turbine locations, and the chosen Grid Connection route was also taken into consideration. It should also be noted that while the operational lifespan of the proposed turbines is 35 years (following which they may be replaced subject to a future permission or decommissioned as proposed in this planning application) the electrical substation and associated infrastructure will become an EirGrid asset and will be a permanent feature of the proposal as it will continue to form part of the electrical infrastructure of the area in the event of the remainder of the site being decommissioned.



Map Legend

- Wind Farm Site
- Onsite 110kV Electrical Substation Options
- Sub 1
- Sub 2
- Sub 3
- Sub 4
- Sub 5

Drawing Title
Initally Considered Substation Locations

Project Title
Knockshanvo Wind Farm

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Map Legend

- EIAR Site Boundary

Onsite 110kV Electrical Substation Options

- Alternative Substation Location (Sub 4)
- Proposed Substation Location (Sub 4a)

N

Drawing Title

Alternatively Considered Substation Locations

Project Title

Knockshanvo Wind Farm

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5 no. substation locations were originally considered at a very early stage of the design of the Proposed Development, as showed in Figure 3-6a, before refining to one location following the assessment of the constraints of the site, ease of access, setback distance from turbine locations, and the chosen Grid Connection route. The chosen onsite 110kV electrical substation (Sub 4) is located in the east of the Wind Farm Site, in the townland of Drumsillagh or Sallybank (Parker).

Following noise and geotechnical analysis, it was decided to reposition the chosen onsite 110kV electrical substation (Sub 4) approximately 150m further east. The revised chosen substation location (Sub 4a) will result in a smaller noise effect on the nearest dwelling, while also reducing the cut/fill required for its construction, thus minimising the geotechnical and ecological effects when compared to the alternative substation location (Sub 4). The location of Sub 4 and Sub 4a is showed in Figure 3-6b above.

A comparison of the potential environmental effects of the alternative location (Sub 4) when compared against chosen location (Sub 4a) is presented in Table 3-9 below.

Table 3-9 Comparison of environmental effects when compared against the chosen option.

Environmental Consideration	Alternative 110kV Electrical Substation Location (Sub 4)	Chosen 110kV Electrical Substation Location (Sub 4a)
Population & Human Health	Potential for slight increase in vehicular and dust emissions during the construction of the substation due to its positioning nearer sensitive receptors.	Potential for slight decrease in vehicular and dust emissions during the construction of the substation due to its positioning further from sensitive receptors.
Biodiversity & Ornithology	Neutral	Neutral
Land, Soils & Geology	Increased volumes of peat and spoil required to level the foundations of the substation.	Lower volumes of peat and spoil required to be excavated.
Geotechnical	Increased potential of peat instability due to the slopes in the area.	Decreased potential for peat instability.
Water	Neutral	Neutral
Air & Climate	Potential for slight increase in vehicular and dust emissions from increased excavation within the site.	Less material will be required to be excavated, resulting in lower vehicular and dust emissions from fewer traffic movements within the site.
Noise & Vibration	Potential for slight increase in detected noise due to its positioning nearer sensitive receptors.	Potential for slight decrease in detected noise due to its positioning further from sensitive receptors.
Cultural Heritage & Archaeology	Neutral	Neutral
Landscape & Visual	Neutral	Neutral
Material Assets	Neutral	Neutral

For the reasons set out above, the proposal to develop the onsite 110kV electrical substation in its chosen location (Sub 4a) was considered to be the most efficient method of electricity production with the lesser potential for significant environmental effects than Sub 4 location.

3.9 Alternative Transport Route and Site Access

Wind turbine components (blades, nacelles and towers) are not manufactured in Ireland and therefore must be imported from overseas and transported overland to the Proposed Development. Alternative ports of entry were considered and with regard to the selection of a transport route to the Proposed Development, in relation to the turbine delivery route and associated site access locations.

3.9.1 Port of Entry

The alternatives considered for the port of entry of wind turbines into Ireland for the Proposed Development included Port of Galway, Shannon Foynes Port and Dublin Port. Shannon Foynes Port is the principal deepwater facility on the Shannon Estuary and caters for dry bulk, break bulk, liquid and project cargoes. Port of Galway and Dublin Ports also offer a roll-on roll-off procedure to facilitate import of wind turbines. All three ports and indeed others in the state, offer potential for the importing of turbine components. The primary chosen port of entry is Shannon Foynes due to its proximity and accessibility from the port to the national and regional roads towards the Proposed Development.

3.9.2 Turbine Delivery Route

For turbine components and other abnormal loads (e.g., prefabricated buildings for construction compound areas etc.) transport, cognisance was taken of the haul routes used for other wind farm developments in the local area in addition to the general preference to minimise the requirement for significant accommodation or widening works along the public road network and associated environmental effects.

3.9.2.1 Turbine Delivery Route Option A

Turbine Delivery Option A involved the delivery of turbine components from Shannon Foynes Port in Co. Limerick to the Proposed Development site. The route involved the National Road network (N69) the Regional Road network (R510, R526, R463, R465) and the local road network (Father Russell Road). Option A involved the turbine delivery vehicle entering the Wind Farm Site off the R465, through a Coillte forest entrance in the townland of Formoyle More. This option was screened out due to vehicle turning constraints and subsequent land requirements, and the number of watercourse crossings along the R465 that were identified in an autotrack assessment, rendering Option A not preferred. The total length of the delivery route was approximately 52 kilometres.

3.9.2.2 Turbine Delivery Option B

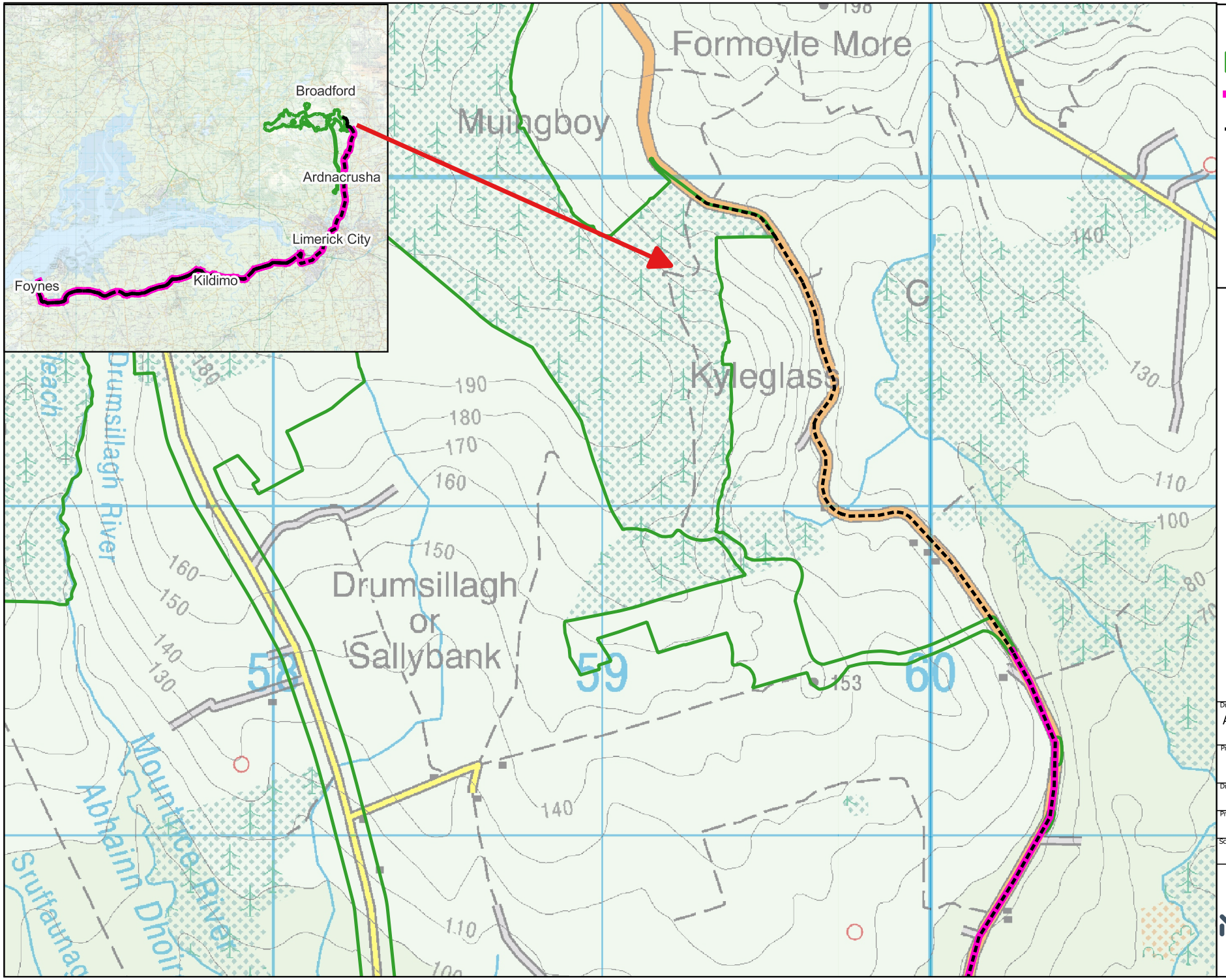
Turbine Delivery Option B involved the delivery of turbine components from Shannon Foynes Port in Co. Limerick to the Proposed Development site, following the same delivery route as Option A. Option B however involves the turbine delivery vehicle entering the Wind Farm Site off the R465, approximately 2km south of the site entrance for Option A, in the townland of Kilmore. The new location for the Wind Farm Site entrance is preferred when compared to Option A, as it avoids the vehicle turning constraints and requires fewer land agreements with third parties. The total length of the delivery route is also shorter at approximately 50 kilometres.

The turbine delivery route options are shown on Figure 3-7. Both turbine delivery route options would require some accommodation works and road widening along the R465, with Option A requiring more extensive works to overcome the vehicle turning constraints.

Option B was selected as the preferred turbine delivery route as there were less potential pinch points, where widening is required, along the route compared to Option A.

Table 3-10 Comparison of environmental effects when compared against the chosen option (chosen turbine delivery route)

Environmental Consideration	Option A	Option B (Chosen option)
Population & Human Health	Neutral	Neutral
Biodiversity & Ornithology	Potential increase in habitat loss due to more potential pinch points requiring widening works.	Potential decrease in habitat loss due to fewer potential pinch points requiring widening works.
Land, Soils & Geology	Neutral	Neutral
Geotechnical	Neutral	Neutral
Water	Neutral	Neutral
Air & Climate	Neutral	Neutral
Noise & Vibration	Neutral	Neutral
Cultural Heritage & Archaeology	Neutral	Neutral
Landscape & Visual	Neutral	Neutral
Material Assets	Potential increase in traffic impacts due to requirement for more widening works along route. More potential for effects on waste management services.	Potential decrease in traffic impacts due to fewer widening works along route. Potential decrease in disruption to the public road network and users due to the shorter delivery route



Map Legend

- EIAR Site Boundary
- Proposed Turbine Delivery Route
- Alternative Turbine Delivery Route

N

Drawing Title: Alternatively Considered Turbine Delivery Routes

Project Title: Knockshanvo Wind Farm

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For the reasons set out above, the proposal to use turbine delivery Option B and the associated Wind Farm Site entrance in the townland of Kilmore was considered to be the most efficient method of developing a renewable energy project with the lesser potential for significant environmental effects than delivery Option A.

It should be noted that while large turbine components and other abnormal loads deliveries will be via the Option B delivery route exclusively and accessing the site along the R465, other general construction material deliveries may be delivered via other major routes (national primary, national secondary and regional routes) in the wider area and travel towards the site from Broadford to the north, Sixmilebridge to the west, or O'Briensbridge to the east. The assessment of traffic volumes associated with the construction, operation and decommissioning phases of the Proposed Development is included in Chapter 15: Material Assets, Section 15.1 of this EIAR.

3.9.3 Temporary Transition Compound (TTC)

The longest components are the turbine blades which are usually the most onerous for delivery. For the first part of the delivery route between Foynes Port to the TTC, it is proposed that the turbine blades will be delivered using the standard method of delivery, where the blade is horizontal on a Super Wing Carrier. The Super Wing Carrier is the critical vehicle in terms of turning requirements, as it is significantly longer than the tower transport vehicle. In order to minimise the impact on the built environment a blade adaptor trailer is required to deliver the turbine components from the TTC to the Wind Farm Site. It is necessary to locate the TTC to the west of Limerick City in order to minimise impact on the built environment of Limerick City, to manoeuvre the 90° junctions in Limerick City and to pass through the city safely and quickly.

Due to the nature of the blade delivery vehicles/carriers, a long straight stretch of road is a prerequisite for visibility and safety and enables the vehicle carriers to exit and re-enter the road with minimal turning movements. The study area for the transition compound was thus limited to focussed on a 2.5km straight stretch along the N69 National Secondary Road. Engagement with local landowners in this study area with sufficient land size requirements (i.e. 200m x 60m) yielded two viable sites for further consideration Option A and Option B.

Option A and Option B are both located adjacent to the N69, in the townland of Court, Co. Limerick. Option A is located to the left hand side of the N69 and Option B is located to the right hand side of the N69 travelling from Foynes Port. The TTC required a long straight stretch of road and therefore the location of these sites on the N69 National Secondary was optimum.

Given option A is on the left hand side of the N69 as the carriers travel north towards Limerick City, they can enter and exit the TTC without the need to cross the N69, or make a right hand turn which would block the road. Also is there a hard shoulder which allows them to slow down without interfering with traffic on the N69 when option A is chosen. It is also noted that landowner consents were not available for Option B at the time of report writing and therefore Option A was the only viable option of those considered in this regard. Construction of the TTC in both locations will involve some minor vegetation removal and re-surfacing with gravel hardstanding. Most of the mature boundary vegetation will be retained (excepting entrance and egress locations).

It is noted that turbine components are generally transported at night when traffic is lightest and this is done in consultation with the roads authorities and An Garda Síochána, and special permits are generally required.

Table 3-11 Comparison of environmental effects when compared against the chosen option (Option A)

Environmental Consideration	Option A (Chosen option)	Option B
Population & Human Health	Neutral	Neutral
Biodiversity & Ornithology	Temporary loss of habitat, hedgerow and some treeline. The TTC site will be restored following completion of the construction phase.	Temporary loss of habitat, hedgerow and some treeline. The TTC site will be restored following completion of the construction phase.
Land, Soils & Geology	Neutral	Neutral
Geotechnical	Neutral	Neutral
Water	Neutral Option A and Option B are mapped within the National Indicative Medium (1 in 100-year) Fluvial Flood Zones. There is also an EPA mapped watercourse in the vicinity of both locations. This stream crosses the N69 to the west of the Option B site and then appears to flow along the southeastern corner of the Option A site. The Temporary Transition Compound, located within the modelled flood zone, will not have a significant effect on flood levels. This compound will be temporary, has a small footprint in comparison to the wider floodplain and will be constructed with permeable materials where practicable. Even in a worst case scenario, whereby the pad is impermeable, the volume of water displaced and the associated increase in water levels are insignificant.	Neutral
Air & Climate	Neutral	Neutral
Noise & Vibration	Neutral	Neutral
Cultural Heritage & Archaeology	Neutral	Neutral

Environmental Consideration	Option A (Chosen option)	Option B
Landscape & Visual	Neutral	Neutral
Material Assets	Option A is on the left hand side of the N69 as the carriers travel north towards Limerick City, they can enter and exit the TTC without the need to cross the N69, or make a right hand turn which would block the road	Option B is on the right hand side of the N69 and will require crossing the N69 to enter the site.

For the reasons set out above, the proposal to use Option A was considered to be the preferable option.

3.10 Alternative Mitigation Measures

Mitigation by avoidance has been a key aspect of the Proposed Development's evolution through the selection and design process. Avoidance of the most ecologically sensitive areas of the site limits the potential for environmental effects. As noted above, the site layout aims to avoid environmentally sensitive areas. Where loss of habitat occurs within the site, this has been mitigated by proposing enhancement lands as described in Chapter 6 Biodiversity and Chapter 7 Ornithology of this EIAR. Any forestry felled as part of the Proposed Development will be replaced offsite, with no net loss. The alternative to this approach is to encroach on the environmentally sensitive areas of the site and accept the potential adverse environmental effects associated with this.

The best practice design and mitigation measures set out in this EIAR will contribute to reducing any risks and have been designed to break the pathway between the site and any identified environmental receptors. These mitigation measures are proven effective. The alternative is to either not propose these measures or propose measures which are not best practice and effective and neither of these options are feasible.