MWP

Chapter 04 Alternatives

Ballynisky Wind Farm

Ballynisky Green Energy Ltd.

December 2025

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Project No.	Doc. No.	Rev.	Date	Prepared By	Checked By	Approved By	Acceptance Code / Status
22569	6006	A	Sept. 2025	SR	LL	AOC	Final
22569	6006	B	Dec 2025	SR	LL	AOC	Final

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4. Site Selection and Reasonable Alternatives

4.1 Introduction

This chapter of the EIAR presents a description of the site selection process for the proposed development and the reasonable alternatives to the proposed development (for example in terms of the project design, location, size and scale) that were studied by the Applicant, which are relevant to the proposed development and its specific characteristics, and a discussion of the main reasons for selecting the chosen option, taking into account the effects on the environment.

4.2 Background

The consideration of Alternatives to a proposed development is a mandatory part of the EIA process. The legal requirements of the EIA Directive, relating to the assessment of Alternatives, are set out in Article 5(1)(d) and Annex IV point 2 of the Directive.

Article 5(1) states that the developer shall include at least:

> d) 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;

Annex IV point 2 expands further:

> 2) 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.

The EU Commission guidance document 'Guidance on the preparation of the Environmental Impact Assessment Report' (2017) defines alternatives as: *'Different ways of carrying out the Project in order to meet the agreed objective'*. That Guidance states '*The number of alternatives to be assessed has to be considered together with the type of alternatives, i.e. the 'Reasonable Alternatives' referred to by the Directive*. 'Reasonable Alternatives' must be relevant to the proposed Project and its specific characteristics, and resources should only be spent assessing these Alternatives. In addition, 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.'

Ultimately, Alternatives have to be able to accomplish the objectives of the Project in a satisfactory manner, and should also be feasible in terms of technical, economic, political and other relevant criteria.

Section 3.4 of the 2022 EPA guidance "Guidelines on the information to be contained in Environmental Impact Assessment Reports" contains guidelines on the consideration of alternatives within the EIAR. It states:

> *"The objective is for the developer to present a representative range of the practicable alternatives considered. The alternatives should be described with 'an indication of the main reasons for selecting the chosen option. 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 in deciding on the selected option. A detailed assessment (or 'mini-EIA') of each alternative is not required."

That guidance also states that analysis of high-level or sectoral strategic alternatives cannot reasonably be expected within a project level EIAR.

4.3 Scope

The purpose of the alternatives analysis is principally to examine the different possibilities for meeting the needs and objectives of the proposed development and to determine whether or not the objectives can be met by different means that avoid, minimise, or mitigate potential significant environmental effects.

During the development design process, alternative wind farm layouts and scales were fully considered in order to find the optimum design solution for the site with the least level of environmental impact. This chapter therefore outlines the site selection process, the process of design evolution for the proposed development, the reasonable alternatives considered during the project inception and design process including a comparison of the environmental effects and the principal reasons for proceeding with the current planning application.

4.4 Site Selection Process

The process of identifying a suitable wind farm site is influenced by a number of factors. At a macro scale: national and regional planning policy together with distance from designated conservation sites; available grid capacity; cumulative impacts with existing and permitted wind farms, as well as other permitted and proposed developments, and; available wind speeds in an area are all integral factors. Interrelated to this, the wind farm must, in non-environmental terms, be commercially viable to ensure it will attract the necessary project finance to progress to the construction phase and ultimately to deliver renewable electricity to the National Grid which is an objective of current National renewable energy policy as set out in Chapter 02 Background of this EIAR.

Prior to selection of the site suitable for such development, a detailed screening exercise was undertaken by the Applicant using a number of criteria and stages to assess the potential of a large number of possible sites, on lands under consideration, suitable to accommodate a wind energy development. In locating potential sites, the Applicant carried out a desk-based geographical information system (GIS) screening exercise. This identified all designated conservation sites (SAC, SPA, NHA), protected views/routes, cultural heritage sites (NMS and NIAH), and other areas of special sensitivity (specified in relevant development plans).

The subject site was the site identified as most suitable to take forward as a potential wind farm location.

The following steps were followed for the screening process.

- Phase 1 Initial Screening;
- Phase 2 Grid Constraints and Facilitators;
- Phase 3 Other Constraints and Facilitators; and
- Site Validation.

4.4.1 Phase 1 Initial Screening

A number of criteria were applied in order to identify which lands/sites might be available, in principle, for wind energy development. The Applicant reviewed the Limerick Development Plan and Renewable Energy Strategy provisions and discounted sites where policy would not be supportive of wind energy developments. In this

regard, sites were discounted if they were not identified as being at least "Open for Consideration" for wind energy development in the relevant Plans/Strategies or if they were within designated conservation areas (Natura 2000).

Figure 4-1 illustrates that the proposed development site is located within a "Preferred Area" for wind energy development designated in the current Limerick Development Plan 2022-2028.

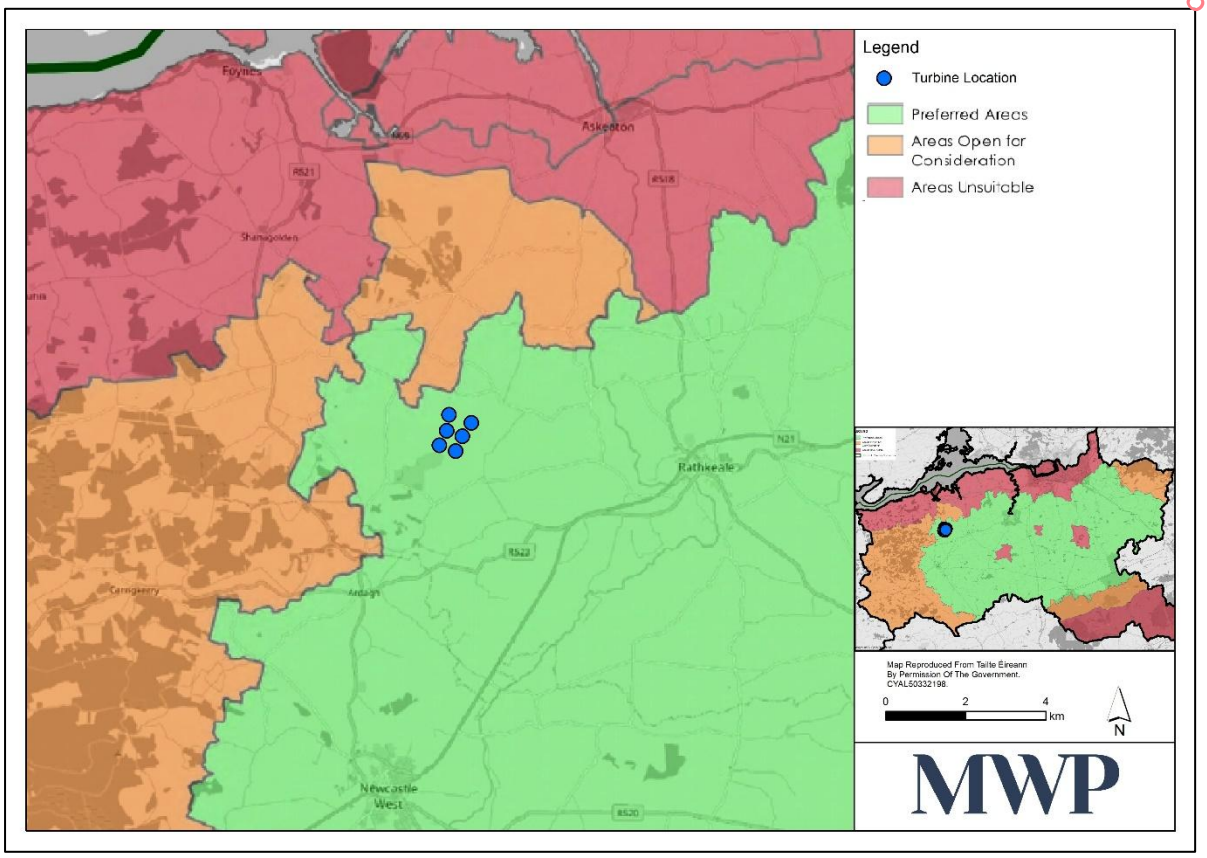

Figure 4-1: Site Selection Based on Wind Energy Designations

The result of applying the Phase 1 Screening criteria was that nine (eight plus the proposed development site) potential wind farm sites were identified (**Figure 4-2**). These were then subject to further assessment and screening, as outlined below.

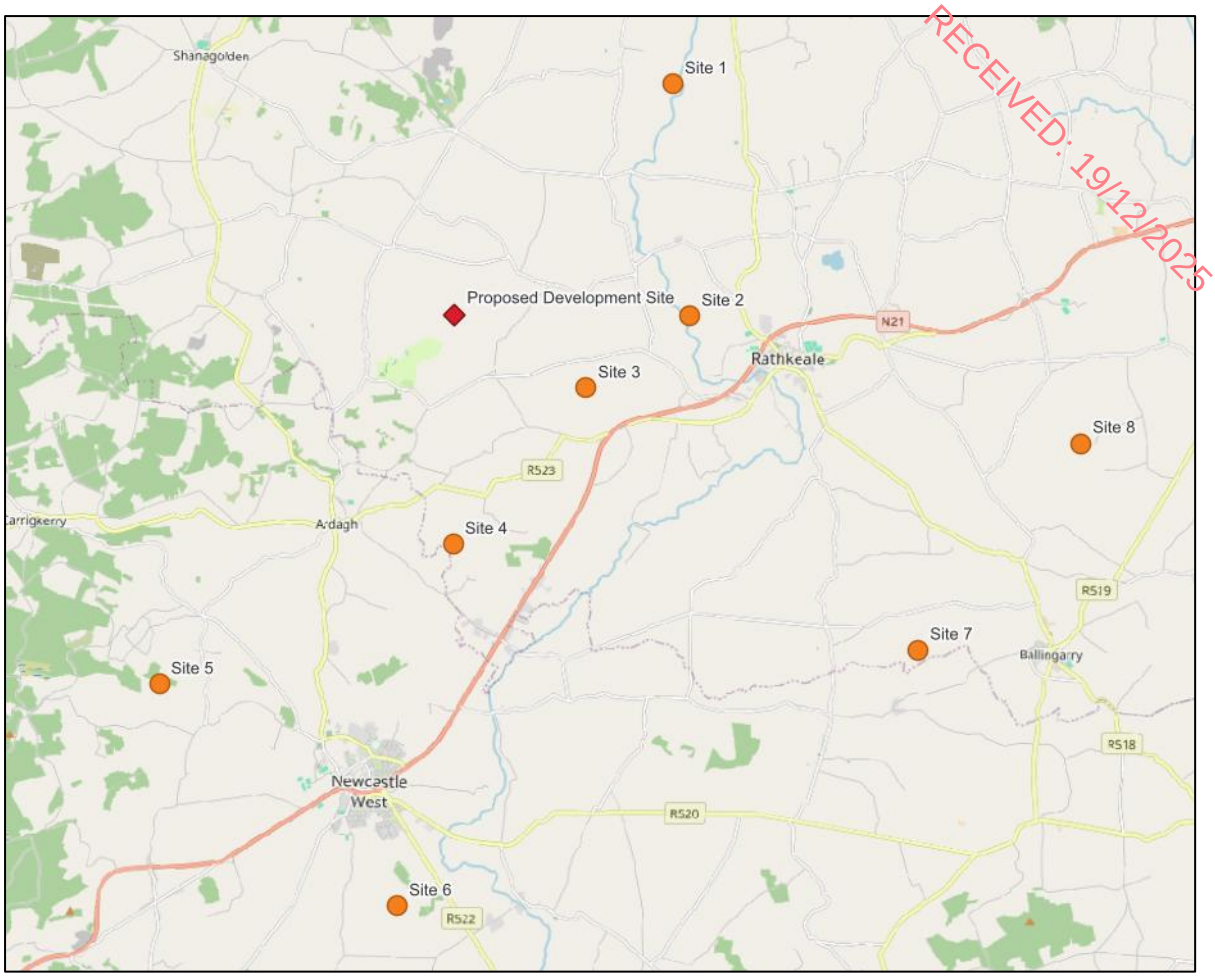

Figure 4-2: Potential Sites Identified as Part of Initial Screening

4.4.2 Phase 2 Potential for Grid Connection

As part of the site selection process, the Applicant considered the potential for grid connection, including distance to potential connection points and the capacity of the grid to accommodate the proposed development.

Following the application of grid constraints to the number of potential wind farm sites identified, a number of sites were discounted due to unviable grid connection points and/or grid capacity not being available. Refer to Section 4.4.3 and Table 4-1 for further details.

4.4.3 Phase 3 Other Constraints and/or Facilitators

Phase 3 Screening included consideration of known local issues or other constraints and/or facilitators. These included the following:

- Amenity, Tourist or Scenic Areas designated in development plans, e.g. Landscape Character Areas, Scenic Views;
- Size of Site/ Development Area, i.e. if site is of insufficient size to be capable of supporting a viable project;

- Avoidance of Natura 2000 Sites i.e. SACs, SPAs;
- Sensitive habitat/species of bird;
- Land Ownership Issues;
- Residential density considerations;
- Potential project scale; and
- Sites with impractical/irregular shape/layout/ topography.

The application of the above criteria resulted in the discounting of further sites, leaving a reduced number of sites for further assessment. The site selection process was, by necessity, strategic and desk-based in nature in order to devise a short list of candidate sites. This is considered to be a rational and appropriate approach and its implementation was clearly founded on knowledge and observation. The proposed development site was identified as most suitable to take forward as a potential wind farm location. **Table 4-1** outlines the various sites identified and the reason for not proceeding.

Based on the screening process, the proposed development site was the preferred candidate site of scale to take through to the next stage of validation.

Table 4-1: Screening of Potential Sites Identified

Site	Screening – Reason for Not Proceeding
1	Proximity to River Deel – potential impact on aquatic environment. Proximity to route of Foynes to Limerick (including Adare Bypass) Road – potential cumulative impacts.
2	Proximity to River Deel – potential impact on aquatic environment. Lands subject to flooding from River Deel. Approximately 1km from town of Rathkeale - residential density considerations.
3	Potential project scale – insufficient development area.
4	Potential project scale – insufficient development area. Unviable grid connection/grid capacity.
5	Potential project scale – insufficient development area. Unviable grid connection/grid capacity.
6	Unviable grid connection/grid capacity.
7	Proximity to Knockfierna Landscape Character Area – potential landscape and visual impacts. Unviable grid connection/grid capacity.
8	Proximity to Knockfierna Landscape Character Area – potential landscape and visual impacts. Unviable grid connection/grid capacity.

4.4.4 Site Validation

The subject site, as a candidate site, was further examined under the following headings to confirm its suitability for wind energy development. The main policy, planning and environmental issues considered for the validation of this wind farm site included:

- Limerick Development Plan policies and objectives;
- Obtainable and economic grid connection;
- Located outside areas designated for protection of ecological species and habitats;
- Consistently high average annual wind speeds;
- Separation distance from residential properties;
- Site topography and stability; and
- Access issues for turbine delivery and construction activities.

The above exercises, based on a number of key environmental, technical and policy-related criteria, determined that the proposed site represented a suitable location for the proposed development in Limerick. The site has satisfied key criteria required for successful wind energy development and these are presented in **Table 4-2.**

Table 4-2: Summary of Site Suitability Criteria

Suitability Criteria	Proposed Development Site
Wind Resource	The predicted wind speed at the proposed development site is approximately 7.3m/s as shown in the Sustainable Energy Authority of Ireland's (SEAI) Wind Atlas.
Proximity to Grid	Proximity to an existing 38kV substation at Carrons wind farm to the west of the site and overhead 38kV line through the site. There are other potentially viable connection options also available, or will be potentially available in the future, as shown on **Figure 4-3**.
Compliance with Planning Policy/Designation	The Limerick Development Plan 2022– 2028 Wind Energy Map 9.1 has identified the site as being within a "Preferred Area' for wind energy development.
Avoidance of Environmental Designations	The site does not overlap with any Natura 2000 sites.
Separation Distance from Residential Dwellings	A minimum setback of four times turbine tip height of 632m (4 x 158m) was applied to residential properties in the surrounding area. This setback is achieved at the site. There are no existing residential properties within 632m of a proposed turbine.
Site Accessibility	Access is available from the public road network. The site can be accessed from the L1219 local public road to the north.
Landscape and Visual Impact	The site is located within the Landscape Character Area LCA 01 Agricultural Lowlands, a mainly flat, farming landscape containing some of the areas designated as suitable for wind developments (Map 9.1). The policy for wind developments within this LCA is to "Encourage the regular arrangement of turbines with equal spacing in proposed wind farm developments, which take field boundaries into account".

4.4.4.1 Proximity to Grid

The site is located approximately 2.5km from an existing substation at Carrons wind farm which is connected to the National Grid. A 38kV overhead line is also present within the site as shown in **Figure 4-3**.

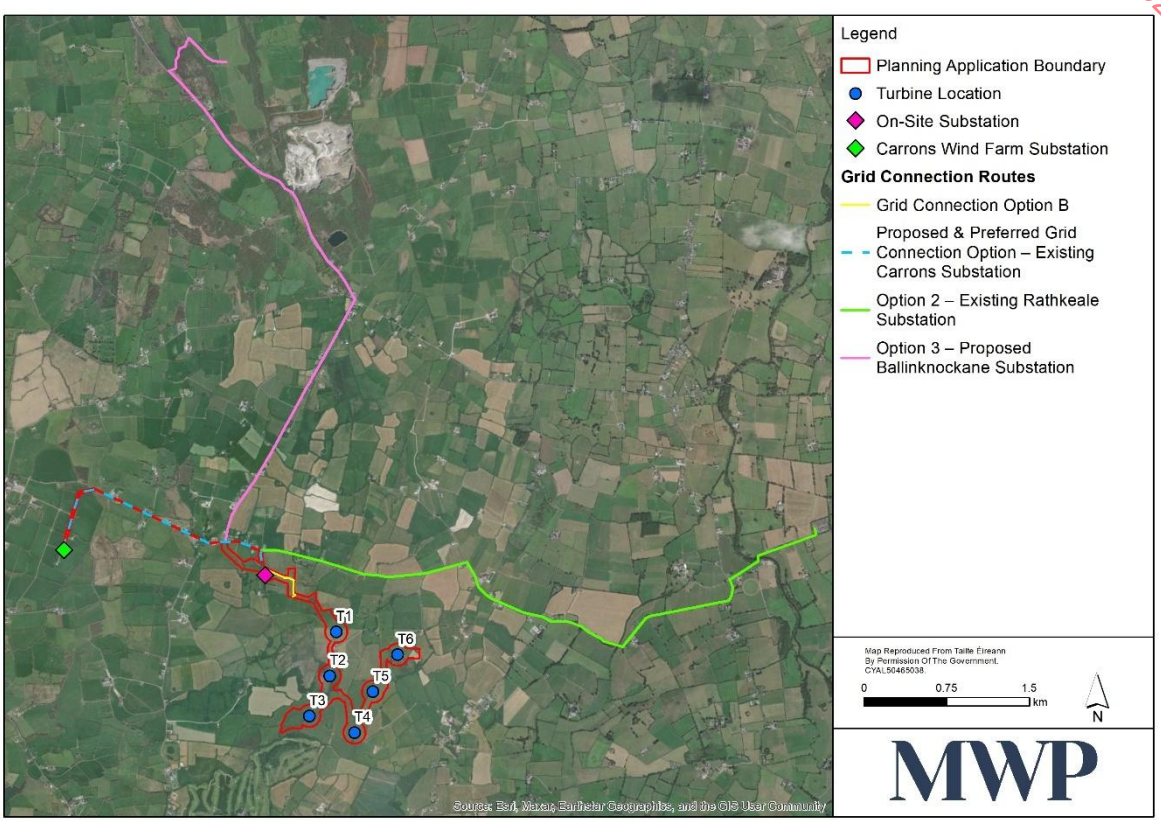

Figure 4-3: Site Selection Based on Grid Connection Options

4.4.4.2 Compliance with Planning Policy/Designation

Objective CAF 028 of the Limerick Development Plan 2022-2028 states that it is an objective of the Council to encourage the development of wind energy, in accordance with Government policy and having regard to the principles and planning guidance set out in the Department of Housing, Planning and Local Government publications relating to Wind Energy Development and the DCCAE Code of Practice for Wind Energy Development in Ireland and any other relevant guidance, which may be issued in relation to sustainable energy provisions during the course of the Plan.

Objective CAF O30 regarding the Location of Wind Energy Developments states: "*It is an objective of the Council to promote the location of wind farms and wind energy infrastructure in the 'preferred areas' as outlined on Map 9.1, to prohibit such infrastructure in areas identified as 'not open for consideration' and to consider, subject to appropriate assessment, the location of wind generating infrastructure in areas 'open for consideration'. A target of 386.45MW by 2030 is proposed in the CDP, which is 65% above the current capacity within the county.*" The subject site and all its turbines are located within an area designated in the current Limerick Development Plan 2022-2028 as a 'preferred area' for wind energy development (refer to **Figure 4-1**).

4.4.4.3 Avoidance of Environmental Designations

This site is not within or adjacent to a Natura 2000 site, as shown on **Figure 4-4**.

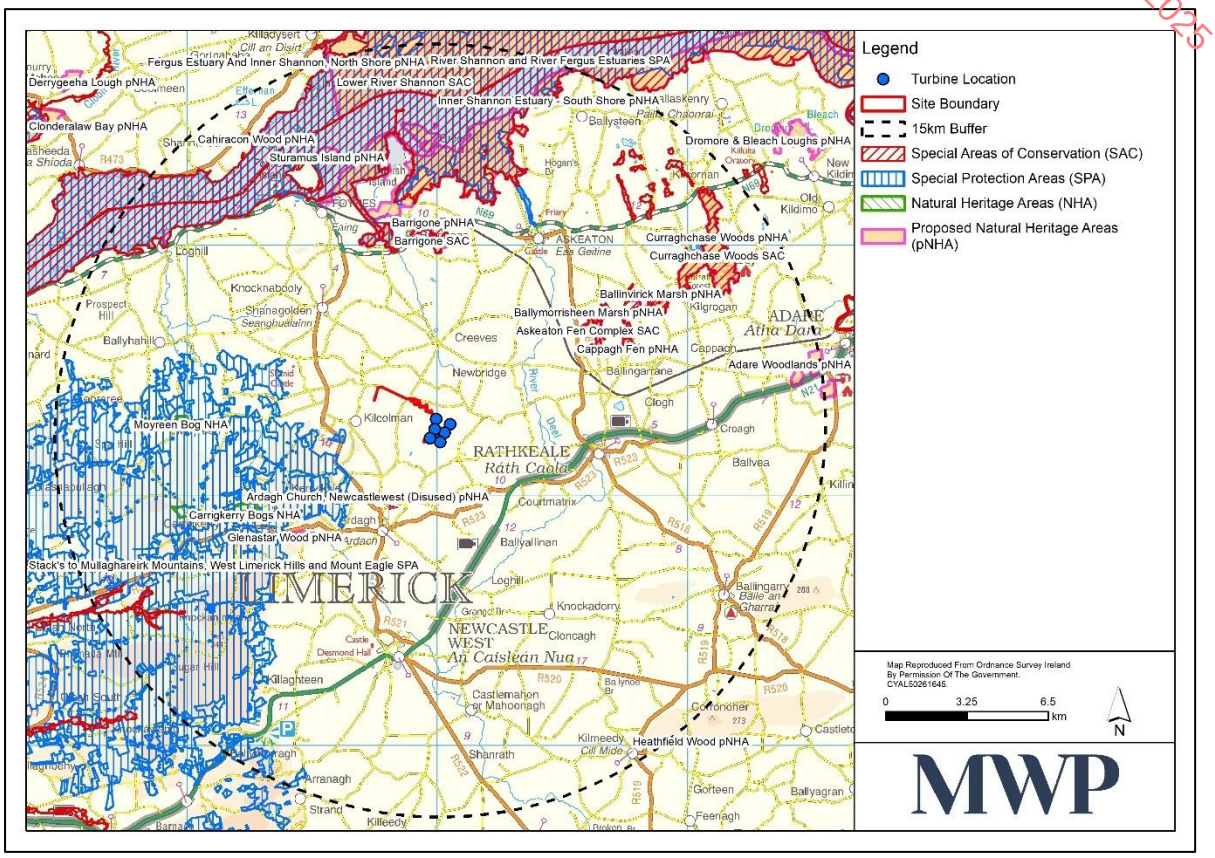

Figure 4-4: Location of Designated Natura 2000 Sites

4.4.4.4 Landscape and Visual Impact

The current Limerick Development Plan contains policy objectives relating to Landscape Conservation Areas, Areas of Special Amenity and also for the assessment of landscape character. It discourages projects on 'sensitive or sloping sites', which this site is not. The site is located within the designated Rural Landscape Character Area LAC01 Agricultural Lowlands which is the largest LCA in Co. Limerick and is mainly a flat farming landscape. In relation to wind developments in this LCA, the objective states "*Encourage the regular arrangement of turbines with equal spacing in proposed wind farm developments, which take field boundaries into account*".

4.5 Design Process

There are a number of drivers that will ultimately influence how a design layout for a project evolves. For wind farm development, this is usually concerned with location and placement of development components within a limited footprint at the site, which is largely defined by aspects such as noise, set-back from residential dwellings, habitat, access, grid connectivity and ground conditions, including slope, peat and drainage regime.

The proposed wind farm has been designed to minimise potential environmental impacts and to maximise wind potential on site. The design was developed following a step by step EIA (Environmental Impact Assessment) process which informed and identified the buildable areas suitable for turbines, tracks and infrastructure based on avoidance of unsuitable areas and following the good practice of mitigation by design.

4.5.1 Identification of Environmental Sensitivities

The EIA process involved the completion of all baseline studies to generate environmental constraints and facilitators that informed the design for the optimum wind farm layout. These studies were undertaken by the environmental, planning and engineering professionals that made up the Project Design team (outlined in Chapter 01 Introduction). Site surveys undertaken between 2019 and 2025 have informed the EIAR and planning application.

Following consultation and baseline assessment of the site, the following key environmental factors were identified:

- Topography;
- Sensitive Habitats;
- Bat Ecology;
- Public Roads and Population Density;
- Ornithology;
- Soils and Geology;
- Hydrology;
- Archaeology; and
- Landscape and Visual.

This analysis of constraints identified potential environmental concerns, or the potential for environmental impacts, associated with the proposed wind farm development site, without design mitigation/other mitigation measures. Environmental concerns consisted of constraints or setback distance (e.g. buffer from watercourses). Buffers and set back distances are the principal tool used by wind farm designers when incorporating mitigation by design and avoidance. This can only be done when all the environmental sensitivities have been established across the project area. Buffers and set back distances derived from relevant guidance documents such as the Wind Energy Development Guidelines, stakeholder input, studies (as outlined above) and project experience are then put in place.

Table 4-3 summarises the physical and environmental constraints which have informed the wind farm design.

Table 4-3: Physical and Environmental Sensitivities

Study Area	Design Constraint
Topography	Ground areas with slope greater than 30^0 were deemed unsuitable for development.
Sensitive Habitats	Identification of habitat type within the site and minimisation of infrastructure within ecologically valuable habitat.
Bat Ecology	98m felling buffer from centre of each turbine to woodland areas as recommended in **Appendix 6D** Bat Survey (Eire Ecology) of **Volume III**.
Public Roads	Apply a minimum distance of 174m from proposed turbine locations to public roads as recommended in the Draft Wind Energy Development Guidelines (2019).
Ornithology	Bird surveys were carried out over winter and summer seasons since 2020. This data was available and used during the design process. No nesting areas identified within the proposed development boundary.
Soils and Geology	Identification of soil type and rock outcrops. Avoidance of unsuitable areas and constructability risk areas.
Hydrology	Minimum infrastructure distance of 50m from EPA watercourses as recommended by Forest Service and IWEA Guidelines (except for watercourse crossings).
Archaeology	Minimum distance of 20m from areas of Archaeological importance, based on professional judgement.
LVIA	Identification of Zones of Theoretical Visibility (ZTV) within 25km of the proposed development as a conservative approach, 5km more than the 20km as per the Wind Energy Guidelines (2006) and Draft Wind Energy Guidelines (2019).
Noise Sensitive Receptors	Apply a minimum distance from proposed turbine locations to nearest existing residential dwellings. The Draft Revised Wind Energy Development Guidelines (2019) advise a setback of at least four times the tip height (158m) from the turbine centre to noise sensitive receptors, which equates to 632m.

4.5.1.1 Topography

The topography of the site is relatively flat which is advantageous, particularly in construction. It slopes gently to the northwest and is dotted with small hills and depressions. Elevations of the site range between approx. 46 - 56 m AOD in areas where infrastructure is to be developed. A flat site is less challenging in terms of construction and the delivery of turbine components, equipment and materials. The risk of impacting ground stability during excavation is also minimised.

The following approach was taken regarding infrastructure layout and ground slopes. The ground surface gradients were determined from 2m Lidar contour data. Using this, the site infrastructure layout was selected and optimised such that areas of minimum gradient were utilised. All areas of the site had a ground slope of less than 9% and therefore were considered suitable for all types of wind farm infrastructure. This approach is based

on the experience/recommendations of the project design team who have extensive knowledge and experience in the design and construction of wind farm developments in similar topography.

4.5.1.2 Sensitive Habitats

The proposed development has been designed to minimise the footprint within sensitive habitats. This has been achieved in collaboration with engineering constraints, for example by taking account of habitat value from ecological site visits and survey work and areas potentially impacted. The proposed development design has followed the basic principles outlined below to reduce and where possible eliminate the potential for significant effects on ecological receptors:

- Avoidance/minimisation of turbine array and wind farm infrastructure at sensitive habitats (e.g. hardstanding areas designed to the minimum size necessary to minimise habitat loss);
- Avoidance of wildlife refuge sites (e.g. waterbodies) insofar as possible; and
- The grid connection options and internal tracks were selected to utilise existing built infrastructure for the majority of their lengths where possible (i.e. cables to be laid within public roads and existing tracks where possible).

4.5.1.3 Bat Ecology

For sites such as at the proposed development site, the SNH guidance document 'Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation' (SNH, 2021) recommends a buffer distance of 50m between a turbine blade tip and the nearest valuable foraging habitat to bats. In the case of the proposed turbines, the foraging features likely to be used by bats are the hedgerows forming field boundaries within the site. The 50m buffer creates a clearance setback of 50m between the arc of the blade's sweep and the nearest hedgerow which could be used by bats without risk of collision with the turbine blades. Based on SNH buffer formula and proposed turbine dimensions, a felling distance of 98m around each proposed turbine will be required to minimise impacts to foraging bats. The 98m calculation is based on a proposed turbine blade length of 68m, hub height of 90m and conservative hedgerow/tree height of 15m. Further details in relation to the calculation and buffers is provided in **Chapter 06 Biodiversity** and Bat Survey (Eire Ecology) (**Appendix 6D** of **Volume III**)

4.5.1.4 Public Roads and Population Density

With regard to proximity of wind turbines to public roads and railways, the 2006 Wind Energy Development Guidelines state '*Although wind turbines erected in accordance with standard engineering practice are stable structures, best practice indicates that it is advisable to achieve a safety set back from National and Regional roads and railways of a distance equal to the height of the turbine and blade*.' In the case of the proposed turbines, that would equate to 158m. The 2019 revised Draft Wind Energy Development Guidelines state *'it is advisable to achieve a safety set back from National and Regional roads and railways of a distance equal to the height of the turbine to the tip of the blade plus 10%*.'

The setback distance specified in the 2019 guidelines (158 + 10% = 174m) from the nearest local road the L1219, has been applied to the proposed development.

As per the Turbine Delivery Route Assessment (**Appendix 3A** of **Volume III**), the delivery route from the port at Foynes, County Limerick to the proposed development is feasible for all turbine components related to the proposed development. Due to the proximity of Foynes Port to the proposed development (approximately 11km) and extensive previous deliveries of turbine components to the port, alternative ports of entry were not considered.

A review of the 2022 Census of Population shows that the recorded population density surrounding the proposed development. Further details in relation to population density are included in **Chapter 05 Population and Human Health**.

4.5.1.5 Ornithology

In accordance with best practice, over two years of bird surveys were completed as part of the baseline EIA studies. These surveys commenced in 2022 and have been ongoing. The baseline surveys collated data on birds using the site and surrounding areas. All flights were mapped and bird counts from field surveys were collated into reports covering the winter and breeding periods each year.

This baseline data was then used in informing any constraints mapping required and in completing impact assessments of the final wind farm layout.

4.5.1.6 Soils and Geology

A scoping exercise was carried out to determine whether a detailed Peat Landslide Hazard and Risk Assessment was required for this site. This scoping exercise reviewed whether peat was present onsite. No peat was mapped on the GSI maps for the site. During a site walkover no areas of peat were identified. As no peat was identified within the site, it was not deemed necessary to carry out a Peat Stability Risk Assessment for this site.

4.5.1.7 Hydrology

A 50m buffer, with the exception of water crossings, was applied to streams shown on the 1:50,000 OSI maps at the design phase in accordance with the Irish Wind Energy Industry Best Practice Guidelines (IWEA, 2012). The guidelines state construction works should be kept 50m from watercourses where reasonably possible, with the exception of crossings which should be minimised.

4.5.1.8 Archaeology

A minimum buffer exclusion zone of 20m was established around areas of Archaeological Importance to avoid any accidental damage during construction.

4.5.1.9 Public Consultation

One-to one consultations and a public information event were organised to provide the community with an overview of the proposed development, answer questions regarding the development, and receive input regarding any issues, queries and recommendations for evaluation in the **EIAR**. A public consultation event was held in December 2022 at Coolcappa Community Hall. Community members were invited to come and receive information about the proposed development and engage with the Applicant. A project website has also been established in order to share information with the local community (https://ballyniskygreenenergy.ie/) and provide opportunity for feedback. This website has continued to be updated regularly throughout the development of the proposed development.

A parallel media campaign was also undertaken to publicise this further public engagement in the locality as outlined in **Appendix 1C Community Benefit Report.**

4.5.2 Identification & Mapping of Constraints & Facilitators

Once the key sensitive environmental concerns were identified, separation distances to constraints were applied using Geographical Information Systems (GIS). Constraint mapping was generated, which identified the most and least environmentally sensitive, or constrained, areas within the site. This approach highlights potentially significant environmental impacts early on in the design process in order that they can be avoided, and if that is not possible, impacts reduced or mitigated. It also limits the area for development within the study site thereby limiting the number of turbines and associated infrastructure.

The constraint mapping documented and visually communicated the environmental concerns (e.g. sensitive habitat, water features) to the wind farm design team, thereby highlighting the optimum locations (areas with few or no constraints) for wind farm infrastructure. Constraint mapping was also cognisant of relevant consultation concerns, such as setback distance from dwellings, noise and shadow flicker. Archaeological constraints are shown in **Figure 4-5**, and watercourses in **Figure 4-6**. Habitats identified as part of constraint mapping are outlined in **Figure 4-7**.

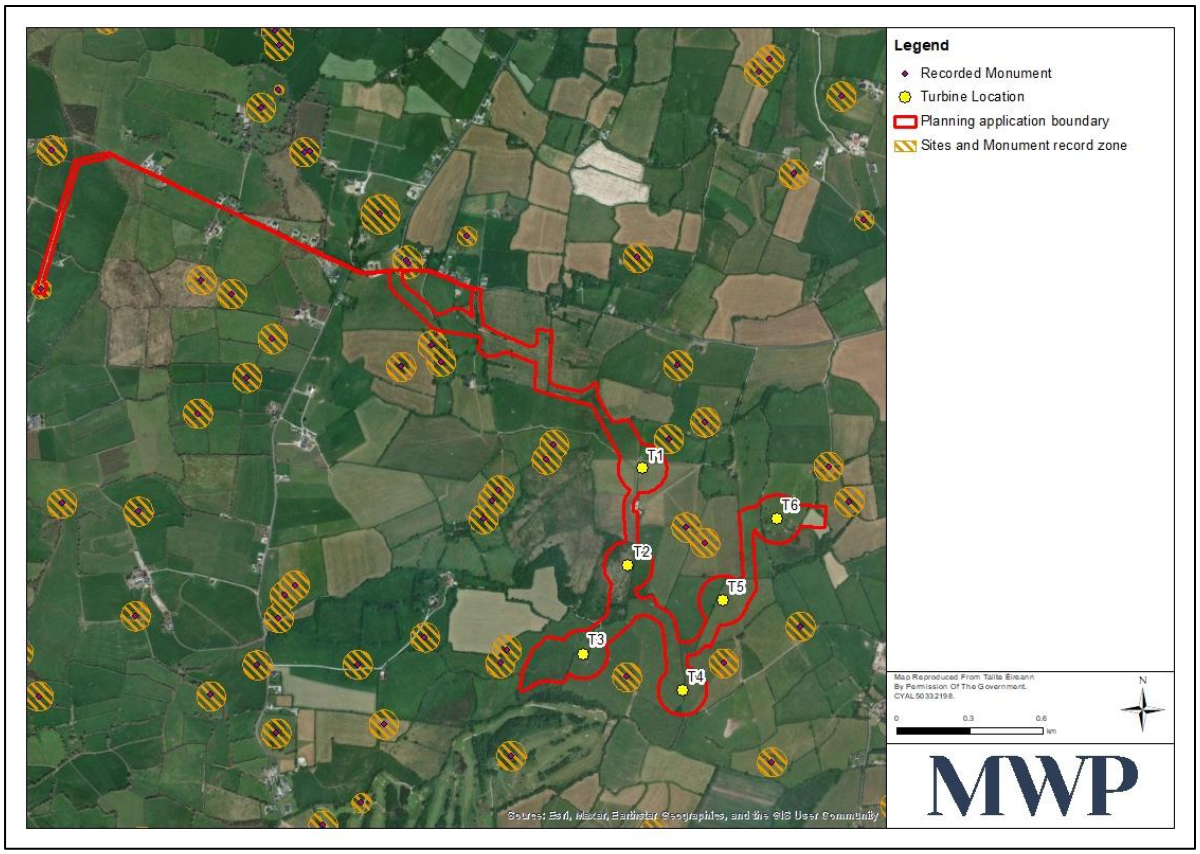

Figure 4-5: Archaeological Constraints

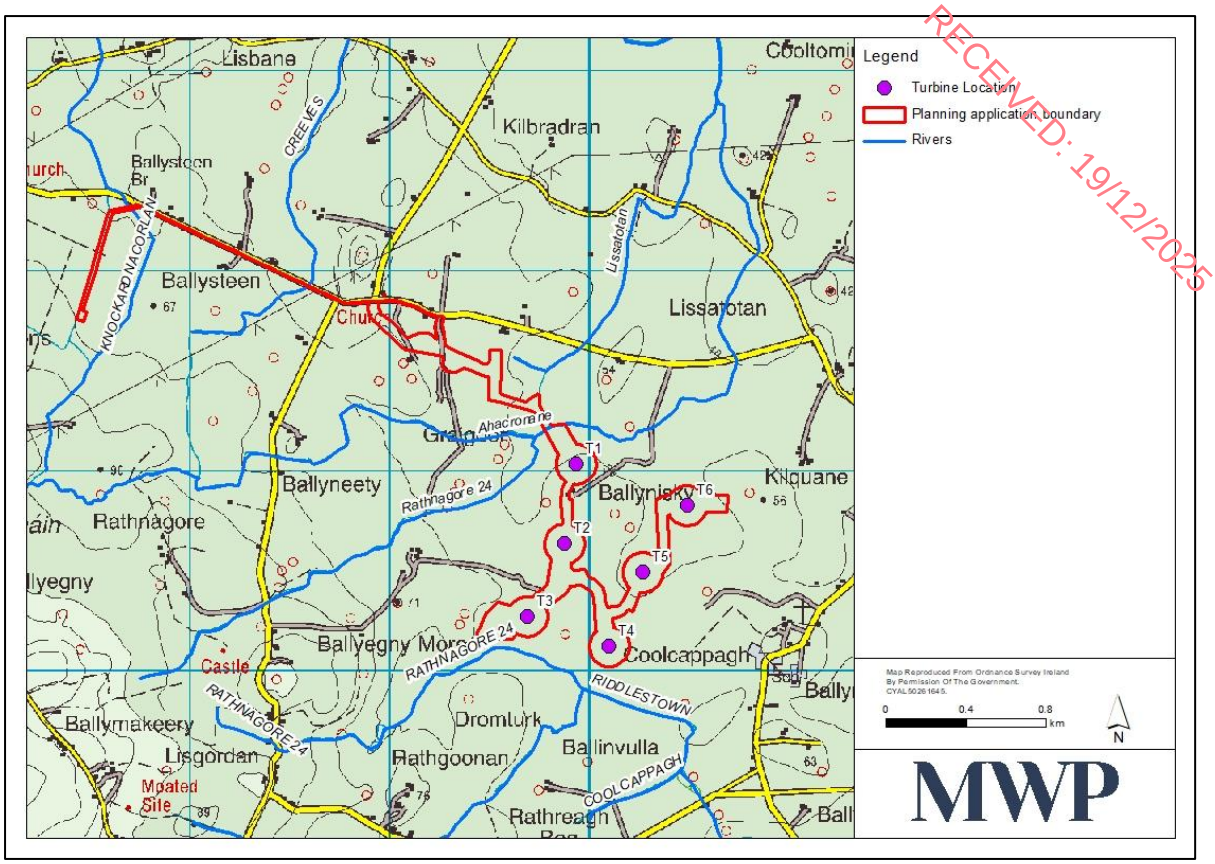

Figure 4-6: Watercourse Constraints

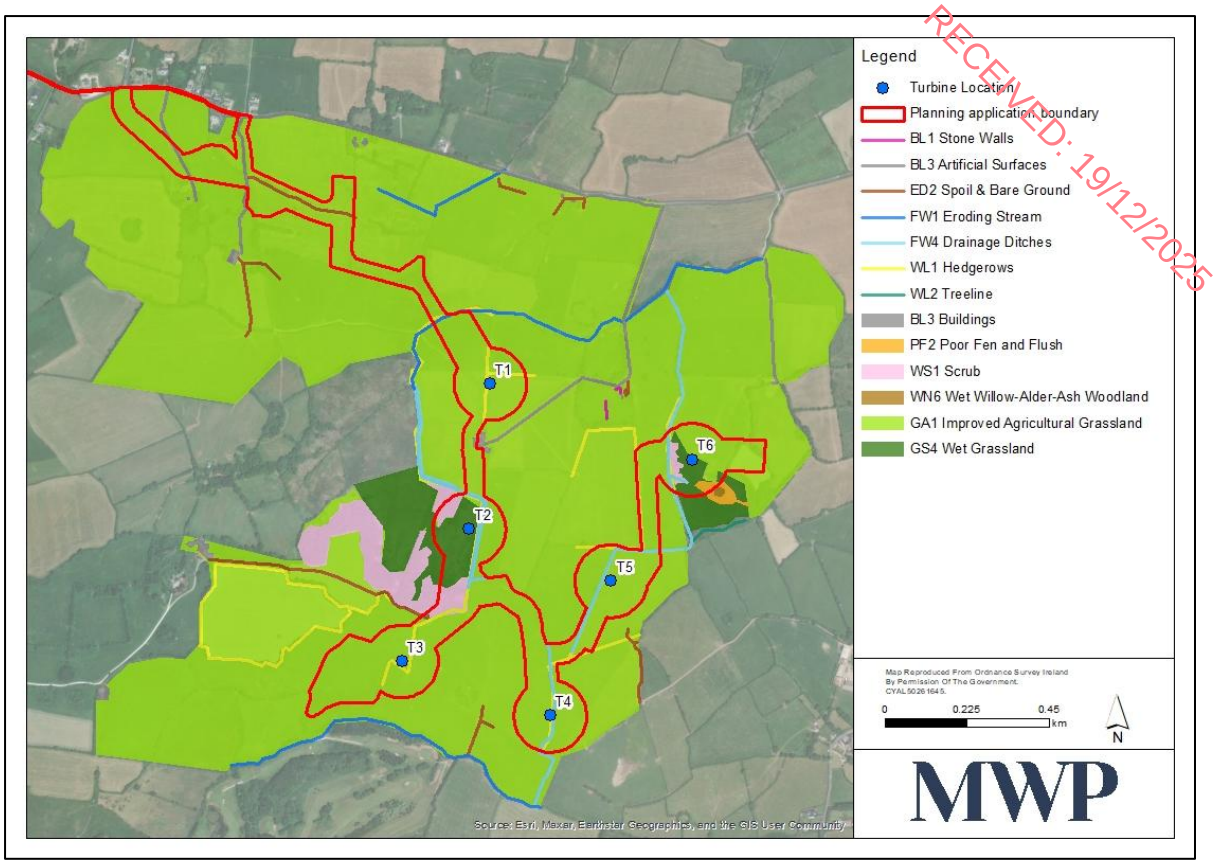

Figure 4-7: Habitats Identified

4.5.3 Preliminary Planning Stage Design

Following identification of all the environmental, technical and engineering constraints for the site, a preliminary layout that fits with the remaining usable areas was developed. The layout included the preliminary internal track network and provisional locations for the electrical substation compound, permanent meteorological mast and material storage areas. The technical design criterion for the layout was to maximise the annual energy yield while maintaining the required separation distances between turbines. The preliminary design layout was then used as a basis for a more detailed site assessment on which the final detailed design would be developed (refer also to Chapter 03 Description of the Proposed Development).

4.5.3.1 Turbine Siting

This EIAR has assessed six (6) No. Turbines which have a maximum tip height of 158m. A number of alternative wind farm design layouts were considered on an iterative basis to arrive at the optimum wind farm layout. A comparison of the environmental effects of the design layouts facilitated the selection of the optimum wind farm layout. The presentation and consideration of the various reasonable alternatives investigated by the applicant is an important requirement of the EIA process. Alternative wind farm layouts and scales were fully considered in order to find the optimum design solution for the site with the least level of environmental impact.

The proposed development examined various turbine layout configurations applying habitat maps, water features, biodiversity impacts and residential receptors before choosing the current layout. Refer to Section 4.6 for further details of the alternatives considered.

4.5.4 Detailed Planning Stage design

The detailed design of the wind farm was driven by a process of mitigation by avoidance as well as a principle of using existing infrastructure to the maximum possible extent. In many cases the relocation of a turbine, substation or internal access track was not straightforward because other turbines and access tracks also had to be moved so as to maintain the required separation distances between them and other technical and environmental constraints, buffers and set-backs.

In total the layout underwent nine (9) iterations driven by engineering, environmental, technical and landowner considerations as the proposed development evolved. These were relatively minor geographically given the site constraints but required significant effort and input from the design team.

4.6 Alternatives Considered

This section outlines the main reasonable alternatives examined and considered during the proposed development design process and indicates the main environmental reasons for choosing the development as proposed. A comparison of the environmental effects on the alternatives considered is also provided.

The alternatives considered include the following:

- Reasonable Alternative Wind Farm Layout and Turbine Scale;
- Reasonable Alternative Grid Connection Methodologies; and
- Reasonable Alternative Construction Methodologies.

4.6.1 Alternative Wind Farm Layout and Turbine Scale

In total there were nine iterations considered before determining the optimum layout with minimal environmental impact. The final design layout was primarily influenced by physical and environmental sensitivities. The iterations are listed in Table 4-4 which outlines the design improvement as the layout, size and scale evolved. As outlined in the European Commission's 2017 Guidance, alternatives provide an opportunity to change the design in order to minimise the project's significant effects on the environment. Preventative action is the most effective way to avoid potential negative environmental effects and this avoidance has been achieved through the design process and the consideration of alternatives and through the review of the proposed development design to minimise environmental effects.

Table 4-4: Design Evolution and Iterations

Iteration	Description of Iteration	Reason for Change	Design Improvement
Initial	10no. turbines up to 150m tip height	N/A	N/A
1	8no. 180m tip height turbines	Reduction in total number of turbines, increased setback from dwellings.	Reduced Landscape & Visual, Noise, Population & Human Health effects.
2	6no. 158m tip height turbines	Reduction in total number of turbines, reduction in tip height of turbines.	Reduced Landscape & Visual, Noise, Population & Human Health effects.
3	Relocation of T1 & T2 (renumbered T6)	Relocated to increase the distance from dwellings.	Reduced Landscape & Visual, Noise, Population & Human Health effects.
4	Relocation of access track and hardstand to T6.	Relocation to reduce potential impact on wet grassland and poor fen and flush habitats.	Reduced biodiversity effects.
5	Relocation of access track and hardstand to T3.	Relocation to reduce potential impact on scrub habitat.	Reduced biodiversity effects.
6	Relocation of substation.	Relocated out of flood risk area.	Reduced flood, aquatic and biodiversity effects.
7	Relocation of access track and site entrance.	Relocated to utilise existing farm track and entrance.	Reduced biodiversity effects.
8	Addition of temporary entrance and access track for construction phase.	Minimise construction traffic along local public road.	Reduced Noise, Population & Human Health effects
9	Relocation of section of temporary access track	Identification of potential archaeology features following geophysical survey.	Reduced effects on potential archaeology features

Figure 4-9 to **Figure 4-17** outline the various iterations and design changes. In **Figure 4-12** to **Figure 4-15** and **Figure 4-17**, the proposed infrastructure is outlined in black, with the previous iteration outlined in orange.

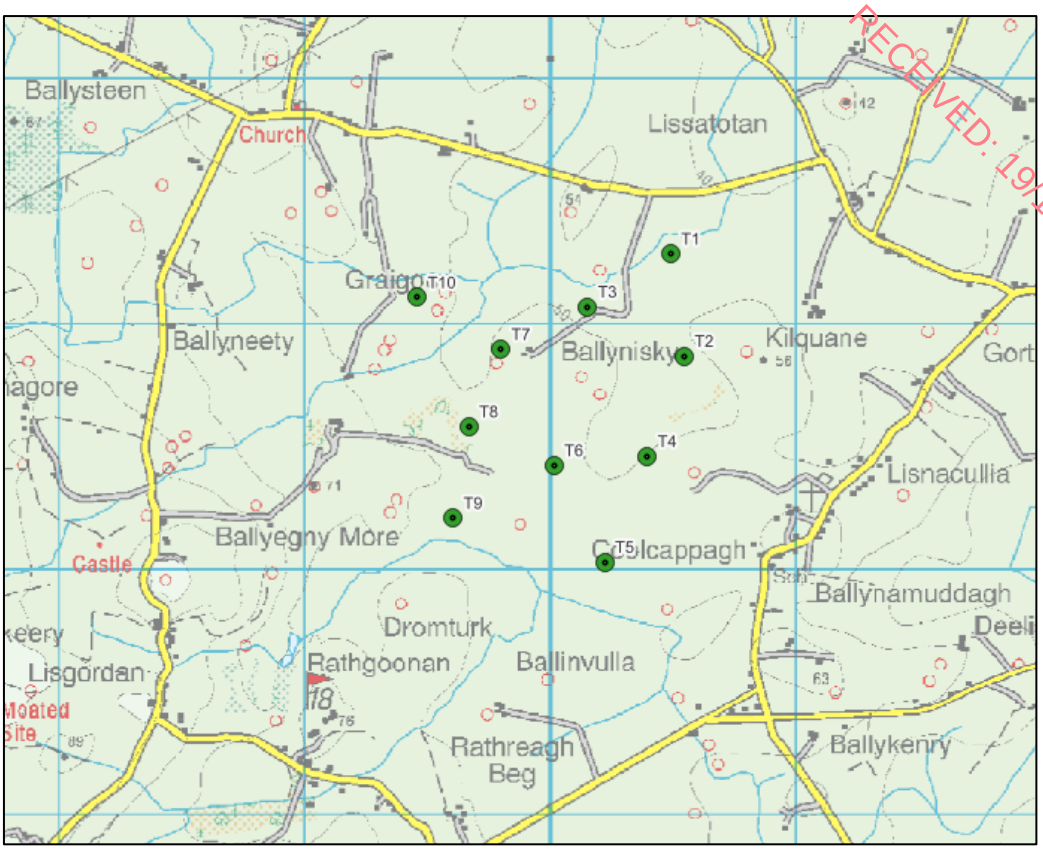

Figure 4-8: Initial 10no. up to 150m Tip Height Turbine Layout

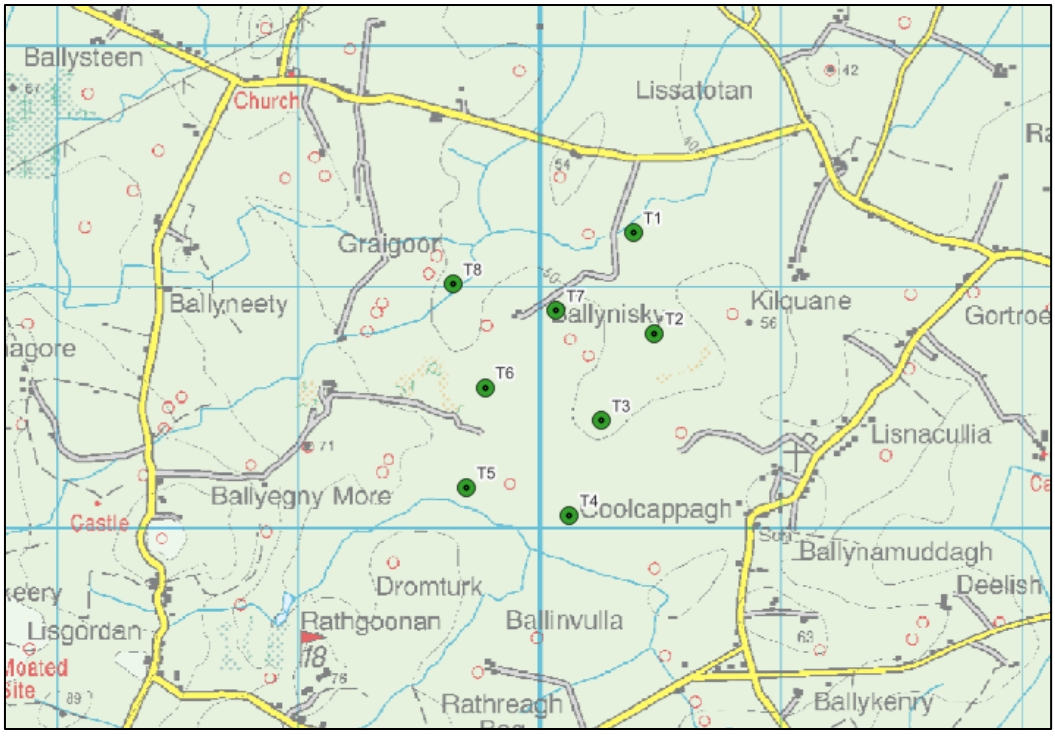

Figure 4-9: Iteration 1 – 8no. 180m Tip Height Turbine Layout

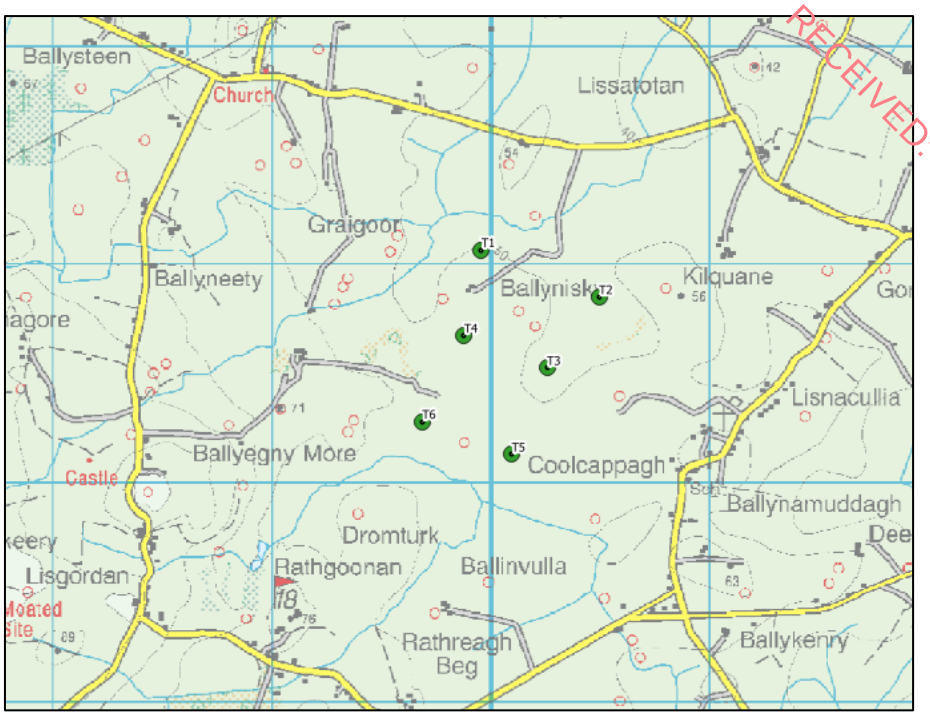

Figure 4-10: Iteration 2 – 6no. 158m Tip Height Turbine Layout

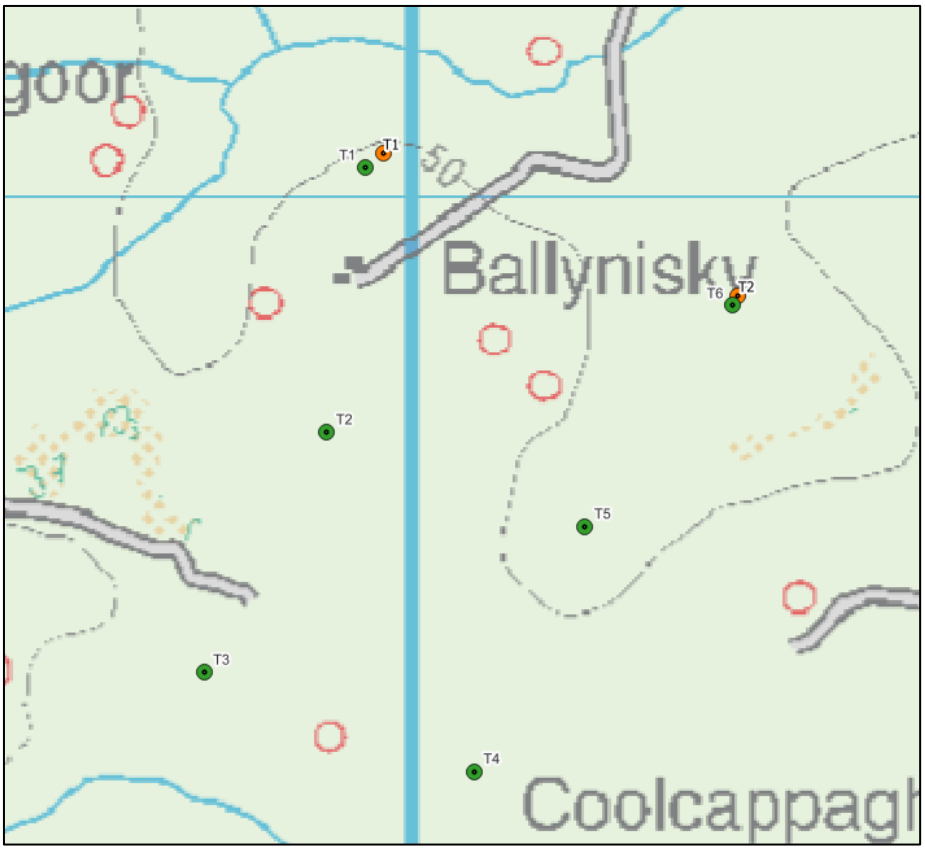

Figure 4-11: Iteration 3 – Relocation of T1 & T2 (Renumbered T6)

Figure 4-12: Iteration 4 – Relocation of Access Track and Hardstand to T6

Figure 4-13: Iteration 5 – Relocation of Access Track and Hardstand to T3

Figure 4-14: Iteration 6 – Relocation of Substation

Figure 4-15: Relocation of Access Track and Site Entrance

Figure 4-16: Addition of Temporary Entrance and Access Track (Outlined Green)

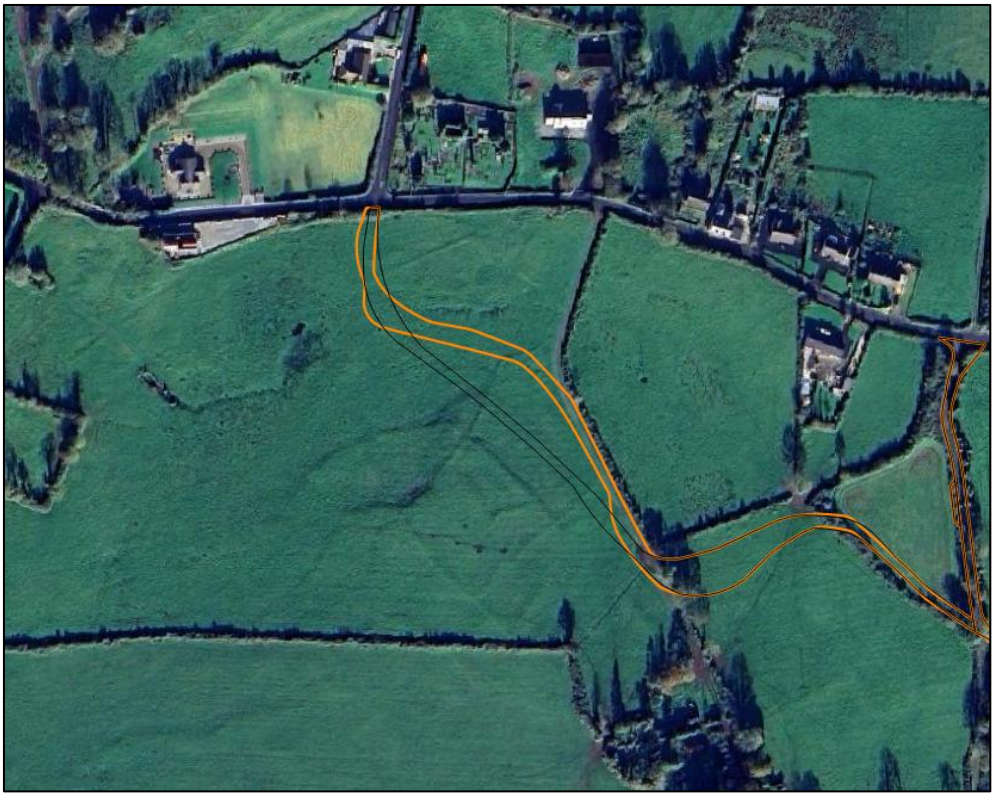

Figure 4-17: Relocation of Section of Temporary Access Track

The final layout represents the most appropriate design for the site conditions, following an iterative approach of design optimization by the engineering and environmental members of the project team. This approach took account of all emerging baseline environmental information during the EIA process, and therefore, the optimum wind farm layout for the development is proposed. **Table 4-5** outlines a comparison of site conditions and environmental effects in relation to the design improvements from initial to final design.

Table 4-5: Comparison of Environmental Effects

Environmental Factor	Initial Design	Final Design
Population and Human Health	10no. turbines	Reduction in number of turbines, increased setback from dwellings.
Biodiversity	Larger development footprint across site.	Development footprint reduced, sensitive habitats minimised.
Air and Climate	Medium scale project	Medium scale project
Landscape and Visual	10no. turbines (150m)	Number of turbines reduced, increased setback from dwellings, landscape and visual impacts reduced.
Water	50m watercourse buffer to infrastructure.	50m watercourse buffer to infrastructure.
Land and Soils	Larger development footprint across site.	Development footprint reduced, impact on land and soils reduced.
Noise	Greater number of turbines, potential for noise impact.	Number of turbines reduced, increased setback from dwellings, potential for noise impact reduced.
Cultural Heritage	No wind farm works within archaeological buffer.	No wind farm works within archaeological buffer.
Material Assets	Construction traffic utilising local public road to entrance.	Temporary construction entrance, reducing traffic on local road.

4.6.2 Alternative Grid Connection Methodologies

Various grid connection options were assessed in relation to connecting the proposed development to the National Electricity Grid (NEG). A ranking of the various options available was completed.

4.6.2.1 Alternative Substation and Grid Connection Infrastructure

As outlined in the previous section, the location for the proposed substation was subject to design iterations as part of the design process for the development. The subject site is located within close proximity of existing and consented transmission infrastructure and has a viable connection to the National Grid in close proximity.

Potential grid connection options were examined, which included both underground (UGC) and overhead (OHL) connection options. These are outlined in **Table 4-6** and displayed in **Figure 4-18**.

The potential grid connection routes considered to existing substations were 1) along the public road and overhead to Carrons 38kV substation and 2) a loop in to the 38kV overhead line that transects the site vis the proposed substation. A connection along the public road to Rathkeale 110kV substation and a connection to the proposed Ballinknockane 110kV substation was also considered.

Table 4-6: Comparison of Environmental Effects

Option	Description	UGL/OHL	Distance (km)
1	Connection to Carrons 38kV Substation	UGL	2.5km
2	Loop in to the 38kV OHL vis the proposed substation	UGL/OHL	Within Planning Boundary
3	Connection to Carrons 38kV Substation	OHL	1.8km
4	Connection to Rathkeale 110kV Substation	UGL	6km
5	Connection to Ballinknockane 110kV Substation	UGL	6.6km

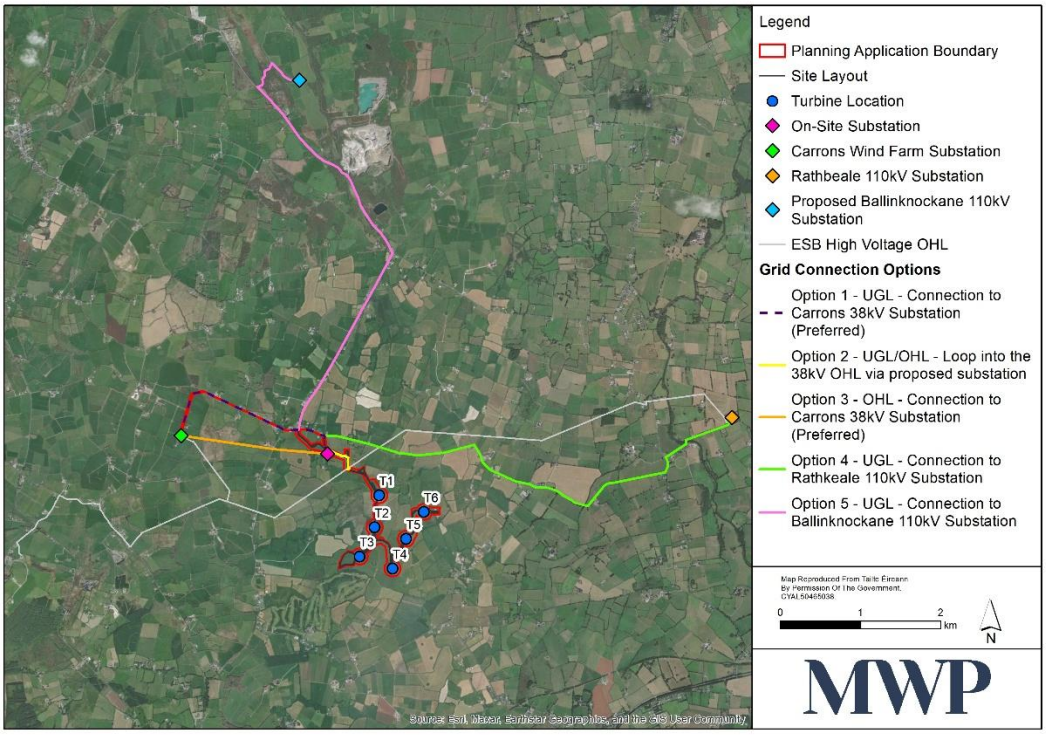

Figure 4-17: Connection Options Considered

Based on the various connection methods identified, these were ranked in relation to the most favourable options (Table 4-7).

Table 4-7: Grid Connection Options Ranking

Rank	Description
1	Loop in to 38kV via proposed substation – Underground to substation, OHL
2	Connection to Carrons 38kV Substation – Underground in public road
3	Connection to Rathkeale 110kV Substation – Underground in public road
4	Connection to Carrons 38kV Substation – Overhead line
5	Connection to Ballinknockane 110kV Substation – Underground in public road

Ultimately, two options are brought forward for the grid connection, an underground grid route to Carrons 38kV substation within the curtilage of the public road for the majority of the route and a loop in to an existing 38kV OHL that transects the site, which would be cut and underground cabling ran to the proposed substation. These options were selected for the following reasons:

- Reduced traffic disruptions in comparison with the routes to Rathkeale 110kV and Ballinknockane 110kV substation;
- Low impact on biodiversity as a result of utilising existing public road for the majority of the connection;
- Reduced visual impact in comparison with the overhead connection option for Carrons route;
- Loop in connection would utilise existing OHL present on site, reduced traffic disruptions in comparison with underground routes within the public road;
- Ballinknockane 110kV substation is currently not constructed;
- Reduced number of watercourse crossings in comparison with the other underground options.

A comparison of potential environmental effects associated with the two top ranking options are outlined in Table 4-8.

Table 4-8: Comparison of Environmental Effects of Grid Connection Options

Environmental Factor	Grid Connection to Carrons 38kV substation (Public Road)	Grid Connection Loop in to Existing 38kV Over Head Line
Population and Human Health	Traffic disruptions during construction phase along approximately 2.5 km stretch of local road.	Line is already in situ and transects the red line boundary for the Proposed Development
Biodiversity	No Effect	No Effect
Ornithology	No Effect	No Effect

Environmental Factor	Grid Connection to Carrons 38kV substation (Public Road)	Grid Connection Loop in to Existing 38kV Over Head Line
Air and Climate	Emissions during construction phase.	Emissions during construction phase.
Lands and Soils	Temporary removal of overburden during laying of cables.	Temporary removal of overburden during laying of cables
Water	Total of 2 No. water crossings.	No Effect
Noise	Construction phase noise	Construction Phase noise
Landscape	No Effect	No Effect
Cultural Heritage	No Effect	No Effect
Shadow Flicker	No Effect	No Effect
Material Assets	Additional traffic during construction phase. Single lane road closures during construction along circa 2.5 km of local road.	No Effect

4.6.3 Alternative Construction Methodology

The proposed construction methods are informed and identified by desktop studies, site walkovers and input from ecological and engineering teams. Construction method alternatives were examined for internal access tracks and are discussed below.

4.6.3.1 Internal Access Tracks

The primary objective when designing the new internal access tracks was to utilise existing tracks where possible and to locate infrastructure where ground conditions are suitable. Maximum use where practicable has been made of existing tracks, however the proposed development, will require new access tracks to the majority of the turbines. The proposed wind farm will use 0.47km of existing tracks and 3.4km of new tracks will be constructed within the proposed development site.

New excavated tracks will be constructed using stone aggregate placed over a layer of geogrid, where required, after all organic and soft subsoil material is excavated to formation level. Geotextile material, used to separate the access track building material from the subsoil, may also be laid at formation level.

Depending on ground conditions encountered, new tracks will be constructed as cut and fill or floated design. Refer to Table 4-9 for the comparison of construction track methods.

Table 4-9: Comparison of Environmental Effects of Internal Track Construction Methods

Environmental Factor	Utilising Existing Tracks	Construction of new tracks – cut and fill	Construction of new tracks – Floated
Population and Human Health	No Effect	Additional traffic during construction phase, import of materials.	Additional traffic during construction phase, import of materials.
Biodiversity	No Effect	Requirement for localised hedgerow removal.	Requirement for localised hedgerow removal.
Ornithology	No Effect	No Effect.	No Effect.
Air and Climate	No Effect	Emissions during construction phase.	Emissions during construction phase.
Lands and Soils	No Effect	Removal of overburden.	No Effect.
Water	No Effect	Increased surface runoff.	Increased surface runoff.
Noise	No Effect	Construction phase noise.	Construction phase noise.
Landscape	No Effect	Screened by existing vegetation will allow for no visual impact on surrounding receptors.	Screened by existing vegetation will allow for no visual impact on surrounding receptors.
Cultural Heritage	No Effect	No Effect	No Effect
Shadow Flicker	No Effect	No Effect	No Effect
Material Assets	Additional traffic during construction phase.	Additional traffic during construction phase.	Additional traffic during construction phase.

4.6.3.2 Deliveries of Materials from Nearby Quarries

In order to facilitate the construction of the proposed development, materials will need to be imported from nearby quarries. The quarries that could potentially provide stone and concrete for the proposed development are:

- Roadstone Joseph Hogans (Creeves) Quarry;
- Knockbowheen Quarry, Ardagh, Co. Limerick; and
- Michael O' Donovan Quarries, Knockbowheen, Co. Limerick.

The use of an onsite borrow pit would eliminate the need to transport large volumes of construction material along the public road network to the site. However, when considering the site characteristics, including

topography, ground conditions, accessibility, habitat and surface water features, it was determined that an onsite borrow pit would not be feasible as it would create a larger local impact than the impact of the traffic generation associated with deliveries of materials to the site. A comparison of the potential environmental effects of the chosen option of obtaining stone material offsite when compared to the alternative of using an onsite borrow pit is outlined in Table 4-10.

Table 4-10: Comparison of Environmental Effects of Material Sourcing

Environmental Factor	Onsite Borrow Pit	Imported Material
Population and Human Health	Volume of traffic on public road network minimised.	Additional traffic during construction phase, import of materials.
Biodiversity	Larger development footprint would result in larger amounts of habitat loss.	Material sourced from regulated, licenced quarry – no loss of on-site habitat.
Ornithology	Potential for disturbance and displacement of ornithology species.	Material sourced from regulated, licenced quarry – no impact on onsite ornithology.
Air and Climate	Potential for additional dust emissions on site due to borrow pit excavation.	Increased effect due to vehicle emissions.
Lands and Soils	Potential for increased impact on land and soils due to excavation.	No effect on lands and soils of development site.
Water	A drainage plan for an onsite borrow pit would be required. Potential for impacts on water quality.	No Effect.
Noise	Potential for increased noise and vibration impacts on receptors in vicinity of development.	Off-site noise emissions including traffic.
Landscape	No effect as borrow pit would be reinstated following use.	No Effect.
Cultural Heritage	Larger development footprint, increasing the potential for impacts on sub-surface archaeology.	No Effect.
Shadow Flicker	No Effect.	No Effect.
Material Assets	Less impact on public road network.	Additional traffic during construction phase.

4.7 Do Nothing Scenario

Should the proposed development not be realised, the development will not contribute to Ireland's renewable energy infrastructure and it will not contribute to Ireland's renewable energy targets. In a do nothing alternative, this site would not contribute to Ireland's commitment to meet its EU and national emissions targets and an opportunity to significantly offset CO_2 emissions will be lost. The proposed development will result in a long-term, significant, positive effect in contributing to Ireland's renewable energy targets and offsetting CO_2 emissions.

A do nothing scenario would result in the continuation of agriculture operations at the entire site, in the absence of wind farm infrastructure in parts of the site. In the do-nothing scenario, no new development will take place, and the present character of the land-use will remain with ongoing agricultural activities.

4.8 Conclusion

The proposed development design process and reasonable alternatives were completed with reference to the EIA Directive, the EPA EIAR Guidelines 2022 and the EU Guidance Document 2017.

The proposed development has been designed to minimise any potential environmental impacts and to maximise wind potential on site.

Alternatives examined included alternative site layouts, alternative turbine scales, alternative grid connections and alternative construction methods.

The final site layout was determined based on multi-discipline inputs and consideration of biodiversity, land and soils, archaeology, hydrology, landscape, local population, engineering constraints and assessments. The development as proposed is the preferred option as it results in the least effects on resources and receptors, while meeting the project objectives of a medium scale renewable wind energy development.

4.9 References

Draft Revised Wind Energy Development Guidelines, Department of Housing Planning and Local Government. (2019).

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EPA (2022) Guidelines on the Information to be contained in Environmental Impact Assessment Reports. Environmental Protection Agency.

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