MWP

Chapter 04 Alternatives

Ballycar Wind Farm

4. Alternatives

4.1 Introduction

This chapter of the EIAR outlines the the consideration of Alternatives in relation to the proposed development (a full description of which is available in **Chapter 2**), which is a mandatory part of the EIA process. The legal requirements of the EIA Directive 2011 and the amending Directive 2014, 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 "*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.

The EPA guidance "*Guidelines on the information to be contained in Environmental Impact Assessment Reports*" (2022) says:

> "*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*."

The EPA 2022 guidance also states that analysis of high-level or sectoral strategic alternatives cannot reasonably be expected within a project level EIAR.

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

During the project 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 effect. 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. The following elements are considered further in this chapter:

- Site Selection;
- Project Design Process; and
- Alternatives Considered.

4.2 Site Selection Process

Prior to selection of the site to cater for such development, a detailed screening exercise was undertaken by Ballycar Green Energy Ltd. (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. These include:

- Wind Resource;
- Proximity to Grid;
- Compliance with Planning Designation;
- Avoidance of Environmental Designations;
- Separation distance from dwellings;
- Site accessibility; and
- Level of visual impact.

A technical review of potential candidate sites for wind energy development over a wide area in the region was conducted using a desk-based geographical information system (GIS) screening exercise. The first step in the selection process was to examine high level constraints to eliminate areas which were deemed unsuitable for wind turbines. This identified all registered environmental designations, protected views, cultural and heritage sites, and other areas of special sensitivity.

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 sites; available grid capacity; cumulative impacts with existing and permitted wind farms, as well as other existing, 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 deliver renewable electricity to the National Grid which is an objective of National energy policy.

Alternative locations were eliminated in the early stages of the site selection process as the goal for this project was to deliver a large-scale wind farm (50MW). The proposed development site was the site identified as most suitable to take forward as a potential wind farm location. The following is a summary of the methodology used in the screening process.

4.2.1 Phase 1 Initial Screening

A number of criteria were applied to lands in order to identify which lands might be available, in principal, for wind farm development. The relevant Development Plan and Renewable Energy Strategy provisions pertaining to these sites were examined and potential sites were discounted where the policy context would not be supportive of wind farm proposals. In this regard, the sites were discounted if they were not identified as being at least "open for consideration" for wind farm development in relevant plan/strategies or if there were environmental designations (Natura 2000) at the sites.

The result of applying the Phase 1 Screening criteria was that ten (9 plus the proposed development site) potential wind farm sites were identified. These were then subject to further assessment and screening, as outlined below in **Figure 4-1**.

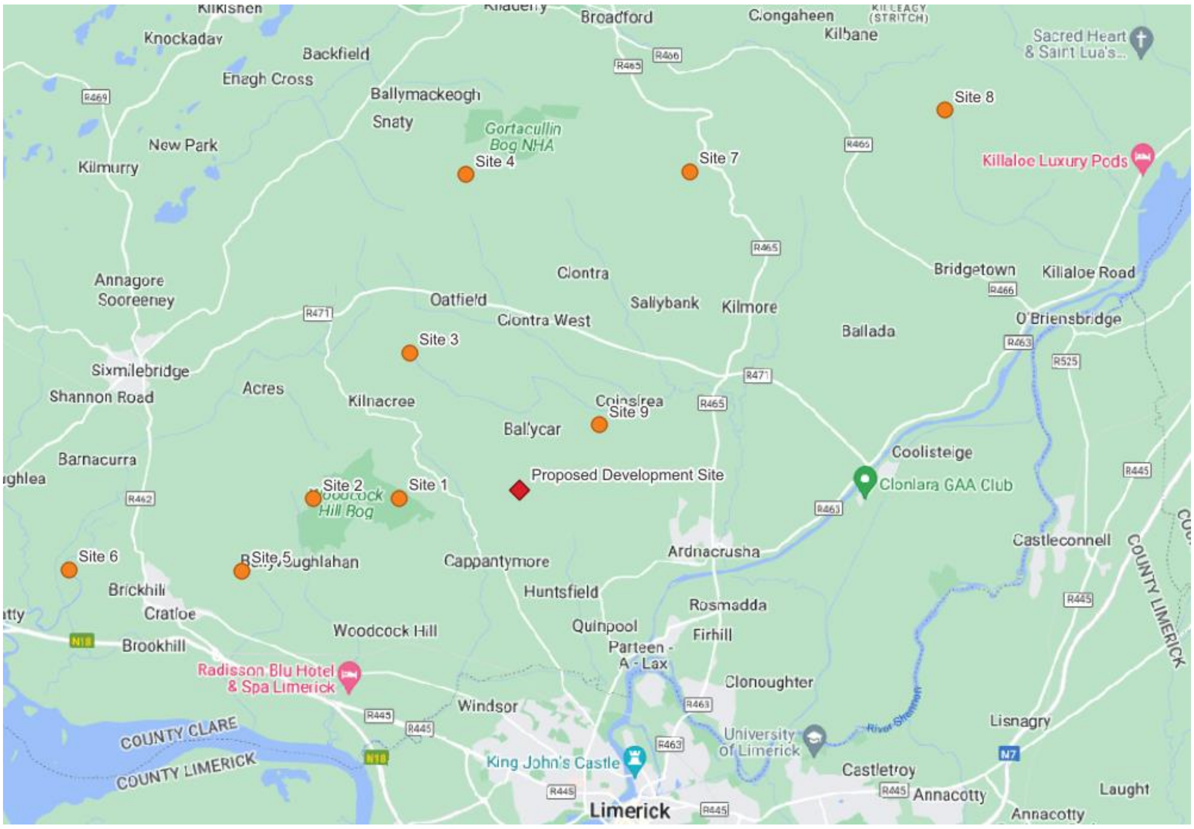

Figure 4-1: Potential Sites Identified as part of Initial Screening

4.2.2 Phase 2 Grid Constraints

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.

4.2.3 Phase 3 Screening

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

- Amenity, Tourist or Scenic Areas;
- Insufficient Development Area;

- Lands utilised for other wind farm developments;
- Natura 2000 Sites;
- Natura Ecological Designations;
- 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 one of the sites 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 Ballycar 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	Located within Woodcock Hill Bog NHA
2	Located within Woodcock Hill Bog NHA
3	Potential project scale, amenity area
4	Lands utilised for other wind farm developments
5	Residential density considerations
6	Proximity to Lower River Shannon SAC
7	Lands utilised for other wind farm developments
8	Lands utilised for other wind farm developments
9	Insufficient Development Area

4.2.4 Site Validation

The proposed development 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:

- Local development plan policies;
- Obtainable, and economic, grid connection;

- Located outside areas designated for protection of ecological species and habitats;
- Consistently high average annual wind speeds;
- Adjacency of residential properties;
- Site topography; 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 development site represented a suitable location for the proposed development in southern Clare. The proposed development site has satisfied a number of 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 speeds at the site vary between 7.5m/sec and 10m/sec as shown in Sustainable Energy Ireland's Wind Atlas.
Proximity to Grid	Proximity to 110kV Ardnacrusha to Drumline and Ardnacrusha to Ennis overhead power lines east and north of the site. Furthermore, the Ardnacrusha 110kV substation is approximately 3km south-east of the proposed development.
Compliance with Planning Designation	The Clare County Development Plan (CDP) 2023 – 2029 Wind Energy Map 9.1 has identified the site as predominantly "strategic" for wind energy. All wind turbines are sited within the "strategic" area for wind energy. The objective for the Strategic Areas (WES8) states that these areas are eminently suitable for wind farm development and notes their good/excellent wind resource, access to grid, distance from properties and location outside designated sites. An overall target of 400MW from these areas is identified. The proposed development site is located within LCA Sliabh Bernagh Uplands which states: *"In the Broadford Hills areas, the areas around Woodcock Hill, Ballycar, Corlea and Knockaunnamoughily are identified as Strategic Areas. Potential Wind Energy from this site is 150MW (LCEA)"*. The proposed development will contribute towards the achievement of the 400MW target.
Avoidance of Environmental Designations	There are no Natura 2000 sites within the development footprint. The nearest identified site is the Lower River Shannon SAC 1.9km south of the development.
Separation distance from dwellings	Minimum setback distance of 500m as per the Wind Energy Development Guidelines, 2006 and the Draft Wind Energy Development Guidelines (2019).
Site accessibility	Primary site access can be achieved from the southeast along the L-7062.
Level of visual Impact	Assessment of the capacity to absorb the proposed wind farm development.

Local Planning Policy View on Suitability of Proposed Site

The key objectives of the Clare County Wind Energy Strategy (WES) focuses on the four classifications identified on the wind energy designations map and are complimented by additional objectives relating to:

- Facilitating renewable energy and developing a low carbon economy in response to national policy;
- Adopting a partnership approach and promoting community involvement;
- Supporting infrastructural development;
- Protecting the environment;
- Supporting auto-producers.

All proposed turbines are located within an area designated as "Strategic" for wind energy development (refer to **Figure 4-2**). The objective for the Strategic Areas (WES8) states that these areas are eminently suitable for wind farm development and notes their good/excellent wind resource, access to grid, distance from properties and location outside designated sites. A target of 400MW from these areas is identified. This site is not contained within or directly adjacent to a Natura 2000 site (refer to **Figure 4-3**).

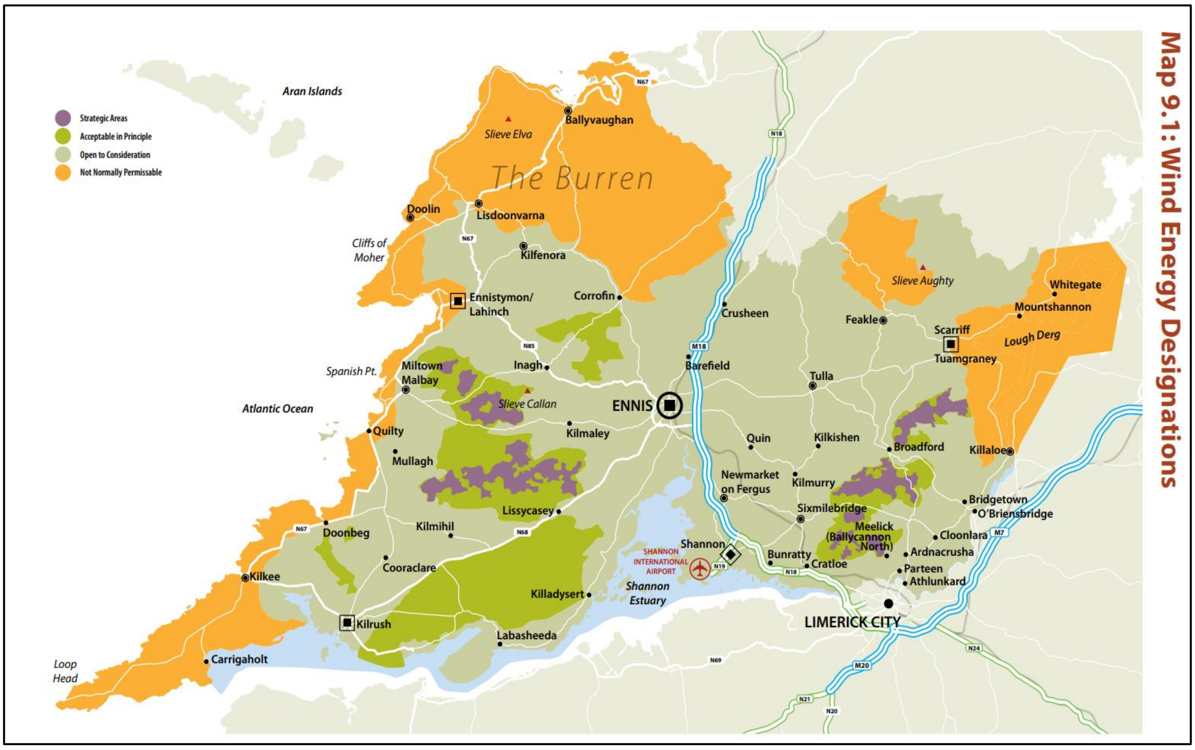

Figure 4-2: Clare RES Wind Energy Designations Map

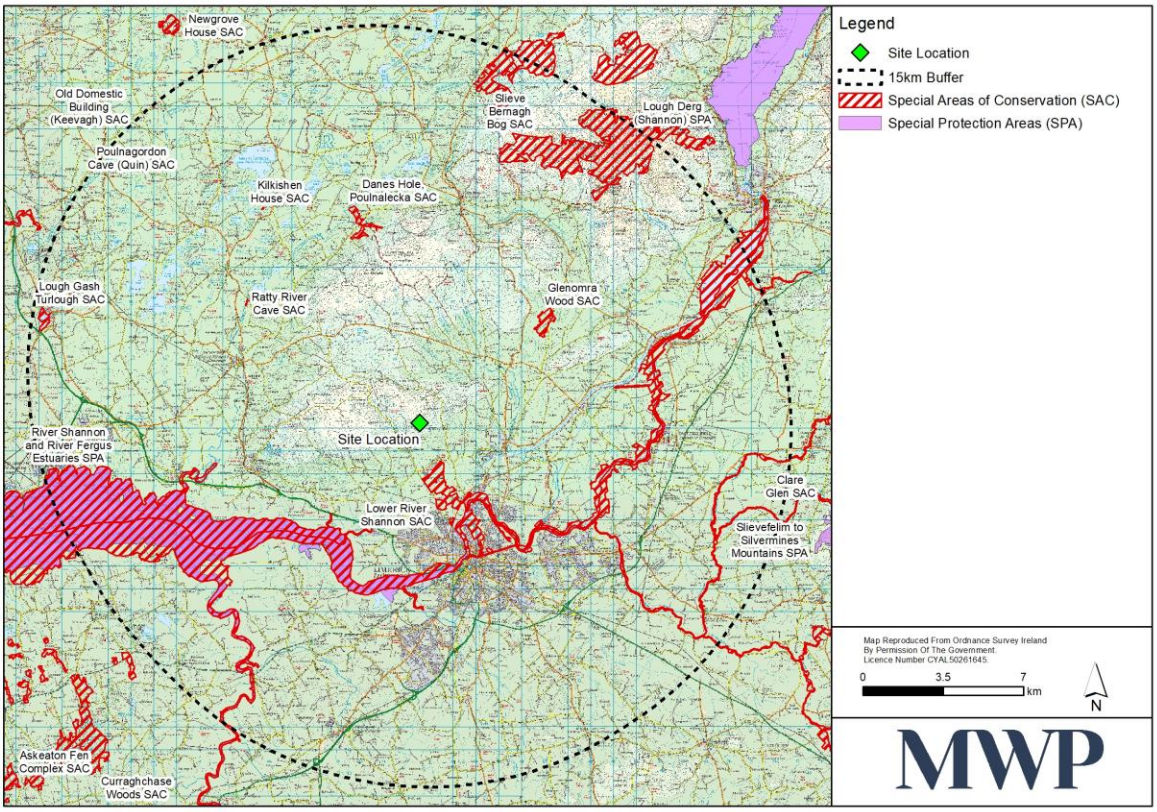

Figure 4-3: Proximity to Natura 2000 Sites

4.3 Design Process

The proposed development has been designed to minimise potential environmental effects and to maximise wind potential on site. The design was developed following a step by step process in line with the EIA Directive which informed and identified the buildable areas suited to turbines, access tracks and infrastructure, based on avoidance of unsuitable areas and following good practice of mitigation by design.

4.3.1 Identification of Environmental Sensitivities

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, soil and drainage regime.

The EIA process involved the completion of all baseline studies to generate environmental constraints 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 wind farm design team. Site visits between 2021 and 2023 have informed the proposed development EIAR and planning application.

The design process is an iterative process, resulting in the assessment of numerous design iterations (or revised designs) to ensure the identified environmental and engineering constraints are applied to successive layout designs. The design iterations, as reasonable alternatives, and the evolution of the final design, or final alternative are discussed.

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
- LVIA.

This analysis of constraints identified environmental concerns, or the potentially significant environmental effects, associated with the proposed wind farm development site. Environmental concerns consisted of constraints or setback distance (e.g. buffer from SAC, NHA). 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	Up to 95m Felling buffer from the centre of each turbine, as recommended in Scottish Natural Heritage Guidelines (2021).
Public Roads	Apply a minimum distance of 185m from proposed turbine locations to public roads as recommended in the Draft Wind Energy Development Guidelines (2019).
Ornithology	No nesting areas identified within the proposed development boundary.
Soils and Geology	Identification of peat depths and rock outcrops. Avoidance of peat slide risk and constructability risk areas.
Hydrology	Minimum infrastructure distance of 50m from watercourses as recommended by Forest Service and IWEA Guidelines.

Study Area	Design Constraint
Archaeology	Minimum distance of 20m from areas of Archaeological importance, based on professional judgement.
LVIA	Identification of Zones of Theoretical Visibility (ZTV) within 20km of the proposed development, as per the Wind Energy Guidelines (2006) and Draft Wind Energy Guidelines (2019).
Noise Sensitive Receptors	Minimum of 500m from turbine centre to noise sensitive receptors, as per turbine separation distances to receptors as per the Wind Energy Development Guidelines, 2006.

4.3.1.1 Topography

The topography of the site varies considerably, with ground surface slopes varying from the relatively flat areas in the southern half of the site to steeper areas at the northern half of the site. The steep areas were avoided as much as possible because of the difficulty of transporting heavy loads on access tracks with excessive gradients and the large volumes of material excavation that would be required for the construction of turbine bases and hardstand areas. Excavation in steep ground can also carry the risk of slope instability.

The following approach was taken regarding infrastructure layout and ground slopes. The ground surface gradients were determined from 1m contour data. With the slope data from 1m contours, the site infrastructure layout was selected and optimised such that areas of minimum gradient were utilised. Areas with ground slope less than 9% were unconstrained for all types of wind farm infrastructure. Areas with a ground slope from 9% to 15% require additional civil engineering works to achieve suitability and are acceptable subject to other constraints such as peat stability. Areas with a ground slope from 15% to 30% require substantial civil engineering works to achieve feasibility requiring detailed investigation if infrastructure was required in these areas. Areas with a ground slope in excess of 30% were deemed unsuitable.

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.

4.3.1.2 Sensitive Habitats

The project has been designed to minimise the footprint of the proposed development 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 project 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 route and internal access tracks were selected to utilise existing built infrastructure for the majority of their lengths where possible (i.e. cables to be laid within public road and existing tracks).

4.3.1.3 Bat Ecology

For low risk sites, such as the proposed development, a Bats and Onshore Wind Turbines: Survey Assessment and Mitigation (2021) document prepared jointly by Scottish Natural Heritage, Natural England, Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd, the University of Exeter and the Bat Conservation Trust (BCT) with input from other key stakeholders, recommends a buffer distance of 50m between a turbine blade tip and the nearest woodland. This buffer creates a clearance setback of 50m between the arc of the blade's sweep and the forest edge which could be used by bats without risk of collision with the turbine blades. Based on the SNH buffer formula and proposed turbine dimensions, a felling distance of up to 95m around each proposed turbine will be required to minimise impacts to foraging bats. The 95m calculation is based on a proposed turbine blade length of 68m, hub height of 90m and the various tree/hedgerows heights present.Further details in relation to the calculation and buffers is provided in Chapter 6 Biodiversity and the Bat Survey Report (Appendix 6A, Volume III).

4.3.1.4 Public Roads and Population Density

The Wind Energy Development Guidelines (2006) outlines the below in relation to turbine proximity to public roads and railways:

'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.'

As outlined in the Draft Wind Energy Development Guidelines (2019):

'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 proposed development has applied the greater distance to Local road L-7062, as outlined in draft guidelines above of minimum buffer of 185m.

As per the Turbine Delivery Route Assessment (Appendix 2C), 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.

A review of the 2022 Census of Population shows that the recorded population density surrounding the proposed development varies. Overall, the region is moderately populated, with densities increasing in areas closer to Limerick City. Further details in relation to population density are included in Chapter 5 Population and Human Health.

4.3.1.5 Ornithology

As advised by a qualified Ornithologist and in line with best practice, should any protected species, be recorded breeding within the given distances of the works area, specific buffer zones depending on the species will be established around the expected location of the nest. All works will be restricted within the zone until it can be demonstrated by an ornithologist that the species has completed the breeding cycle in the identified area.

See Chapter 7 Ornithology for additional information.

4.3.1.6 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 a small area of peat was noted in the north-western corner of the site. The extents of the peat were mapped and peat probes were carried out. The peat probes confirmed this is a localised flat area with depths of 0.1 to 1m.

When designing the layout for the wind farm, the peat area was completely avoided. As no infrastructure is proposed within the peat area of the site, it was not deemed necessary to carry out a Peat Stability Risk Assessment for this site.

Overall, there is no risk of instability of the site, access tracks, turbine bases, or grid connection from peat.

A combination of site surveys and desktop analysis of Geological Survey Ireland (GSI) online maps identified rock outcrops indicating potential borrow pit locations within the site.

4.3.1.7 Hydrology

A 50m buffer, with the exception of water crossings and some other minor works, was applied to watercourses 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.

4.3.1.8 Archaeology

As advised by the project archaeologist based on their significant professional experience, a minimum buffer exclusion zone of 20m was established around areas of Archaeological Importance to avoid any accidental damage during construction.

4.3.1.9 Public Consultation

One to one consultations and public information events were organised to provide the community with an overview of the project, answer questions regarding the project, and receive input regarding any issues, concerns and recommendations for evaluation in the EIAR. An information day was held in June 2022 in which the local community were invited to discuss the project and any concerns or questions they may have had. Members of the public were also invited to an operational wind farm in County Clare.

Engagement also included letter-drops, door to door visits, and a dedicated project website to provide updated information and an opportunity for feedback. A parallel media campaign was also undertaken to publicise this further public engagement in the locality as outlined in Appendix 1A Ballycar Community Report of Volume III.

4.3.2 Constraint Mapping and Buildable Area

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. **Figure 4-4** outlines the watercourse and archaeological constraints.

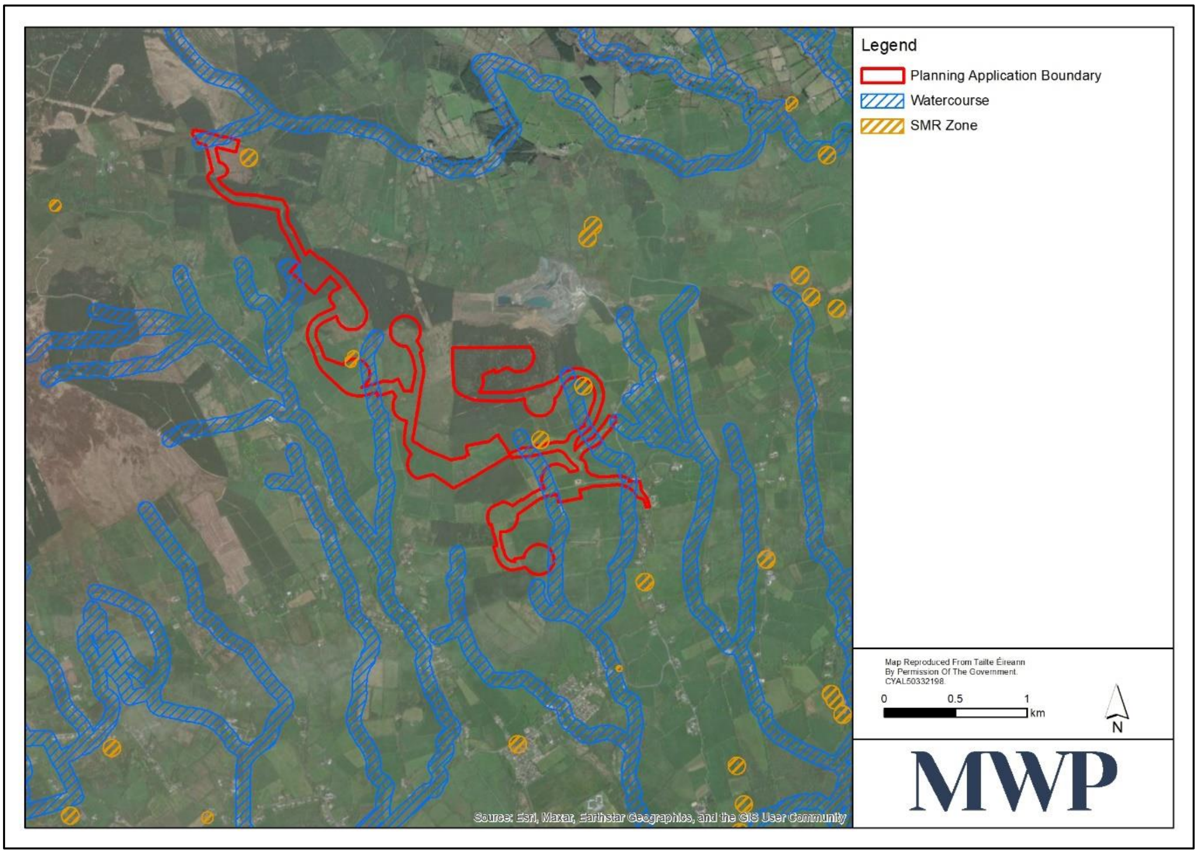

Figure 4-4: Watercourse and Archaeological Constraints

Habitats identified as part of constraint mapping are outlined in **Figure 4-5** and **Figure 4-6**.

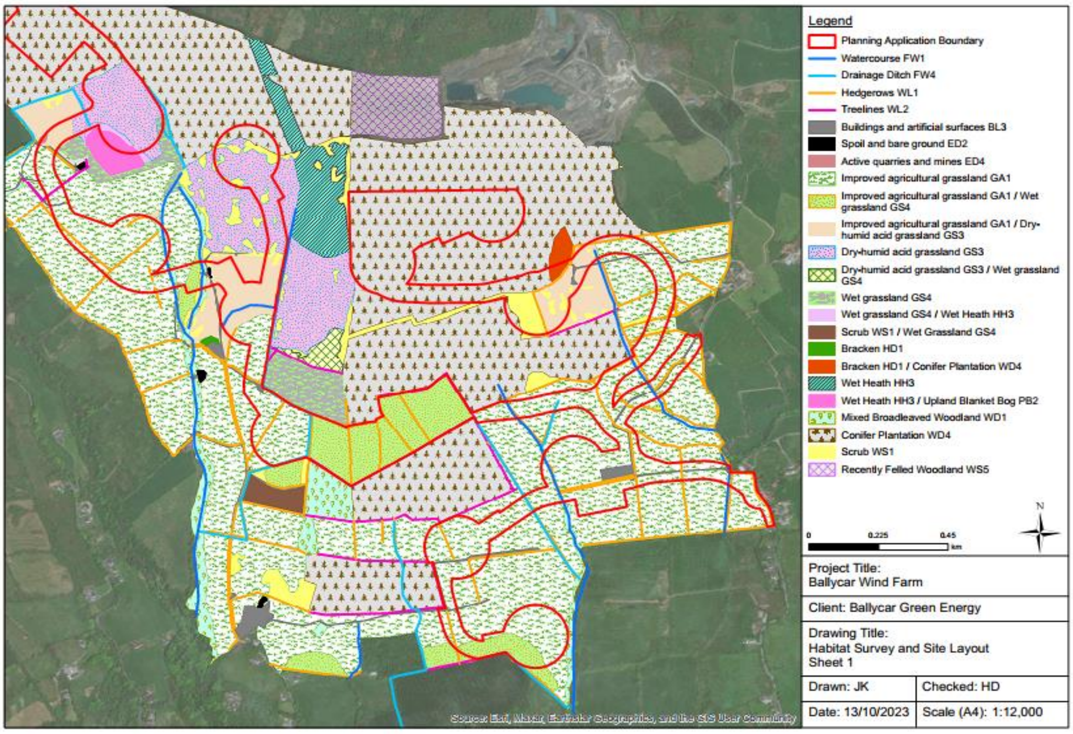

Figure 4-5: Habitats Identified (Sheet 1 of 2)

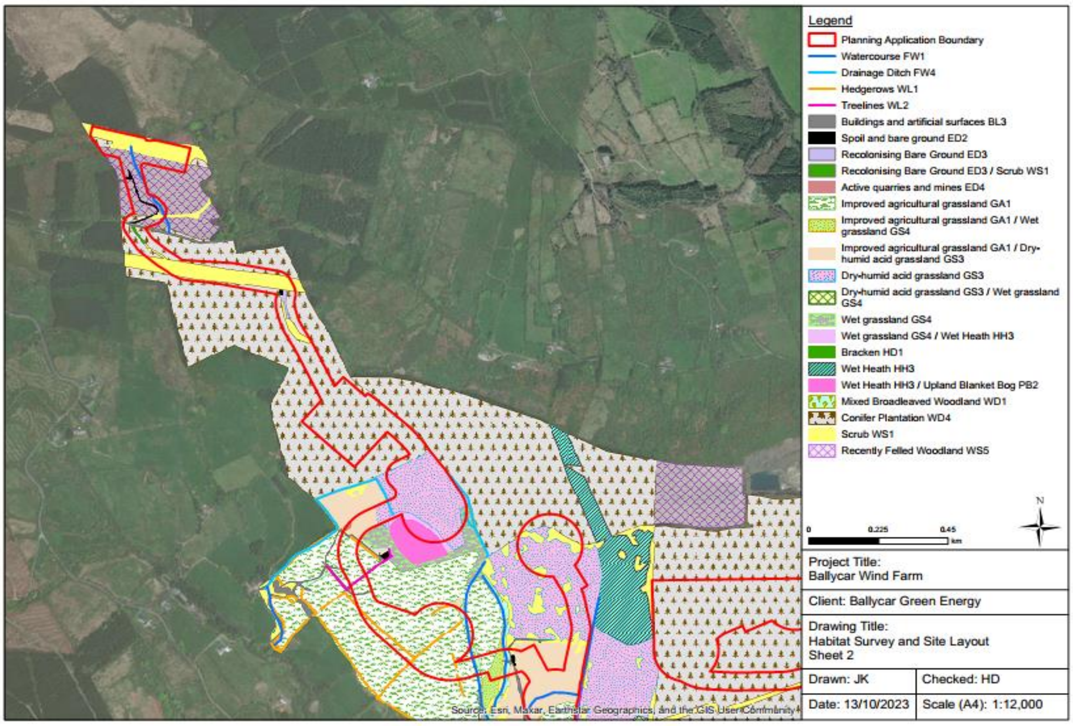

Figure 4-6: Habitats Identified (Sheet 2 of 2)

4.3.3 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 useable areas was developed. The layout included the preliminary internal access track network and provisional locations for the electrical substation compound, permanent meteorological mast, borrow pit and deposition 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 3 Civil Engineering**).

4.3.3.1 Position of Turbines

This EIAR has assessed twelve (12) No. Turbines which have a maximum tip height of up to 158m (11 turbines with a tip height of 158m and one turbine with a tip height of 150m). 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, peat survey data and residential receptors before choosing the current layout.

4.3.4 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, other technical and environmental constraints, buffers and set-backs.

In total the initial layout proposed underwent 7 iterations driven by engineering, environmental, technical and landowner considerations as the project evolved. These were relatively minor geographically given the site constraints, however required significant effort and input from the design team.

4.4 Alternatives Considered

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

4.4.1 Alternative Wind Farm Layout and Turbine Scale

In total there were 7 layout iterations considered, prior to 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 project design to minimise environmental effects.

Table 4-4: Design Evolution and Iterations

Iteration	Description of iteration	Reason for change	Design Improvement
Initial	15no. turbines up to 150m tip height	N/A	N/A
1	9no. 175m tip height turbines	Reduction in total number of turbines, increased setback from dwellings.	Reduced Landscape & Visual, Noise, Population & Human Health effects.
2	12no. 158m tip height turbines	Reduction in overall tip height of the turbines to 158m enabled an increased number of reduced height turbines.	Reduced Landscape & Visual, Population & Human Health effects.
3	Relocation of T1	Relocated to increase distance from of a limited area of peat identified as part of habitat surveys.	Reduced Biodiversity, Land & Soils effects.
4	Relocation of T2	Relocated to increase distance to archaeological features present north of T2.	Reduced Cultural Heritage effects.
5	Relocation of T12	Relocation of T12, therefore no felling required to woodland area.	Reduced Biodiversity effects.
6	Relocation of T10, reduction in tip height to 150m	Relocation of T10 in order for the turbine foundation to be outside the 50m watercourse buffer.	Reduced Biodiversity, Water effects.
7	Relocation of T6	Relocated due to a change in landownership.	Landowner considerations.

Figures 4-7 to **4-14** outline the various iterations and design changes.

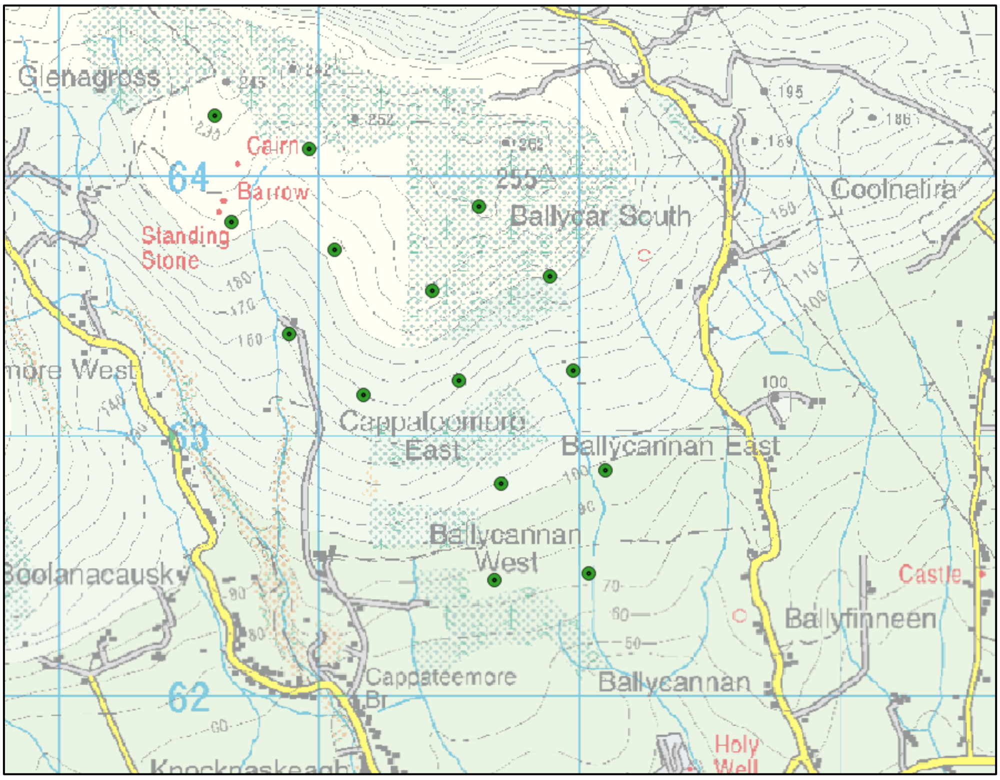

Figure 4-7: Initial 15no. 150m Tip Height Turbine Layout

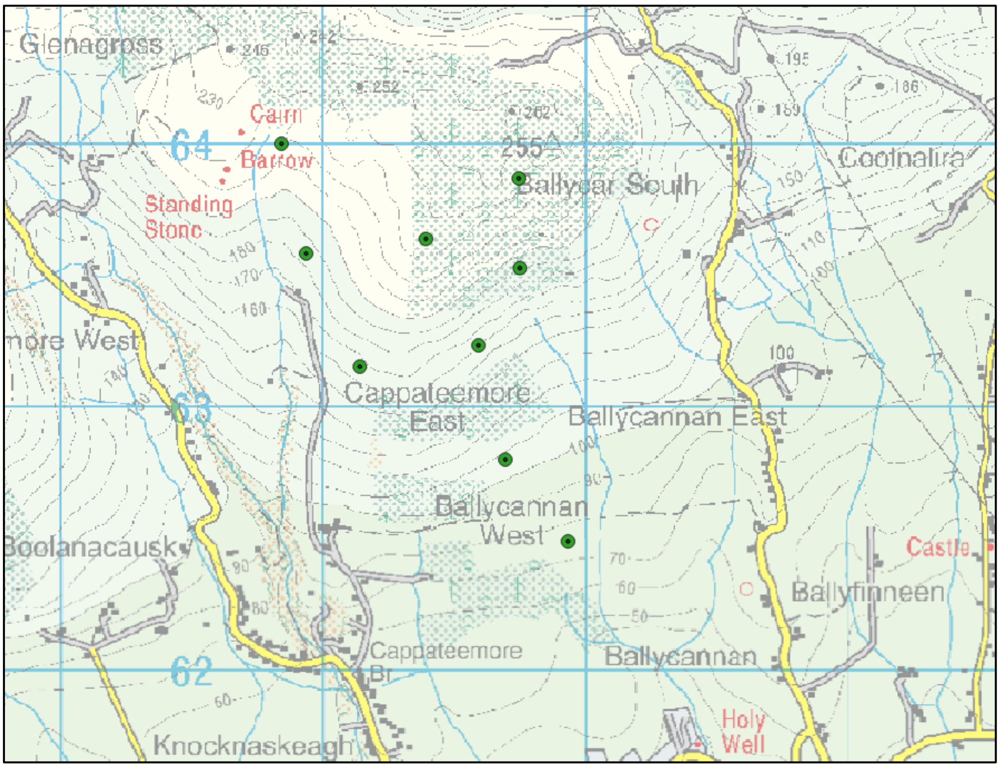

Figure 4-8: Iteration 1 – 9no. 175m Tip Height Turbine Layout

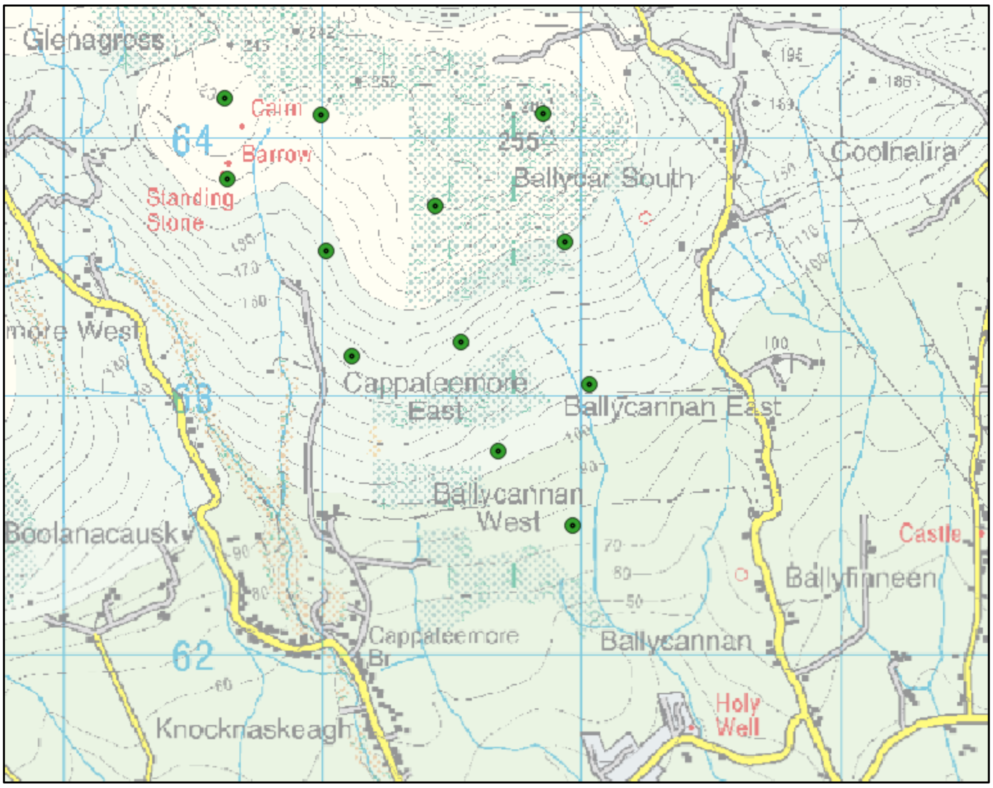

Figure 4-9: Iteration 2 – 12no. 158m Tip Height Turbine Layout

Figure 4-10: Iteration 3 – Relocation of T1 – Increase distance from area of Upland Bog/Wet Heath

Figure 4-11: Iteration 4 – Relocation of T2 - Increase distance from Archaeological Features

Figure 4-12: Iteration 5 - Relocation of T12 to Avoid Felling of Woodland

Figure 4-13: Iteration 6 – Relocation of T10, Turbine Foundation outside watercourse buffer

Figure 4-14: Iteration 7 – Relocation of T6 due to landowner considerations

The final layout represents the most appropriate design for the site conditions, following an iterative approach of design optimisation 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	500m setback from dwellings	Increased setback from dwellings
Biodiversity	Larger area across site	Sensitive habitats avoided, reduced development footprint
Air and Climate	Large scale project	Large scale project
Landscape and Visual	15 turbines (150m)	Reduced number of turbines and visual effect
Water	50m watercourse buffer to turbine locations	50m watercourse buffer to all works associated with turbines
Land and Soils	Interaction with area of upland bog/wet heath	Low risk design and area of upland bog/wet heath avoided
Noise	500m setback from dwellings	Increased setback from dwellings
Cultural Heritage	Turbine works within archaeological buffer	No works within archaeological buffers

4.4.2 Alternative Grid Connection Methodologies

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

4.4.2.1 Alternative Substation and Grid Connection Infrastructure

The proposed development site is located within close proximity to existing and consented transmission infrastructure and has a viable connection to the National Grid.

Potential connection options to the existing Ardnacrusha substation south east of the proposed development were examined. This included both underground (UGC) and overhead (OHL) connection options. These are outlined below in Table 4-6 and displayed in Figure 4-15.

Table 4-6: Connection Options Considered to Ardnacrusha 110kV Substation

Option	UGC/OHL	Distance (km)
1	UGL (via existing public road network)	3.5km
2	UGL (via 3rd party lands)	3.1km
3	OHL	3.5km

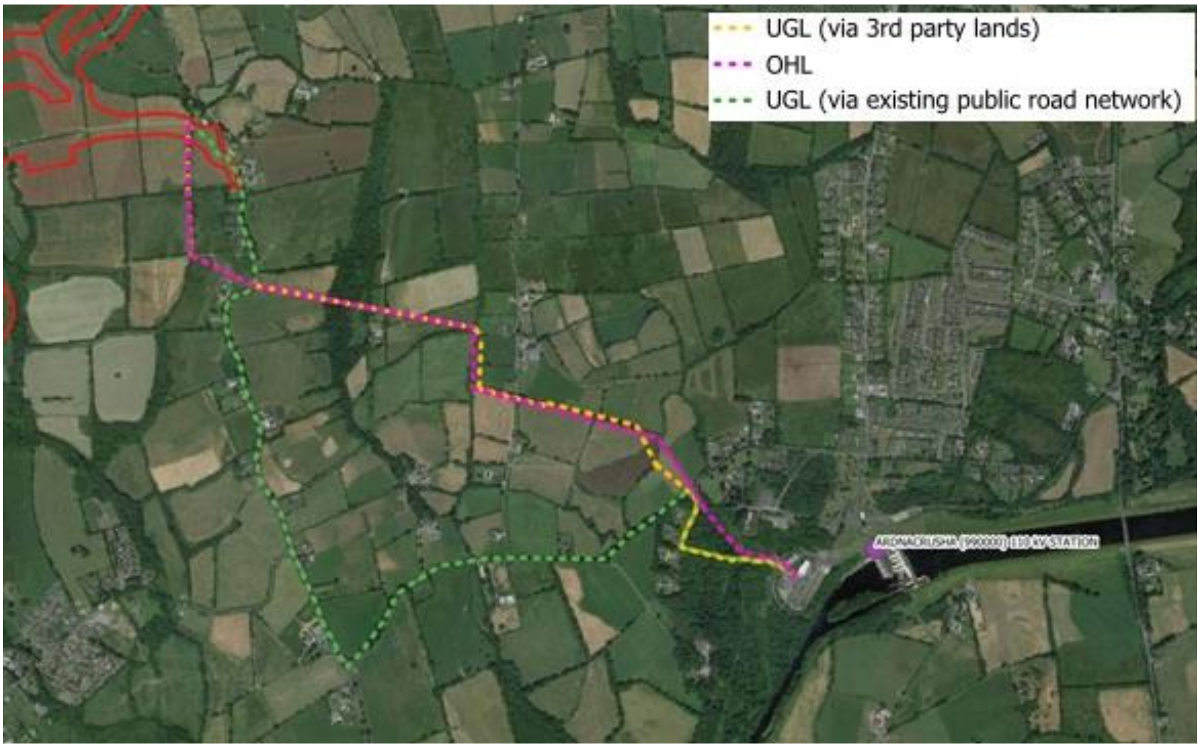

Figure 4-15: Connection Options Considered to Ardnacrusha 110kV Substation

Due to the proximity of the proposed development to existing overhead transmission lines, consideration was given to connecting the development to this infrastructure as an alternative to connecting to Ardnacrusha 110kV substation. **Figure 4-16** outlines the location of the Ardnacrusha – Ennis and Ardnacrusha – Drumline 110kV overhead lines in relation to the proposed development.

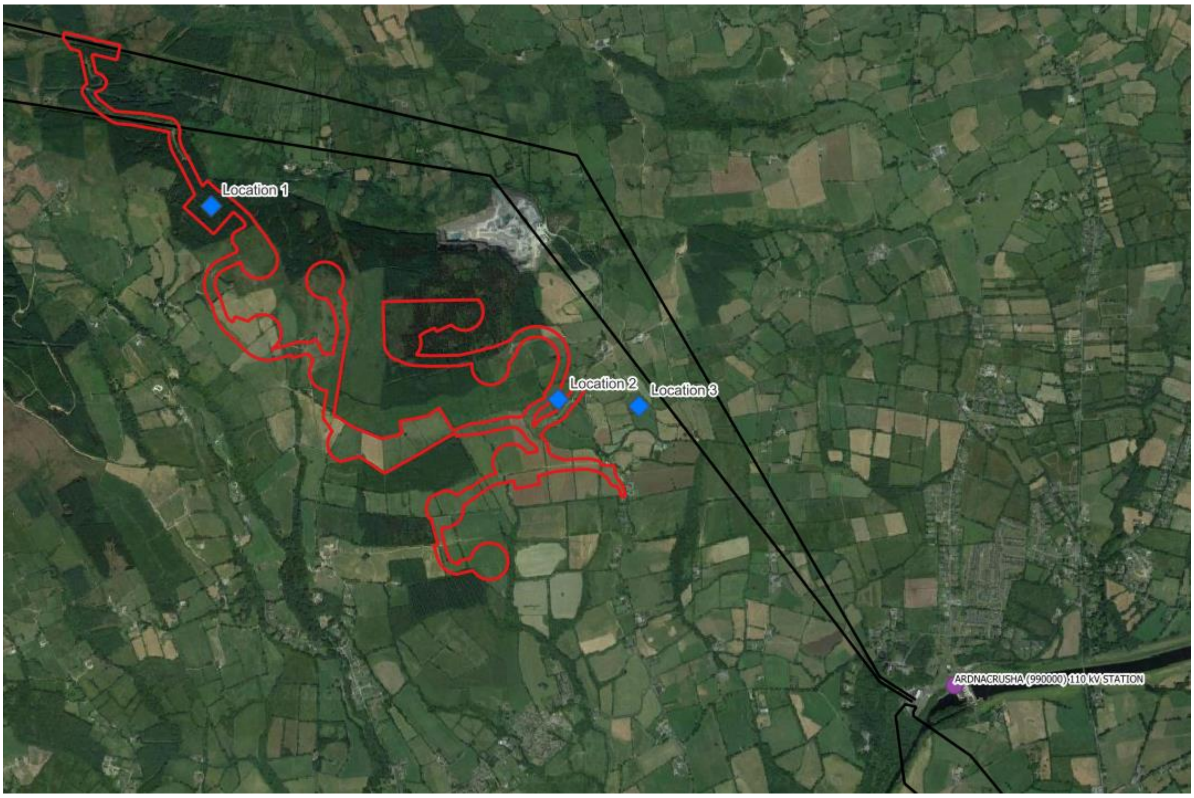

Figure 4-16: Existing OHLs in the vicinity of the proposed development

To connect to existing 110kV overhead lines (OHL), a loop-in connection with a new substation is required. Several locations in relation to the loop-in substation and connection point to the OHL were considered as outlined in **Figure 4-16**. **Table 4-7** outlines a comparison in relation to the 3 locations considered.

Table 4-7: Loop-in Substation Location Comparison

Location	UGC/OHL
1	Preferred location – reduced Biodiversity, Visual, Noise effects.
2	Initial proposed substation location, relocated to reduce Landscape and Visual, Noise effects.
3	Potential for Biodiversity, Visual and Noise effects.

Based on the various connection methods identified, these were ranked in relation to the most favourable options.

Table 4-8: Substation and Grid Connection Options Ranking

Rank	Description
1	Substation and Loop-in to existing 110kV OHL (Location 1)
2	UGL to Ardnacrusha 110kV substation (via existing public road network)
3	UGL to Ardnacrusha 110kV substation (via 3rd party lands)
4	Substation and Loop-in to existing 110kV OHL (Location 2)
5	Substation and Loop-in to existing 110kV OHL (Location 3)
6	OHL to Ardnacrusha 110kV substation

Ultimately, the substation (location 1) and grid connection route to the existing 110kV overhead line located northwest of T1 (**Figure 4-16**) was selected for the following reasons:

- Reduced traffic disruptions in comparison with the route to Ardnacrusha 110kV substation along approximately 3.5km stretch of local road;
- Utilisation of approximately 1,020m of existing forestry track minimising the requirement for new access track infrastructure associated with the connection;
- Reduced impact to existing utilities located along public roads;
- Enhancement of the electricity network through the addition of a new "loop in" substation providing potential for additional connections into the future;
- Low impact on biodiversity as a result of utilising existing forestry tracks for the majority of the connection;
- Reduced number of watercourse crossings in comparison with the other options.

Table 4-9 shows the comparison of potential environmental effects of the grid connection and proposed substation for the first 3 ranked options.

Table 4-9: Comparison of Environmental Effects of grid connection and proposed substation options

Environmental Factor	Grid Connection and proposed substation to the existing Ardnacrusha 110kV substation (Public Road)	Grid Connection and proposed substation to the existing Ardnacrusha 110kV substation (Overland)	Grid connection and proposed substation to existing Overhead line (Underground) Preferred Option
Population and Human Health	Traffic disruptions during construction phase along approximately 3.5 km stretch of local road.	Traffic disruptions at two localised crossing points on local roads during construction phase.	Traffic disruptions at one localised crossing point on local road during construction phase.

Environmental Factor	Grid Connection and proposed substation to the existing Ardnacrusha 110kV substation (Public Road)	Grid Connection and proposed substation to the existing Ardnacrusha 110kV substation (Overland)	Grid connection and proposed substation to existing Overhead line (Underground) Preferred Option
Biodiversity	No Effect	Habitat losses. Requirement for significant established woodland felling and habitat splitting. Hedgerow loss.	Low impact on biodiversity along the majority of the grid which is to be located in existing forestry tracks. There will be felling associated with the substation location.
Ornithology	No Effect	Displacement and disturbance of species utilising woodland and hedgerow.	Low impact on birds along the majority of the grid which is to be located in existing forestry tracks. Some localised displacement and disturbance of species utilising woodland and hedgerow.
Air and Climate	Emissions during construction phase.	Emissions during construction phase.	Emissions during construction phase.
Lands and Soils	Temporary removal of overburden during laying of cables. Cut and fill requirements associated with substation.	Temporary removal of overburden during laying of cables. Cut and fill requirements associated with substation.	Temporary removal of overburden during laying of cables. Cut and fill requirements associated with substation.
Water	Total of 4 No. water crossings.	Total of 5 No. water crossings.	Total of 2 No. water crossings.
Noise	Construction phase noise	Construction Phase noise	Construction Phase noise. Nearest noise sensitive receptor (NSR) to proposed substation is further distance (418m) than previous substation location, which was approximately 120m from NSR.
Landscape	Potential Landscape and visual effects from substation	Potential Landscape and visual effects from substation	Reduced Landscape and visual effect

Environmental Factor	Grid Connection and proposed substation to the existing Ardnacrusha 110kV substation (Public Road)	Grid Connection and proposed substation to the existing Ardnacrusha 110kV substation (Overland)	Grid connection and proposed substation to existing Overhead line (Underground) Preferred Option
Cultural Heritage	No Effect	Potential for underground impacts.	Potential for underground impacts. This should be minimal in previously disturbed ground along forestry tracks.
Shadow Flicker	No Effect	No Effect	No Effect
Material Assets	Additional traffic during construction phase. Single lane road closures during construction along circa 3.5 km of local road.	Single lane road closures during construction at two localised local road crossing points.	Single lane road closure during construction at one localised local road crossing point. Minimal impact on existing utilities as majority of grid will be located off road.

4.4.3 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 the internal access tracks and source of aggregate materials. These are discussed in the following subsections.

4.4.3.1 Internal Access Tracks

The primary objectives when designing the new internal access tracks was to utilise existing tracks where possible and to locate infrastructure where ground conditions were most suitable. Maximum use has been made of existing tracks, however the proposed development, will require new tracks to the majority of the turbines.

New excavated tracks will be constructed using site won stone aggregate obtained from the proposed on-site borrow pit and 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.

Table 4-10: Comparison of Environmental Effects of Access 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 of minor forest felling	Requirement of minor forest felling
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 and nearby forestry and will allow for no visual impact on surrounding receptors	Screened by existing vegetation and nearby forestry and 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.

4.4.3.2 Borrow Pit

An on-site borrow pit is proposed as a source of stone and aggregate materials for the development to minimise the amount of imported material and HGV traffic to the site during the construction phase. The only other potential alternative is to import all the material from authorised quarries outside of the site which would result in additional significant traffic on public roads.

Table 4-11: Comparison of Environmental Effects of Material Sourcing

Environmental Factor	On-site Borrow Pit	Imported Material
Population and Human Health	Volume of traffic on public road networks kept to a minimum	Increased public disruption due to increased traffic volumes on public road networks associated with import of materials
Biodiversity	Loss of habitat	No loss of on-site habitat
Ornithology	No Effect	No Effect
Air and Climate	Vehicle emissions	Increased effect due to vehicle emissions
Lands and Soils	Ground surface disturbance. Provision of suitable repositories for storage of surplus excavated soils	Alternative engineered storage facilities required on site for placement/storage of surplus excavated soils or else transported off-site
Water	No effect	No effect
Noise	No effect	Off-site Noise emission
Landscape	No effect	No effect
Cultural Heritage	No effect	No effect
Shadow Flicker	No effect	No effect
Material Assets	Volume of traffic on public road networks kept to a minimum	Additional traffic on public road networks

The preferred alternative is to develop and utilise on site aggregate resources over importation where feasible due to:

- The advantages of reduced traffic volumes on the public road network and associated reduced public disruption, noise, and air quality effects;
- The advantages that an on-site borrow pit provides suitable repositories for storage of surplus excavated soils.

4.5 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 CO2 emissions will be lost. The proposed project will result in a long-term, significant, positive effect in contributing to Ireland's renewable energy targets and offsetting CO2 emissions.

A do nothing scenario would result in the continuation of agriculture and commercial forestry 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 agricultural activities and alternating felling and replanting of forestry.

4.6 Conclusion

The project design process and reasonable alternatives were completed with reference to EIA Directive and EU Guidance Document 2017.

The proposed development has been designed to minimise potential environmental effects 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 (iteration number 7) was determined based on multi-discipline inputs and consideration of topography, biodiversity, land and soils, archaeology, hydrology, landscape, and 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 large scale renewable wind energy development.

4.7 References

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