# 4 PROJECT DESIGN PROCESS AND ALTERNATIVES CONSIDERED

## 4.1 INTRODUCTION

This Chapter outlines the reasonable alternatives considered during the project inception and design process and the principal reasons for proceeding with the proposed development.

The Consideration of Alternatives is a mandatory part of the EIA process. The legal requirements of the 2014 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 "*Guidance on the preparation of the Environmental Impact Assessment Report*"[1] (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 Draft EPA guidance "*Guidelines on the information to be contained in Environmental Impact Assessment Reports*" (2017) 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.*"

1. See: http://ec.europa.eu/environment/eia/pdf/EIA_guidance_EIA_report_final.pdf

That 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 need 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 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. The following elements are considered further in this chapter:

- Site Selection
- Project Design Process
- Alternatives Considered

## 4.2 SITE SELECTION PROCESS

Below is a description of the Applicant's site screening and site selection process and an examination of a number of potential alternative locations. The site selection process was completed by the Applicant during 2018.

In locating potential sites, the Applicant carried out a desk-based geographical information system (GIS) screening exercise in 2018. This identified all registered environmental designations, protected views, cultural and heritage sites and other areas of special sensitivity. These areas and their surrounds were not considered for future development.

**Table 4-1 2018 Feasibility Study - Key Development Constraints**

| Development Constraints | | |
|---|---|---|
| • wind speed | • proximity to existing grid | • airports |
| • existing generation in the region | • existing electrical loads in the region | • environmental designations and sensitivities |
| • tourism amenity | • grid line route | • topography |
| • haulage route | • land use | • water bodies |
| • landowner status and number of landowners | • level of grid upgrades required to accommodate project | • turbary rights |

Residential and commercial building locations were attained from Eircode's database of 2.2 million address points. A buffer of 700m was applied to each building point, provisionally ensuring an adequate setback distance from each dwelling. This setback distance could later be altered based on site specific conditions, ensuring compliance with all relevant guidelines and regulations. This produced an output of multiple sites which were suitable for development according to relevant planning guidelines.

A concerted effort was made at this stage to focus attention on development within Kerry County Council's designated "Strategic Site Search Zones", as illustrated in the Renewable Energy Strategy (2012).

As depicted below, there were not sufficient "Buildable Areas" within this zone after excluding all environmental designations, state lands and housing setbacks, to establish a wind farm project in-keeping with Kerry County Council and national planning guidelines. The primary issue is the housing density within these zones. Therefore, the Applicant focused primarily on areas zoned by the council as "Open to Consideration" for wind energy development.

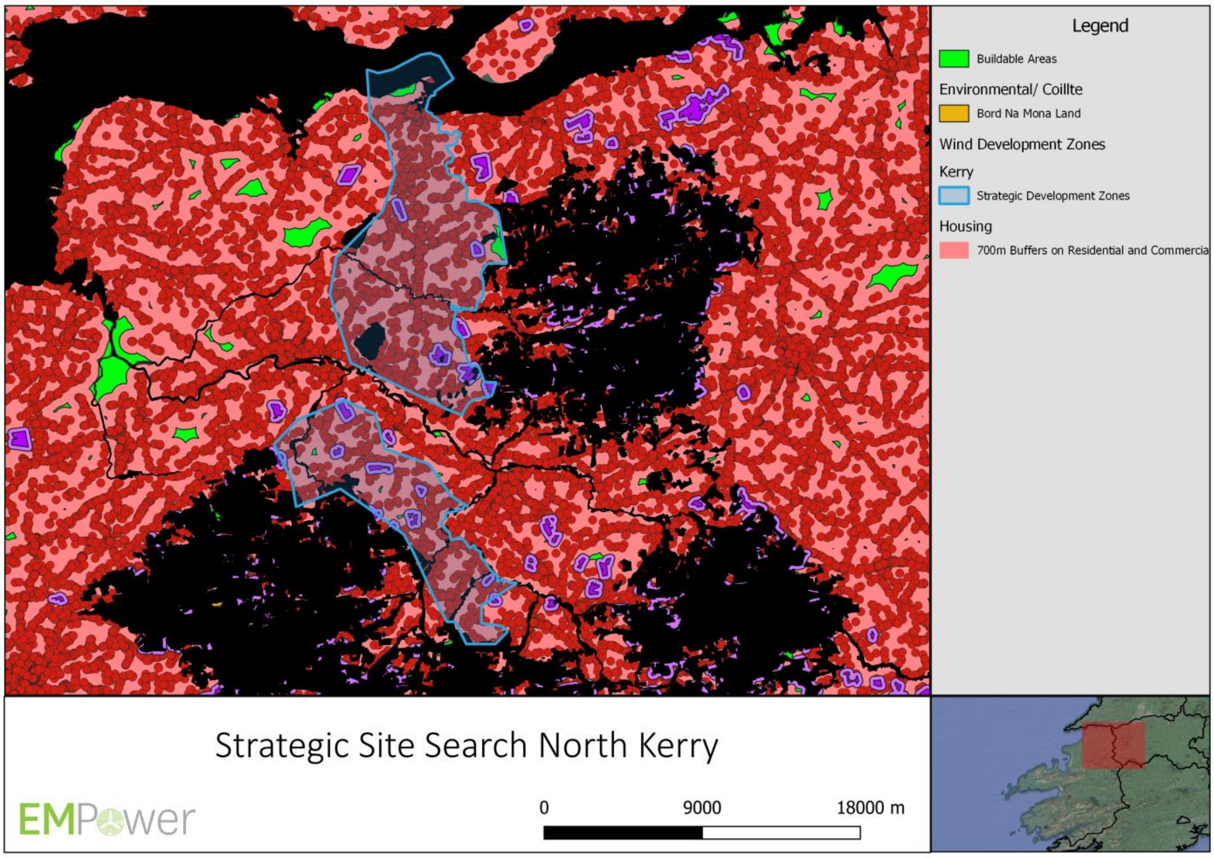



**Figure 4-1**. **Strategic Site Search Analysis 2018**

The Buildable Areas were subsequently cross referenced against Ireland's wind resource, provided through a research wind map, along with the existing electricity grid infrastructure. All sites with a wind speed of less than 6 m/s at a height of 80m were considered to have insufficient wind resource. All sites that were located at a distance of greater than 20km from an existing transmission substation were considered to be of uneconomic distance from grid. These sites were excluded from the development screening process.

Based on this analysis, four sites were selected for further investigation; Derrinculig which is situated near Kilgarvan, Shronowen which is located 6km north of Listowel, Knockmanagh which is due east of Killarney, and Killognaveen which is due east of Cahirciveen. These sites are illustrated and listed in the figures below. Site visits were carried out in early 2018 to verify ground conditions, land use, transport infrastructure, potential impacts on tourism and aesthetics, as well as proximity to existing electrical substations.

After a detailed site investigation, each project was evaluated based on key characteristics, the results of which are demonstrated in the Table 4.2.

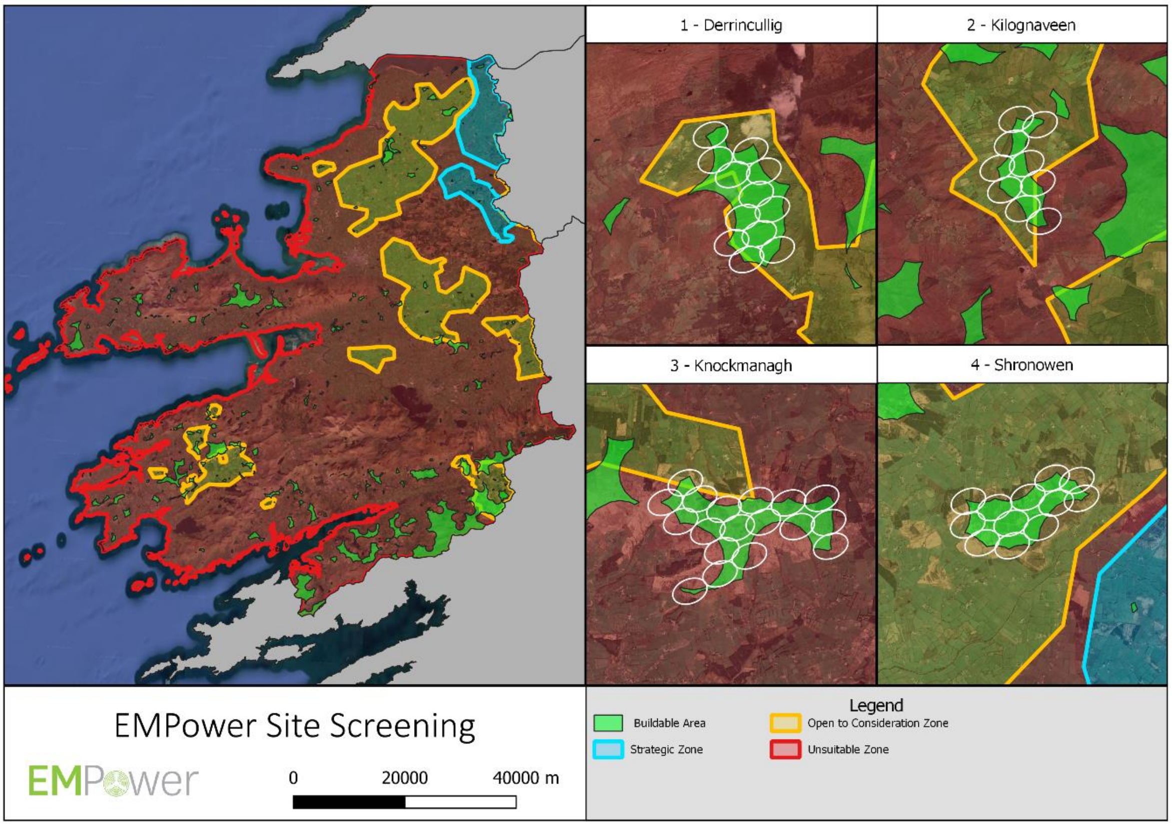



**Figure 4-2. Strategic Search Area – Identification of Potential Sites**

### 4.2.1 Derrincullig

The Derrincullig site is located within a large "Open to Consideration" area in the mountains bordering counties Kerry and Cork. This site is in the vicinity of several existing wind farms, including Coomagearlahy 1,2 and 3, Midas and Grousemount Wind Farms. There was a previous application submitted including lands within this site, which was refused by Kerry County Council and An Bord Pleanála in 2013 and 2014 respectively. Reasons cited in the refusal included the visual impact that the project would have on the landscape. Although this site is in the "Open to Consideration" zone and it may be possible to minimise the visual influence on the landscape through layout design, the Shronowen site is deemed to be of less impact and a preferable development opportunity.

### 4.2.2 Killognaveen

The Killognaveen site is located due east of the town of Cahirciveen in South Kerry. It is located within Kerry County Council's "Open to Consideration" wind development zone and benefits from an excellent wind resource. The site is located within 5km of the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC. In addition, the site is situated 34km from the nearest substation, Oughtragh 110kV substation, which may present economic challenges concerning grid connection. For these reasons, the proposed Shronowen Wind Farm is considered a lesser impact and more technically feasible alternative.

### 4.2.3 Knockmanagh

The site screening process showed the Knockmanagh site, which is located approximately 7.5km due north-east of Killarney, to have strong wind resource and a relatively large contiguous buildable area. This is a rare combination given the housing density of many parts of rural Ireland. The site is also situated within close proximity to Knockearagh substation. However, the site falls outside Kerry County Council's "Strategic Site Search" and "Open to Consideration" wind development zones and would be clearly visible from areas of Killarney National Park and the Mcgillicuddy's Reeks mountain range. The proposed Shronowen Wind Farm was therefore considered a lesser impact alternative.

### 4.2.4 Shronowen

The Shronowen site is located approximately 6km due north of Listowel town in North Kerry. It is situated in a mainly flat rural landscape, with a mix of agricultural lands and areas of bog. Shronowen's comparative advantage is demonstrated across numerous categories in Table 4.2 below. Based on the analysis completed, it was deemed to present the most viable opportunity from a technical, financial and planning perspective, while imposing the least impact on its receiving environment.

**Table 4-2 EMPower - Comparative analysis of potential wind farm development sites, 2018.**

| | Derrinculig | Killognaveen | Knockmanagh | Shronowen |
|---|---|---|---|---|
| Turbines | 13 | 11 | 19 | 12 |
| KCC Wind Dev. Zone | Open to Consideration | Open to Consideration | Unsuitable | Open to Consideration |
| Wind resource | Class 2 | Class 2 | Class 2 | Class 2 |
| Tourism/ Environmental risk | High – Situated within 2km of McGillycuddy's Reeks SAC. Visual impact sited as reason for refusal of previous planning application on site. | High – Views possible from Macgillicuddy's Reeks | High – SAC 2.6km from site, views possible from Macgillicuddy's Reeks and Killarney National Park | Medium – Not located within a high-volume tourism area. |
| Ornithology risk | High – Eagle activity sited as reason for refusal in previous planning application | Medium - Area not known to have Annex 1 birds present | Medium - Area not known to have Annex 1 birds present | Medium - Area not known to have Annex 1 birds present |
| Grid risk | Medium – Numerous existing and under construction wind farms in the vicinity. Clonkeen substation located 7km from site. | High – 34km to Oughtragh 110kV substation, need for deep connection works, no guarantee on timeline | Low – 5km north of Knockearagh substation where available capacity exists | Low – Tralee to Kilpadogue 110kV line runs through site, no need for external grid connection |
| Planning precedence in area | Coomagearlahy 1,2 and 3, Midas and Grousemount Wind Farms in the vicinity. There was also a previous application submitted including | Cahirciveen project located 1.5km from Killognaveen site. Cumulative | Barna Wind Farm 8km East. Not as much cumulative presence of wind farms as | Tullahennel and Leanamore projects within 5km. |

| | | | | |
|---|---|---|---|---|
| | lands within this site, which was refused by Kerry County Council and An Bord Pleanála in 2013 and 2014 respectively. | effect must be considered. | other alternatives, local residents may not be familiar with wind development. | |
| Terrain/ land use | Mountainous, bog, agricultural | Rural general, peat harvesting, bog | Rural general, peat harvesting, bog | Rural general, bog, peat harvesting, small forestry |
| Housing Density | Low | Medium | Medium | Medium |

Following on from completion of the site selection process, the Applicant met with the planning department of Kerry County Council in February 2019 to discuss the proposed Shronowen wind farm site and the approach being adopted in the preparation of a planning application. The initial intent of the applicant was to submit the application to Kerry County Council as the original project was to have between 7 and 10 turbines and this would have been below the Strategic Infrastructure threshold of 50MW or 25 turbines.

The EIA baseline assessments were completed during 2019 and a development area was established. As studies progressed it was proposed that there would be potential for 10-12 turbines subject to compliance with the requirements of the national wind energy guidelines and subject to completion of all ecological and EIA impact studies. A series of design iterations were then developed, and this process led to a layout of 12 turbines. Given a candidate turbine of 4.2 MW, this 12-turbine layout amounts to a 50.4MW generation capacity and this moved the application into the Strategic Infrastructure Development process in accordance with the Strategic Infrastructure Development Act 2006. Wind Farm development projects that have a capacity in excess of 50MW or have more than 25 turbines automatically fall with the Strategic Infrastructure criteria. The SID pre-application process further confirms the status of a project.

The pre-application consultation with An Bord Pleanala took place in two meetings held in April and July 2020 with the Board confirming Strategic Infrastructure project status in September 2020.

## 4.3 DESIGN PROCESS

The proposed development 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 process which informed and identified the buildable areas suited to turbines, roads and infrastructure based on avoidance of unsuitable areas and following the good practice of mitigation by design.

The proposed layout and design was also driven by the following parameters:

- Set back from housing driven by compliance with noise limits and wind farm guidelines
- Availability of lands for development from interested landowners
- Working within the parameters of turbary and rights of way mapped within Shronowen bog
- Suitable location for a 110kv substation in close proximity to the existing Kilpaddoge to Tralee 110kv line.

- Ground conditions relative to depth of peat and constructability of infrastructure
- Turbine model and blade length relative to turbine delivery route to site
- Set back from any known archaeological features
- Buffering from streams and watercourses

The EIA process and constraints driven approach identified the key constraints and thus the suitable or buildable areas for wind farm infrastructure were identified. Throughout the design process the three main drivers to the extent and layout of the site were set back from houses, peat depths and available lands/avoidance of turbary.

### 4.3.1 Identification of Environmental Sensitivities

The EIA (Environmental Impact Assessment) 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 investigations between 2019 and 2020 have informed the proposed development EIA and planning application.

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

- Shadow Flicker
- Noise
- Public Roads and access
- Ornithology
- Soils, Geology and Peat
- Archaeology
- Landscape and Visual Impact Assessment (LVIA)

This analysis of constraints identified environmental concerns, or the potentially significant environmental impacts, associated with the proposed wind farm development site. Environmental concerns consisted of constraints (e.g. peat depths within the bog) or setback distance (e.g. buffer from a nearby house). 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 guidance documents, 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 |
|---|---|
| Shadow Flicker | Proximity to houses, and the existences of several operating wind farms nearby and wind farms that have planning and not yet constructed. Cumulative effects needed to be considered. |
| Noise | Proximity to houses, and the existences of several operating wind farms nearby and wind farms that have planning and not yet constructed. Cumulative effects needed to be considered. |
| Public Roads | The width and scale of local roads in relation to importation of materials, passing bays, local traffic and the necessity for a traffic management plan. |
| Ornithology | Hen Harrier noted during two years of bird surveys, but primarily skirting the site edge or offsite with defined patterns of use. |
| Soils and Geology | Identification of extensive peat depths across the bog varying from zero to 6.7m in depth. Lands are primarily flat with extensive cut over areas and some areas of intact peat banks. Peat depth in terms of engineering a constructability solution and removal and storage of peat on site. |
| Archaeology | No monuments on site. But there is established evidence of significant archaeological finds in bog lands in North Kerry. |
| LVIA | Identification of Zones of Theoretical Visibility (ZTV) within 30km of the proposed development. There are a number of operating, and granted wind farms adjoining, or in proximity to the proposed project site, so cumulative effects would be a key focus. |

#### 4.3.1.1 Shadow Flicker

The proposed wind farm site is located in rural north Kerry and there are one off houses and local farmsteads in proximity to the site. The locations of all properties were mapped and verified with site visits. All house locations were logged with location co-ordinates and the data was used within a shadow flicker model. The model identifies the theoretical amount of shadow flicker that could occur at any property based on a series of parameters. However, all new wind turbines come with shadow flicker management modules which can be programmed to eliminate shadow flicker effects and thus Shadow Flicker is not an issue for this project.

#### 4.3.1.2 Noise

At the outset of the project, the locations of all properties were mapped within GIS and verified by site visits. A number of receptor zones were identified that represent the closest individual or clusters of houses that are in proximity to the proposed wind farm site. Baseline noise monitoring is then completed. Once baseline monitoring is completed then a series of candidate wind turbines are selected and these are then modelled relative to noise levels set out in the Wind Energy Development Guidelines (2006) in order to ensure that the design layout meets the noise limit criteria. The noise model then identifies any constraints or potential risk areas. This then informs the positioning and location of the final turbines on the proposed site.

#### 4.3.1.3 Public Roads and Access

As outlined in the Wind Energy Development Guidelines (2006) in regard to turbine proximity to 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 layout of the proposed development has maintained a setback of tip height +10% to the closest turbine to the L6021. Turbine T2 is 171m setback from the L6021 and all other turbines are in excess of that minimum setback. The wind turbines are significantly set back from any regional or National Road to the location of the site relative the road network.

Local roads adjacent to the site and serving as access to the site from the regional and national routes are narrow in nature. This is a consideration in terms of traffic management during the construction phase of the project. A traffic management plan is required and a one-way system of entry and exit is required in order to facilitate delivery of construction materials including imported stone, hardcore, geotextile, steel, ready mixed concrete and general building materials. This can be accommodated given the road network locally and also the two entrances to the project would facilitate this. In addition, there are a number of options available to apply local diversions if required during period of increased or concentrated traffic volumes.

Delivery of turbine components from Foynes Port to the Site will use the eastern access only. Once components are offloaded on site the empty trucks/trailers can then exit the site via the eastern entrance.

A Turbine Delivery Route (TDR) assessment has been completed which examines the delivery of wind energy turbine components from the Port of Foynes to the site. The TDR follows a proven route for wind turbine deliveries that has been used for the construction of projects in North Kerry including the adjacent Leanamore Wind Farm and Tullahennel Wind Farm projects. There are a number of other possible routes to deliver turbines from the ports of Cork or Galway, but each of those routes will have to approach the site using the road from Foynes and onwards to Tarbert and to the site in North Kerry. The route from Foynes Port is the shortest and most viable route to site for wind farm components. Localised hedge trimming, temporary removal of signage and improvement to road edges will be required along the route. The delivery of the wind turbine components will be the subject of a permit for abnormal load delivery from Kerry County Council and from An Garda Siochana.

#### 4.3.1.4 Ornithology

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

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

#### 4.3.1.5 Soils, Geology and Peat

The proposed wind farm site is located within a peatland complex in north Kerry. The Shronowen bog has been heavily modified over time with extensive drainage and peat harvesting having taken place over the last century. The bog has extensive areas of cutover or worked out peat deposits, active peat cutting areas and areas of intact peat. In the initial walkover surveys peat probing was completed to understand the typical depths of peat on site at different locations. It was apparent that there were areas of the bog where there were depths of peat exceeding 6 metres in depth which is significant. However, the lands and bog areas have a flat topography, and does not have a presence of watercourses or streams. The bog has a network of drains that feed to a local stream to the north of the site and to a local river to the south of the site. Drainage of the bog has taken place in order to facilitate the harvesting of turf overtime.

Peat depths while significant did not drive peat stability risk, rather the deep depths pose a challenge in terms of the volume of peat excavation required for infrastructure and storage of same on site in permanent suitable locations. The engineering focus is on constructability, peat storage and methods of road construction along with localised approach at each turbine location.

Following on from the initial desk study constraints identification, further investigations were completed on the site. The investigations consisted of peat probing, gouge coring and shear strength testing (with hand shear vane). The analysis of this data, together with knowledge gained on site, was used to broadly classify the site in terms of low, medium and high-risk areas. Any identified high-risk areas would then be avoided or buffered when developing a layout. Full details are provided in the Peat Stability Risk Assessment Report (See Volume 3 of EIAR).

#### 4.3.1.6 Archaeology

The assessment was completed using a combination of (1) desk-based assessment of all available archaeological, historical, cultural and cartographic sources; (2) inspection of the limits of the proposed development site first in January 2019 and final re-visit in August 2020. The following steps or resources were used in completing the assessment:

- Sites and Monuments Records / Record of Monuments and Places
- Topographic Files of the National Museum of Ireland
- Excavation Bulletin
- Placename Studies
- Historic Ordnance Survey mapping
- Analysis of aerial imagery

The outcome of the abovementioned desk studies and associated fieldwork and baseline studies demonstrated that there were no archaeological constraints that would limit the development of a wind farm layout. Given the historical records of archaeological finds in the boglands of north Kerry along with the mapped and known archaeological features in North Kerry it was prudent to complete an extensive assessment of the site.

#### 4.3.1.7 Landscape and Visual

The Kerry County Development Plan 2015 – 2021 and associated Renewable Energy Strategy (RES) has identified primary areas in north Kerry for the development of wind farms. This zoning and the availability of strong grid infrastructure in north Kerry has prompted developers to put forward, design and construct a number of wind farm projects. Projects have been granted by Kerry County Council and by An Bord Pleanala following appeals.

Recently constructed wind farm development projects include:

- Leanamore Wind Farm
- Curraderrig Wind Farm
- Tullahennel Wind Farm

In addition, Ballylongford Wind Farm was granted planning by An Bord Pleanala and a second project called Ballyhorgan Wind Farm is currently with An Bord Pleanala for further consideration. North Kerry has become a landscape dominated by energy infrastructure including Tarbert Power Station, High Voltage infrastructure with 400, 200 and 110kv infrastructure coupled with a number of operating and planned wind farms. This evolution in landscape character has been driven by Development Plan zoning and policy.

The approach in LVIA considers the current North Kerry landscape, possible future projects and current wind farm development zoning, as prescribed by the Kerry Wind Energy Strategy 2012. The approach included a desk study, site visits, generation of ZTV, wireframes and preliminary viewpoint montgages in order to assist in assessing the impact of the proposed Shronowen project on the landscape. Cumulative impact is a key aspect, given the presence of energy infrastructure in north Kerry, versus the capacity of the landscape and zoning.

#### 4.3.1.8 Public Consultation

Public information events were organised to provide the public with an overview of the project, answer questions and receive feedback, concerns and recommendations for evaluation in the EIAR.

The Applicant held the first Public Consultation event on the 25th September 2019 at the Ballydonoghue GAA club in Coolard, Listowel, Co. Kerry. This event was published in the Kerry's Eye Newspaper on the 19th September 2019 and was organised to introduce the project to the local community. Information regarding the environmental impact assessment activities being undertaken, as well as the scale and layout of the project, was displayed through presentation materials enclosed in **Appendix 1-4**. Public consultation brochures, summarising the project were provided to all attendees. It was estimated to have been attended by approximately 40 local residents.

In September 2019, a project website was also established in order to share information with the local community (www.shronowenwindfarm.ie). This website will continue to be updated regularly by the applicant throughout the development of the proposed project.

A second event was scheduled for April 2020 but this had to be postponed due to Covid-19 restrictions. The Applicant attempted to reschedule and host another public consultation event on 26th August 2020, which was advertised in the Kerry's Eye Newspaper on 13th August 2020. Government restrictions surrounding COVID-19 also necessitated the postponement of this event.

Furthermore, while the Applicant had scheduled to perform door to door visits to all local residents situated within 2 kilometres of the project in May and again in August of 2020, this was not possible as it would contradict the public health guidance at the time.

In order to ensure the health and safety of staff and local residents during public consultation, the applicant sent a letter to each household within 2 kilometres of the project on 9th September 2020. This letter outlined the proposed project and invited the recipient to a live online Public Consultation Webinar, hosted by the applicant on 17th September 2020. This event was advertised in the Kerry's Eye Newspaper on the 10th September 2020. During this Webinar, information on the ongoing environmental impact assessment, project design and the community fund allocation was presented. There was also an interactive Q&A session during which the applicant answered questions submitted by local residents. The materials presented at this Webinar are included in **Appendix 1-4**.

Additionally, the applicant established a Virtual Consultation Room for the proposed Shronowen Wind Farm. This resource can be accessed through the project website, or directly at the following link (https://tours.innovision.ie/v/90qlym3p1Y6) . This online space allows residents to access information such as videos, project literature, maps and photomontages in an interactive way.

Attendees of the physical public consultation event, the online Public Consultation Webinar and the Virtual Consultation Room were encouraged to submit feedback to the applicant by email, telephone or post.

### 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,  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. deep peat, set back from house, turbary ownership constraints, 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.

One of the prime drivers in developing a layout for the site is the available land area and this is particularly influenced by the extensive number of turbary rights plots across the site. Many of the adjustments in layout throughout the design process were driven by this factor.

### 4.3.3 Preliminary Planning Stage Design

At the outset of the project it was envisioned that a layout of between 7 and 10 turbines may be possible for this site given the available land area. Following identification of the main environmental, technical and engineering constraints for the site, a preliminary layout was developed to fit within available lands that were in control of EMPower and avoided turbary ownership constraints.

The preliminary layout contained 10 turbines with a maximum tip height of 150m and with a hub height of 91.5m and a blade length of 58.5m. This layout was discussed with Kerry County Council planning Department on the 2nd of February 2019. At that juncture in time it was envisioned that this project would have a generating capacity of less than 50MW which is the primary threshold of qualification for the Strategic Infrastructure Development process.

The available buildable areas were located in flat areas of bog with little or no slope but within areas of deep peat. The layout included the preliminary internal road network, provisional locations for turbines, provisional locations for the electrical substation compound, permanent meteorological mast and deposition areas for excavated peat. 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 and more specific ground investigations on which the final detailed design would be developed.

The key drivers in developing the initial preliminary layout were set back from houses and location of infrastructure within available lands and turbary areas where the applicant had control or consent.

Following from the preliminary layout of the project the baseline assessment continued and any constraints were mapped in GIS and used in developing an expanded layout. In parallel, turbary areas were mapped so as to identify no-go areas or key pinch points. A preliminary examination of the likely turbine delivery route from Foynes to port was completed and this was done particularly in the context of 58.5m blade length.

Further analysis was completed by the Applicant that focussed on available turbary areas and increasing the number of turbines from 10 to 12 machines. This approach increased the overall energy yield for the project. The infrastructure required to service a 12-turbine layout was then developed into an advanced preliminary layout. That then had to be tested in terms of environmental, planning and landowner constraints.

#### 4.3.3.1 Position of Turbines

Initial preliminary layouts of 10 and 12 turbines were focussed on available land areas and were driven by setback from houses and avoidance of key constraints. The turbine locations were also dictated by adequate spacing between turbines in order to preserve and maximise energy yield.

Initial peat probing on site identified deep peat that varied in depth between zero and 6.7m in depth. The approach in terms of road layout and access to turbine locations was to use the alignment of existing bog roads with widened and upgraded infrastructure. The main spine roads would then be expanded with new spur roads to access proposed preliminary turbine locations.

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 a number of turbine layout configurations taking cognisance of engineering and environmental constraints including habitat, water features, biodiversity impacts, peat survey data and residential receptors before adopting a 12 turbine layout. See **Table 4-4** below:

**Table 4-4 Constraints Inclusions**

| ASPECT | INITIAL INCLUSIONS |
|---|---|
| Engineering | Peat depths, existing road infrastructure, drainage, access to site, TDR. |
| Traffic and Transport Study | Road highlighted – eastern and western access locations identified, narrow scale local road network. |
| Landholding | Available lands and accommodation of turbary rights. |
| Noise | Mapping of all houses, running of noise model. Meet the limit criteria for noise as set out in the 2006 Wind Energy Guidelines. |
| Hydrology (and the Water Framework Directive) | Drainage, watercourses, buffers of 50m from watercourses. |
| Landscape and Visuals | ZTV, Wireframes, view point montages, site visits, review of scenic areas in the surrounds. Cumulative effects of key concern. Scenic views from Co. Clare across the Shannon Estuary towards north Kerry. |
| Local Population | Houses and buildings, residential setback of minimum of 600m |
| Shadow Flicker | Preliminary model to assess potential impacts on houses within a 10 rotor diameter study area, equivalent to 1.36 km. |
| Biodiversity – Birds (and the Birds Directive) | Mapping of all flight paths of bird species through and passing by the site. Review of data from adjoining wind farm projects + local knowledge of the area by MWP surveyors. |
| Cultural Heritage | Mapping of all national monuments and known areas of sensitivity and applying adequate buffers. |

The proposed turbine locations were initially identified by the applicant's wind resource analysis team with the final locations derived collaboratively between multi-discipline inputs and considerations including ecology, set back from houses, turbary plots, archaeology, engineering, peat depths, landscape assessment etc.

### 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 within available lands. This involved an iterative design process using the preliminary design as a basis for more detailed site assessment and investigations.

Site investigations were carried out along the proposed internal road route, at each proposed turbine location and at the sites of all other infrastructural elements. This detailed information allowed a location specific assessment of the peat stability risk to be carried out along with a buildability assessment in terms of engineering. The site investigations identified significant peat depths across the proposed development footprint, however the ground topography is flat in nature and thus peat slippage or instability risk was not determined as being high. The extensive peat depths require novel approaches to constructing internal wind farm roads, hardstand areas and turbine bases. The driver then became constructability and developing a method of designing and constructing a floating road network within the site. In addition, the approach to excavation and formation of the large footprint required for the turbine foundation base and associated crane hardstand.

This exercise was further informed by very tight land availability due to multiple turbary rights on site. That then meant that infrastructure had to fit within defined available land areas that had little flexibility in movement. Effectively the area available for turbine base and hardstands was within a predefined footprint. Likewise, the road infrastructure layout made the maximum use of existing bog roads while still working within defined corridors that were not restricted by turbary ownership.

Site investigation on site confirmed that there were no suitable borrow pit areas available to source rock on site for use in infrastructure development.

The design/engineering approach adopted was as follows:

- Design of a floating road infrastructure to service all turbine locations – this included both upgrading and widening existing tracks and building new roads.
- Importation of all stone required for road infrastructure, hardstands, substation and compound areas.
- Two construction approaches required for excavation and construction of hardstand and turbines bases. In areas where peat depth does not exceed 3m battered sloped back excavation with adequate working space is used. In areas where peat depths exceed 3m a sheet piled workspace footprint is required for reasons of stability and safety.
- Balancing of excavation volumes relative to peat depths as a site deposition area on site is required for permanent storage.

The presence of deep peat across the site dictates a prescribed approach to construction, and this was further influenced by tight available land footprints that the developer had control of within turbary areas.

Based on this information, the position of turbines, crane hardstandings, roads and other infrastructure were adjusted, relocated or removed so as to work within available lands and within a constructable and engineered solution.

## 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 of the alternative considered is also provided. The alternatives considered include the following:

- Reasonable Alternative Wind Farm Layouts
- Reasonable Alternative Technologies
- Alternative Grid Routes – 2 options explored
- Reasonable Alternative Construction Methodologies

### 4.4.1 Alternative Wind Farm Layout

In total there were 9 No. of iterations considered before determining the optimum layout with minimal environmental impact. The final design layout was primarily influenced by Physical and

Environmental Sensitivities. Key iterations of the wind farm design, which were mainly driven by the mitigation by avoidance strategy, are described in the following sections.

#### 4.4.1.1 Design Iteration No. 1

Iteration No. 1 represents the first layout provided by EMP and this included a layout of 10 turbines. This was initially generated based on wind energy yield and turbine spacing combined with setback from house and focussing within available lands. It also took account of set back from watercourses, avoidance of designated sites or known national monuments.

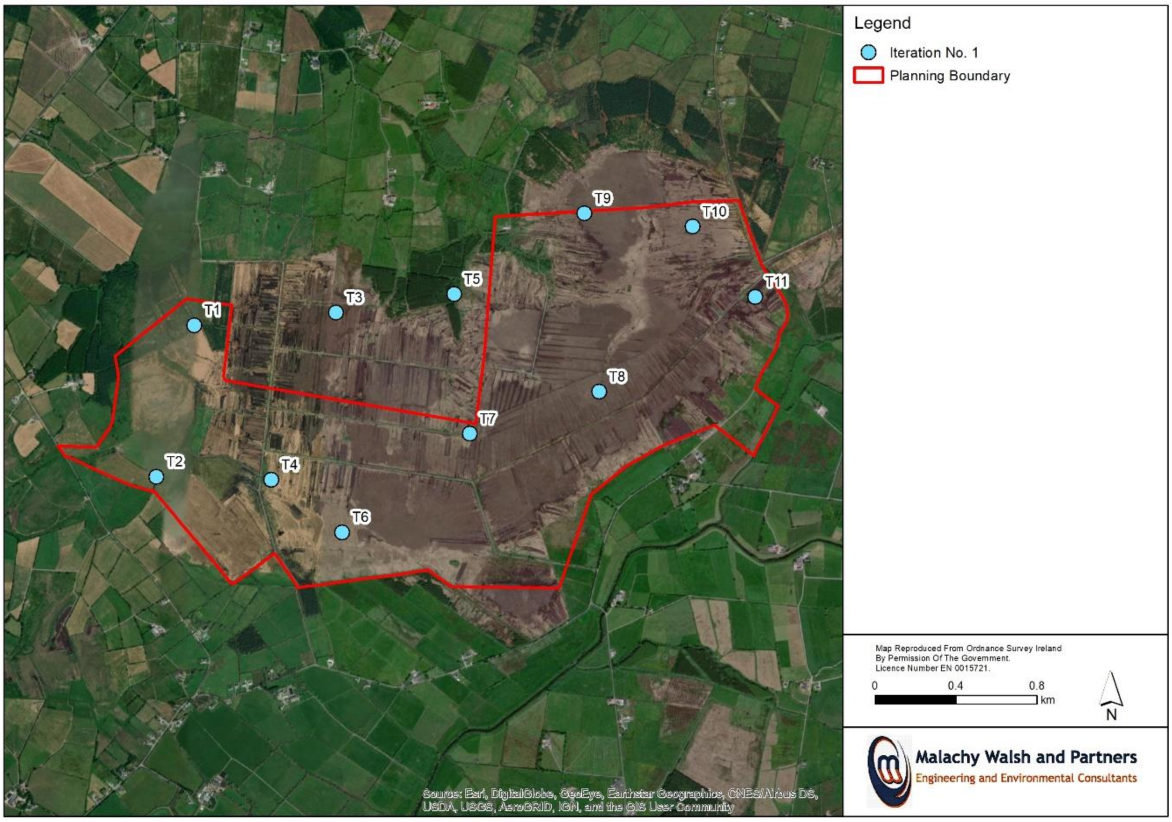



**Figure 4-3 Design Iteration No. 1**

**Table 4-5 Iteration No. 1 Summary**

| | |
|---|---|
| Iteration No. | 1 of 9 |
| No. turbines | 10 |
| Date | January 2019 |
| Key Environmental Influences on Wind Farm Design | **Topography:** Turbines located in areas of low gradient or flat topography<br>**Water Quality:** Minimum of 50m from streams and rivers<br>**Ecology:** Sensitive habitats were avoided<br>**Residences**: Minimum of 600m buffer from nearest residence<br>Landownership + avoidance of turbary areas |
| Key outcome benefits | Minimum of 600m between nearest turbine and closest residences<br>Outside any SAC or SPA boundary<br>Avoidance of sensitive habitats<br>Buffers from streams and watercourses |

#### 4.4.1.2 Design Iteration No. 2

Iteration No. 2 changed the layout from 10 turbines to 12.


**Figure 4-4 Design Iteration No. 2**

**Table 4-6 Iteration No. 2 Summary**

| | |
|---|---|
| Iteration No. | 2 of 9 |
| No. turbines | 12 |
| Date | March 2019 |
| Key Drivers of Change | 1. Modelling of turbine locations and wind energy yield<br>2. Further mapping of landownership and turbary<br>3. Feedback from baseline studies and engineering<br>4. Mapping of all houses in proximity to the wind farm |
| Key Environmental Influences on Wind Farm Design | 1. Feedback from modelling relative to meeting the limit criteria for noise |
| Key Changes to Wind Farm Layout since previous Iteration | • Increase in number of turbines |
| Additional Key Benefits of Changes to Wind Farm Layout | • increase in energy yield while working within the overall available lands |

#### 4.4.1.3 Design Iteration 3

Design Iteration No. 3. was driven by peat depths and the location of turbary boundaries on site.

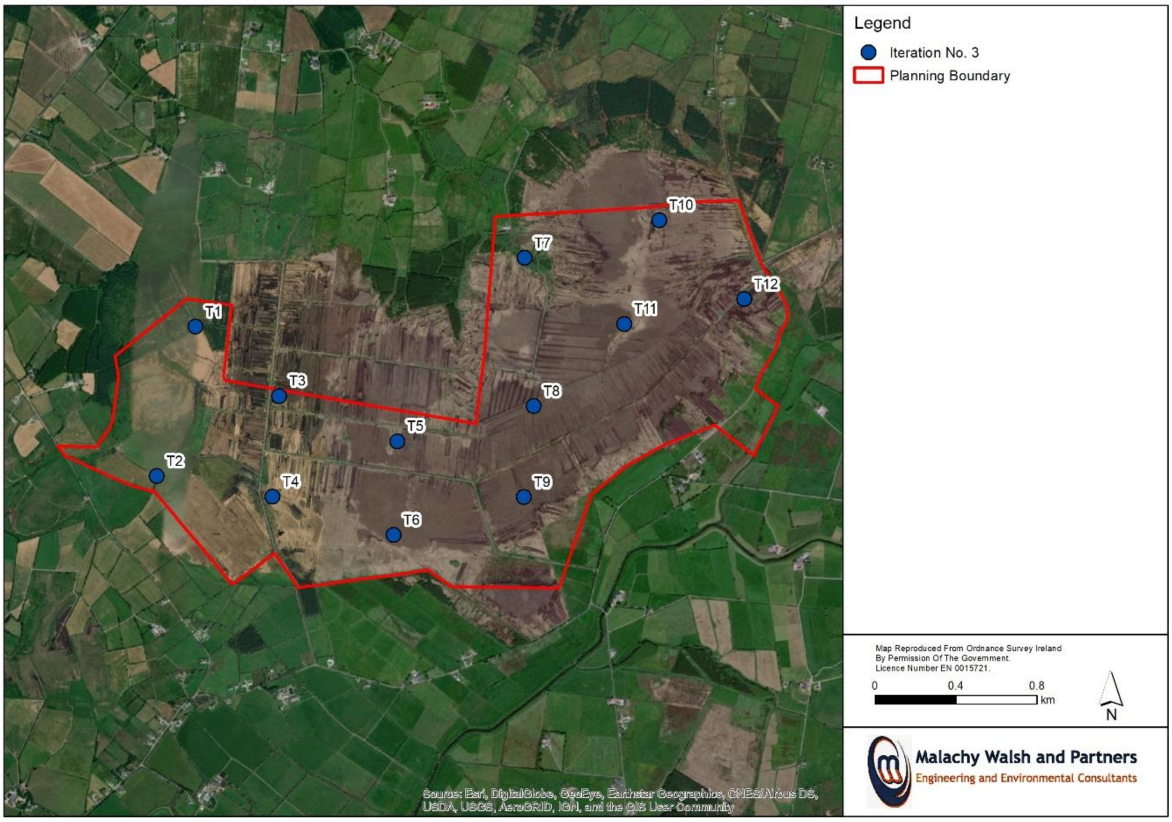



**Figure 4-5 Design Iteration No. 3**

**Table 4-7 Iteration No. 3 Summary**

| | |
|---|---|
| Iteration No. | 3 of 9 |
| No. turbines | 12 |
| Date | April 2019 |
| Key Drivers of Change | 1. Movement/adjustment of turbines T3, T5, T8 and T11 relative to turbary boundaries.<br>2. Movement of T10 and T11 for reasons of deep peat.<br>3. Movement of T9 100m to avoid peat stability risk area. |
| Key Environmental Influences on Wind Farm Design | 1. Peat depths and stability risk |
| Key Changes to Wind Farm Layout since previous Iteration | • Movement of location of turbines due to peat depth<br>• Movement of turbines due to turbary boundaries |
| Additional Key Benefits of Changes to Wind Farm Layout | • Avoidance of peat risk.<br>• Simplification of constructability approach on deep peat areas. |

### 4.4.1.4 Design Iteration No. 4

Iteration No. 4 included adjustment to the roads layout, turbine locations, location of met mast and substation.

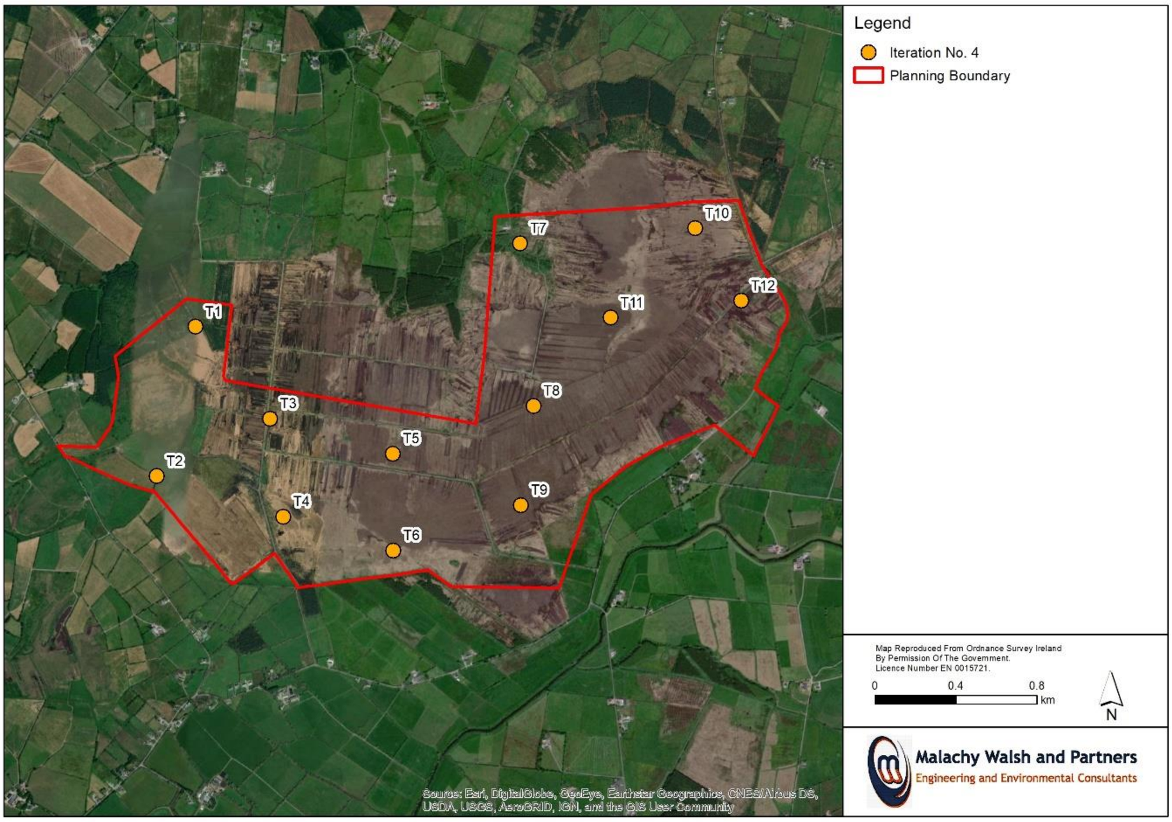



**Figure 4-6 Design Iteration No. 4**

**Table 4-8 Iteration No. 4 Summary**

| | |
|---|---|
| Iteration No. | 4 of 9 |
| No. turbines | 12 |
| Date | August to September 2019 |
| Key Drivers of Change | 1. Peat depths<br>2. Optimising use of existing tracks/cutover areas and footprint of hardstand and turbine bases for constructability<br>3. Turbary rights<br>4. Optimisation of layout of all infrastructure elements to meet with Vestas technical specifications and construction requirements<br>5. Finalisation of all elements of wind farm infrastructure required |
| Key Environmental Influences on Wind Farm Design | 1. Peat depths and constructability in order to minimise excavation volumes |
| Key Changes to Wind Farm Layout since previous Iteration | 1 Adjustments to hardstand locations and blade set down areas.<br>2. Movement of T1 due to turbary plots<br>3. Addition of substation future expansion area<br>4. permanent met mast + access track thereto<br>5. Examination of construction buffers around turbines in deep peat in terms of constructability |

| | |
|---|---|
| | 6. Addition of peat deposition areas on site for permanent peat storage + service roads<br>7. Addition of passing bays along internal roads<br>8. Two construction compounds added<br>9. New western entrance added to facilitate construction<br>10. Loop road added between T5 and T3<br>11. Road design and construction methods decided upon as primarily floating roads with all stone being imported |
| Additional Key Benefits of Changes to Wind Farm Layout | 1. Optimised layout in terms of engineering and buildability<br>2. Minimisation of peat excavation by use of floating roads<br>3. Adoption of on-site peat deposition areas avoids movement of spoil off site, which in turn reduces traffic<br>4. Improved access to site which facilitates better Traffic Management<br>5. Improved internal circulation for wind farm construction stage traffic and turbine deliveries |

### 4.4.1.5 Design Iteration No. 5

Iteration No. 5 required further micro-siting due to engineering constraints such as peat depths, tracks and hardstands. Turbary dictated movement of infrastructure. New Turbine configuration – Tip height of 150m remains the same, blade length increases to 68m and hub height drops down to 82m.

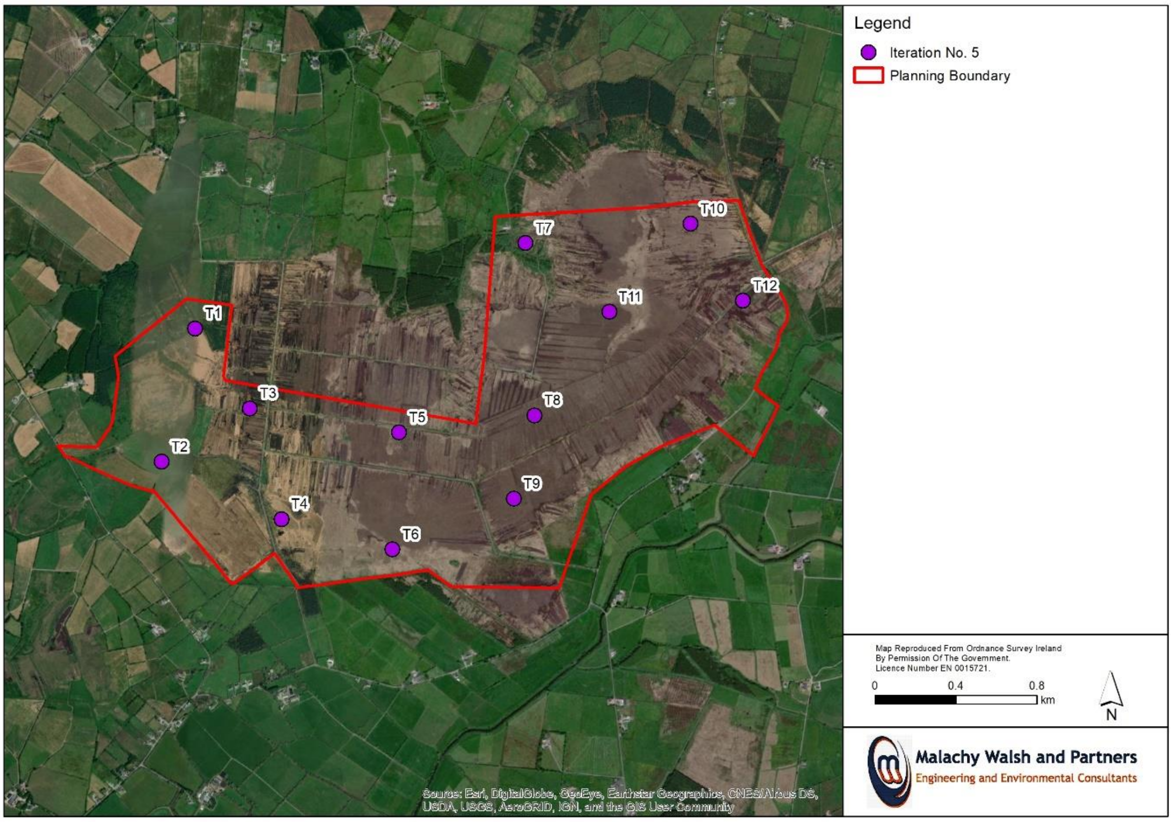



**Figure 4-7 Design Iteration No. 5**

**Table 4-9 Iteration No. 5 Summary**

| | |
|---|---|
| Iteration No. | 5 of 9 |
| No. turbines | 12 |
| Date | October and November 2019 |

| | |
|---|---|
| Key Drivers of Change | 1. Turbary rights<br>2. Minimisation of excavation and storage of peat<br>3. Improved constructability and future expansion at substation location<br>4. Increasing energy yield from wind farm site<br>5. Reduction in noise output |
| Key Environmental Influences on Wind Farm Design | 1. Peat excavation and storage<br>2. Minimisation of traffic by avoiding removal of excavated material from site<br>3. Increased energy yield provides further benefits in terms of carbon reduction |
| Key Changes to Wind Farm Layout since previous Iteration | 1. Change in wind turbine configuration – larger rotor diameter<br>2. Movement of T4 relative to turbary plot<br>3. Revision to hardstand and blade set down for longer blade |
| Additional Key Benefits of Changes to Wind Farm Layout | 1. Increased energy yield<br>2. Improved access and space for blade erection<br>3. Slight reduction in noise output |

### 4.4.1.6 Design Iteration No. 6

Iteration No. 6 required movement to infrastructure due to turbary.

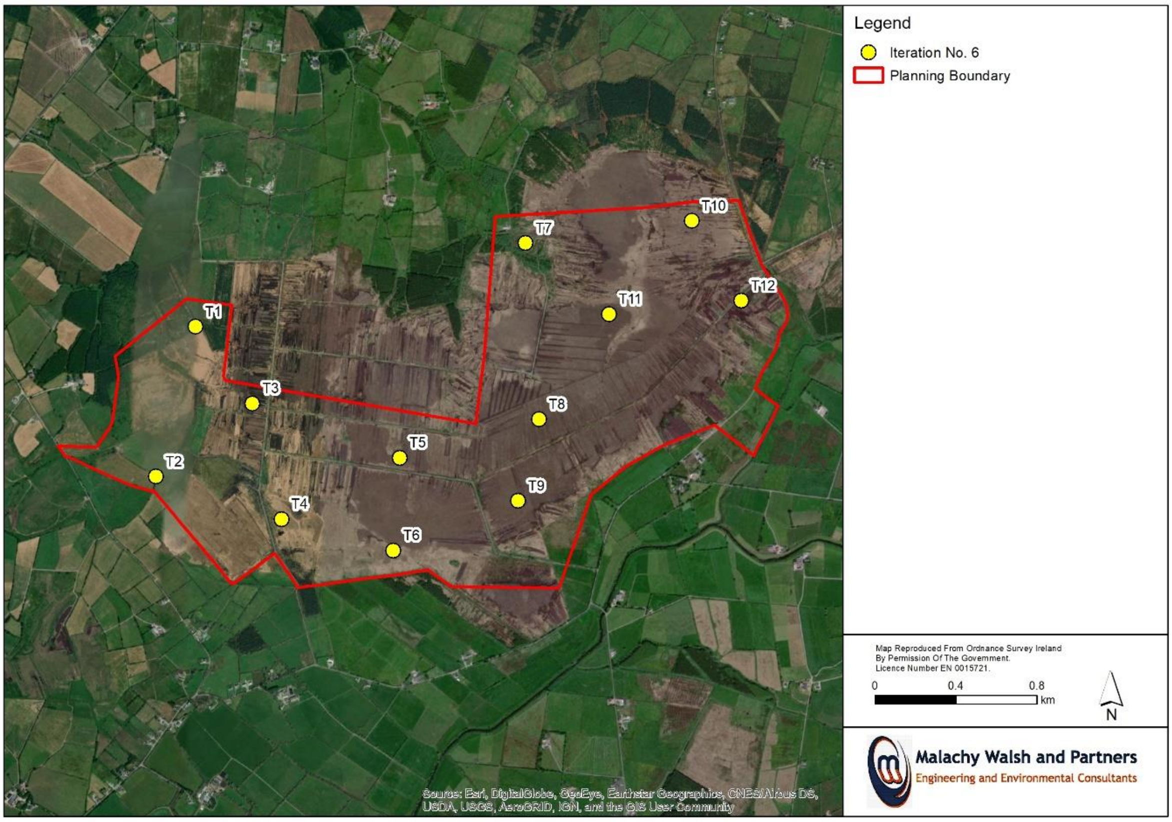



**Figure 4-8 Design Iteration No. 6**

**Table 4-10 Iteration No. 6 Summary**

| | |
|---|---|
| Iteration No. | 6 of 9 |
| No. turbines | 12 |

| | |
|---|---|
| Date | February/March 2020 |
| Key Drivers of Change | 1. Turbary rights |
| Key Environmental Influences on Wind Farm Design | 1. none |
| Key Changes to Wind Farm Layout since previous Iteration | 1. Movement in turbine locations, roads and substation to work within turbary rights<br>2. Avoidance of deposition area at T4<br>3. Movement of substation to align with turbary boundary |
| Additional Key Benefits of Changes to Wind Farm Layout | None, movement driven by Turbary boundaries rather than design or environmental. |

### 4.4.1.7 Design Iteration No. 7

Iteration No. 7 was mainly concerned with movement of turbine T5 and adjustment to internal road layouts.

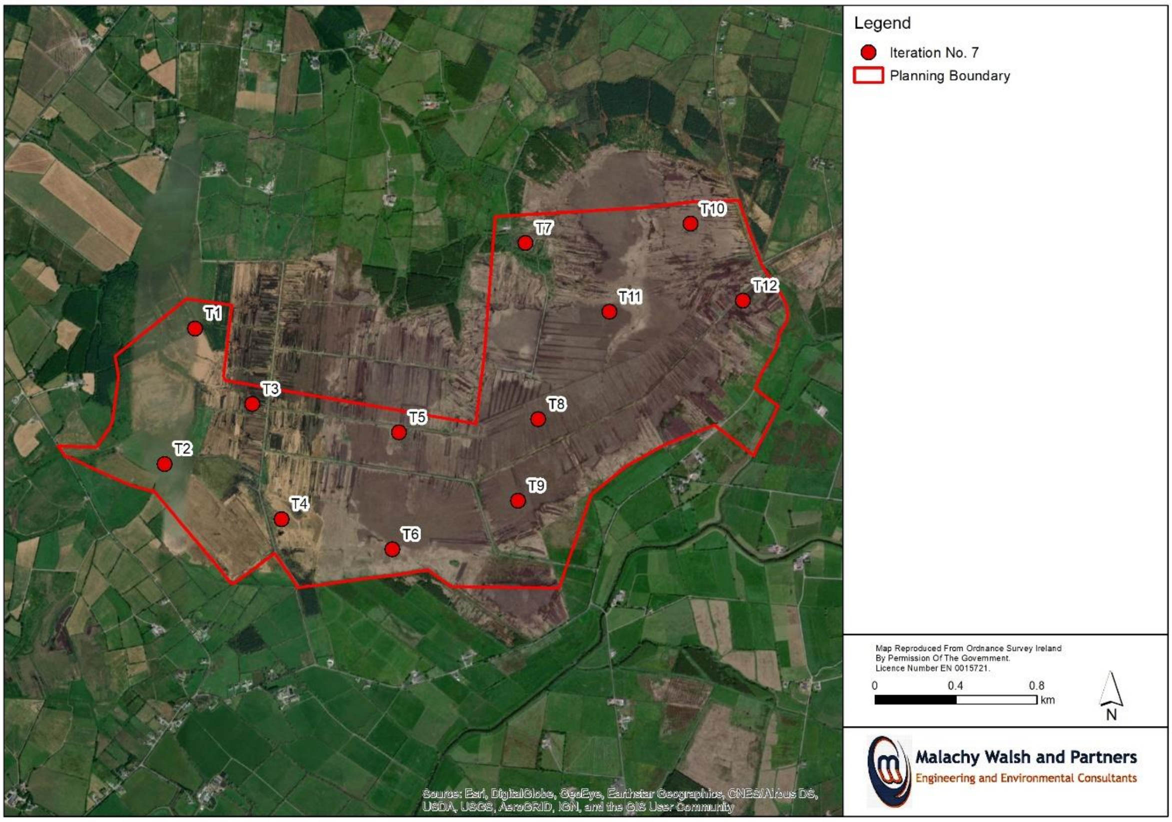



**Figure 4-9 Design Iteration No. 7**

**Table 4-11 Iteration No. 7 Summary**

| | |
|---|---|
| Iteration No. | 7 of 9 |
| No. turbines | 12 |
| Date | June 2020 |

| | |
|---|---|
| Key Drivers of Change | Optimising layout for constructability |
| Key Changes to Wind Farm Layout since previous Iteration | 1. Movement of T5<br>2. Layout of road between T4 and T2 altered. |
| Additional Key Benefits of Changes to Wind Farm Layout | More efficient layout and optimised for constructability |

### 4.4.1.8 Design Iteration No. 8

Iteration No. 8 was mainly driven by adjustments required due to turbary landownership and ensuring compliance with manufacturer's requirements in terms of blade set down, boom supports and space on hardstands.

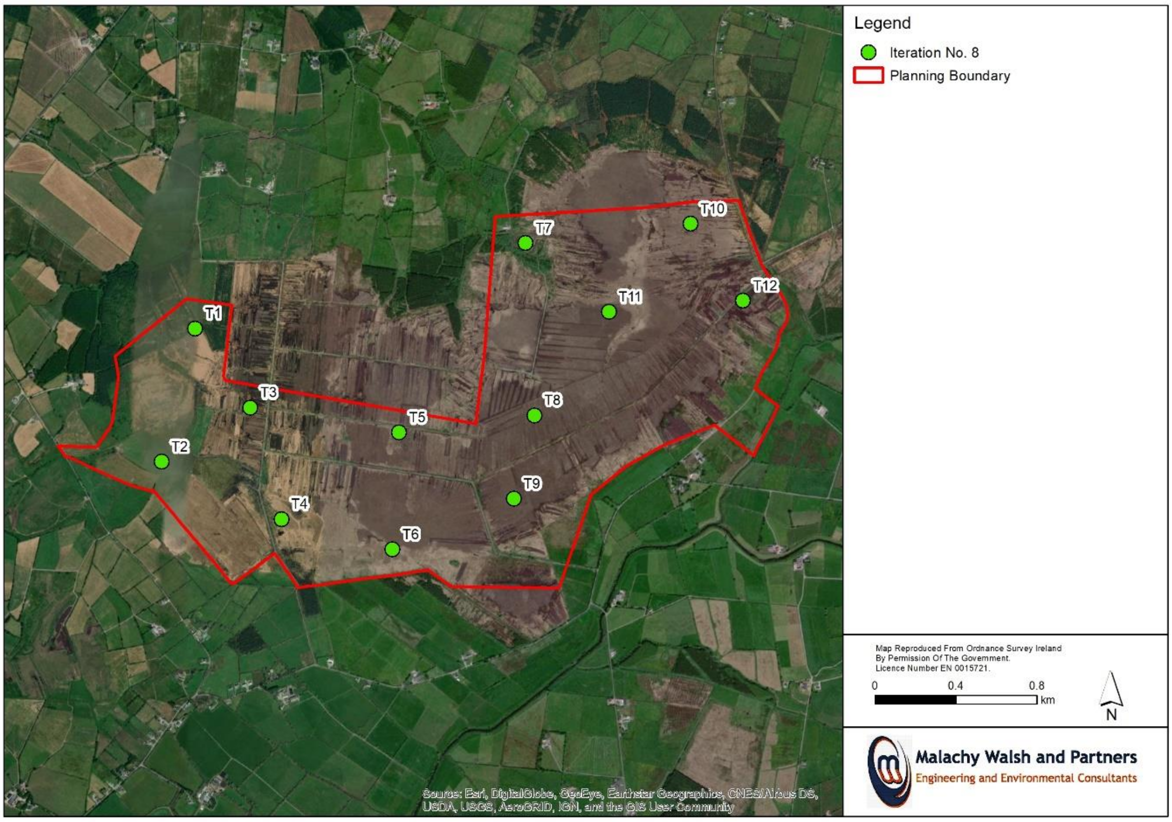



**Figure 4-10 Design Iteration No. 8**

**Table 4-12 Iteration No. 8 Summary**

| | |
|---|---|
| Iteration No. | 8 of 9 |
| No. turbines | 12 |
| Date | August/September/October 2020. |
| Key Drivers of Change | 1. Adjustment to layout due to turbary land ownership.<br>2. Requirement for replacement lands for felling.<br>3. Adjustment of set down areas for turbine blades to facilitate erection of turbines in accordance with Vestas requirements. |

| | |
|---|---|
| Key Changes to Wind Farm Layout since previous Iteration | 1. Movement of location of Turbines T2,11,6 and 1. Movement of substation, finalisation of felling areas around T1 and T7.<br>2. Movement of T3 and changing location of associated hardstand.<br>3. Adjustment to peat deposition area footprint.<br>4. Adjustment of hardstand areas and set down for turbine blades.<br>5. Adjustment of internal road junction near western entrance for blade set down, boom supports and erection to meet Vestas requirements |
| Additional Key Benefits of Changes to Wind Farm Layout | Optimised layout for delivery and erection of turbines |

#### 4.4.1.9 Design Iteration No. 9

Iteration No. 9 was mainly driven by adjustments based on ensuring further set back of wind turbines from local roads infrastructure. This aspect was highlighted during the local consultation stage and some concerns were raised due to proximity of the turbines to the local roads. In order to provide a greater set back from the local road infrastructure the layout was adjusted and effectively the configuration of the turbine array was consolidated within the site. This revised layout led to movements in a number of turbine locations and the adjustments to associated roads and hardstands.

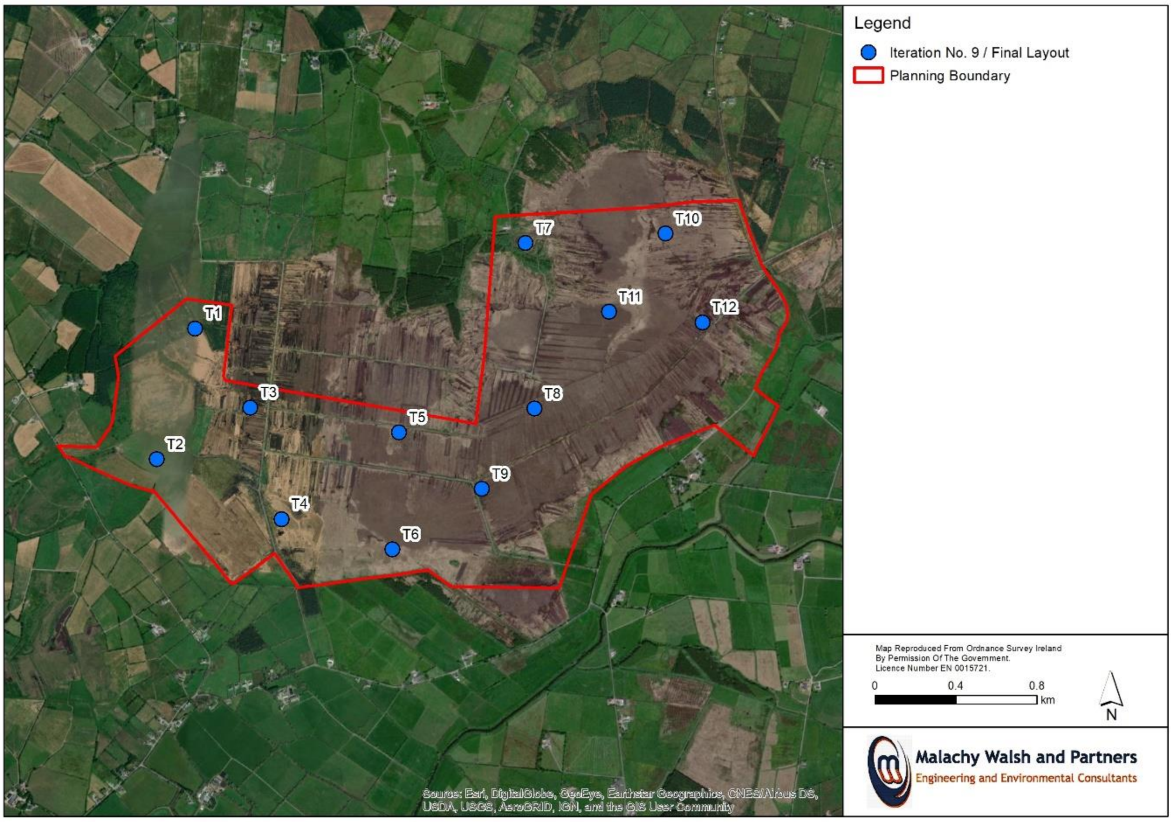



**Figure 4-11 Design Iteration No. 9**

**Table 4-13 Iteration No. 9 Summary**

| | |
|---|---|
| Iteration No. | 9 of 9 |
| No. turbines | 12 |
| Date | November/December 2020 |
| Key Drivers of Change | 1. Improvement of setback of wind turbine infrastructure from local road network. |
| Key Environmental Influences on Wind Farm Design | The drivers for the change in layout were set back from local road infrastructure rather than environmental considerations. However in consolidating the turbine layout within the wind farm site it also increased the separation from some local houses. |
| Key Changes to Wind Farm Layout since previous Iteration | Movement of turbines within the site in order to give greater separation from public road infrastructure. This necessitated adjustment to road layout, orientation of hardstands and changes to associated drainage layout. |
| Additional Key Benefits of Changes to Wind Farm Layout | Improved separation of wind farm infrastructure from local road network.<br><br>Optimised layout in terms of engineering and buildability<br><br>Improved internal circulation for wind farm construction stage traffic |

**Table 4-14 Comparison of Environmental Effects of Design Iterations**

| Effects | Iteration No. 1 | Iteration No.2 | Iteration No.3 | Iteration No. 4 | Iteration No. 5 | Iteration No.6 | Iteration 7 | Iteration 8 | Iteration 9 |
|---|---|---|---|---|---|---|---|---|---|
| | 10 turbines | 12 turbines | 12 turbines | 12 turbines | 12 turbines | 12 turbines | 12 turbines | 12 turbines | 12 turbines |
| **Population and Human Health** | Requirement of meeting the limit criteria for noise | Requirement of meeting the limit criteria for noise | Effects similar to that of layout Iteration 2 | Effects similar to that of layout Iteration 2 | Effects similar to that of layout Iteration 2 | Effects similar to that of layout Iteration 2 | Effects similar to that of layout Iteration 2 | Effects similar to that of layout Iteration 2 | Increased separation from local roads |
| **Biodiversity** | Habitat loss for footprint of infrastructure unavoidable | Increased footprint of habitat loss | Effects similar to that of layout Iteration 2 | Increased footprint of infrastructure leads to increased habitat loss | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | No change relative to habitat loss or biodiversity |
| **Ornithology** | No effect to SAC / SPA. Potential Effect on avian species using the site | No effect to SAC / SPA. Potential Effect on avian species using the site | No effect to SAC / SPA. Potential Effect on avian species using the site | No effect to SAC / SPA. Potential Effect on avian species using the site | No effect to SAC / SPA. Potential Effect on avian species using the site | No effect to SAC / SPA. Potential Effect on avian species using the site | No effect to SAC / SPA. Potential Effect on avian species using the site | No effect to SAC / SPA. Potential Effect on avian species using the site | No change in terms of impacts to ornithology |
| **Air and Climate** | Temporary addition of VOC, NOx, and CO emissions to the local airshed during construction. Large-scale project c. 50MW with positive air and climate change effects Increased further offsetting of non-renewable electricity. | Increased emission due to increased temporary construction traffic over and above 10 turbine layouts. But increased positive air and climate change effects. | Effects similar to that of layout Iteration 2 | Increased emission due to increased temporary construction traffic given that we have additional infrastructure. | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | No Change in terms of Air and climate |
| **Lands and Soils** | Peat needs to be excavated and stored on site in deposition areas. | Increase in volume of peat over and above that required for the 10 turbine layout. | Effects similar to that of layout Iteration 2 | Increase in volume of peat over and above that required for iteration 3 because of additional infrastructural elements | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | Infrastructure location change has no further effects or any negative effects |
| **Water** | 50m buffer applied to streams and rivers | 50m buffer applied to streams and rivers | 50m buffer applied to streams and rivers | 50m buffer applied to streams and rivers | 50m buffer applied to streams and rivers | 50m buffer applied to streams and rivers | 50m buffer applied to streams and rivers | 50m buffer applied to streams and rivers | No change in terms of water |

| Effects | Iteration No. 1 | Iteration No.2 | Iteration No.3 | Iteration No. 4 | Iteration No. 5 | Iteration No.6 | Iteration 7 | Iteration 8 | Iteration 9 |
|---|---|---|---|---|---|---|---|---|---|
| **Noise** | Construction-related increases in ambient noise levels Operational phase - Layout meets DoEHLG noise limits | Construction-related increases in ambient noise levels Operational phase - Layout meets DoEHLG noise limits | Construction-related increases in ambient noise levels Operational phase - Layout meets DoEHLG noise limits | Construction-related increases in ambient noise levels Operational phase - Layout meets DoEHLG noise limits | Construction-related increases in ambient noise levels Operational phase - Layout meets DoEHLG noise limits | Construction-related increases in ambient noise levels Operational phase - Layout meets DoEHLG noise limits | Construction-related increases in ambient noise levels Operational phase - Layout meets DoEHLG noise limits | Construction-related increases in ambient noise levels Operational phase - Layout meets DoEHLG noise limits | Consolidation of layout gives greater separation from houses and local road infrastructure , so gives increased buffer in terms of noise |
| **Landscape** | Layout and scale appropriate to landscape setting. Visual effects unavoidable | Layout and scale appropriate to landscape setting. Visual effects unavoidable | Layout and scale appropriate to landscape setting. Visual effects unavoidable | Layout and scale appropriate to landscape setting. Visual effects unavoidable | Layout and scale appropriate to landscape setting. Visual effects unavoidable | Layout and scale appropriate to landscape setting. Visual effects unavoidable. | Layout and scale appropriate to landscape setting. Visual effects unavoidable | Layout and scale appropriate to landscape setting. Visual effects unavoidable | Consolidation of layout is positive in terms of the layout being more compact |
| **Cultural Heritage** | No adverse effects on existing cultural resources and known archaeological resources. Potential for impacts on unknown archaeological/cultural resources during construction. | No adverse effects on existing cultural resources and known archaeological resources. Potential for impacts on unknown archaeological/cultural resources | No adverse effects on existing cultural resources and known archaeological resources. Potential for impacts on unknown archaeological/cultural resources | Potential for increased impacts on unknown archaeological or cultural resources due to increased footprint of built infrastructure outlined in Iteration 4 | Effects are the same as those outlined for iteration 4. | Effects are the same as those outlined for iteration 4. | Effects are the same as those outlined for iteration 4. | Effects are the same as those outlined for iteration 4. | No change in effects |
| **Shadow Flicker** | Potential for shadow flicker due to the presence of 10 turbines in the landscape. No effect with implementation of mitigation. | Increase in potential risk of shadow flicker due to two additional turbines. No effect with implementation of mitigation. | No effect with implementation of mitigation. | No effect with implementation of mitigation. | Increased potential risk of shadow flicker due to increased rotor diameter. No effect with implementation of mitigation. | No effect with implementation of mitigation. | No effect with implementation of mitigation. | No effect with implementation of mitigation. | No change in effects |
| **Material Assets** | Increase in traffic volumes on public roadway during | Additional Increase in traffic volumes on public roadway during construction due to | Effects similar to that of layout Iteration 2 | Potential for increased impacts on traffic volumes due to increased | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | Effects similar to that of layout Iteration 4 | No change in effects |

| Effects | Iteration No. 1 | Iteration No.2 | Iteration No.3 | Iteration No. 4 | Iteration No. 5 | Iteration No.6 | Iteration 7 | Iteration 8 | Iteration 9 |
|---|---|---|---|---|---|---|---|---|---|
| | construction unavoidable | two additional turbines unavoidable | | footprint of built infrastructure outlined in Iteration 4 | | | | | |

### 4.4.2 Alternative Technologies

Alternative technologies examined by the Applicant included two alternative wind turbines configurations and two alternative grid connection options. These are discussed in the following subsections.

#### 4.4.2.1 Alternative Wind Turbine Configurations

Two configurations of turbine were explored during the stages of development of the project layout and adopting a final design.

The first configuration was as follows:

- 150m maximum tip height, hub height of 91.25m and max blade length of 58.5m (February 2019).

The second configuration was as follows:

- 150m maximum tip height, hub height of 82m and max blade length of 68m (October 2019).

Table 4-15 below outlines a comparison of effects with two different turbine configurations.

**Table 4-15 Comparison of Environmental Effects of Alternative Wind Turbine Configurations**

| Environmental Factor | Development with Turbine Configuration 1 | Development with Turbine Configuration 2 |
|---|---|---|
| Population and Human Health | Not significant with implementation of mitigation | Not significant with implementation of mitigation |
| Biodiversity | No significant effect | No significant effect |
| Ornithology | No significant effect | No significant effect |
| Air and Climate | No significant effect | Increased energy yield, but no change to significant effects |
| Lands and Soils | No significant effect | Marginally larger footprint to facilitate larger blade set down areas. No change to significant effects |
| Water | No significant effecst | Marginal increase in surface runoff from increased hardstand areas. |
| Noise | Operational phase - Layout meets Wind Energy Development Guidelines (2006) | Operational phase - Layout meets Wind Energy Development Guidelines (2006) |
| Landscape | Scale and height appropriate to landscape setting. Visual effects unavoidable | Scale and height appropriate to landscape setting. Visual effects unavoidable. Slight increase in the visual extent due to larger rotor diameter, but imperceptible from VP locations. |
| Cultural Heritage | No Effect | No Effect |
| Shadow Flicker | Less than 30 hours per year of shadow flicker on sensitive receptors | Increased potential shadow flicker due to increased rotor diameter area. No effect with implementation of mitigation. |
| Material Assets | Minor upgrading works along delivery route from port to site. | Minor upgrading works along delivery route from port to site. |

As presented in Table 4-15 above the change in turbine configurations does not introduce a change in the effects or outcomes in terms of significance. Adopting either model configuration within the final layout has no change in outcome to the assessments.

Therefore, the preferred alternative wind turbine configuration is configuration 2 as outlined above for the following reasons:

- The larger turbine rotor diameter and lower hub heights do not increase potential environmental impacts such that a significant effect would result.
- The larger turbines will provide an additional renewable energy to export to the National Electricity Grid and therefore result in beneficial effects in relation to air and climate.

#### 4.4.2.2 Alternative Grid Connection Infrastructure

The individual turbines within the wind farm will be connected electrically by underground cables to a new proposed (permitted) 110kV substation on the eastern side of the wind farm adjacent to the L6021 and in proximity to the existing Kilpaddoge to Tralee 110kV Overhead Line.

Two options were explored for connection of the wind farm to the National Grid network. The Applicant engaged Mullan Grid Consultants to carry out grid connection feasibility studies for Shronowen Wind Farm in order to identify viable, least impact options.

Two options were initially explored as outlined below:

Option 1: Overhead line connection from the wind farm substation to the existing Kilpaddoge to Tralee overhead 110kV line on the east of the site.

Option 2: Underground on-road cable connection to the granted Drombeg/Tullamore Solar Project (50MW), which is located approx. 5.5km south of the proposed Shronowen Wind Farm site. This project if constructed would then have a connection to the Kilpaddoge–Tralee 110kV overhead line circuit.

Option 1 was the preferred option due to its proximity to the proposed wind farm substation, avoidance of any on-road underground cabling works and associated road closure works. It is also a more cost-effective solution with a simpler and effective design solution from a technical and electrical perspective.

However , in December 2020, a further updated assessment of the grid connection options was completed by TLI. This assessment identified an underground cable route connection from the wind farm substation to the existing 110kv transmission line due east of the site as being the optimum technical solution. The underground cable connection was adopted as the preferred grid connection method for the purposes of planning and EIAR assessment. See **Figure 4.12** below for layout of underground grid connection.

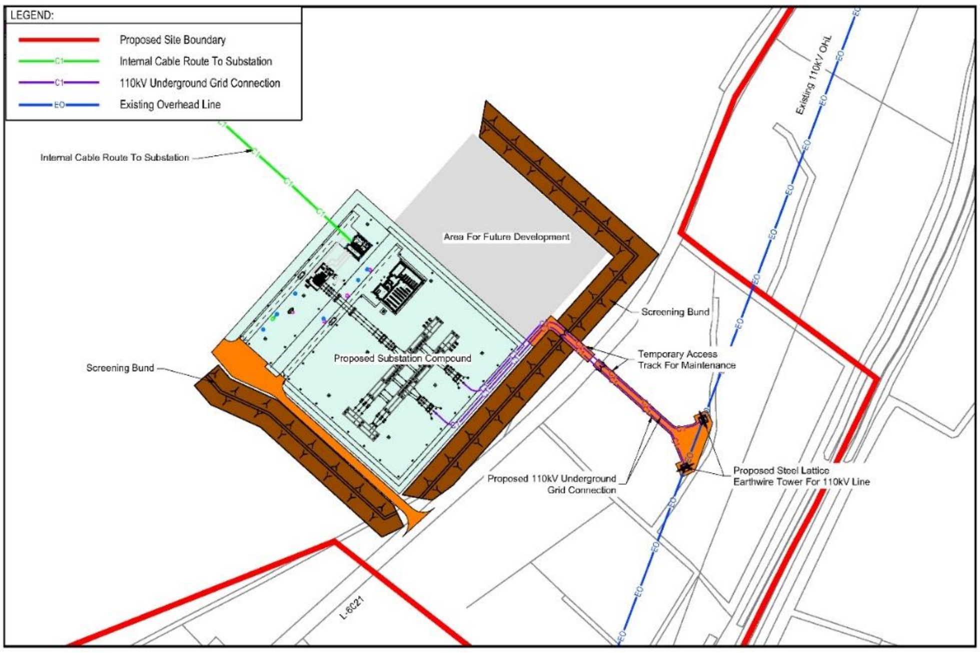
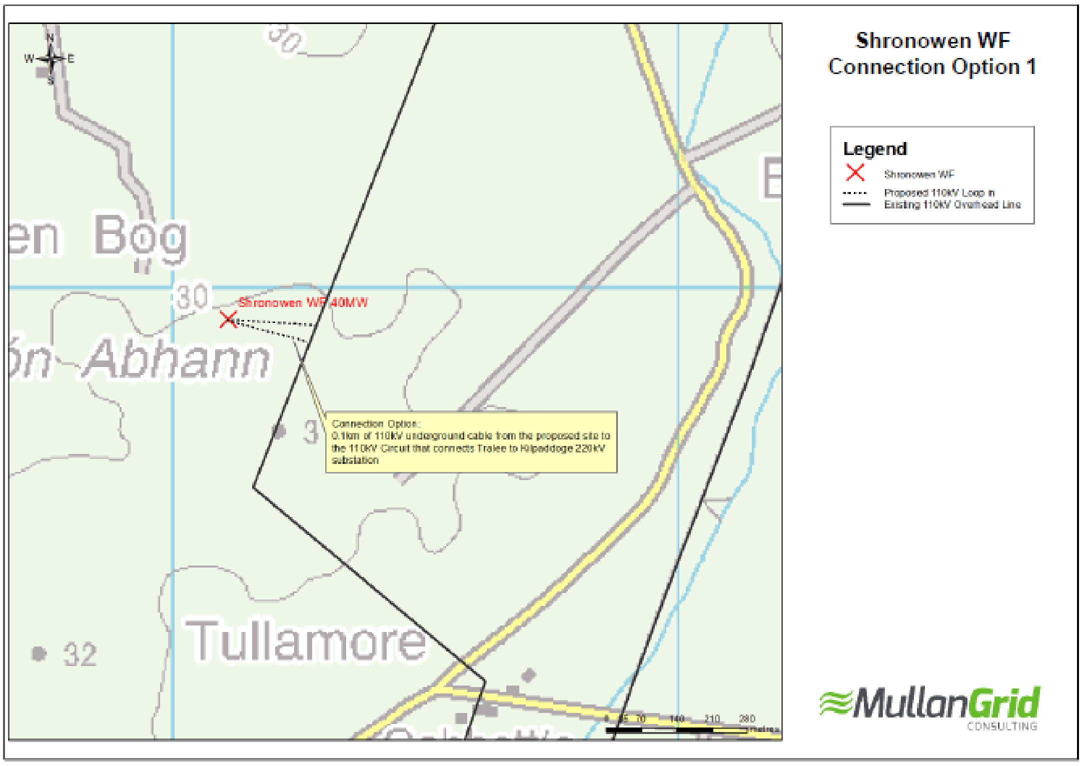



**Figure 4-12. Preferred underground cable route connection to the existing 110kv Transmission line.**

The original Option 1 and Option 2 grid connections solutions are illustrated below:

**Option 1:** Connection to the Existing Tralee to Kilpaddoge 110kV Overhead Line



**Option 2:** Underground 110kV Cable Connection to Tullamore Solar Project

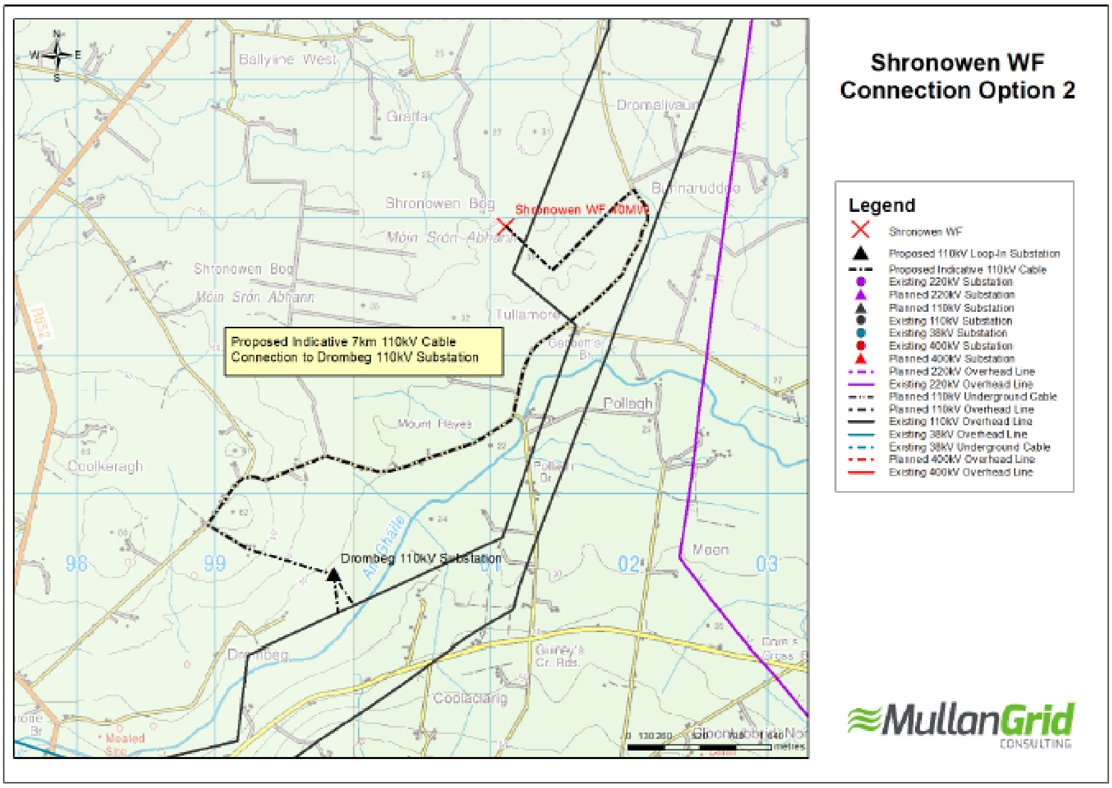



**Table 4-16 Comparison of Environmental Effects of grid connection options**

| Environmental Factor | Underground cable Connection to Tralee to Kilpaddoge 110kV Line | Underground on road 110kV C Cable Connection to permitted Solar Farm |
|---|---|---|
| Population and Human Health | temporary road closure for trenching for cable crossing local road | Traffic disruptions during construction phase on local roads |
| Biodiversity | Short term disturbance to grassland within agricultural lands during construction of underground cable route trenching and access tracks. | No effect |
| Ornithology | No effect due to being underground | No Effect |
| Air and Climate | Emissions during construction | Emissions during construction. |
| Lands and Soils | Temporary effects during trenching works on road crossing and through agricultural lands | Temporary removal of overburden during laying of cables and removal of any waste off site |
| Water | No effect | No effect |
| Noise | Construction phase noise | Construction Phase noise |
| Landscape | No effect with infrastructure located underground | No effect with infrastructure located underground |

| Environmental Factor | Underground cable Connection to Tralee to Kilpaddoge 110kV Line | Underground on road 110kV C Cable Connection to permitted Solar Farm |
|---|---|---|
| Cultural Heritage | No effect, no presence of mapped monuments or archaeological features along the route | No effect, no presence of mapped monuments or archaeological features along the route |
| Shadow Flicker | No Effect | No Effect |
| Material Assets | Temporary road closure for cable crossing of local road | Additional traffic during construction phase. Single lane road closures to facilitate road opening for laying of underground cable route. Local disruption to residents |

The preferred grid connection option is the underground cable route connection from the wind farm substation to the Tralee to Kilpaddoge 110kV line due to its short distance, minimal construction works and its technical electrical solution.

The alternative underground cable grid connection is assessed in this EIAR as a potential viable technical route option. This option has a longer length of 5.5km on road and its construction period would be significantly longer than the preferred technical solution of an underground cable connection. Ultimately the exact connection method will be adjudicated upon by Eirgrid but, for the purpose of this EIAR, both options are assessed.

### 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 internal access roads, turbine bases and hardstands. These are discussed in the following subsections.

#### 4.4.3.1 Internal Access Roads

The primary objectives when designing the new internal access roads was to utilise existing tracks where possible and to locate infrastructure where ground conditions are suitable. Maximum use has been made of the footprint of existing roads which will have to be widened, upgraded, and constructed as floating roads. New floating roads will also be required to service all turbine locations, peat deposition areas and ancillary infrastructure including permanent met mast and temporary compounds.

Floating roads will be required throughout the site due to the presence of deep peat that could not be avoided in the design of the access road layout. A combination of geogrid, geotextile and imported felled logs will be placed over the vegetation on the existing surface to be traversed with the floating road. All stone will be sourced off-site and imported to site.

There will be no site-won material from borrow pits and consequently all material for the project will be imported.

**Table 4-17 Comparison of Environmental Effects of Internal roads**

| Environmental Factor | Utilising Existing Roads – widened and upgraded as floating infrastructure | Construction of new roads – Floated design |
|---|---|---|
| Population and Human Health | Use of existing infrastructure reduces the volume of stone required and avoids extensive excavation of peat. | Additional traffic during construction phase, import of materials, but avoidance of extensive excavation of peat. |
| Biodiversity | No Effect | No effect |
| Ornithology | No Effect | No Effect |
| Air and Climate | No Effect | No Effect |
| Lands and Soils | No Effect | No Effect |
| Water | No Effect | No Effect |
| Noise | No Effect | No Effect |
| Landscape | No Effect | No effect |
| Cultural Heritage | Less risk due to the avoidance of deep excavation | Less risk due to the avoidance of deep excavation |
| Shadow Flicker | No Effect | No Effect |
| Material Assets | Additional traffic during construction phase due to importation of all materials required for road construction. | Additional traffic during construction phase due to importation of all materials required for road construction. |

#### 4.4.3.2 Turbine Base and Hardstand Areas

Excavating the hardstand and turbine foundation base will be done as one operation. In areas where peat depths are less than 3m and good bearing ground strata is apparent then a dig and replace approach will be adopted. In shallower peat depths it is possible to excavate safely with battered edges to the area of excavation.

In areas of peat that exceed 3m in depth the utilisation of sheet piling to define and enclose the footprint of excavation will be adopted. This approach allows safe excavation and minimises the volume of peat excavation and avoids overly large, battered back edge slope to the excavation area. It also maintains stability in the surrounding peat strata. Once good bearing material is identified imported stone will be placed in the excavated area to provide a sound, level and adequate bearing layer.

The impacts of adopting either approach depending on peat depth will have the same effects from an environmental perspective. However, the option of a sheet piled solution in deeper peat areas requires the excavation of more peat and the importation of more stone.

Both approaches are controlled and the focus is on safe construction practice, achieving the optimum turbine base and hardstand in terms of design load, while minimising the excavation volumes.

## 4.5 CONCLUSION

The project design process and reasonable alternatives were completed with reference to EIA Directive 2014 and EU EU Commission "*Guidance on the preparation of the Environmental Impact Assessment Report"* 2017.

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

Alternatives examined included alternative site layouts, alternative turbine configurations, alternative grid connection routes and alternative construction methods.

The final site layout (iteration number 9) 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.

## REFERENCES

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

*Environmental Impact Assessment of Projects: Guidance on Scoping.* European Commission (2017).

*Environmental Impact Assessment of Projects: Guidance on the preparation of the EIA Report.* European Commission (2017)

*Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.* Department of Housing, Planning and Local Government. (2017).

*Wind Energy Development Guidelines.* Department of the Environment, Heritage and Local Government. (2006).