4 PROJECT DESIGN PROCESS AND REASONABLE ALTERNATIVES

4.1 INTRODUCTION

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.*"

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

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

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

As outlined in Chapter 1, Donegal County Council granted planning permission for a similar development by the Applicants at the Drumnahough site in March 2009 (PL. Ref. 08/50687). Prior to selection of the site to cater for such development, a detailed screening exercise was undertaken by Coillte & SSE using a number of criteria and stages to assess the potential of a large number of possible sites, on lands within its stewardship, suitable to accommodate a wind energy development. Drumnahough was one of the sites identified as most suitable to take forward as a potential wind farm location. Further validation for its suitability for wind farm development was demonstrated as the site successfully received a planning grant for the development of fifteen (15) No. turbines in 2009.

The applicant is now applying to An Bord Pleanála for a revised wind farm development on the same site with newer, more modern and efficient technology and therefore, an assessment of alternative locations is not considered to be applicable in this instance. However, a number of studies were undertaken in 2018 to assess the potential for the Site to be redesigned to cater for an amended layout design. To this end, ecological, ornithological and landscape and visual assessments were carried out as part of an overall feasibility study for the site. The main design results of this are outlined in the sections below.

A recent review of the potential for renewable energy development within Coillte's estate, undertaken in 2014, has further validated that the proposed site represents on optimum location for wind energy development. The steps completed in this 2014 review included screening to select optimum locations for wind development. This was followed by disregarding areas with grid constraints. A further detailed screening removed any areas with potential impact to scenic areas, protected habitats and potential landowner restrictions. 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 the Coillte estate, in order to identify which lands might be available, in principal, for wind farm development. This stage in the selection process discounted lands that were not available for development under a number of criteria, as follows:

- Committed Lands - Lands already identified/in use for forestry recreation or biodiversity development.
- Millennium Sites – This is a Coillte environmental designation – these sites were planted and managed for provision of a tree for every household in the country as part of the Millennium tree planting project
- Life Site – Coillte began Life Sites in 2004, aiding in important areas of habitat restoration. Raised bogs and blanket bogs have been identified as priority habitats for restoration.
- Wild Nephin Properties – The Wild Nephin project aim is to create 11,000 hectare of wilderness areas in the Nephin Beg Mountains of North West Mayo.
- National Parks – Coillte forest exploration have identified over 260 recreational forestry sites within Ireland. The sites have provided recreational activities such as walking trails, camp sites, forest parks, playgrounds and orienteering.
- Statutory Designated Areas – Protected areas of the countryside due to existing wildlife, landscape or cultural aspects.

In addition to the above criteria, sites that made it through this initial screening were further screened in terms of their suitability, at a high-level, for wind farm development. Coillte reviewed the relevant Development Plan and Renewable Energy Strategy provisions pertaining to these sites and discounted sites 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, where no such designations exists, if there were environmental designations (Natura 2000) at the sites.

The result of applying the Phase 1 Screening criteria was that a large number of potential wind farm sites were identified. These were then subject to further assessment and screening, as outlined below.

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
- Telecoms
- Natura 2000 Sites
- Natura Ecological Designations

- Land Ownership Issues
- Residential density considerations
- 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. Drumnahough was one of those sites identified as most suitable to take forward as a potential wind farm location.

4.2.4 Site Validation

Drumnahough, as a candidate site, was further examined under the following headings in order 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;
- 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 mid-Donegal. The proposed development site has satisfied a number of key criteria required for successful wind energy development and these are presented in Table 4-1 below:

Table 4-1 Summary of Site Suitability Criteria

Suitability Criteria	Proposed Development Site
Wind Resource	Sites where the average wind speed at 80 metres above ground level was less than 7 meters per second were discounted. 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	Binbane to Letterkenny 110kV overhead power line crosses along the northern section of the site. Furthermore planning permission has been permitted for Lenalea 110kV substation east of the proposed development.
Compliance with Planning Designation	The proposed site has previously been granted planning permission for 15 No. turbines in 2009 Planning Ref. 08/50687. The Donegal County Development Plan (CDP) 2018 – 2024 Wind Energy Map 8.2.1 has identified the site as "acceptable for augmentation/ improvements to existing wind farm". This is currently under review. The Donegal CDP 2011-2018 identifies the site within 'areas open to consideration' for Wind Energy
Avoidance of Environmental Designations	There are no Natura 2000 sites within the development footprint. The nearest identified site is the River Finn SAC 0.23km southwest of the development.
Proximity to other wind farm developments and associated infrastructure	Wind energy is a key land-use surrounding the proposed site with long established neighbouring operational wind farms of Cark (1997), Meentycat (2004), Culliagh (2000 and 2012) and Cark Extension (2012).
Separation distance from dwellings	Setback distance of minimum four times turbine tip height 670m was applied from individual properties.
Site accessibility	Primary site access can be achieved from the southeast along the L-10142; a second site access to the northwest of the site will be via the L-1622-1.
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 decision by Donegal County Council to provide a consent at this site in 2009 (DCC Planning Ref. 08/50687) has previously validated the initial selection process.

Recent local planning policy maintains a preferred status for wind development for the Drumnahough site, with the Donegal County Development Plan (2018-2024) outlining that the site is located in an area that is deemed "*acceptable for augmentation of/improvements to existing wind farms*" and notes the following:

E-P-12: It is the policy of the Council to:

Consider the development of appropriate new wind energy developments within the areas identified as 'Open to Consideration' on the Wind Energy Map 8.2.1, subject to compliance with all other relevant objectives and policies contained within this Plan.

Consider the augmentation, upgrade and improvements of existing wind farm developments within areas identified as 'Acceptable for augmentation of/improvements to existing wind farms' on the Wind Energy Map 8.2.1 on a case by case basis subject to compliance with other relevant objectives and policies contained within this plan.

It is noted that the Donegal County Development Plan 2018-2024 wind energy map and wind energy standards have been removed 'by Order made on the 5th day of November, 2018, in proceedings bearing Record Number 2018/533JR between Planree Limited, Applicant and Donegal County

Council, Respondent, certain provisions of the County Donegal Development Plan 2018-2024, being Section 6.5(c) and (f) of the Wind Energy standards at Part B: Appendix 3, Development Guidelines and Technical Standards and Map 8.2.1 as contained in the County Donegal Development Plan 2018-2024 as published were ordered to be deleted and/or removed from the County Donegal Development Plan 2018-2024. The Development Plan should be read in light of the Order in question pending any possible future variation of same'[i]. At the time of completing this report, Donegal County Council did not have an active wind energy policy as part of the County Development Plan.

(C) ***Reapplication***

In areas located outside of Natura 2000 sites, where an existing wind farm has been permitted and this permission has expired, a revised proposal will be considered within the planning unit of the previously permitted development, and where it is demonstrated that there is no net increase in turbines

This site is not contained within a Natura 2000 site, as previously stated, furthermore it is within a consented but expired wind farm site and does not exceed the previously permitted fifteen (15) turbines previously consented (Planning Ref. 08/50687).

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.

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 2018 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:

- Topography
- Sensitive Habitats
- Bat Ecology
- Public Roads
- Ornithology
- Soils and Geology
- Hydrology
- Archaeology
- 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 stability risk zone) or setback distance (e.g. buffer from SAC). 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 4-2 summarises the physical and environmental constraints which have informed the wind farm design:

Table 4-2 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 site and minimisation of infrastructure within ecologically valuable habitat such as Blanket Peat.
Bat Ecology	95m felling buffer from centre of each turbine as recommended in Scottish Natural Heritage Guidelines (2019)
Public Roads	Apply a minimum distance of 185m from proposed turbine locations and public roads.
Ornithology	Identification of Merlin Nest during Breeding Season 2018, resulting in a 350m buffer.
Soils and Geology	Identification of peat depths and rock outcrops. Avoidance of high peat slide risk and constructability risk areas.
Hydrology	Minimum infrastructure distance of 50m from watercourses as recommended by Forest Service
Archaeology	Minimum distance of 20m from Malt Kiln Sites within Site Boundary
LVIA	Identification of Zones of Theoretical Visibility (ZTV) within 30km of the proposed development

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 and 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 roads 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 a 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.

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/eliminate the potential for significant effects on ecological receptors:

- Avoidance/minimisation of turbine array and wind farm infrastructure at sensitive peat 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 roads were selected to utilise existing built infrastructure for the majority of their lengths (i.e. cables to be laid within public roads 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 (January 2019) 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 50 m between a turbine blade tip and the nearest woodland. This buffer creates a clearance setback of 50 m 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 SNH buffer formula and proposed turbine dimensions, a felling distance of 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 71m, hub height of 95m and tree heights (Sitka spruce) of 20m.

4.3.1.4 Public Roads

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 proposed development has applied the greater distance to Local road L-10142, as outlined in draft guidelines above of minimum buffer of 185m.

4.3.1.5 Ornithology

A main ornithological driver of the design was the presence of Merlin which nested at the proposed development site in 2018 and 2019. This species is listed on Annex I of the EU Birds Directive, so is afforded European protection. The design of the project includes a buffer between the Merlin nest site and proposed turbine locations. This buffer distance was based on findings of Ruddock & Whitfield (2007) who suggested distances between 200m and 500m, dependent on topographical factors. The proposed development infrastructure and nest are screened by conifer plantation and the nest site is at greater elevation than the nearest proposed development components. Following guidance from SSE Ecologist and consultation with MWP Ecologist, a 350m buffer was proposed. With regard to buffer calculation, NPWS advised to use the central point of the Merlin nest sites recorded each year. The Merlin nest location and proposed buffer distance of 350m was discussed with NPWS representative in February 2020.

4.3.1.6 Soils and Geology

Following on from the initial desk study constraints identification, investigations were carried out throughout 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. The high risk areas were included among the constraints where any infrastructural work was to be avoided. Full details are provided in the Peat Stability Risk Assessment Report (See Volume 3 of EIAR).

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 the water crossings, was applied to streams and lakes 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

A Malt Kiln was recorded at the northeast boundary of the Drumnahough site on the eastern upland slopes of Cronaglack in the townland of Meenadaura. As advised by MWP archaeologist, a minimum buffer exclusion zone of 20m was established around the malt kiln to avoid any accidental damage during construction.

4.3.1.9 Public Consultation

Public Information events were organised to provide the public with an overview of the project, answer questions regarding the project, and receive input regarding any issue, concerns and recommendations for evaluation in the EIAR. An information day was held in September 2019 in which the local community were invited to discuss the project and any concerns or questions they may have had. A second public consultation meeting was scheduled for April 2020, but required cancellation due to Covid-19 issues. The developers instead initiated an alternative means of engaging and further involving the local community via letter-drops, establishment of a detailed public engagement website, provision of updated information with opportunity for feedback to be provided, with a parallel media campaign also undertaken to publicise this further public engagement in the locality as outlined in **Appendix A-1**.

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.

4.3.3 Preliminary planning stage design

Following identification of all the environmental, technical and engineering constraints for the site, a preliminary layout that fit with the remaining useable areas was developed. These remaining areas were generally characterised by relatively low surface gradients and shallow peat depths. The layout included the preliminary internal road network and provisional locations for the electrical substation compound, permanent meteorological mast, borrow pits 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.

4.3.3.1 <u>Position of Turbines</u>

The site has previously received a planning grant to develop a fifteen (15) No. turbine wind farm. This EIAR has assessed twelve (12) No. Turbines which have an increased turbine tip height of 32.5m when compared against the previously consented application. 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, see **Table 4-3** below:

Table 4-3 Drumnahough Constraints Inclusions

ASPECT	INITIAL INCLUSIONS
Engineering	Slope, peat, existing roads, drainage
Traffic and Transport Study	Road highlighted – southeast and northwest access identified
Hydrology (and the Water Framework Directive)	Peat, drainage, watercourses, buffers of 50m watercourses
Landscape and Visuals	ZTV, Wireframes, Review of scenic areas in the surrounds
Local Population	Houses and buildings, residential setback of minimum of 670m
Shadow Flicker	Preliminary model, assessment of houses within 1.45km
Biodiversity – Birds (and the Birds Directive)	Review approximate Merlin nest location, infrastructure setback of 350m
Biodiversity – SAC (and the Habitats Directive)	Review location of River Finn SAC
Cultural Heritage	Setback 20m buffer to Malt kiln

The proposed turbine locations were initially identified by the applicant's engineering and wind resource analysis team with the final locations derived collaboratively between multi-discipline inputs and consideration including ecology, archaeology, engineering, landscape assessment etc. The locations were based on topography, potential wind resource, peat depths and Landscape and Visual Impact assessments.

- Site topography was examined and areas of steep slope or potentially unstable ground were avoided.
- Turbines were suitably spaced to ensure efficient operation.
- Turbine locations were selected to utilise existing access tracks as much as possible.
- Site layout design included a suitable separation distance of 50m between infrastructure and existing watercourses.
- Landscape Visual Impact Assessments (LVIA) guided turbine locations and assessed the landscape and capacity to receive larger modern turbines.
- Initial site ornithology surveys identified a suspected Merlin nest east of proposed turbine No. 5. The site layout was revised and 'mitigation by avoidance' applied by ensuring a minimum buffer distance of 350m between the suspected Merlin nest and site infrastructure was incorporated into the revised 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. 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. Based on this information, the position of turbines, crane hardstandings, roads and other infrastructure were adjusted, relocated or removed so as to reduce the risk of peat instability. In many cases the relocation of a turbine was not straightforward because other turbines and access roads also had to be moved so as to maintain the required separation distances between them. This in turn required further site investigations so that the suitability of the revised layout could be fully verified. The route of the access road also had to be modified and verified accordingly. Because of this iterative process, a substantial quantity of geotechnical data was collected and analysed for the site. This resulted in a comprehensive overview of the ground conditions throughout.

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
- Reasonable Alternative Technologies
- Reasonable Alternative Construction Methodologies

4.4.1 Alternative Wind Farm Layout

In total there were 6 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 included a 12 turbine layout which was optimised using industry standard software for wind resource assessment WAsP (Wind Atlas Analysis and Application Program) wind flow maps, biodiversity data, boundary setback and water course constraints.

Table 4-4 Iteration No. 1 Summary

Iteration No.	1 of 6
No. turbines	12
Date	24/1/2019
Key Environmental Influences on Wind Farm Design	**Topography:** Turbines located in areas of low gradient slopes **Water Quality:** Minimum of 50m from streams and rivers **Ecology:** Sensitive habitats were avoided where possible **Residences**: Minimum of 680m buffer from nearest residence
Key outcome benefits	✓Minimum of 680m between nearest turbine and closest residences ✓Minimum of 50m between nearest turbine and streams and rivers ✓Outside any SAC or SPA boundary ✓Avoidance of steep slopes ✓Minimum of 1km between nearest turbine and closest recorded archaeological monument

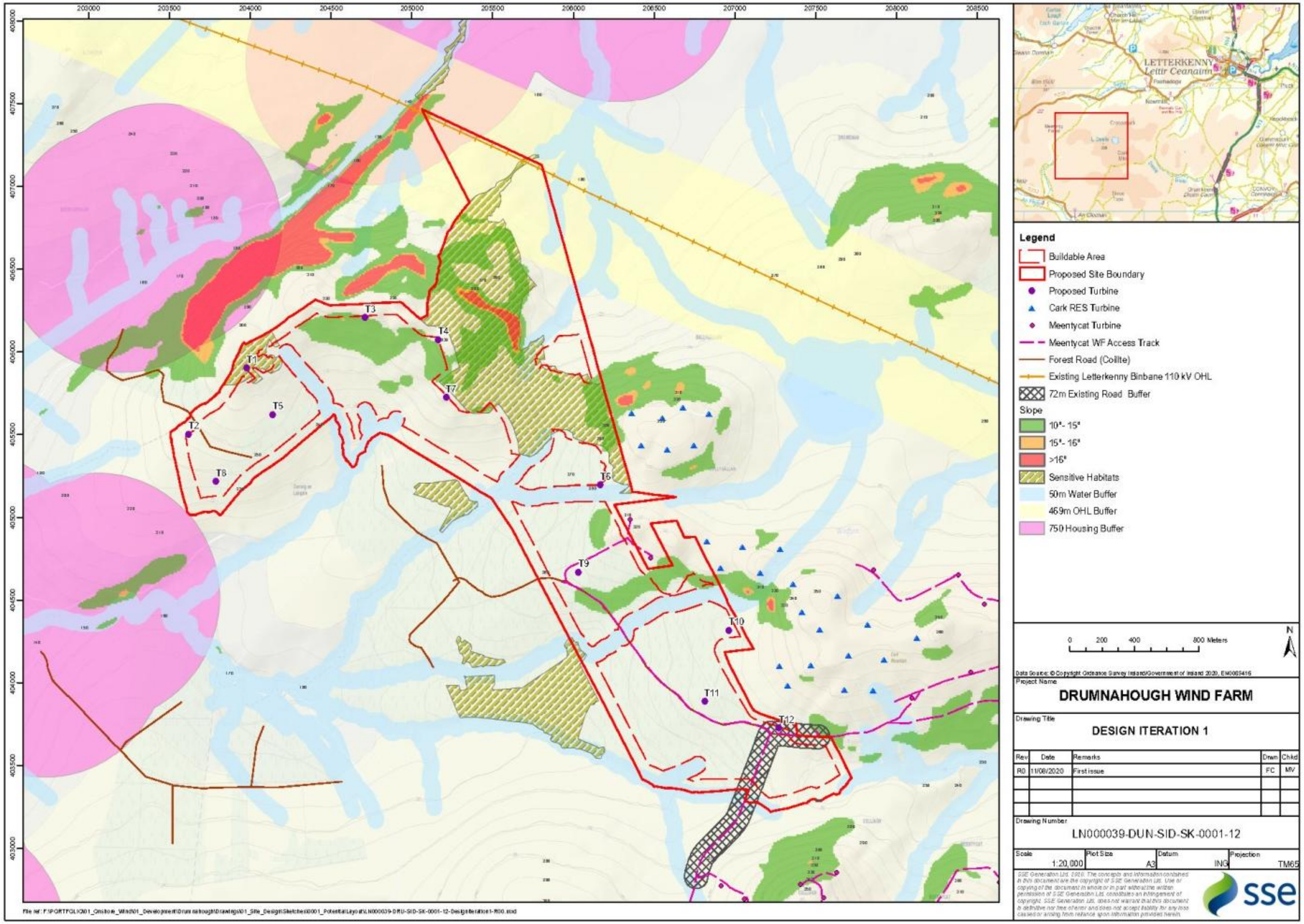

Figure 4-1 Proposed Layout 1

4.4.1.2 Design Iteration No. 2

Iteration No. 2 constraint included a buffer around the public road. There was no change made to the wind flow model (WAsP based).

Table 4-5 Iteration No. 2 Summary

Iteration No.	2 of 6
No. turbines	12
Date	7/6/2019
Key Drivers of Change	1. Buffer to the public road added to the constraints 2. New Computational Fluid Dynamics (CFD) model utilised, which includes LiDAR forestry survey data
Key Environmental Influences on Wind Farm Design	**Traffic and Transportation:** Improved safety in design of wind farm outside of public road buffer - turbines repositioned as below **Biodiversity:** Reposition of turbine to increase setback distance from biodiversity areas.
Key Changes to Wind Farm Layout since previous Iteration	• Turbine 1 was moved southwest to increase the setback from a biodiversity area • Turbine 12 was moved south to avoid the public road constraint. • Reconfiguration of the remaining turbines on site based on CFD wind model and Forestry LiDAR data.
Additional Key Benefits of Changes to Wind Farm Layout	✓ Increased distance of Turbine 1 from a sensitive habitat ✓ Safety buffer maintained from public road

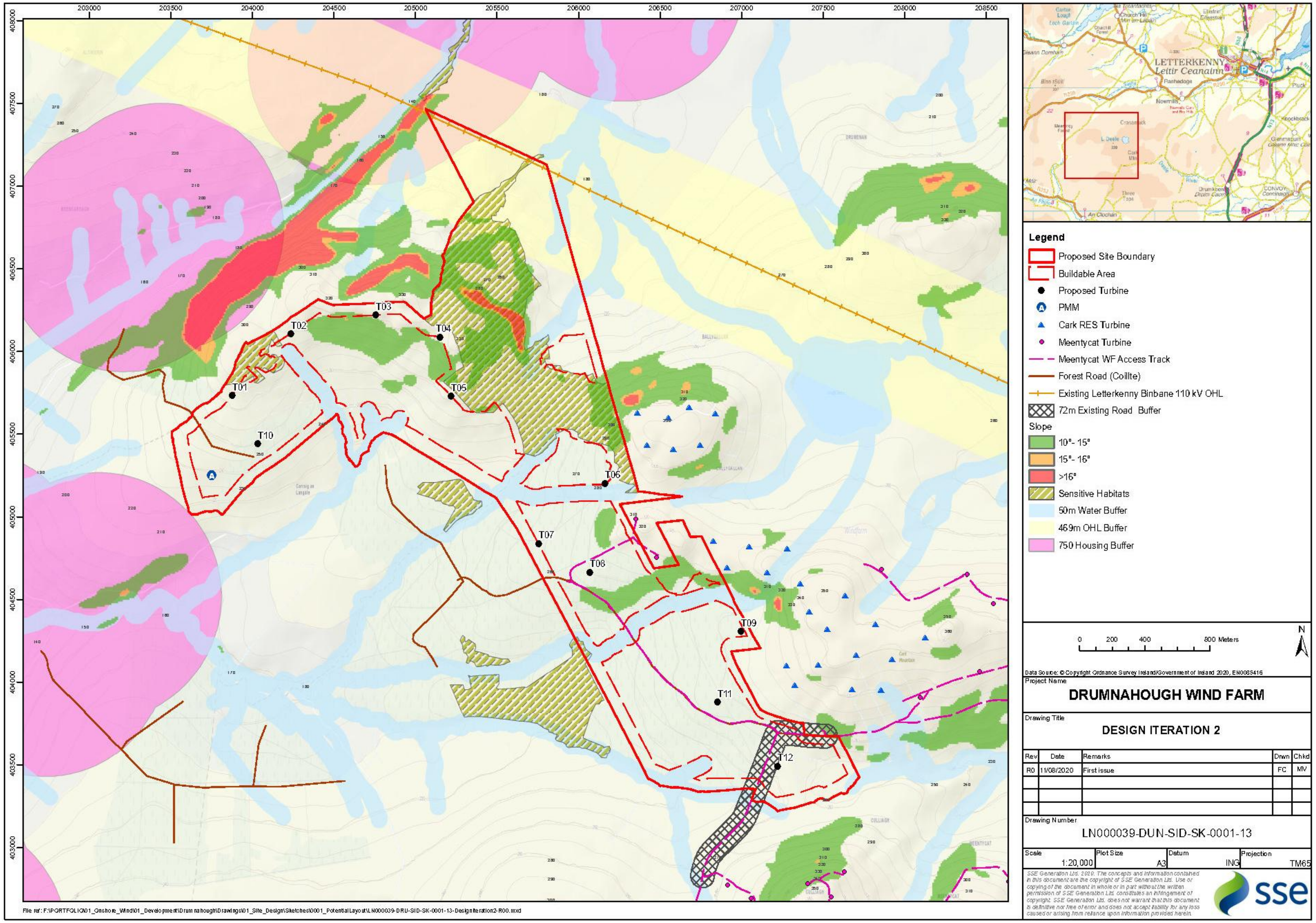

Figure 4-2 Proposed Layout 2

4.4.1.3 Design Iteration 3

Design Iteration No. 3 was updated using the latest CFD (Computational Fluid Dynamics) wind flow model, which takes account of the LiDAR (Light Detection and Ranging) flyover forestry survey.

Table 4-6 Iteration No. 3 Summary

Iteration No.	3 of 6
No. turbines	12
Date	23/8/2019
Key Drivers of Change	1. Merlin nest recorded on site during ecological survey work. 350m buffer applied to the nest location. 2. Three Malt Kiln Settlements (A-C) located during archaeology survey work. 3. Borrow pit locations 1 and 2 required by the design team and determined via site walkover survey.
Key Environmental Influences on Wind Farm Design	**Biodiversity:** Mitigated potential impact on Merlin **Archaeology:** 20m buffer applied to Malt Kiln Settlements
Key Changes to Wind Farm Layout since previous Iteration	• One of the turbines, associated access track and development footprint moved outside the 350m buffer zone related to the Merlin nest. • On-site substation option identified in relation to proximity to the overhead line. Associated access track designed to avoid the Malt kiln Settlement. • Site boundary changed to allow for the substation and Merlin nest buffer. • Borrow pit locations 1 and 2 determined via site walkover survey and avoidance of key constraints.
Additional Key Benefits of Changes to Wind Farm Layout	✓ Mitigated potential impact on nesting birds by design ✓ Mitigated potential impact on archaeology by design ✓ Located borrow pits and substation outside of biodiversity and archaeological constraint areas.

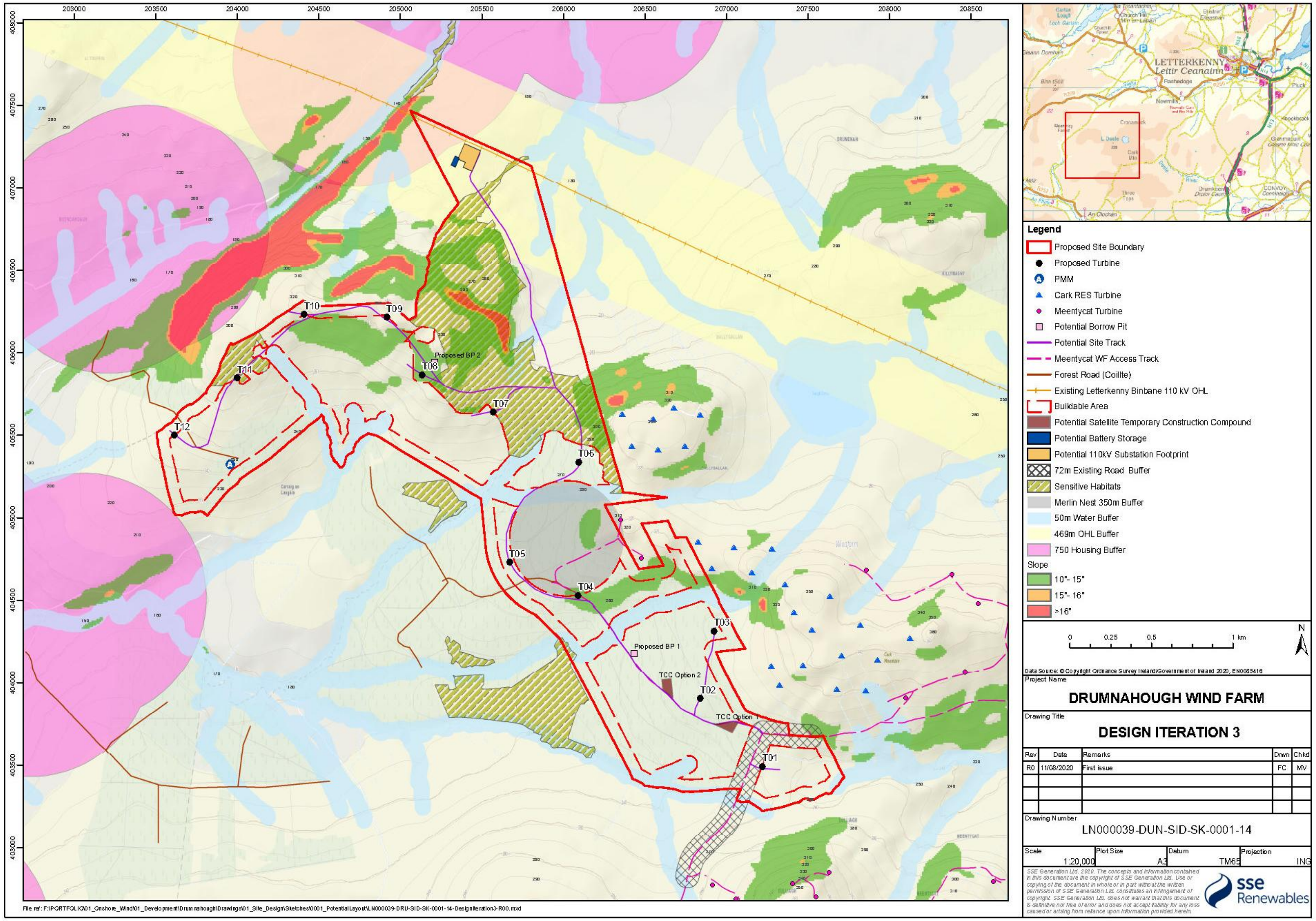

Figure 4-3 Proposed Layout 3

4.4.1.4 Design Iteration No. 4

Iteration No. 4 included a change in turbine numbering. Turbine locations were further micro-sited after consideration of peat depth and topography.

Table 4-7 Iteration No. 4 Summary

Iteration No.	4 of 6
No. turbines	12
Date	9/1/2020
Key Drivers of Change	1. Further micro-siting by engineering due to constraints including peat depth, slopes, tracks and hardstands. 2. A revised buffer to the public road was required to be larger than that for the site tracks. 3. Rotor diameter 145m included in wind farm analysis
Key Environmental Influences on Wind Farm Design	**Traffic and Transportation:** Increased public road buffer **Peat Stability:** Peat depths and slope considerations influence the layout design from the Peat Stability Risk Assessment **Engineering constraints**: ground conditions and engineering layout design principles.
Key Changes to Wind Farm Layout since previous Iteration	• Turbine 1 position was refined based on the public road buffer • Turbines 4-8 positions refined between 30- 90m of last layout positions based on ground conditions and engineering constraints.
Additional Key Benefits of Changes to Wind Farm Layout	✓ Reduced impact on areas of peat ✓ Increased safety buffer maintained from public road

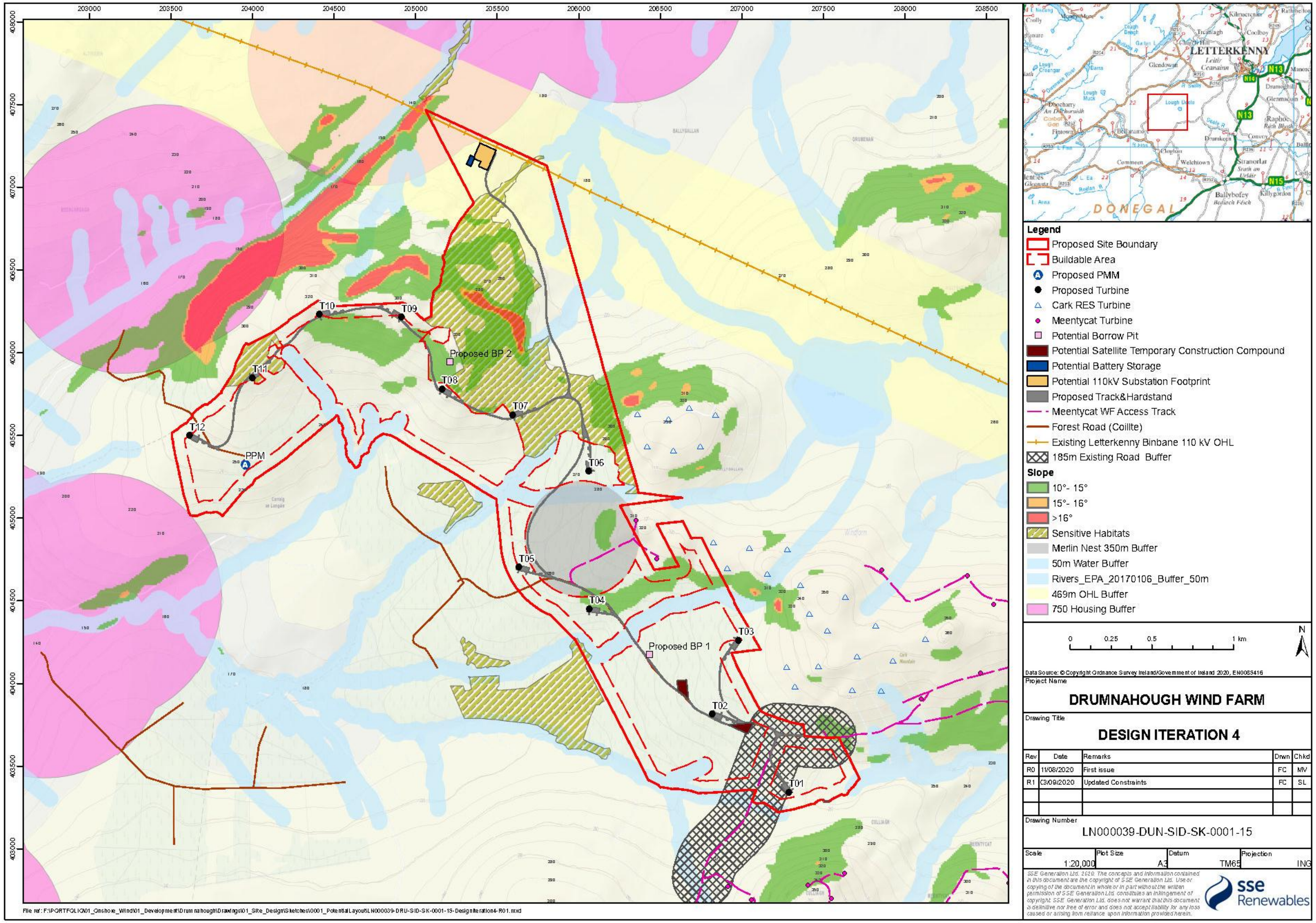

Figure 4-4 Proposed Layout 4

4.4.1.5 Design Iteration No. 5

Iteration No. 5 required further micro-siting due to engineering constraints such as peat depth, slopes, tracks and hardstands.

Table 4-8 Iteration No. 5 Summary

Iteration No.	5 of 6
No. turbines	12
Date	27/4/2020
Key Drivers of Change	1. The cut/fill balance required additional borrow pits to be located on site 2. Results of the peat probing / shear vane testing
Key Environmental Influences on Wind Farm Design	**Peat Stability:** Peat depths and slope considerations influence the borrow pit locations from the Peat Stability Risk Assessment
Key Changes to Wind Farm Layout since previous Iteration	• Turbine 3/5/9/10/ micro sited due to turbine technology alternative and technology alternative of an increased rotor diameter. • Four borrow pits (two additional) – T4 in close proximity to borrow pit 3, therefore relocated. • The road from T06 to T07 has been relocated in order to avoid peatland areas. • Turbine T07 hardstand area moved to avoid peatland • Road from T07 to T09 has been relocated in order to avoid peatland areas. • The road from T09 to T10 has been realigned to suit the new hardstand orientations • The road from T10 to T11 has been relocated in order to avoid peatland areas
Additional Key Benefits of Changes to Wind Farm Layout	✓ Reduced impact on areas of peat – avoidance by design

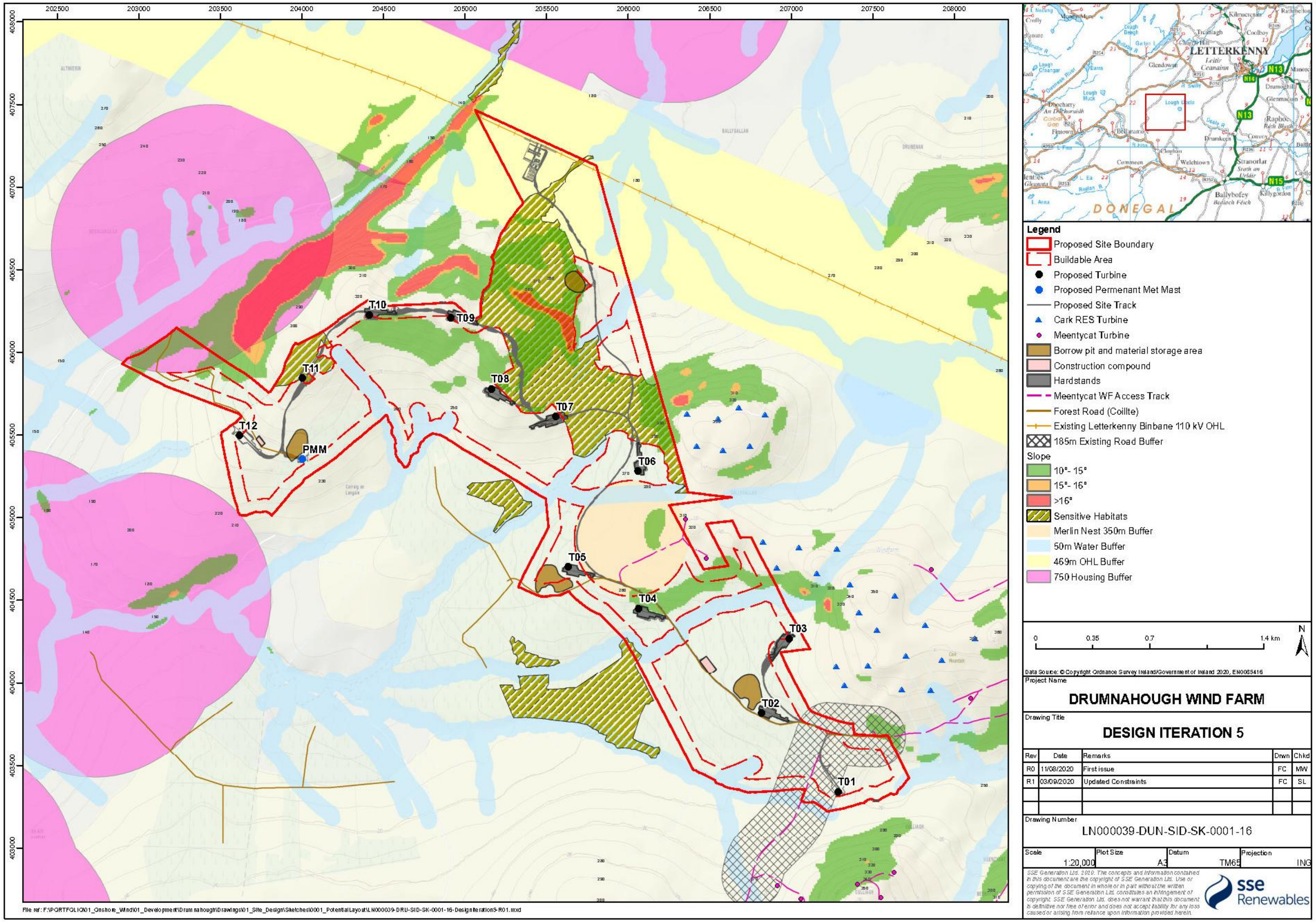

Figure 4-5 Proposed Layout 5

4.4.1.6 Design Iteration No. 6

Iteration No. 6 has included grid route connection to the consented Lenalea substation within the site boundary. There were no further updates to turbine locations.

Table 4-9 Iteration No. 6 Summary

Iteration No.	6 of 6
No. turbines	12
Date	06-2020
Key Drivers of Change	Site boundary to encompass permitted Lenalea substation. Red line planning boundary to include TDR access through Meentycat Wind Farm, resulting in a positive effect on traffic.
Key Changes to Wind Farm Layout since previous Iteration	Consented Lenalea substation is now included within site boundary. Site boundary includes TDR access through Meentycat Wind farm.

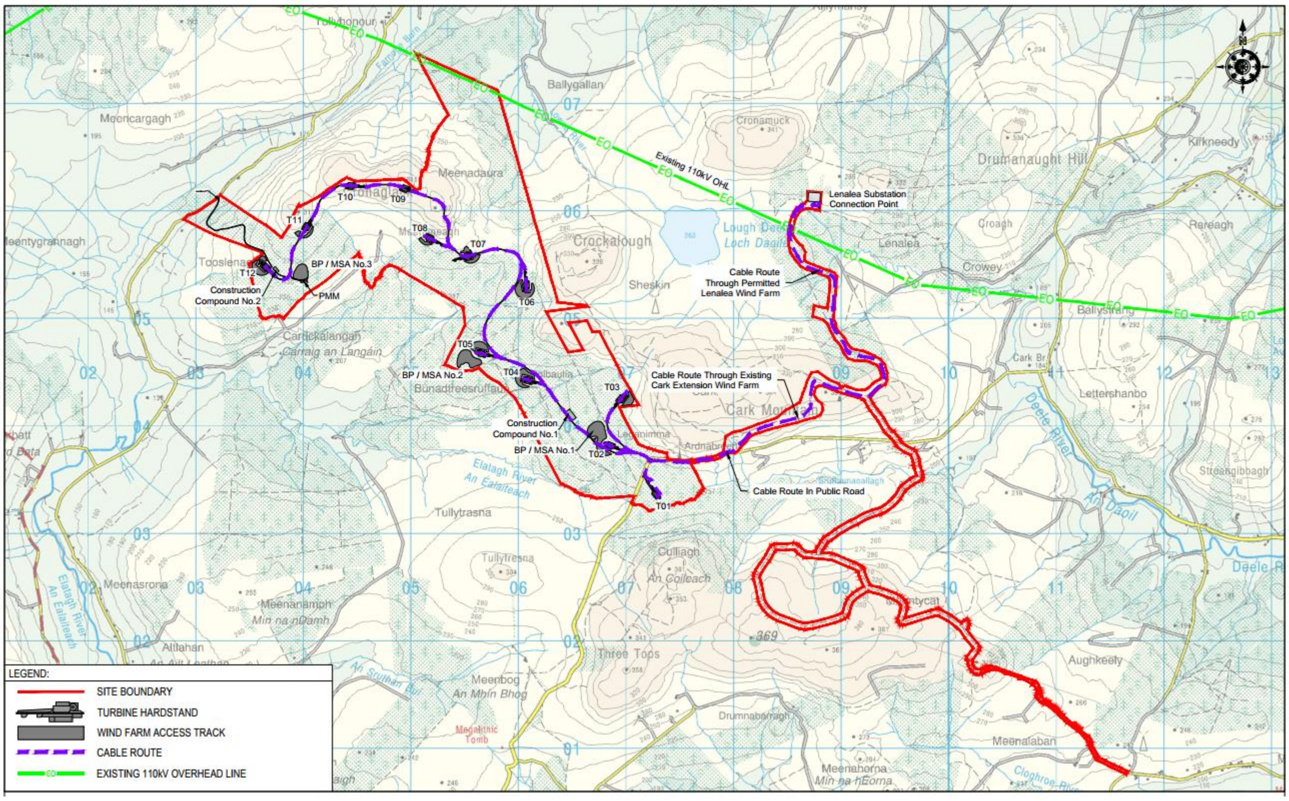

Figure 4-6 Proposed Layout 6

Table 4-10 Overview of Project Design Evolution

	Permitted 2009 Wind Farm	Iteration No. 1	Iteration No.2	Iteration No.3	Iteration No. 4	Iteration No. 5	Iteration No.6
No of Turbines	15	12	12	12	12	12	12
Design improvement	Original design, therefore no improvement to note.	• Minimum of 680m between nearest turbine and closest residences • Minimum of 50m between nearest turbine and streams and rivers • Outside any SAC or SPA boundary • Avoidance of steep slopes • Minimum of 1km between nearest turbine and closest recorded archaeological monument	• Increased distance of Turbine 1 from a sensitive habitat • Safety buffer maintained from public road	• Mitigated potential impact on nesting birds by design • Mitigated potential impact on archaeology by design • Located borrow pits and substation outside of biodiversity and archaeological constraint areas.	• Reduced impact on areas of peat • Increased safety buffer maintained from public road	• Reduced impact on areas of peat – avoidance by design	Grid Connection Option to permitted Lenalea substation now included. Site boundary includes access through Meentycat Wind farm.

Table 4-11 Comparison of Environmental Effects of Design Iterations

Effects	Permitted 2009 Wind Farm	Iteration No. 1	Iteration No.2	Iteration No.3	Iteration No. 4	Iteration No. 5	Iteration No.6
Population and Human Health	Not significant with implementation of mitigation	Potential public safety effect due to location of T1	Potential public safety effect reduced in severity	Effects similar to that of layout Iteration 2	Potential public safety effect further reduced.	Effects similar to that of layout Iteration 4	Effects similar to that of layout Iteration 4
Biodiversity	Loss of habitat unavoidable. Effect on sensitive habitats.	Loss of habitat unavoidable. Effect on sensitive habitats.	Loss of habitat unavoidable. Effect on sensitive habitats reduced in severity to that of Layout Iteration 1.	Loss of habitat unavoidable. Effect on sensitive habitats further reduced in severity to that of Layout Iteration 2.	Loss of habitat unavoidable. Effect on sensitive habitats further reduced in severity to that of Layout Iteration 3	Loss of habitat unavoidable. Effect on sensitive habitats further reduced in severity to that of Layout Iteration 4	Loss of habitat unavoidable. Effect on sensitive habitats similar to that of Layout Iteration 5. Selection of Grid Connection Option to permitted Lenalea substation reduces extent of habitat loss and tree felling.
Ornithology	No effect within SAC/SPA. Potential Effect on avian species using the site	No effect within SAC / SPA. Potential Effect on avian species using the site	No effect within SAC / SPA. Potential Effect on avian species using the site	No effect within SAC / SPA. Potential effect on avian species using the site reduced in severity to that	Effect on ornithology similar to that of Layout Iteration 3	Effect on ornithology similar to that of Layout Iteration 3	Effect on ornithology similar to that of Layout Iteration 3. Selection of Grid

Effects	Permitted 2009 Wind Farm	Iteration No. 1	Iteration No.2	Iteration No.3	Iteration No. 4	Iteration No. 5	Iteration No.6
				of Layout Iteration 2 due to buffer apply for merlin.			Connection Option to permitted Lenalea substation would reduce extent of potential effects.
Air and Climate	Temporary addition of VOC, NOx, and CO emissions to the local airshed during construction. Project of circa 45MW of renewable energy - positive air and climate change effects	Temporary addition of VOC, NOx, and CO emissions to the local airshed during construction. Large-scale project c. 60MW with positive air and climate change effects Increased further offsetting of non-renewable electricity. Improved energy optimisation with Battery storage facility.	Effects similar to that of layout Iteration 1	Effects similar to that of layout Iteration 1	Effects similar to that of layout Iteration 1	Effects similar to that of layout Iteration 1	Effects similar to that of layout Iteration 1 with slightly reduced amount of air pollutant emissions and fugitive dust levels associated with construction due omission of onsite substation. Reduced benefit with omission of Battery Storage facility if Grid Connection Option to permitted Lenalea is selected
Lands and Soils	Ground surface disturbance and changes in impervious surfaces unavoidable.	Reduced risk of peat instability and volume of peat and spoil to be managed.	Further reduced risk of peat instability and volume of peat and spoil to be managed.	Further reduced risk of peat instability and volume of peat and spoil to be managed to that of layout Iteration 2	Further reduced risk of peat instability and volume of peat and spoil to be managed to that of layout Iteration 3	Further reduced risk of peat instability and volume of peat and spoil to be managed to that of layout Iteration 4	Effects similar to that of layout Iteration 5. Effect reduced if Grid Connection Option to permitted Lenalea is selected due to reduction in the total area and volume of soil disturbance associated with clearing and excavation. Also decrease in peat and spoil volumes.
Water	Construction activities minimum 50m separation distance to	50m buffer applied to streams and rivers. 3 water course crossings required.	50m buffer applied to streams and rivers. 3 water course crossings	50m buffer applied to streams and rivers. 3 water course crossings required.	50m buffer applied to streams and	50m buffer applied to streams and rivers. 3 water course crossings	50m buffer applied to streams and rivers. 4 additional water

Effects	Permitted 2009 Wind Farm	Iteration No. 1	Iteration No.2	Iteration No.3	Iteration No. 4	Iteration No. 5	Iteration No.6
	water features.		required.		rivers. 3 water course crossings required.	required.	crossings required within the Cark Extension and Lenalea site.
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.
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.
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 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 effect on malt kiln reduced in severity to that of Layout Iteration 2. Potential for impacts on unknown archaeological/cultural resources	Effects similar to that of layout Iteration 3	Effects similar to that of layout Iteration 3	Effects similar to that of layout Iteration 3
Shadow Flicker	Less than 30 hours per year of shadow flicker on sensitive receptors	Increased potential shadow flicker due to increase in turbine heights. 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 effect with implementation of mitigation.	No effect with implementation of mitigation.
Material Assets	Increase in traffic volumes on public roadway during construction unavoidable	Increase in traffic volumes on public roadway during construction unavoidable Potential public safety effect due to location of T1. (formerly T12)	Increase in traffic volumes on public roadway during construction unavoidable Potential public safety effect reduced in severity.	Effects similar to that of layout Iteration 2.	Effects similar to that of layout Iteration 2. Potential public safety effect further reduced.	Effects similar to that of layout Iteration 4.	Effects similar to that of layout Iteration 4. Underground cabling works required along 750m of public road.

Table 4-11, Comparison of Effects for Design Iterations, summarises the identified effects of each of the layout alternatives. As presented in Table 4-11, each layout alternative would result in similar effects on resources. The severity of identified effects however varies among the alternatives and overall declines from Iteration 1 to Iteration 6.

The physical disturbance required to install the proposed 12 number turbines would be less than that of the previously permitted 15 no. turbines (permitted 2009 development). The 3 turbines eliminated relative to the permitted 2009 layout are those in areas having the potential to affect sensitive resources, specifically biological resources, and certain locations close to sensitive receptors.

The repositioning of turbines from Iteration 1 to Iteration 5 to avoid and minimise impacts to sensitive resources and receptors reduces the environmental effect of the wind farm development.
Turbines T9, T10 and T11 were relocated northward to the ridge of the hill in order to move from blanket bog to eroded blanket bog. Repositioning of turbines T9, T10 and T11 has added benefits of minimising indirect impact of on Blanket Bog (PB2) (i.e. changing the groundwater regime and draining it).

Crane hardstands were rotated or adjusted based on site constraints such as topography and proximity to sensitive habitats. Turbines T7 and T8 hardstand area were rotated in order to avoid areas of Blanket Bog (PB2).

The access road layout is generally similar for each alternative, however the minor realignment of internal access roads from Iteration 1 to Iteration 5 avoids and minimise effects to sensitive resources and receptors. Where possible, site access roads were chosen to maximise use of existing forestry roads, reducing the need for construction of new tracks. The proposed road layout and other infrastructure has been selected on the basis of field investigations, using criteria such as peat depth and gradients to minimise both the impact of peat slippage and impacts on higher value peat habitats. Areas of deep and soft peat have been avoided insofar as possible. The proposed roads comprise a combination of those that ‘float’ on the peat surface (in flatter/wetter and deeper areas) as well as the ‘cut and fill’ type (on sloping ground).

Track layout iterations included extending a road east-west between the proposed meteorological mast and T7. A review of peat stability, sensitive habitat areas and topography indicated that a track in this location would require additional drainage within Upland Blanket Bog (PB2) habitats. By altering the track north to T8 and T9 and following the ridgeline west the track would reduce any potential impact on blanket bog drainage. There were some areas where road infrastructure crosses blanket bog and drained blanket bog habitats. Where possible, the majority of infrastructure has been placed within low value habitats. Potential access routes between T7 and T8 to T9 were analysed as shown in **Figure 4-9** and **Table 4-12** below.

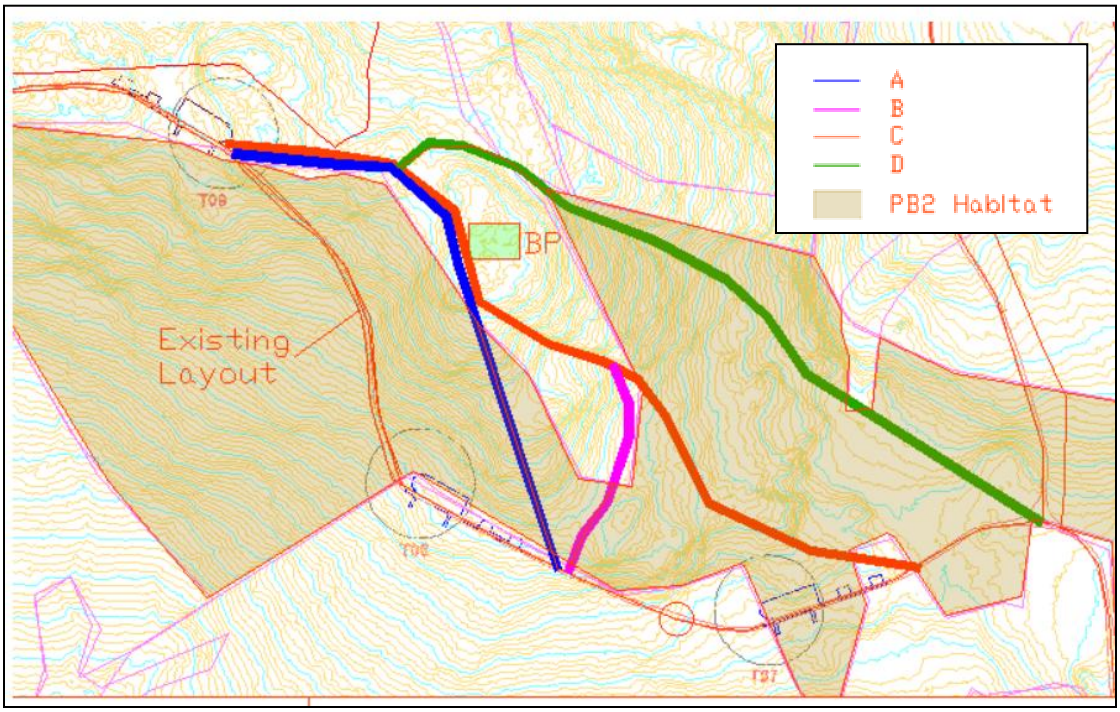

Figure 4-7 Proposed access tracks between T7, T8 and T9

Table 4-12 Summary of Access Track Options for T7 to T9

Route	Comment
A	Peat removal required in areas of blanket bog. Potential for floated road along ridge at top of hill reduces impact on hydrological regime.
B	Access track transverses relatively flat section of blanket bog allowing for floated road.
C	Access track transverses relatively flat section of blanket bog allowing for floated road.
D	Peat removal required in areas of blanket bog. Access tracks can be floated in portion of blanket bog.

Following desktop review, Route Option B and C underwent further ecological and engineering site investigations. Route B has the minimum impact on blanket bog and was selected as the preferred route option.

The only variation between layout Iteration 5 and Iteration 6 is the change in grid connection point.

Iteration 6 would require works along 750m of the public road to install the underground medium voltage cables from the wind farm to the grid connection point. The physical greenfield disturbance however required to construct Iteration 6 would be less than that of Iteration 5 due to the omission of the on-site substation and battery storage facility and reduction in extent of new internal service roads. Iteration 6 would require approximately 7.2km of new internal services roads to be constructed while approximately 8.9km of new roads would be required for layout Iteration 5. This reduces the extent of required new services roads by 1.7km.

Iteration 6 has therefore emerged as the preferred option as it further reduces the impact and severity of effects of the wind farm development on resources and receptors.

4.4.2 Alternative Technology

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

4.4.2.1 Alternative Wind Turbine Scale

The wind turbine scales examined by the applicant included the previously consented turbine with tip height of 135m and blade length of 50m and a proposed larger turbine with tip height of 167.5 and blade length of approximately 71m.

Table 4-13 Comparison of Environmental Effects of Alternative Wind Turbines

Environmental Factor	Development with original proposed 15 No. turbines (c. 3MW, 135m tip height)	Development with 12 No. larger turbines (c. 5MW, 167.5m tip height)
Population and Human Health	Not significant with implementation of mitigation	Not significant with implementation of mitigation
Biodiversity	Loss of habitat unavoidable. Effect on sensitive habitats.	Loss of habitat unavoidable. Effect on sensitive habitats reduced in severity due to reduced disturbance footprint.
Ornithology	No effect within SAC / SPA. Potential Effect on avian species using the site	No effect within SAC / SPA. Increased potential effect on avian species using the site due to increased rotor swept area.
Air and Climate	Project of circa 45MW of renewable energy - positive air and climate change effects	Large-scale project c. 60MW with positive air and climate change effects Increased further offsetting of non-renewable electricity.
Lands and Soils	Ground surface disturbance and changes in impervious surfaces unavoidable.	Ground surface disturbance and changes in impervious surfaces unavoidable. Effect reduced in severity due to reduced disturbance footprint.
Water	Increased surface runoff from hardstand areas.	Reduced number of hardstand areas resulting in beneficial effect.
Noise	Operational phase - Layout meets DoEHLG noise limits	Operational phase - Layout meets DoEHLG noise limits
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 extend from limited areas to the south and south east.
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 increase in turbine heights. 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 4-13, both turbine scales would result in similar effects on Population and Human Health, Noise, Shadow Flicker, Cultural Heritage and Material Assets. The severity of identified effects for other environmental factors however varies. In the case of effects on Biodiversity, Air and Climate, and Lands and Soils, the alternative comprising a lesser number of larger turbines would have a reduced environmental effect to that of the alternative comprising a greater number of smaller turbines.

In the case of effects on Landscape, the larger turbine alternative will result in a slight increase in the extent of theoretical visibility from limited areas to the south and south east of the site. The landscape assessment (EIAR Chapter 12) however indicates that the proposed larger turbines will not result in significant visual effects.

In the case of effects on Ornithology, the longer turbine blade length would increase the rotor swept area and thus increase potential effects on avian species. However the impact would be of a similar significance to that of the other alternative of smaller blades and the ornithology assessment (EIAR Chapter 7) concludes that the proposed larger turbines will not result in significant collision effects on bird species.

Developments in turbine technology since the previously consented project (PL. Ref. 08/50687) have meant that larger turbines would potentially represent the most efficient for use on the site. The use of the most efficient turbines is intended to maximise the electricity generated from the wind resource. Therefore the preferred alternative wind turbine scale is the fewer number larger c. 5MW turbines for the following reasons:

- Reducing the proposed number of turbines by 3 will reduce the proposed development footprint and areas of forestry felling and therefore result in lesser effects in relation to biodiversity, land and soils, and water.
- The larger turbines do not increase potential environmental impacts such that a significant effect would result.
- The larger turbines will provide an additional 15MW of 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 Drumnahough site is located within close proximity of existing and consented transmission infrastructure and has two reasonable grid connection alternatives. A potential grid connection option exists via the permitted Lenalea substation east of the proposed development. A second potential grid connection option is to construct a new 110kV substation adjacent to the existing 110kV Binbane to Letterkenny overhead line, within the northeast boundary of the proposed development site. The connection of the twelve (12) No. turbines to the National Electricity Grid will be dependent on future grid offers and will ultimately be decided by EirGrid, accordingly both potential connection options have been assessed in this EIAR.

Table 4-14 Comparison of Environmental Effects of grid connection options

Environmental Factor	Grid Connection to proposed new 110kV substation	Grid Connection to permitted 110kV Lenalea substation
Population and Human Health	No Effect	Traffic disruptions during construction phase on local roads
Biodiversity	Habitat losses. Requirement for minor forestry felling along route. Forest felling at proposed substation.	No effect
Ornithology	No Effect	No Effect
Air and Climate	Emissions during construction phase.	Emissions during construction.
Lands and Soils	Removal of overburden and excavation of substation infrastructure foundation.	Temporary removal of overburden during laying of cables
Water	Total of 3 No. water crossings. (1 existing crossing within existing on-site forestry tracks and 2 new crossings).. Increased surface runoff at substation location	A total of 7 water crossings including 2 No. within the proposed development site (1 existing and 1 new), 1 No. water crossing adjacent to the public road (existing) and 4 No. within the Cark Extension and Lenalea sites along the existing or permitted access tracks.
Noise	Construction phase noise	Construction Phase noise
Landscape	No Effect	No Effect
Cultural Heritage	No Effect	No Effect
Shadow Flicker	No Effect	No Effect
Material Assets	Traffic during construction phase.	Additional traffic during construction phase. Single lane road closures during construction along circa 750m of local road.

The preferred grid connection option is Lenalea connection due to reduced requirement of forestry felling and temporary effect on land and soils. However both grid connection options have been identified with available capacity for exportation of electricity to the National Electrical Grid (NEG) and have both been assessed throughout the EIAR.

4.4.2.3 Battery Storage Systems

Developments in power storage since the previously consented project (PL. Ref. 08/50687) has meant that developments now have the ability to store surplus energy and export to the National Electricity Grid when required. When considering the alternative grid connection via a new proposed substation within the site, the applicant also examined this alternative with and without battery energy storage systems.

Table 4-15 Comparison of Environmental Effects of Battery Energy Storage System

Environmental Factor	Site Development with Battery Energy Storage System	Site Development without Battery Energy Storage System
Population and Human Health	Not significant with implementation of mitigation	Not significant with implementation of mitigation
Biodiversity	Requirement of minor forestry felling	Reduced disturbance footprint.
Ornithology	No Effect	No Effect
Air and Climate	Emissions during construction of facility. Improved renewable energy system. Stability and energy efficiency through ability to store energy until required	Loss of ability to store energy and additional decarbonisation
Lands and Soils	Removal of overburden and excavation of infrastructure foundation. Hardstand areas.	No Effect
Water	Increased surface runoff from Hardstand areas.	No Effect
Noise	Construction Phase noise	No Effect
Landscape	Will be screened by existing vegetation and nearby forestry and will allow for no visual impact on surrounding receptors.	No Effect
Cultural Heritage	No Effect	No Effect
Shadow Flicker	No Effect	No Effect
Material Assets	Additional traffic during construction phase. The provision of the Battery Storage System allows for the optimising of the renewable energy generated through ability to store surplus energy and export to the National Electricity Grid when required	Loss of ability to store surplus energy

If the alternative grid connection via a new on site substation is to be progressed, the preferred technology alternative is inclusion of battery energy storage systems for the following reason:

- Inclusion of battery storage system will allow for the storage of surplus energy and export of electricity to the National Electricity Grid when required.

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 and source of aggregate materials. 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 existing roads, however the proposed development, will require new service roads to the majority of the turbines. The proposed wind farm will use 3.2km of existing forestry and existing wind farm tracks and 7.1km of new roads will be constructed within the proposed development site.

New excavated roads will be constructed using site won stone aggregate obtained from the proposed on-site borrow pits 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 road building material from the subsoil, may also be laid at formation level.

Floating roads will be required in areas of deep peat that could not be avoided in the design of the access road layout. Where gradient and topographical conditions permit, floated roads will also be utilised in areas of blanket bog habitat. The use of floating road methods will minimise the excavation of peat and reduce interference with the existing drainage regime in these areas of the site. A combination of geogrid and geotextile will be placed over the vegetation on the existing surface to be traversed with the floating road.

The proposed development will utilise all three internal access road options, utilisation of existing access roads was applied where possible. Depending on existing environment, new roads will be constructed as cut and fill or floated design.

Table 4-16 Comparison of Environmental Effects of Internal roads

Environmental Factor	Utilising Existing Roads	Construction of new roads – cut and fill	Construction of new roads – 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 Pits

On-site borrow pits are proposed as a source of stone and aggregate materials for the development. The only other potential alternative is to import the material from authorised quarries outside of the site.

Table 4-17 Comparison of Environmental Effects of Material Sourcing

Environmental Factor	On-site Borrow Pits	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 peats and soils	Alternative engineered storage facilities required on site for placement/storage of surplus excavated peat and 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 on-site borrow pits provide suitable repositories for storage of surplus excavated peats and soils.

4.5 CONCLUSION

The project design process and reasonable alternatives were completed with reference to EIA Directive 2014 and EU Guidance Document 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 scales, alternative grid connections and alternative construction methods.

The final site layout (iteration number 6) 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.

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