

2 Design Iteration

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2 Design Iteration

2.1 Executive Summary

- 2.1.1 This chapter provides a description of the site selection process and design iterations that were undertaken prior to arriving at the final design of the Proposed Development, which is described in detail in Chapter 3.
- 2.1.2 Throughout the process, the Applicant has considered key environmental receptors and has aimed to remove and reduce environmental effects as far as possible through design.

2.2 Introduction

- 2.2.1 The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (as amended) require that the Environmental Impact Assessment Report (EIA Report) must include *“a description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment”* (Regulation 5(2)(d)) (Scottish Government, 2017).
- 2.2.2 The final design of the Proposed Development represented in this EIA Report was arrived at following iterative consideration of many alternative design configurations. This chapter describes the design iteration process from which the Proposed Development design was selected.

2.3 Site Selection

- 2.3.1 The location of the Proposed Development site was selected as part of a nationwide search for potential wind farm sites.
- 2.3.2 The Applicant considered 120 potential sites throughout the UK to establish the most appropriate locations for a wind farm development. This review included consideration of:
- Scottish Planning Policy (SPP) (Scottish Government, 2014);
 - international, national and local designated sites;
 - initial assessment using NOABL database to ensure wind speeds greater than 7 m/s at 45 m height;
 - transport facilities;
 - operating airports;
 - reasonable proximity to a potential grid connection point;
 - distance from residential receptors; and
 - other operational, consented or in planning wind farm developments.
- 2.3.3 Of the initial sites investigated, the Applicant elected to progress with more detailed feasibility studies for approximately 20 sites, of which the Proposed Development site was one.

2.4 Opportunities and Constraints

Opportunities

- 2.4.1 The Proposed Development site benefits from a number of opportunities as a wind farm site, including:
- good wind resource;
 - lack of peat and geological designations;

- contained landscape and visual effects;
- lack of designated cultural heritage;
- current land use.

Wind Speed

2.4.2 The Proposed Development site averages measured wind speeds in excess of 8m/s at the proposed turbine height This is higher than average for Scotland. It is predicted the wind farm will produce around 129.507 GWh¹ of electricity annually, equating to powering the equivalent of 34,729 homes².

Landscape and Visual

2.4.3 Due to the backdrop of hills to the east of the Proposed Development the visual effects are contained to the west, north-west and south-west. There is limited visibility along the A78 due to intervening land form. While there will be visibility along the eastern shore of Bute this will be contained, with little to no visibility along the centre and western shore.

Peat, Geology and Hydrogeology

2.4.4 No Sites of Special Scientific Interest (SSSIs), or Geological Conservation Review (GCR) sites, designated for their geological interest, are present within the Proposed Development site boundary.

2.4.5 There is a minimal extent of peatland on the site, with a small area of Class 3 peatland (dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type) located at the north-east of the site. Peat surveyed in this area was found ubiquitously to be less than 1 m deep.

Cultural Heritage

2.4.6 There are no designated cultural heritage receptors within the Proposed Development site boundary.

Land Use

2.4.7 The Proposed Development site is currently used for sheep-grazing by the landowners. The land occupied by the site boundary is of minimal agricultural value, with only 4% of the land classed as Prime Agricultural Land, with a Land Capability designation of Class 3.1 (land capable of producing consistently high yields of a narrow range of crops and/or moderate yields of a wider range). The majority of the site is of the Land Capability designation classes 4.2, 5.3 and 6.2, all of which are of low agricultural value, either capable of producing a narrow range of crops or capable of use as rough grazings. During operation the site will continue to be used for sheep-grazing with no restrictions, excepting controlled access to the substation compound.

Constraints

2.4.8 Like any potential wind farm site, the Proposed Development site also has some environmental constraints which have been taken into consideration during the design iteration process. These are principally:

- ornithological receptors;
- landscape and visual constraints;
- cultural heritage outwith the site boundary;

1.1.1

¹ This has been calculated by multiplying the target capacity of the Proposed Development by the hours in a year (8760) and the capacity factor (35.2%) (BEIS, 2019).

² This has been calculated by dividing the annual energy output (129.5 GWh) by annual UK average household consumption (3.729 MWh) (RenewableUK, 2019).

- ecological constraints; and
- hydrology.

Ornithology

- 2.4.9 The Renfrewshire Heights Special Protection Area (SPA) and Site of Special Scientific Interest (SSSI) lies immediately adjacent to the site boundary to the north-east. The SPA and SSSI are designated for hen harrier (*Circus cyaneus*).
- 2.4.10 To develop a detailed understanding of the ornithological site constraints, the Applicant has undertaken a range of surveys including:
- breeding raptor survey;
 - wintering bird walkover survey;
 - black grouse survey;
 - targeted nocturnal survey; and
 - vantage point surveys.

Landscape and Visual Amenity

- 2.4.11 The Proposed Development site has the potential to impact upon landscape and visual amenity of receptors such as:
- North Ayrshire Special Landscape Area (SLA);
 - Great Cumbrae SLA;
 - Bute and South Cowal Area of Panoramic Quality (APQ); and
 - Waterhead Moor Wild Land Area, Muirshiel.
- 2.4.12 The Applicant undertook Zone of Theoretical Visibility (ZTV) analysis and consultation with relevant consultees to establish the potential impact of the Proposed Development on landscape and visual amenity. The ZTV of all turbines has been reduced to a minimal extent through the iterative design process, where turbines and infrastructure have been moved to reduce the visual impact of the Proposed Development on sensitive receptors. The ZTV indicates just 20.78 % of the area (land and sea) within the 40 km study area has a view of all turbines and 28.15 % with a view of at least one turbine. Turbine locations were amended based on identified receptors, as outlined in Chapter 5 and in Section 2.6 of this chapter.
- 2.4.13 Specifically, turbines were relocated as far north as possible within the southern extent of the Proposed Development in order to utilise lower ground where views will be screened by local topography, thereby greatly reducing the visual impact upon Brisbane Glen, adjacent to the east of the site, Skelmorlie village to the Northwest, Largs to the southwest and further visual receptors.

Cultural Heritage

- 2.4.14 The Scheduled Monument of the Outerwards, Roman fortlet comprises the upstanding remains of a small Roman fortlet dated to the mid-2nd century and is located approximately 500 m east of the Proposed Development boundary and 1 km from the nearest turbine location. It is of national importance as it retains some the foundations of a defensive Roman fortlet.
- 2.4.15 The setting of the fortlet in a strategic location with commanding views in all directions contributes to an understanding of its cultural value and, as such, it is sensitive to changes within its setting. The turbines within the Proposed Development have the potential to span across one key strategic sightline from the fortlet.
- 2.4.16 This formed a key consideration of the design iteration outlined in this chapter, with turbine locations positioned to maintain the key strategic sightlines of the Outerwards, Roman fortlet as much as possible.

Ecological Constraints

- 2.4.17 The Skelmorlie Glen SSSI lies within the Proposed Development site boundary towards its western extent, designated for representing a good example of semi-natural woodland in North Ayrshire and hosting a diverse community of ground flora. Furthermore, an area included in the Ancient Woodland Inventory is also located within the Proposed Development site mainly along the banks of both the Skelmorlie Water and also the unnamed watercourse of Fardens Glen.
- 2.4.18 Through design, potential impacts of the Proposed Development on the Skelmorlie Glen SSSI and areas of Ancient Woodland Inventory have been avoided by relocating turbines away from these areas.
- 2.4.19 To develop a further understanding of the ecological constraints of the site and to inform the design iteration process further, the Applicant has undertaken a range of detailed site surveys, including:
- Extended Phase 1 Habitat Survey;
 - National Vegetation Classification Survey; and
 - protected species surveys, including for bat (*Chiroptera spp.*), otter (*Lutra lutra*), and badger (*Meles meles*).

Hydrology

- 2.4.20 The Proposed Development site contains numerous natural and man-made watercourses including the Skelmorlie Water. These watercourses have been surveyed by the Applicant and, where possible, the Proposed Development infrastructure has been designed to minimise impact to watercourses through the use of 50 m buffers and a minimisation of the number of watercourse crossings required (refer to Chapter 10).

2.5 Design Principles

- 2.5.1 Current best practice guidance provides a framework for the consideration of key design issues including turbine size, layout composition, wind farm design in relation to landscape character and designing for multiple wind farms (SNH, 2017).
- 2.5.2 Taking into consideration the above constraints and opportunities, the following principles were adopted during the design iterations undertaken by the Applicant to ensure that the final design of the Proposed Development was the most suitable for the site:
- maximising wind yield and maintaining adequate spacing between turbines;
 - avoiding areas of peat where reasonably practicable;
 - a minimum buffer of 50 m being maintained around watercourses for turbines and disturbance limited to as per best-practice guidance;
 - consideration of key views, in particular from Outerwards, Roman fortlet;
 - a minimum buffer of 85 m being maintained between turbines and woodland bat features and a minimum buffer of 30 m being maintained between turbines and trees with identified bat roost potential;
 - a buffer zone of approximately 200 m north and 300 m south of the Fardens property following the identification of bat roosts;
 - a minimum buffer of 60 m being maintained between turbines and the Renfrewshire Heights SPA, abutting the northern edge of the site boundary; and
 - avoiding inconsistent turbine spacing, such as relatively large gaps, outliers or excessive overlapping turbines to minimise visual confusion and ensure a balance/compact array from key views.

2.6 Proposed Development Design Iterations

2.6.1 Following the selection of the site location, the Applicant has undertaken multiple design iterations of all aspects of the Proposed Development, including the site boundary, the turbine layout and the infrastructure layout. This section describes the principal design iterations that have been undertaken as the Applicant has sought to maximise the number of turbines on site, whilst minimising the environmental effects of the constraints identified above.

Turbine Layout

Layout A

2.6.2 The site boundary and turbine layout considered initially were developed to maximise the capacity of the Proposed Development site. This initial layout, designed to identify the theoretical maximum capacity that the site could accommodate, incorporated 33 turbines spread across the extent of a site boundary. The site boundary ranged from Kelly Burn and Upper Skelmorlie in the north, to Outwards Reservoir in the south, as shown in Figure 2.1.

Layout B

2.6.3 Following this initial design, the Applicant undertook a number of environmental surveys including:

- peat slide hazard and risk assessment;
- Phase 1 Habitat Survey;
- National Vegetation Classification survey;
- protected species surveys;
- freshwater fish survey;
- ornithology survey; and
- an Aviation Assessment.

2.6.4 Informed by the information gathered by these surveys and desk-based study, the Applicant reduced the site boundary in size substantially to an extent more similar to the one proposed in this EIA Report (refer to Figure 2.1).

2.6.5 This reduction in area aimed to reduce the impact of the Proposed Development on the environmental qualities of the area, in particular residential amenity of properties in Skelmorlie, near Barr Farm, at Outwards and along the Noddsdale Water.

2.6.6 A total of 14 turbines were removed, with Layout B incorporating a resultant 19 turbines, as demonstrated in Figure 2.1. Turbines were removed from both Upper Skelmorlie and the Outerwards area.

Layout C

2.6.7 In August 2019, the Applicant submitted the EIA Scoping Report for the Proposed Development to North Ayrshire Council (refer to Appendix 4.1). Within the EIA Scoping report Layout C was proposed which built upon the design of Layout B. This led to a further reduction in the number of turbines from 19 to 12, and a relocation of the turbine sites to reduce the impact of the Proposed Development on ecological aspects, as shown in Figure 2.2.

2.6.8 The major considerations which informed the design of Layout C were ecological constraints. Upon identification of bat roosts at the Fardens property, the turbine layout was modified to respect a buffer zone of approximately 200 m north and 300 m south of the property to ensure bats commuting out of the roots would not be impacted by turbines.

2.6.9 Furthermore, a buffer of 85 m was implemented around the woodlands of Skelmorlie Glen to minimise the impact of the Proposed Development on potential bat roost features within the glen, and bats commuting along the woodland edge and to maintain the integrity of the SSSI. The

cumulative impact of these ecological considerations led to a general removal of turbines from the west of the site.

Layout D

- 2.6.10 Following receipt of the 2019 EIA Scoping Opinion and initial consultation with statutory consultees, further modification was made to the design of Layout C to produce Layout D. This involved the reduction in the number of turbines from 12 to 11 and the relocation of the turbine sites to reduce the impact of the Proposed Development on both peatland and cultural heritage assets, as shown in Figure 2.3.
- 2.6.11 The northern most turbine of Layout C was removed from the Proposed Development design, in order to reduce the amount of construction required on areas of deeper peat (>0.75 m). Further relocation of other turbines was undertaken in order to minimise peat disturbance, moving the turbines to the east.
- 2.6.12 The distance between the turbines and Outerwards, Roman fortlet was increased, moving the eastern most turbines towards the west.

Layout E

- 2.6.13 Layout E continued to fine-tune the layout with turbines being micro-sited to reduce their potential effects on sensitive environmental receptors and a single turbine was added to the design to maximise the capacity of the Proposed Development (refer to Figure 2.4).
- 2.6.14 For example, it was noted that two turbines to the north-east of the Proposed Development were in proximity to the 60 m buffer applied around the Renfrewshire Heights SPA. These turbines were then sited towards the south-west to increase the distance between the turbines and the SPA, thereby decreasing the impact of potential effects.
- 2.6.15 Furthermore, the south-western turbines were micro-sited away from the 50 m watercourse buffers, in order to lessen their impact on the site hydrology.
- 2.6.16 A further turbine was added to the design in the eastern extent of the Proposed Development, to seize the opportunity afforded by this area being outwith any known constraints at the time, increasing the total number of turbines included in the Proposed Development from 11 to 12.

Layout F

- 2.6.17 Layout E was refined into Layout F after consideration was given to the impact of the Proposed Development on aspects of landscape and visual amenity and cultural heritage, with the aim to reduce the impact of effects on several key site characteristics. This was to address the main areas of feedback given by local residents of concern surrounding both visibility and impacts upon cultural heritage, as outlined in the PAC Report. Firstly, consideration was given to the visual impact of the turbines on the residential properties to the south of the site, namely East Grassyards and Outerwards. To reduce this impact, turbines near the southern site boundary were shifted northward off the prominent ridgeline where they were highly visible to the aforementioned properties. Secondly, the turbines were micro-sited to minimise obstruction of key viewpoints and lines of sight from the Outerwards Roman fortlet. The changes made to the Proposed Development design are demonstrated in Figures 2.5.

Layout G

- 2.6.18 Further modifications were made to the site layout to increase the distance between the turbines and Outerwards, Roman fortlet by a further 150 m and to decrease the potential for noise and shadow flicker effects on residential properties. The turbines closest to the southern site boundary were shifted further north and north-east and two turbines were removed from the Proposed Development, with the remaining 10 turbines constituting the design proposed in this EIA Report. This allowed a minimum distance of 1 km between the Outerwards, Roman fortlet and the closest turbine. The changes made to the Proposed Development design are demonstrated in Figures 2.6.

Infrastructure Layout

2.6.19 Following confirmation of the turbine locations, the design of the accompanying infrastructure was considered. This included hardstandings, substation compound, the borrow pit search area, temporary construction compound and access tracks.

Layout 1

2.6.20 Layout 1 (refer to Figure 2.7) was the initial infrastructure layout. This has three main access tracks. The principle access track linked the entry of the site at Craigmarloch Road out to turbine T10, utilising an existing crossing over the Meigle Burn and a newly proposed watercourse crossing across the Skelmorlie Water in the north-eastern extent of the site area. The principle access track was designed to use an existing farm track where possible. The second access track branches from the primary track and to connect with turbines T1, T2, T5, and T6. This access track incorporated a U-turn around the borrow pit search area to range south-westward. The final access track incorporated a branch from turbine T9 to turbine T7.

2.6.21 The temporary construction compound was located adjacent to the principle access track before it reaches turbine T3.

2.6.22 The substation compound is located adjacent to the principle access track between turbines T9 and T10.

Layout 2

2.6.23 Layout 2 improved upon Layout 1 by moving southward the portion of the principle access track which passes turbine T3 and T4, thereby reducing the magnitude of impact from the Proposed Development upon ecological receptors, such as:

- bat roost features identified within trees bordering the Skelmorlie Water;
- the Skelmorlie Glen SSSI; and
- the areas of Ancient Woodland Inventory in this area.

2.6.24 Furthermore, the U-bend of the second access track was refined and tightened, in order to make more use of the farm track in this area and avoid hydrological receptors, and the shape of the borrow pit re-designed.

2.6.25 A comparison is made between Layouts 1 and 2 in Figure 2.7.

Layout 3

2.6.26 Layout 3 was produced following substantial changes to Layout 2, as shown in Figure 2.8. Firstly, the temporary construction compound was shifted south-westward and closer to the access track. This design decision was made to reduce the length of access track needed across the entire site and also to reduce the impact of the development on hydrological receptors in proximity to the temporary construction compound in Layout 2.

2.6.27 The location of the substation compound was also moved north-eastward closer to turbine T9 to an area of shallower peat to limit the impact of the Proposed Development on peat deposits on-site.

2.6.28 For all turbines, hardstandings were adapted to a more compact design to reduce the amount of total land-take required, giving particular consideration to the areas of deeper peat located in the northern extent of the site.

Conclusion

2.6.29 Turbine Layout G and infrastructure Layout 3 are the layouts which have been taken forward as the design for the Proposed Development. Further design work may be required following the detailed ground investigations which will take place post-consent. For this reason a micro-siting allowance of up to 50 m in all directions in respect of each turbine and its associated infrastructure has been applied for. No micro-siting will be undertaken that would result in an increase to the significance of reported adverse environmental effects.

2.7 Do-Nothing Scenario

- 2.7.1 Should the Proposed Development as described in Chapter 3 not be consented (the “do-nothing” scenario) it is anticipated that the Proposed Development site will not alter from the current environmental baseline as described above and in Chapters 5-15.

2.8 Summary

- 2.8.1 The final layout has been informed by a robust EIA and design iteration process, considering potential environmental, landscape and visual impacts and their effects, physical constraints, and health and safety considerations. The information used to inform the design iteration process included consultation responses received, baseline data and the impact assessment undertaken.
- 2.8.2 The final layout comprises ten turbines of up to 149.9 m tip height, and their associated infrastructure, including hardstanding, access tracks, substation compound and borrow pit, as shown in Figure 3.1.
- 2.8.3 The Proposed Development layout is considered to represent the most appropriate design, considering potential environmental impacts on their effects, physical constraints, and health and safety considerations, while maximising the generating capability of the site.

2.9 References

BEIS (2019). *The Renewables Obligation for 2019/20. Calculating the Level of the Renewables Obligation for 2019/20.* Available at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/747218/2019-20-renewables-obligation-level.pdf

RenewableUK (2019). *Wind Energy Statistics Explained.* Available at:

<https://www.renewableuk.com/page/UKWEDEexplained>

Scottish Government (2014). *Scottish Planning Policy.* Available at:

<https://www.gov.scot/publications/scottish-planning-policy/>

Scottish Government (2017). *The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017.* Available at:

<http://www.legislation.gov.uk/ssi/2017/102/contents/made>

Scottish Natural Heritage (2017). *Siting and Designing Wind Farms in the Landscape.* Available at:

<https://www.nature.scot/siting-and-designing-wind-farms-landscape-version-3a>

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