2 Design Iteration

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2 Design Iteration

2.1 Introduction

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 which is described in Chapter 3.

2.2 Background

2.2.1 The site is in the ownership of William Mitchell & Sons Ltd (and associated parties) of Hazelside Farm, Glespin (part of the same group of companies as the Applicant - refer to Appendix 1.1 - and, hereafter referred to as the Landowner), with the exception of part of the access road from the M74 motorway which is owned by Hargreaves Land Limited and the Douglas West Bing which is owned by South Lanarkshire Council.

2.2.2 Part of the site is currently occupied by the Hagshaw Hill Wind Farm (the "Existing Development"), operated by ScottishPower Renewables under a lease from the Landowner. The southern site area is undeveloped moorland and agricultural grazing land that is flanked on either side by the Hagshaw Hill Extension.

2.2.3 The Existing Development was constructed in 1995 and is now nearing the end of its operational life. The planning permission for the Existing Development requires that the site is decommissioned and restored within six months of ceasing to generate electricity.

2.2.4 As Scotland's first wind farm, Hagshaw Hill offers one of the county's first opportunities to replace the aging, first generation wind turbine technology with modern and more efficient machines which will maximise the strong wind resource available at the site. This will ensure that Scotland's first wind farm continues to make a meaningful contribution to Scotland's renewable energy and decarbonisation targets in the years to come.

2.2.5 As landowners of Hagshaw Hill, the Applicant proposes to repower the Existing Development as part of a phased programme for redevelopment of the 'Hagshaw Cluster' (Hagshaw Hill and Extension, Douglas West and a potential extension to Douglas West, discussed further in Chapter 3) over the next five years.

2.3 Site Selection

2.3.1 As noted above, the Proposed Development site is partly occupied by the Existing Development, constructed in 1995.

2.3.2 Wind turbine technology has developed greatly since 1995. The much shorter separation distances between the smaller machines that were erected at that time mean that a greater land take is required to accommodate the wake separation distances for the modern, larger turbines. These modern, larger machines are required to support the site's continued viability in a subsidy-free market.

2.3.3 The Applicant identified that the existing lease area which the Existing Development occupies could be extended onto the Landowner's land holding to the south, to take in an area of the hill that is flanked on either side by the later Hagshaw Hill Extension, and to the west-south west by the Galawhistle Wind Farm (refer to Figure 3.2). This will provide sufficient land to repower the site with modern machines to ensure the site can deliver its full renewable generation potential.

2.3.4 The selection of the site area, considered appropriate for development, took account of the positioning of existing and consented wind energy developments in the local area. In considering the appropriate southern extent of proposals for the Proposed Development, the Applicant and its professional advisors considered that it would be suitable for the Proposed Development to occupy land south of the Existing Development, alongside the Hagshaw Hill Extension and Galawhistle wind farms. A southern "boundary" was envisaged, effectively following the contours of the hill eastward

from the southern-most Galawhistle turbine. It was considered that development north of that "boundary" would be appropriate and would not represent a southward encroachment of new development any nearer to the A70 and valley floor, than what is already the case at Galawhistle, Hazelside and Douglas West Wind Farms. The Proposed Development site boundary was devised on this basis, and design iteration within that boundary progressed (see below).

2.4 Alternative Sites

2.4.1 EIA legislation requires the consideration of alternatives and an indication of the reasons for selecting the site advanced, except, as noted in Planning Advice Note (PAN) 58, where limited by constraints of commercial confidentiality.

2.4.2 As noted above, the Proposed Development site partly comprises an operational wind farm nearing the end of its operational life. It is therefore considered to be a suitable site for wind energy development (repowering), making use of some existing site infrastructure and recognising the accepted principle of wind energy generation at the site.

2.4.3 The Proposed Development site is considered an appropriate and viable location for a wind energy project due to:

- proven good average wind speeds and generation capacity, given the successful operation of the Existing Development on site since 1995, and the potential to achieve substantially greater electrical generation using modern turbines;
- within an established wind farm landscape, where there is an opportunity to progress a coordinated layout, phasing, access, grid connection and landscape strategy for the future of the 'Hagshaw Cluster';
- easily accessible direct from the M74 without passing through any communities;
- ability to re-use a former railway line and existing tracks with minor upgrading;
- in close proximity to a viable (existing) grid connection point;
- can positively contribute towards regional and national renewable energy targets; and
- can provide a series of significant social and economic benefits for the local area.

2.5 Design Process

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 The following principles were adopted during the design iterations made by the Applicant to ensure that the final design of the Proposed Development was the most suitable for the site:

- the Proposed Development should avoid inconsistent turbine spacing, such as relatively large gaps, outliers or excessive overlapping turbines to minimise visual confusion and ensure a balanced / compact array from key views;
- the positioning of turbines within the footprint of the Existing Development and southward alongside the existing Hagshaw Hill Extension and Galawhistle Wind Farms, limiting the southern development extent to be no nearer the A70 and valley floor than is already the case;
- retain a separation of at least 1 km from the closest isolated residential dwellings in the surrounding area; and

- other environmental constraints and associated buffers are to be respected.

Turbine Layout and Scale

2.5.3 The Applicant has considered a number of alternative layouts and turbine scales for the Proposed Development. Turbines ranging in tip height from 150 m to 200 m have been considered, based on the availability of modern turbine models and commercial viability of the repowering project. Different rotor diameters, and therefore turbine spacings to deal with wake effects, are applicable to the range of turbine scales considered. Therefore, a number of preliminary layout options were considered, for the range of turbine scales. The preliminary layouts took account of identified technical and environmental constraints based on desk-based study and walkover survey work, as well as preliminary wind yield analysis.

2.5.4 Preliminary wireframes were generated for a range of turbine size and layout options, to assess the suitability of design with respect to visual effects on key receptors. The wireframes were generated for key viewpoints in the local landscape, each of which has gone on to be a representative assessment viewpoint in the LVIA (Chapter 6). The Applicant's professional advisors produced and reviewed the preliminary wireframes and analysed the landscape capacity of the Proposed Development site, in order to advise on the most appropriate design to maximise renewable energy generation while not resulting in unacceptable landscape and visual effects. Regard was taken in this process to the other consented schemes in the landscape near to the site and the manner in which they would already serve to create a wind farm landscape in which the Proposed Development would be sited. The comparative wireframes which illustrate potential turbine heights of 150 m, 175 m and 200 m are set out in Appendix 2.1.

2.5.5 The review established that the landscape had the capacity to accommodate turbines of up to 200 m without giving rise to effects on character or visual amenity that would greatly exceed those of the 150 m turbines consented in the immediate vicinity. Indeed, in many cases, the proposed 200 m turbines would remain a smaller vertical feature in the view than one of the consented developments, for example in views from Coalburn, as represented by Viewpoint 1 (Appendix 2.1). Similarly, in almost all cases the turbines would lie beyond one or more of the existing schemes which would serve to give the impression that the Proposed Development is either at the same scale or indeed smaller than the other schemes, notwithstanding its greater height. This can be seen for example in the visualisations for Viewpoint 5 on the A70 at Rigside (Appendix 2.1).

2.5.6 Following confirmation of the Proposed Development layout, one further iteration was undertaken to move the position of turbine T4 from the southeast corner of the site to a new location at the west of the site (refer to Figure 2.2). This was to reduce visual impacts on receptors south and south east of the site (e.g. the village of Glespin), from where the previous position of T4 had resulted in it being visible from the village.

Turbine Capacity

2.5.7 The Applicant has been in ongoing discussion with turbine manufacturers to establish suitable candidate turbines which would fit into the tip height envelopes for the scenarios tested, as noted above. Up to the date of public exhibitions (mid-September 2018, refer to Chapter 4), it had been the Applicant's understanding that the optimal capacity turbine for this site with a maximum tip height of 200 m, currently or imminently available on the market, was a 5 MW turbine. Since then, and reflecting the pace at which turbine technology is advancing, it has become evident that a 6 MW turbine with the same tip height dimensions (200 m) will be available ahead of construction of the Proposed Development and capable of generating significantly better yields.

2.5.8 Therefore, although the anticipated overall capacity presented at the public exhibitions was approximately 70 MW, it is now proposed that the overall capacity is approximately 84 MW, based on 14 turbines each of approximately 6 MW. This results in up to £70,000 per annum more in community benefit. No change is proposed to the tip height dimensions, location or number of turbines presented at the public exhibitions.

2.5.9 It is important to stress that optimisation of renewable electricity generation has been a key facet of the design iteration process. The optimal capacity of a turbine limited to 150 m or 175 m tip height (depending on assumed hub height), given the wind regime and economic considerations at this site, is approximately 3.8 to 4.3 MW, respectively. Therefore, a 14-turbine development at this site with 150 m turbines would likely have resulted in a total capacity of approximately 53.2 MW or approximately 60.2 MW for 175 m turbines, with annual generation anticipated to be in the order of 148 to 167 GWh. Using a larger, 6 MW turbine at 200 m to tip would result in a total site capacity of 84 MW, and annual generation in the order of 237 GWh.

2.5.10 As noted in paragraph 2.2.5 above, the review of different turbine scales and layouts established that turbines of 200 m would not give rise to effects on landscape character or visual amenity that would greatly exceed those of the 150 m turbines consented in the immediate vicinity. It is therefore considered that the potential additional generation capacity (over 57% more than for 150 m turbines and almost 42% more than for 175 m turbines) within the same site area and from the same number of turbines – also resulting in up to £154,000 per year more community benefit – would greatly outweigh any slightly increased landscape and visual effects resulting from the installation of 200 m, instead of 150 m or 175 m turbines.

Access Tracks and Crane Hardstandings

2.5.11 On confirmation of the proposed turbine layout, AECOM undertook site walkovers and assessments of site topography, ground conditions and watercourses in order to establish a suitable design for the site access, on-site access tracks and crane hardstandings.

2.5.12 The site benefits from existing access direct from the M74 Junction 11, along an existing tarmac haul road and then the route of a former rail line (which would be upgraded to be suitable for construction and abnormal load delivery traffic), then onto the Existing Development access road or onwards via a new southern access route. The Applicant considered that it would be prudent to allow for an alternative access route in the event that the Existing Development access could not be used during the early stages of development, which may overlap with decommissioning the original site. Furthermore, the steep nature of the access road to the Existing Development may not be suitable for the transport of new, larger turbine components. Therefore, a new southern access track is proposed, continuing south along the former rail line then west to the south east corner of the main development area. These two routes are largely defined by existing infrastructure and have not been subject to any substantial iteration.

2.5.13 The on-site tracks are also in part defined by existing infrastructure (tracks). Proposed new tracks in the southern site area have been designed based on site topography, ground conditions and to minimise and appropriately locate water crossings. No substantial iterations have been undertaken, apart from the re-location of the crossing of the Smithy Burn between T2 and T3, following a site visit which identified that the originally proposed location (slightly to the south) was physically impractical.

Substation and Construction Compounds

2.5.14 The proposed substation location, which will also incorporate an energy storage facility, is at the entrance to the main development area, providing best access to grid infrastructure. The proposed main construction compound is also located at the entrance to the main development area. (Refer to Figure 1.2a.) Both have been sited to avoid watercourses and sensitive habitats.

2.5.15 A second construction compound is proposed to be located adjacent to an existing bing along the proposed southern access route (Figure 1.2b). The bing materials are proposed to be used for site construction (subject to suitability testing), therefore the compound will allow for plant and vehicles to access this area and facilitate excavation and removal of materials.

2.5.16 A separate turbine and component laydown area has been sited near the entrance to the main development area (Figure 1.2a). This area is required to provide a facility for laying out and temporarily storing turbine components pending turbine erection. The laydown area was initially located further west and at a different orientation than its final location, however this was identified

as being coincident with the High Broomerside farmstead, a historic feature which it was considered desirable to avoid. Several iterations were therefore undertaken to re-site the laydown area, avoiding the archaeological asset but also seeking to avoid or minimise impact on nearby sensitive habitat (principally bog habitat to the north of the proposed T3 location). The final laydown area is partly coincident with an area of potentially moderate groundwater dependent terrestrial habitat, however the hydrology assessment (Chapter 11) confirms that in this part of the site it is actually surface water running off the hillsides and ponding on low-permeability till at the foot of the hills that is likely to be sustaining the habitats in this location – not groundwater. It is also noted that the laydown area is a temporary facility with no deep excavation work proposed. Therefore, the final proposed layout and orientation of the laydown area, which avoids bog habitats and potential highly groundwater dependent habitats, is considered to be the most suitable option available.

2.5.17 Figure 2.1 shows the main laydown area iterations considered, overlain on mapped habitats.

2.6 Summary

2.6.1 The final Proposed Development layout has been informed by a robust design iteration process, taking into account 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 baseline data, review of preliminary visualisations, ongoing impact assessments, and wind yield optimisation.

2.6.2 The final turbine layout and scale has been designed to maximise renewable energy generation from the site, whilst keeping within acceptable limits for potential impacts on the environment.

2.6.3 The EIA Report is based on the final layout selected for the Proposed Development. The final layout comprises 14 turbines of up to 200 m in height and associated access tracks and crane hardstandings, substation and energy storage facility, underground electrical cabling, construction compounds, laydown area, borrow pit workings, and two meteorological masts.

2.6.4 It is acknowledged that in practice every wind farm site has some local impact; however, in both a national and regional context the repowering of Hagshaw Hill Wind Farm is considered to represent an excellent opportunity for an appropriately designed renewable energy development.

2.7 References

Scottish Government (1999). Planning Advice Note (PAN) 58: Environmental impact Assessment.

SNH (2017). Siting and Designing Wind Farms in the Landscape, Version 3a