Chapter 3

Site Selection & Design

SCOTTISHPOWER RENEWABLES

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3.1 Introduction

1. This Chapter outlines the process undertaken in selecting the Site as a potential location for a windfarm, provides a description of the Site and surrounding area, and discusses the design evolution process.

2. The principles of the EIA process, that Site selection and project design should be an iterative constraint-led process, have been followed as part of the proposed Development. This has ensured that potential negative impacts, as a result of the proposed Development, have been avoided or minimised as far as reasonably possible.

3. This Chapter draws on issues considered in more detail in the relevant technical Chapters (**Chapters 6 to 14**). This Chapter does not pre-empt the conclusions of the later Chapters, but rather explains how potential environmental effects have informed the design of the proposed Development.

4. The final design for the proposed Development is described in **Chapter 4: Development Description** and is shown on **Figure 4.1** of that chapter.

3.2 Site Selection & Consideration of Alternatives

5. In accordance with Schedule 4 (2) of the EIA Regulations, reasonable alternatives (in terms of project design, technology, location, size and scale and characteristics) of the proposed Development have been considered. The Energy Consents Unit of the Scottish Government (ECU) agree that only if an applicant has considered alternative sites, either in a national or local authority context, would Scottish Ministers expect such studies to be provided in an EIA report. Alternative sites have not been considered in the case of the proposed Development and so the matter is not considered further in the EIA Report.

6. The main alternatives including design, turbine specification, location, size and scale have been considered for the Site. This Chapter explores these options and explains how the final design of the proposed Development has evolved. It should also be noted that the selection of the Site location and refinement of the Application boundary evolved from an initial landscape feasibility study. This study analysed the landscape to test for areas that had the potential to accommodate windfarms. Once

3.2.1 Location

7. The proposed Development would be located approximately 6 km to the north east of Barrhill in South Ayrshire, centred on British National Grid (BNG) reference BNG (229473, 588551), and as shown within **Figure 1.1**. The proposed access route would be from the A714, heading north. This access falls within the administrative boundary of Dumfries and Galloway Council (D&GC). Whereas the windfarm would fall wholly within the administrative boundary of South Ayrshire Council (SAC).

8. A number of factors were considered when selecting the Site for windfarm development including:

- there are no international or national statutory designations for landscape and nature conservation in, or within close proximity of, the turbine area of the Site;
- there are no planning policies which, in principle, preclude wind energy development. The Site is located within an area which the Local Development Plan has identified as having potential for windfarm development;
- initial desk-based studies and wind monitoring onsite suggest that there is likely to be a good wind resource and the Site is available for wind energy development;
- there are available options to connect the proposed Development onsite substation to the substation at the nearby Mark Hill Windfarm;
- it has good access from the public road network particularly for longer blades which allows consideration of larger turbines to make the best use of the expected wind resource;
- potential to use and upgrade much of the existing forestry track, especially along the access route, from the A714. As well as re-using some of the existing FLS borrow pits; and
- the Site is a reasonable distance away from the nearest residential properties.

9. In addition, Scottish Planning Policy (SPP) (June 2014) provides support for wind development in principle and encourages local authorities to guide developments towards appropriate locations. Paragraph 154 states that planning authorities "*should support the development of a diverse range of electricity generation from renewable energy technologies – including the expansion of renewable energy generation capacity*".

10. SPP Paragraph 155 also states that "*development plans should seek to ensure an area's full potential for electricity and heat from renewable sources is achieved, in line with national climate change targets.*" In response to these policy requirements SAC has undertaken a landscape capacity study (2018) to identify those landscapes which, in principle, have the capacity to accommodate wind turbines. SAC has identified the landscape which the Site largely sits in, as having the capacity to accommodate wind turbines and this has helped inform the site selection process. The iterative design process, informed by this EIA, helps to ensure that the Site's full potential for electricity generation is achieved.

3.2.2 Technology Size & Scale

11. Onshore wind continues to be the cheapest form of renewable energy; however, the challenge is to meet the Scottish Government targets within a context of no Government support mechanism for onshore wind.

12. The supply of smaller turbines across Europe is already reducing due to lack of demand as manufacturers are recognising the world market is shifting to larger machines and are focussing their development work on larger turbines which secure the highest yield.

13. Larger turbines must be considered if onshore wind development is to continue to contribute to both the UK and Scottish Government's renewable energy targets. The Scottish Government's Onshore Wind Policy Statement (December 2017) challenges the industry to develop the first 'subsidy free onshore windfarm' which is only possible if taller turbines are installed.

14. The proposed Development would comprise 18 three-bladed horizontal axis turbines up to 200 m tip height with a combined rated output in the region of 100 megawatts (MW). The proposed Development includes associated infrastructure including:

- turbine foundations;
- crane hardstandings;
- transformer/switchgear housings;
- access tracks (existing, upgraded or new as required);
- watercourse crossings (existing, upgraded or new as required);
- underground electrical cabling;
- permanent control compound area including substation, control buildings, LIDAR station, external equipment and ancillary grid service equipment/battery storage;
- permanent anemometer mast;
- up to four temporary Power Performance Masts;
- close circuit television mast(s);
- communication mast(s);
- site signage;
- permanent operations building;

- potential temporary laydown area;
- up to eight borrow pit search areas; and
- two temporary construction compound areas.

15. The proposed Development would also require forest restructuring works to enable construction and operation of the windfarm.

16. It is proposed that one of the temporary construction compounds could be partially converted to a permanent car park for recreational users upon completion of construction works. The details of this would be agreed with Forestry and Land Scotland.

3.3 Site Location & Description

17. The Site is predominantly covered by commercial Sitka spruce plantations which are currently owned by Forestry and Land Scotland (FLS). Forested moorland is dominant throughout much of the site, with the exception of the north eastern section which is open rugged hillside. The topography rises in the northern section of the Site (above 300 AOD) with distinctive, steeply sloped hills, such as Fell Hill and Craigenreoch. Loch Scalloch is the only loch contained within the Site boundary. Loch Moan lies in close vicinity to the south east.

3.3.1 Surrounding Area

18. The surrounding area is rural, with the land predominantly used for agriculture and forestry. The site also lies within the boundary of the Galloway Forest Park and the buffer zone of the Galloway Forest Dark Sky Park. There are no Listed Buildings within the Site. The immediate area surrounding the Site is rural in nature with land predominantly used for commercial forestry purposes and agriculture. The nearest sizeable settlement to the Site is Barrhill which is located around 6.6 km to the south west of the nearest turbine. Other nearby settlements include Barr, located approximately 4.5 km to the north, Pinwherry located 7.4 km to the west and Glentrool at 10.8 km to the south (all to the nearest respective turbine).

19. The closest landscape designation out with the Site and not including the South Ayrshire Scenic Area, is the Dumfries and Galloway Regional Scenic Area located 0.3 km to the east of the Site boundary.

20. The Merrick Wild Land Area is located approximately 4.6 km to the east of the Site boundary at the nearest point.

21. There are three ecologically designated sites located within 5 km of the proposed Development which are as follows:

- Feoch Meadows Site of Special Scientific Interest (SSSI) – 4 km west from Site;
- Merrick Kells SSSI - 4.8 km east from the Site; and
- Merrick Kells Special Area of Conservation (SAC) – 4.8 km from Site.

22. The Site is also located within the buffer zone of Galloway and Southern Ayrshire Biosphere, a non-statutory designation aimed at ensuring sustainable development within its boundary, which is part of the UNESCO biosphere programme.

3.4 Design Concept & Approach

23. In EIA, the identification of constraints should continue throughout the design process as more detailed surveys reveal additional constraints to development. In this way, the findings of the technical and environmental studies can be used to inform the design of a development, and hence achieve a ‘best fit’ within the environment of the proposed Development Site.

24. This approach has been adopted in respect of the Site; where potentially significant effects have been identified, efforts have been made to avoid these through evolving the design of the proposed Development. This is referred to within this EIA as mitigation embedded in the proposed Development layout and design, or simply ‘embedded mitigation’. Further information on embedded mitigation is explained within each technical Chapter of this EIA Report as appropriate. A number of design principles and environmental measures have also been implemented and incorporated into the proposed Development as standard practice.

25. ‘Embedded mitigation’ includes but is not limited to:

- sensitive siting of the proposed infrastructure incorporating appropriate buffer distances from environmental receptors to avoid or reduce effects on the environment;
- considering the size and scale of the proposed Development appropriate to the location;
- considering the appearance, finish and colour of wind turbines and the control building in accordance with SNH Guidance ‘Siting and Designing Wind Farms in the Landscape’, V3a (SNH, 2017);
- re-using existing forestry tracks as much as possible to access proposed turbine locations;
- design of the tracks to minimise cut and fill, reducing landscape and visual effects as well as costs;
- inclusion and design of borrow pit(s) to minimise the amount of the material required to be imported to the Site; and
- potential for up to 50 m micrositing of infrastructure during construction to ensure the best possible location is chosen based on Site investigations.

26. Throughout the design evolution of the proposed Development layout, a key driver was the consideration of potential landscape and visual effects on receptors and how the proposed Development would relate to the existing landscape character as well as existing windfarms in the landscape. In particular, regard was had to the scale and number of turbines proposed, cumulatively with existing windfarms in the area, in particular the adjacent Mark Hill Windfarm. The landscape and visual effects potentially caused by the proposed Development has been considered extensively from key receptors. The resulting analysis has been an important input into the design evolution process of the proposed Development and in particular to the layout design of proposed turbines.

27. Siting and Designing Windfarms in the Landscape (Version 3a) SNH states that:

“*In a wind farm, turbines can be arranged in many different layouts. The layout should relate to the specific characteristics of the landscape - this means that the most suitable layout for every development will be different. For a small wind farm, this might comprise a single row of wind turbines along a ridge; while, for a larger development, a grid of wind turbines is often taken as the starting point, with the turbines spaced at minimum technical separation distances*.”

28. The layout and design of the proposed Development were considered as part of an iterative design process aimed at reducing the potential landscape and visual effects of the windfarm whilst taking into account other Site constraints and commercial requirements.

29. The initial areas considered at feasibility stage for the proposed Development were larger and included the elevated ridge to the north east. This was later ruled out of possible development due to potential landscape effects, in particular to minimise impacts on the Merrick Wild Land Area.

30. An iterative design approach works in tandem with the EIA process and allows a receptive design process where incremental changes in layout and design result from a continually developing understanding of environmental considerations. This iterative approach allows potential environmental effects, as they are identified, to be minimised through alterations in design.

31. It is considered that the design respects the form of the underlying landscape and its scale. Wind energy development is clearly a key characteristic of the existing baseline landscape and visual context, and it is expected to continue to be for the foreseeable future; this has been an important consideration in the design of the proposed Development.

3.5 Design Objectives

32. The main landscape and visual design factors and other considerations that were identified comprised the following:

- proximity to and visibility from residential properties as well as the settlements of Barrhill to the south west, Barr to the north, and Pinwherry and Colmonell to the west;
- visibility from the Merrick Wild Land Area;
- a layout which achieves a reasonably balanced group of turbines when seen from key receptor locations in the surrounding landscape;
- consideration of the cumulative landscape and visual impacts from the proposed Development in addition to the Mark Hill Windfarm, as well as other nearby consented wind farms;
- proximity to Cairnderry chambered cairn, which is a Scheduled Monument, and proximity to other non-designated assets; and
- cumulative noise impact.

33. The key design objectives applied in developing the proposed Development, which were agreed with ScottishPower Renewables (SPR) were as follows:

- avoid the ridgeline and upper eastern slopes at the north of the Site;
- limit proximity to closest residential receptors;
- limit impacts on priority peatland and carbon areas;
- respect other environmental constraints;
- create a scheme which maximises the potential of the Site to generate and store renewable energy; and
- use of the existing infrastructure (tracks and borrow pits on the Site) as far as practicably possible.

3.6 Constraints Identification and Mapping

3.6.1 Introduction

34. The design of any windfarm is driven by the key objective of positioning turbines so that they capture the maximum energy possible within a suitable area further informed by environmental and technical constraints.

35. The environmental designations and other constraints within the Site (refer to **Figure 3.1**) and surrounding area (refer to **Figure 3.2**) were identified as the first part of the constraints mapping process.

36. The known environmental and technical constraints within the Site were identified as part of the early stage constraints mapping. It is important to note that the identification of a constraint does not necessarily result in the exclusion of that area from the potential development envelope; rather it means that careful thought and attention was paid to the constraint and the design altered appropriately. The key constraints which were considered during the design process included:

- topography;
- identified landscapes and visual constraints;
- presence of ornithology, protected habitats and species;
- ground conditions (including peat);
- presence of watercourses, private water supplies and related infrastructure;
- presence of cultural heritage features;
- location of residential properties – potential impacts on residential visual amenity, proximity to noise sensitive receptors; and potential for shadow flicker effects;
- aviation;
- key recreational and tourist routes;
- forestry; and
- presence of power lines, pipelines and telecommunications links.

37. The identification of constraints continued throughout the design evolution process as more detailed surveys refined the development envelope.

38. A description of how the various environmental and technical disciplines have contributed to the design through detailed assessment is described below. Information in respect of the survey work undertaken is provided in the technical Chapters of this EIA Report.

3.6.2 Wind Analysis

39. Wind analysis and efficiency modelling has been carried out by SPR at key stages throughout the design evolution process to identify the areas of the Site likely to produce the most yield and ensure the commercial viability of the scheme.

40. For turbines to work as effectively as possible, they must be suitably spaced relative to the predominant wind direction. If they are too close together in this direction, the wake effects from the turbines located on the upwind edge of the array will create turbulent air for the next row and so on through the array. A high wake effect (expressed as a percentage) is disadvantageous to overall Site productivity. Conversely if turbines are located too far apart the opportunity to maximise the capacity and thereby electricity generation from the Site is reduced.

41. There is no industry standard for spacing, only manufacturer recommendations and rules of thumb. Six times rotor diameter on the predominant wind direction against four times rotor dimeter cross wind is a common starting point. This is understood to provide a reasonable compromise between turbine proximity and Site capacity without unduly compromising turbine operation. The proposed Development may however employ turbines which are not yet on the market and therefore a more flexible methodology was considered to find the right balance of turbine efficiency and productivity over a wide variety of potential rotor diameters, with spacing increased out to seven times five rotor diameter (7D x 5D).

42. The wind analysis has also been used to locate a permanent anemometer mast. This mast would be used to independently monitor turbine performance in operation, supplemented by LIDAR and four temporary power performance masts (PPMs).

3.6.3 Topography

43. Whilst the majority of the Site has relatively gentle topography, the steepest areas of the Site have been avoided for the development of infrastructure.

44. Slope stability has been taken into consideration to understand whether infrastructure could be located within certain areas of the Site. Where slope stability was identified as an issue, these areas were deemed to be unsuitable for infrastructure and have therefore been avoided due to the potential for slope instability and peat slide risk.

3.6.4 Landscape Character and Visual Amenity

45. Potential effects on the landscape and visual resource have been an important factor in this iterative process, with both the appearance of the proposed Development considered on its own, and its appearance within the context of Mark Hill Windfarm being considered. This was carried out through the repeated testing of layout iterations as seen from agreed design viewpoint locations representing key local landscape and visual receptors around the Site.

46. The design of the windfarm layout is a vital part of the EIA process, as it is the stage where the biggest contribution can be made to mitigate potential effects. Due to the generally high visibility of windfarms, landscape and visual aspects are particularly important, and have therefore driven the layout design from an early stage.

47. The final turbine layout has been optimised for landscape and visual reasons as far as possible using the agreed viewpoints.

48. Where possible, proposed excavation for access tracks and other infrastructure has been minimised and the location of the control/substation compound and the construction compounds has been reviewed to minimise visual effects as well as impact on habitats and peat.

3.6.5 Ecology and Ornithology

49. Ecological surveys have been carried out across the Site throughout 2019, including a Phase 1 habitat survey, a National Vegetation Classification (NVC) Survey and protected species surveys (including badger, otter, water vole, pine marten and red squirrel), in order to identify broad areas of constraint to windfarm development. Constraint mapping included the identification of sensitive ecological features, including habitats present within the Site and species which use the Site. Buffers were then placed around these sensitive features and the design of the Site was amended accordingly.

50. Areas with potential to be true Groundwater Dependent Terrestrial Ecosystems (GWDTEs) were found to be limited in extent across the Site and mainly confined to forest rides and within the open area to the north east of the Site. These areas were avoided as far as possible in initial turbine layout designs. As the design evolved, these areas were further investigated to establish whether they were confirmed GWDTEs.

51. The recommended habitat standoff distances from blade swept path to key habitat features have been incorporated into the design to reduce collision risk to bats.

52. Ornithology surveys have been carried out across the Site from 2012 to 2019 (continuous since 2017), including vantage point watches; scarce breeding birds (for raptors, divers and any other species listed in Schedule 1 of the Wildlife and Countryside Act 1981); and winter walkovers for non-breeding birds. Black grouse surveys have also been completed. Suitable buffers were considered during the design evolution process and no turbines are proposed within 100 m of known nest sites.

3.6.6 Peat Depth

53. As defined on Scottish Natural Heritage (SNH)'s Carbon and Peatland 2016 Map (SNH, 2016), there is an area to the west of the Site and smaller areas in the north and east of the Site which are shown to be within Class 1 and 2 Priority Peatland Habitat. Site visits have confirmed the presence of peat, of variable condition and depth across the Site, with deeper peat occurring on plateau and other shallow slope areas.

54. Peat probing was undertaken in 2019. A review of this data in conjunction with slope gradients allowed areas of deep peat (typically greater than 2.5 m) to be avoided for development at an early stage. The peat data is discussed in **Technical Appendix 7.2: Peat Landslide Hazard Risk Assessment**. Where possible, proposed turbines and infrastructure would be located within areas of peat less than 1 m deep.

55. As part of the proposed Development all turbine locations, access tracks, control/substation compound, construction compounds and borrow pits have been designed to avoid any areas which may be subject to peat slide risk. The ground condition constraints that were taken into account in the design of the proposed Development were:

- identification of peat depths in excess of 1.5 m – to minimise incursion, protect from physical damage, minimise excavation and transportation of peat, reduce potential for peat instability and minimise potential soil carbon loss;
- identification of slope angles greater than 5˚- to minimise soil loss and potential instability; and
- avoidance of areas where initial peat stability concern was identified where possible – to avoid areas with possible instability issues and associated indirect effects on surface water.

3.6.7 Hydrology and Hydrogeology

56. A 50 m buffer zone has been applied around all watercourses which traverse the Site. These buffers were used to ensure that turbines and infrastructure, other than tracks, were not located in close proximity to hydrological features in accordance with windfarm construction best practice guidelines. This reduces the risk of run off and water pollution into existing watercourses. In some cases, the use of existing tracks, which are already less than 50 m to a watercourse, have been identified as the best option for design, minimising the need for new tracks.

57. Watercourse crossings have been minimised as far as possible; and where possible, existing crossings would be used. Three bridge crossings are necessary, and although further investigation may determine that the existing bridges can be utilised, for EIA purposes it has been assumed that new bridge construction will be required. Existing culverts may be upgraded or replaced.

58. Data on private water supplies was obtained from SAC and identified as a constraint to development. A 1 km radius of the Site boundary with any Private Water Supply (PWS) was established. Several PWS's were located within the 1 km radius and assessed during a site visit. The proposed Development respects a 500 m buffer applied to PWS's, where turbines cannot be located. A PWS feeding pond within the property at Ferter was identified and a risk assessment undertaken to determine the risk from construction works. This considered the application of pollution control and good practice measures and deemed the risk to be low.

59. Development on peatland has been limited based on the peat probing data collected in 2019 and fully considered as part of optimizing the design and in recognition of peat as a carbon sink. A carbon balance assessment has been undertaken to determine the payback period for the windfarm.

3.6.8 Cultural Heritage Features

60. The proposed Development has been designed to mitigate effects on heritage assets, the main one being that Cairnderry Cairn Scheduled Monument. Effects have been mitigated by the relocation of the proposed temporary construction compound/recreational car park (CC1, shown on **Figure 4.4**). It was considered that the original location for the compound may have had the potential to have an effect on the setting of the Cairn. The compound was moved further north to mitigate this potential effect. Non-designated heritage assets were identified within the Site, which mainly relate to agricultural settlement and land division, and probably date to the post-medieval period. These features have been avoided through design as far as possible.

3.6.9 Noise Sensitive Receptors

61. For the purposes of early constraints mapping, avoidance buffers of 1 km were applied to residential properties in the vicinity of the Site.

62. During 2019 background noise monitoring was undertaken at noise sensitive receptors. These were selected and agreed with SAC as being representative of the noise sensitive receptors located closest to the proposed Development on the basis of preliminary noise prediction modelling. Background noise data taken during the development of Mark Hill Windfarm was also used within the noise assessment and consideration given to the cumulative impacts of the operational noise from Mark Hill windfarm.

63. Using the background noise measurements, noise modelling was undertaken for the proposed turbine layout at various stages of the design process, to predict the likely sound level which would result from the proposed Development at nearby residential properties. The difference between measured background noise levels and predicted noise levels requires to be compliant with ETSU-R-97: 'The Assessment and Rating of Noise from Wind Farms' (Department for Trade and Industry (DTI), 1996) to avoid a significant impact. Applying design criteria in accordance with ETSU guidance, ensures that no exceedances of acceptable noise levels would occur for the proposed Development.

3.6.10 Shadow flicker

64. Shadow flicker has the potential to be an issue for properties which are closer to a wind turbine than a distance of ten times the diameter of the turbine's blade length. This was considered as part of the constraints mapping process and separation distances between turbines and residential properties maintained.

3.6.11 Forestry

65. The commercial plantations across much of the Site have been considered in the design of the proposed Development. Forestry forms an integral part of the proposed Development as trees would require to be felled around infrastructure positions to allow for construction of the development. A Windfarm Forest Plan (see **Technical Appendix 14.4**) has been developed for implementation if the proposed Development is consented. Felling, and subsequent requirements for compensatory planting, have been minimised as far as possible. Turbines have been 'keyholed' into the existing forestry where feasible, so that only the trees required for the infrastructure and its associated buffer zones will be cleared.

66. In terms of forest restocking, the restocking plan has been amended to integrate the proposed Development infrastructure requirements into the forest design. This includes an increase in the area of broadleaf planting by 24.9 hectares.

3.6.12 Telecommunications

67. Consultation with Ofcom and BT identified no links which could potentially be affected by the proposed Development.

3.6.13 Infrastructure

68. A 275 kV overhead power line runs west to east along the north west boundary of the Site. A suitable buffer (turbine height plus 10 %, and three times rotor diameter) was included to ensure that no turbines were placed in the vicinity of the overhead line.

3.7 Design Evolution

3.7.1 Siting and Design Guidance

69. The proposed Development would be largely located in the 'Plateau Moorland' Landscape Character Type area defined in Scottish Natural Heritages (SNH) digital map based Landscape Character Assessment (2019) and the 'Plateau Moorland With Forest and Wind Farm' Landscape Character Type (18c) identified in South Ayrshire Council (SAC) Landscape Wind Capacity Study (LWCS) August 2018.

70. The LWCS acknowledges that the key characteristics of the landscape: 'its large scale, simple landform and land cover together with its sparsely settled nature …reduces sensitivity to larger turbines', and that 'there is some limited scope for the Very Large typology (turbines >130m) to be accommodated within this landscape', but also finds that the landscape is of High-medium sensitivity to wind turbines in the Very Large typology (turbines > 130m).

71. In respect of siting and design guidance for development, the LWCS states (paragraph 21.3.1) that 'Development should be sited within the simpler basins and low hills lying in the interior of this upland plateau and set well back to avoid intrusion on adjacent smaller scale settled valleys and glens. The setting of the high rugged Galloway and Carrick Forest Hills is a key constraint to siting turbines in the eastern part of this character type, particularly turbines >150m which would be likely to be more intrusive and require lighting'.

72. The LWCS identifies that the main opportunity to accommodate development in this LCT is the 'generally simple landform, expansive scale and uniform land cover of commercial coniferous forestry and the sparsely settled interior of this landscape, where large turbines could be sited to minimise effects on adjacent smaller-scale valleys and glens'.

73. Several key constraints are however identified in the LWCS, including, most relevantly:

- The outer edges of this upland plateau which form the immediate skyline to the smaller scale settled Duisk and Stinchar valleys;
- Steeper hill slopes and higher ground present in the north and east at the transition with the Rugged Hills, Lochs and Forest (21) character type;
- The strong sense of remoteness experienced within the forested plateau north of the Duisk Valley which influences its dark skies;
- Dramatic views to the Galloway Hills suddenly revealed when travelling south-east on the designated tourist route of the A714 as dense forest cover opens up in the Corwar area;
- The high, rugged Galloway Hills focused on Merrick within Dumfries and Galloway and the Carrick Forest Hills which are popular with walkers, offering a strong experience of wildness that could be diminished by development lying close-by and/or being perceived as incrementally encircling these hills; and
- Potential cumulative effects with the operational and consented wind farms of Hadyard Hill, Arecleoch, Mark Hill, Kilgallioch and Chirmorrie on landscape character and views from the Stinchar and Duisk Valleys.

74. The LWCS also provides the following design guidance 'There is potential for wind farm development to accelerate positive change to existing commercial forestry within this character area. Any proposals for wind farm development should aim to improve the composition, age structure and design of existing forestry in accordance with current guidance. A high proportion of broadleaves species should be restocked on the fringes of moorland and pastures to ameliorate often geometric hard margins'.

75. Several turbines of the proposed Development are also located just within and near to the transition with the Rugged Uplands, Lochs and Forest LCT (LCT 21), which covers the northern edges of the Site, and extend to form a western spur of the Carrick Forest Hills. These hills lie to the north of the Rugged Granite Uplands that culminate in the distinctive high uplands of Merrick. As a whole, the Rugged Uplands, Lochs and Forest LCT (21) is assessed in the LWCS as having more constraints for wind turbine development, due to the complexity of the topography, dramatic craggy mountainous scenery, and more varied land cover of the extensive upland tract which includes the high hills of Merrick.

76. The LWCS identifies the area of this LCT within and immediately north-east of the site as a 'band of smoother, more rounded but steep-sided hills lying to the west (of the LCT)' and as 'enhancing' the rugged uplands to the south that form 'dramatic craggy mountainous scenery, which is a feature of the granite hills lying at the core of this landscape'. The hills within the north-eastern part of the site (Cairn Hill, Pinreck Hill, Polmaddie Hill) form the western edge of a spur of larger scale rugged uplands and form part of the wider upland backdrop in views. They are, however, formed by lower more rounded, less craggy and dramatic hills in comparison to the landform of the Rugged Granite Uplands LCT that define the large-scale uplands of the Merrick, although part of the range of the Carrick Forest Hills identified as 'Landmark Hills', in the LCWS.

77. Several narrow, smaller scale pastoral valleys are cut into the foothills and moorlands of the uplands, including the Stinchar Valley (to the north of the site) and its tributary the Duisk Water Valley (to the west). The Stinchar Valley is an intimate, settled landscape, defined by distinctive landform attributes in the complex area along the Southern Uplands Fault zone. These elements, together with a number of cultural heritage features, contribute to a well-defined sense of place, although modern residential and transport development has created some discordant features. The Intimate Pastoral Valley LCT forms the basis of the boundary of the southern parts of the Ayrshire Scenic Area, which seeks to protect the key characteristics of the Duisk and Stinchar Valleys. The SALWCS notes the sensitivity of potential extensions to the existing Mark Hill Wind Farm if extending visibility into and/or siting turbines on sensitive skylines which contain this LCT. The small scale and intimate character of this LCT would suggest a high sensitivity to wind energy development, however the enclosure provided by the steep and wooded valley sides tends to reduce its susceptibility to windfarm development in adjacent LCTs provided development is set back from the upland edge to the valley.

3.7.2 Layout Design Approach

78. SPR commissioned Landscape and Visual Feasibility Studies between 2016 and 2018 for the Site and these were carried out by Optimised Environments Ltd (OPEN). These studies examined various layouts for the Site in respect of landscape and visual considerations but taking account of known environmental and technical constraints, such as set back from water courses, slope constraints and overhead transmission lines.

79. Based on review of these background documents, taking account of SNH's Siting and Design guidance (2017) and drawing on fieldwork observations, the following key landscape and visual sensitivities were identified in the vicinity of the Site which have influenced the windfarm layout design of the proposed Development:

- proximity to the adjacent smaller scale, more diverse and higher sensitivity valleys of the Duisk and Stinchar Rivers with associated visual receptors in scattered settlements, in particular Barr, Barrhill, Pinwherry, Pinmore and Colmonell;
- proximity to the local residences within the adjacent surrounding area;
- proximity to the South Ayrshire Scenic Area; the Galloway Hills Regional Scenic Area (RSA); and the Dark Sky Park;
- potential visibility from the Merrick Wild Land Area and effects on its perceived wildness;
- potential visibility from nearby settlements as noted above, the A714, B7027, B734 roads, the Girvan to Stranraer railway line, cyclists on NCR 7, and walkers on the Southern Upland Way as well as nearby Core Paths; and
- proximity to adjacent operational windfarms at Mark Hill (28 turbines at 110m); Hadyard Hill (52 turbines at 110m blade tip height) Arecleoch (60 turbines at 118m blade tip height); and the operational Kilgallioch development (96 turbines at 146.5 m blade tip height), as well as other cumulative windfarms in the wider surrounding area.

80. Design objectives for the proposed Development were developed which comprise achieving a layout which:

- consolidates the association of larger turbines with the large-scale operational wind farms of the extensive *Plateau Moorland with Forest and Windfarm* LCT;
- achieve a reasonably consistent and balanced relationship with the large scale and simple landform of the Site when seen from the surrounding area;
- achieve a satisfactory relationship with the adjacent operational Mark Hill Windfarm by being perceived as a discrete group of larger turbines adjacent to Mark Hill Windfarm which minimises visual confusion between the different sized turbines;
- achieve a reasonable degree of setback from the adjacent Intimate Pastoral Valley landscapes to the west and north of the Site associated with the Duisk and Stinchar Rivers;
- minimises effects on visual amenity for nearby settlements, including visibility of aviation lighting at night-time, from the closest settlements: Barrhill, Pinwherry: Colmonell and Barr as well as smaller hamlets along the river valleys;
- turbines sited within the west and south of the site within the Plateau Moorland with Forest and Wind Farms LCT (18c), which has a greater capacity to accommodate windfarm development, while generally avoiding turbines on the higher ground of the Rugged Uplands with Lochs and Forest LCT (21);
- minimises the lateral extension of the proposed Development in front of the upland backdrop formed by the Merrick uplands in views from the plateau moorlands of Galloway and contain this lateral spread to the west of the Nick of the Balloch, thereby avoiding turbine development in front of the upland backdrop formed by the Merrick Wild Land Area;
- locates the majority of turbines in the windfarm layout outside the Ayrshire Scenic Area in order to accord with LDP policies on 'Landscape Quality' and 'Protecting the Landscape';
- minimises the effect of the proposed Development on the setting of communities/skylines within the Stinchar Valley by setting turbines well back into the upland interior to minimise intrusion on containing upland skylines; and
- sites the turbines in order to reduce as far as possible the effects of the proposed Development on the perceived qualities of the Merrick WLA.

3.7.3 Engineering Design Evolution

81. In addition to the landscape and visual considerations in the Site layout design approach, the following technical, engineering and environmental objectives were developed:

- Maximise wind energy yield from the turbines as far as possible;
- Avoidance of slopes in excess of 12 degrees;
- Avoid areas of peat and known wet/boggy areas;
- Reduce requirement for watercourse crossings and maintain a buffer of 50 m from watercourses;
- Locate all turbines at least 1 km from nearby residential properties;
- Maintain appropriate buffer from the overhead line to the north east of the Site; and
- Maintain appropriate buffers from ecological, ornithological and cultural heritage features.

82. Other objectives were to maximise the use of existing infrastructure on the Site including existing forestry tracks and borrow pits. The changes to the layout, during the design process are described below.

3.8 Layout Evolution

83. The following sections provide a summary of the main turbine layout iterations for the proposed Development. The iterations are illustrated in the following figures:

- Figure 3.3 – turbine layout A;
- Figure 3.4 – turbine layout B;
- Figure 3.5 – turbine layout C;
- Figure 3.6 – wirelines illustrating layouts A, B, C & D from Viewpoint 1, located at Chirmorrie Cairn;
- Figure 3.7 – wirelines illustrating layouts A, B, C & D from Viewpoint 7, located on Auchensoul Hill;
- Figure 3.8 – wirelines illustrating layouts A, B, C & D from Viewpoint 8, located on The Merrick;
- Figure 3.9 – wirelines illustrating layouts A, B, C & D from Viewpoint 11, located on Mullwharchar; and
- Figure 4.1 – turbine layout D (proposed Development layout).

3.8.1 Layout A

84. Layout A (shown on **Figure 3.3**) was the layout developed to inform the EIA Scoping Report issued in March 2019. Layout A comprised 16 turbines at 200 m to blade tip.

85. At scoping stage, a "likely developable area" was identified within a larger site boundary, which aimed to keep development predominantly within the commercial Sitka spruce plantations which are typical of the Site. The boundary of the likely developable area also aimed to provide a limit to the eastern edge of the Site, ensuring turbines remained an appropriate distance from the Merrick WLA. Turbines locations were selected following a review of landscape and visual feasibility studies as described in Section 3.7.2. At this stage on-site baseline surveys were still to be completed and the wind speed monitoring campaign was on-going.

3.8.2 Layout B

86. Layout B (shown on **Figure 3.4**) comprised 16 turbines at 200 m to blade tip. It was developed following a design meeting held on 29 April 2019 with the aim of improving buildability and energy yield.

87. Wind yield analysis by SPR identified several turbines which could benefit from yield improvements. Turbines to the north of the Site (T13, T14 and T15) were moved to more elevated positions to increase their energy yield. T16 moved approximately 450m to the east, as its location in Layout A was a low-spot with low wind speeds. Turbines also moved slightly east and west to improve their separation and reduce losses in energy yield due to turbulence effects.

88. Further review of the topography highlighted that T4 and T10 could be moved to less steep areas, to improve their buildability and reduce the requirement for cut/fill operations.

89. Peat probing information was not available at this time but from a desktop review of SNH and British Geological Survey (BGS) resources, it appeared likely that T1 and T2 would have been located in areas of deeper peat and their locations were revised accordingly.

90. The results of the ecology surveys were also considered, particularly in regard to sensitive habitats. Although, it was established that the proposed turbines weren't located in sensitive habitats.

91. Layout B improved energy yield and buildability but increased the visibility of the turbines from the Merrick WLA area and the closest settlements.

3.8.3 Layout C

92. Layout C (shown on **Figure 3.5**) comprised 18 turbines at 200 m to blade tip. In June 2019, sufficient data had been obtained from the site's two temporary anemometer masts to gain a good understanding of the wind regime on the Site. A review of the wind data allowed a change in the direction of the turbine ellipses which created two gaps in the layout and subsequently allowed for two additional turbines to be included within the same development footprint.

93. At a second design meeting on 17 June 2019, the locations of the 18 turbines were determined to maximise the energy yield from the Site, with slight elevation gains and improved inter-turbine spacing.

94. Whilst Layout C was attractive from an energy yield perspective, the landscape and visual concerns from previous layout iterations remained.

95. Peat probing was undertaken in July 2019 to examine the peat depths at turbine and track locations for this layout.

3.8.4 Layout D

96. On 15 August 2019 a third design workshop was held. It was agreed that turbines T14 and T15 required movement to reduce the visibility of the Site from the Merrick WLA. By moving these turbines south by approximately 200m and 400m, respectively, the visibility from viewpoints within the core area of the Merrick WLA could be removed. It

was recognised that from the western slopes of the Merrick WLA the turbines remained visible, but that this was in the context of a landscape with existing windfarms and dense forestry cover.

97. Responding to feedback from Public Information Days and an initial review of residential amenity wirelines, it was also decided that turbines T2, T3 and T18 should be relocated to increase their distance from the closest residential receptors. There were also minor revisions to the neighbouring turbines to accommodate these changes.

98. Other site infrastructure was sensitively sited in accordance with the design principles. Further details on site infrastructure siting is detailed in Section 3.8.5 below.

99. Layout D was taken forward as the final layout (described in detail in **Chapter 4: Development Description** and shown on **Figure 4.1**), consisting of 18 turbines at 200 m to blade tip. This layout appears well balanced from most viewpoints and partially mitigates concerns with regards to effects on the WLA and other nearby receptors. It is considered the layout has achieved a good compromise between high energy yield and landscape and visual effects.

3.8.5 Other Site Infrastructure

3.8.5.1 Site Access

100. The proposed access to the Site has not varied throughout the design process. It is proposed that the wind turbines would be likely delivered to the George V Dock in Glasgow. The turbines would be moved from the port of entry to the Site under escort. The port of Cairnryan is much smaller, however this will also be considered and from here turbines would be moved south along the A77, A751, A75 and then the unclassified road past Newton Stewart and then north along the A714 to the Site entrance. In the case of George V Dock the turbines would be moved along the A74 (M) to the M6 where they would be turned northwards at junction 44, along the A75 to the unclassified road past Newton Stewart where they would join the A714. This route has previously been used during the construction of Arecleoch and Kilgallioch Windfarms and would minimise the amount of new and upgraded track required as part of the proposed Development.

101. HGV construction vehicles would access from the A714, travelling north to the windfarm development area.

3.8.5.2 Site Tracks

102. The onsite access tracks have been designed to use existing tracks as far as possible; whilst minimising cut and fill requirements in order to reduce the amount of ground disturbance, the amount of material required for construction, the loss of sensitive habitats and landscape and visual effects.

103. All access tracks have been designed to follow routes which do not include excessive gradients. This is to aid the safe delivery of turbine components and associated parts.

104. As part of the design process, consideration was given to the use of the existing access tracks used by the local residents and how best to minimise disruption to their access. A key outcome of this was the inclusion of a new section of track (shown in **Figure 4.3**) to provide as much separation as possible between construction traffic and residents access routes.

3.8.5.3 Borrow Pits

105. Borrow pits are required as a source of rock to be used in the construction of the tracks, hardstandings and foundations. Potential locations for the borrow pits were identified based upon a review of geological mapping and Site reconnaissance. The location of each was considered and refined with respect to the Site infrastructure and environmental constraints.

106. During design optimisation, the locations of infrastructure and track design was refined in order to minimise the amount of earthworks and cut and fill required to construct the proposed Development. The total number and size of borrow pits was selected to meet the estimated volume of rock required to construct the tracks, hardstandings and foundations. This included evaluation of the use of existing and historic borrow pits on the Site. This required consultation and agreement with FLS.

107. If the proposed Development was consented, further intrusive geotechnical investigation would be carried out to identify which of the eight borrow pit locations would yield the required quality of rock for each aspect of the infrastructure. It is likely that not all eight borrow pits would be needed, but this gives flexibility in case there is low yield identified at any location.

3.8.5.4 Temporary Construction Compounds

108. The temporary construction compounds have been located with the aim of limiting the effects on sensitive habitats, deep peat and existing forestry. Steep areas have been avoided to reduce the requirement for cut and fill. The construction compounds have also been located for practical purposes; to control traffic entering the Site, to be located close to the wind turbines and to facilitate construction of the substation and energy storage facility.

3.8.5.5 Permanent Control Compound

109. The proposed permanent control compound hosting the control buildings, substation, ancillary grid services equipment and energy storage facility would be located on land which avoids sensitive habitats, areas of deep peat and steep slopes. NGR 227485, 587617 has been selected as an appropriate location for the proposed control compound.

110. The control buildings would be located greater than topple distance from the proposed turbines. The internal site grid connection cables would be undergrounded within the Site from each turbine to the control building, therefore having no visual impact.

3.9 Micrositing

111. In order to be able to address any localised environmental sensitivities, unexpected ground conditions or technical issues that are found during detailed intrusive Site investigations and construction, it is proposed that agreement is sought for a 50 m micrositing allowance around windfarm infrastructure. The technical assessments (presented in Chapters 6 to 14) have considered the potential for micrositing and it is considered that the proposed infrastructure could be microsited within 50 m without resulting in potential new effects. During construction, the need for any micrositing would be assessed and agreed with the onsite Environmental Clerk of Works (ECoW).

3.10 Conclusion

112. The final layout of the proposed Development is described in detail in **Chapter 4: Development Description** and shown on **Figure 4.1**.

113. The EIA process has been an iterative one, so that potential effects identified throughout the EIA and design process could be avoided and overall impacts of the proposed Development avoided or reduced.

114. The assessment of potential effects of the proposed Development is addressed in **Chapters 6 to 14** of the EIA Report. The residual effects after mitigation and good practice have been applied are provided in each relevant technical chapter and are summarised within **Chapter 15: EIA Summary**.

3.11 References

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