Chapter 2

Site description and design evolution

SCOTTISHPOWER RENEWABLES

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2.1 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 7 to 16**). 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 3: Description of the Development** and is shown on **Figure 3.1**.

2.2 Site selection and consideration of alternatives

5. In accordance with Schedule 4 (2) of the EIA Regulations, reasonable alternatives in terms of Site location and characteristics of the proposed Development have been considered. Regulation 40 (2)(c) of the 2017 Regulations requires that an EIA report should include (in respect of alternatives studied by an applicant): *"The main alternatives studied by the applicant and the main reasons for his choice taking into account the effects on the environment."* 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.

2.2.1 Location

7. The proposed Development would be located near the village of Barrhill in South Ayrshire, centred on NGR NX 19194, 80689 as shown within **Figure 1.1**.

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. Further information on this is provided in **Chapter 4: Renewable Energy and Planning Policy**;
- 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;
- potential connection options to the electrical grid system including the possibility to connect the proposed Development onsite substation to the substation at the nearby Kilgallioch or Mark Hill Windfarms;
- 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 share or re-use existing Arecleoch Windfarm infrastructure where possible, including sharing much of the access track. re-using some of the existing borrow pits, the construction compound and the other existing hardstandings; 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 South Ayrshire Council (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 Site 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.

2.2.2 Technology, size and 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 need to be considered if onshore wind development is to continue to make a contribution 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 13 three-bladed horizontal axis turbines up to 200 m tip height with a combined rated output in the region of 72.8 megawatts (MW). As an extension of Arecleoch Windfarm the proposed Development would re-use and share existing infrastructure from Arecleoch Windfarm where possible. This includes sharing much of the access track, re-using some of the existing borrow pits, the construction compound and other existing hardstandings, thus maximising efficiency and reducing the cost to the consumer. The proposed Development includes associated infrastructure including:

- turbine foundations;
- crane hardstandings;
- transformer/switchgear housings located adjacent to turbines;
- new and upgraded access tracks including watercourse crossings where necessary;
- underground electrical cabling;
- substation compounds including control buildings, external equipment and ancillary grid service equipment/battery storage;
- one permanent anemometer mast;
- up to four temporary Power Performance Masts;
- close circuit television mast(s);
- communication mast(s);
- site signage;
- search areas for up to six borrow pits; and
- one temporary construction compound area **(Figure 3.4**).

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

16. The proposed Development would produce between 200 GWh and 230 GWh of electricity annually. This equates to the annual power consumed by approximately 53,000 – 60,000 average UK households. By using the latest turbine technology, each turbine at the proposed Development could produce 4 to 4.5 times the annual electricity of an existing Arecleoch Windfarm turbine and in total around 75 – 85 % of the annual output of Arecleoch Windfarm. This would be achieved with an additional 22% of the number of turbines (13 turbines compared to 60 at Arecleoch). Turbines with a maximum height of 200 m to blade tip have been selected due to the increased yield that can be achieved from taller turbines and also the environmental benefits intrinsic to larger turbines. Using taller turbines means that the overall number of turbines required on a per MW basis is reduced, which in turn reduces the scale of the associated infrastructure required. With larger turbines the amount of concrete per MW produced is lower than a scheme with smaller turbines, and similarly the length of new access track (km) required per MW produced is also generally less. Fewer but taller turbines also reduces the felling required by increasing the rotor clearance above the tree canopy which reduces the impacts upon existing forestry operations Broadleaf planting in some areas will be brought forward in terms of the felling plan and thus the associated benefits will be realised sooner. Overall, larger turbines of this scale would help to deliver new onshore wind capacity required to help the Scottish Government meet its climate goals and provide low-carbon power that assist in the reduction of consumer bills.

17. In recent years, the onshore wind industry has experienced the reduction in supply of smaller turbines across Europe due to lack of demand from mainland Europe, where the tendency is to install turbines at higher tip heights (e.g. 175 – 240m to blade tip). Therefore, it is highly unlikely that a range of smaller turbines (e.g. 120m) would be available at competitive prices by the time the proposed Development is ready to be constructed, if consented. Larger turbines need to be considered if onshore wind development is to continue to make a contribution to both the UK and Scottish Government's renewable energy targets.

2.3 Site location and description

18. The Site is located on the National Forest Estate approximately 3 km south west of Barrhill in South Ayrshire, centred on NGR NX 19194, 80689 as shown within **Figure 1.1**. The majority of the Site is located within the South Ayrshire Council (SAC) area. The entrance to the Site is within the Dumfries and Galloway Council (D&GC) area. Access to the Site for turbine deliveries would be via the existing entrance at Wheeb Bridge on the A714. The Site is characterised by a Plateau Moorland landscape covered mainly by commercial forest and encompasses the western side of Shiel hill (228.4 m AOD). A number of small tributaries run through the Site and feed the Water of Tig,Cross Water and Haw Burn. These three water courses then in turn feed into the Duisk River and River Stinchar.

19. The Site passes through the South Ayrshire Scenic Area due to the application boundary encompassing the existing Arecleoch and Kilgallioch Windfarm access tracks from the A714 at Wheeb bridge and Bents Farm. This is the only landscape designation located within the Site.

20. Topography rises from the Duisk River valley situated to the north east with high points within the Site ranging between 202 m – 230 m AOD forming a series of gently rounded hill summits on the plateau which are difficult to perceive due to both the simplicity of the landform and the uniformity of forest cover. There are no Listed Buildings or Scheduled Monuments within the Site.

2.3.1 Surrounding area

21. The immediate area surrounding the Site is rural in nature with land predominantly used for commercial forestry purposes and agriculture. The nearest settlement to the Site is Barrhill which is located around 3 km north east of the Site. Other nearby settlements include Pinwherry and Colmonell which are to the north of the Site at a distance of approximately 3.3 km and 3.5 km respectively.

22. The closest landscape designations outwith the Site and not including the South Ayrshire Scenic Area, are the Dumfries and Galloway Regional Scenic Area located 5.2 km to the east of the Site entrance, and the nationally designated Garden and Designated Landscape of Glenapp located 7.3 km to the west of the Site, shown on **Figure 2.1**.

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

- Craig Wood Site of Special Scientific Interest (SSSI) – 2.29 km from Site;
- River Bladnoch Special Area of Conservation (SAC) – 3 km from Site;
- Feoch Meadows SSSI – 2.8 km from Site;
- Kirkcowan Flow SAC and SSSI – 3.06 km from Site;
- Blood Moss SSSI – 4.82 km from Site.

2.4 Design concept and approach

24. In EIA, the identification of constraints should continue throughout the design process as more detailed surveys revealed 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.

25. 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 as appropriate. A number of design principles and environmental measures have also been implemented and incorporated into the proposed Development as standard practice.

26. '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', V3 (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;
- sharing or re-using existing Arecleoch Windfarm infrastructure where possible including, re-using some of the existing borrow pits, the construction compound and the other existing hardstandings;
- 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.

27. 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 Arecleoch Wind Farm. 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 and locating of infrastructure on the Site.

28. 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."

29. 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.

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.

2.5 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 north east and Colmonell to the north;
- visibility from the more sensitive landscapes of the Stincher, Duisk and Glen Tig Valleys;
- achievement of 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 Arecleoch Wind Farm, as well as other nearby consented wind farms; and
- cumulative noise impact.

33. The key design objectives for the development of the proposed Development, which were agreed with SPR were as follows:

- avoid the ridgeline and upper eastern slopes at the north east of the Site around Shiel Hill;
- 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.

2.6 Constraints identification and mapping

2.6.1 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 designations within the Site and surrounding area were identified as the first part of the constraints mapping process. These are shown on **Figure 2.1**.

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 taken into account 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 – 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. In order to progress the wind turbine positioning, a ‘traffic light’ based constraints plan **(Figure 2.2)** was developed whereby each constraint was assigned a red, amber or green category depending on their significance.

39. 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.

2.6.2 Wind analysis

40. 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.

41. 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.

42. 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 (6D x 4D) 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.

43. The wind analysis has also been used to locate the permanent anemometer mast. This mast would be used to independently monitor turbine performance in operation.

2.6.3 Topography

44. Whilst the majority of the Site is relatively flat, the steepest areas of the Site (greater than 10% slope gradient) have been avoided for the development of infrastructure.

45. 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.

2.6.4 Landscape character and visual amenity

46. 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 Arecleoch 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.

47. 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.

48. The final turbine layout has been optimised for landscape and visual reasons as far as possible using the 23 agreed viewpoints.

49. Where possible, proposed excavation for access tracks and other infrastructure has been minimised and the location of the substation compounds, construction compounds and met masts has been reviewed to minimise visual effects.

2.6.5 Ecology and ornithology

50. Ecological surveys have been carried out across the Site from 2015 to 2019, including a Phase 1 habitat survey, a National Vegetation Classification (NVC) Survey and protected species surveys (including badger, otter, water vole 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.

51. Area with potential to be Groundwater Dependent Terrestrial Ecosystems (GWDTEs) were found to be limited in extent across the Site and mainly confined to forest rides and adjacent to watercourses. 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 GWDTE and where considered to be groundwater fed were avoided.

52. 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.

53. Ornithology surveys have been carried out across the Site from 2012 to 2019 (not continuous), 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. Suitable buffers were considered during the design evolution process and no turbines are proposed within 100 m of known nest sites.

2.6.6 Peat depth

54. As defined on SNH's Carbon and Peatland 2016 Map (SNH, 2016), less than approximately 1.0 % of the Site is 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 more likely to occur on plateau and other shallow slope areas.

55. Peat probing was undertaken from 2018 to 2019. A review of this data in conjunction with slope gradients allowed areas of deep peat (typically greater than 2.5m) to be avoided for development at an early stage. The peat data is discussed in **Technical Appendix 10.1: Peat Landslide Hazard Risk Assessment**. Where possible, proposed turbines and infrastructure would be located within areas of peat less than 1 m deep.

56. As part of the proposed Development all turbine locations, access tracks, substation compounds, construction compounds and borrow pits have been designed to avoid any areas of 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.

2.6.7 Hydrology and hydrogeology

57. 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.

58. Watercourse crossings have been minimised as far as possible; and where possible, existing crossings would be used. Existing culverts may be upgraded or replaced.

59. 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 PWS's was established. Several PWS's were located within the 1 km radius and required to be assessed. The proposed Development respects a 250 m buffer applied to PWS's, where turbines cannot be located.

2.6.8 Cultural heritage features

60. 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.

2.6.9 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. These buffers were further refined during the design process based on expert noise advice.

62. During 2018 and 2019 background noise monitoring was undertaken at several 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.

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 needs 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, therefore, ensures that no exceedances of acceptable noise levels would occur for the proposed Development.

64. During operation, the closest properties to the proposed wind turbines would be Glenour, Kilrenzie and Wheeb. During refinement and finalisation of the design, the maximum distances possible were employed between these properties and the proposed turbines.

2.6.10 Shadow flicker

65. 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 turbines blade length. This was considered as part of the constraints mapping process.

2.6.11 Forestry

66. 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 3.2**) 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, so that only the crops required for the infrastructure and its associated buffer zones will be cleared.

2.6.12 Telecommunications

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

2.6.13 Infrastructure

68. A 132kV wooden pole overhead power line runs west to east through the centre of the Site. A suitable buffer (turbine height plus 10 %) was included to ensure that no turbines were placed in the vicinity of the overhead line. The upgraded Site tracks would pass beneath the overhead line but would maintain sufficient clearance.

2.7 Design evolution

2.7.1 Landscape and visual design iteration

69. The proposed Development, which would be an extension to Arecleoch Windfarm, would be 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 Area identified in South Ayrshire Council (SAC) Landscape Wind Capacity Study (LWCS) August 2018. The key characteristics of this area are described in the SNH document as follows:

- Topography is comparatively level with extensive plateaux rising to soft contoured ridges;
- Underlain by basalts to the east and greywackes to the south-west;
- Covered by blanket bog, heather and grass moorland, with extensive mosses and peatland forming an important component of this landscape type;
- Frequent extensive areas of coniferous forest of uniform age which, in places, have significantly modified the original character of these areas in terms of colour, texture and views;
- Largely undeveloped with a sparse network of roads;
- Wind farm development on the north-eastern margins;
- Open, exposed and rather remote landscape, wild in character, although this is lessened in places by the presence of wind turbines and associated infrastructure; and
- Views are open and medium to longer distance depending on undulations in the local topography.

70. The LWCS describes the character of the Plateau Moorland with Forest and Wind Farm as:

"This landscape forms an expansive upland plateau which extends into neighbouring Dumfries and Galloway to the south and south-east. It has a simple landform of broad rounded hills and shallow basins which form a low, even and generally indistinct backdrop to smaller scale settled valleys and glens within South Ayrshire. Land cover is dominated by coniferous forestry, particularly to the north of the Duisk Valley, with small areas of open moorland and moss mainly present on lower slopes at the transition with the Duisk and Stinchar valleys. Small pockets of rolling farmland, wooded policies, lochs and settlement are found in the south-eastern part of this landscape (and extend into Dumfries and Galloway).

This landscape is sparsely settled with few roads. Extensive operational and consented wind farm development is a key feature of this landscape. While the large scale, simple landform and land cover and sparsely settled nature of these uplands reduces sensitivity to larger turbines, the extent of operational and consented wind farm development already accommodated in the generally less sensitive parts of this landscape reduces scope for additional development. Remaining undeveloped areas in this landscape either lie closer to more sensitive features such as lochs and farmland, adjacent settled valleys and glens or landscapes with a strong sense of wildness. Potential cumulative effects with other wind farm developments in relation to turbine size, design and layout may also constrain development in parts of this landscape."

71. The LWCS acknowledges that the key characteristics of the landscape: *"its large scale, simple landform and cover together with its sparsely settled nature …reduces sensitivity to larger turbines".*

72. The LWCS concludes that the landscape of the Plateau Moorlands with Forestry and Wind Farms is of High-medium sensitivity to wind turbines in the Very Large typology (turbines > 130m). In respect of Guidance for development the LWCS states (paragraph 21.3.1 that *"there is some limited scope for the Very Large typology to be accommodated within this landscape",* acknowledging that capacity is close to being reached in the parts of this landscape character type which lie to the south of the Duisk valley.

73. SPR commissioned Landscape and Visual Feasibility Studies between 2015 and 2017 for the Site and these were carried out by Land Use Consultants. 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 as well as infrastructure on site including the railway line and overhead transmission lines. Layouts consisted of between 24 turbines at 117 m to blade tip height and 14 turbines at 225 m to blade tip height.

74. 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:

- 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 Barrhill, Pinwherry, Pinmore and Colmonell;
- proximity to the South Ayrshire Scenic Area; the Galloway Hills Regional Scenic Area (RSA); and the Dark Skies Park;
- potential visibility from the Merrick Wild Land Area;
- 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 Arecleoch (60 turbines at 118m blade tip height, although consented at 135 m); consented Chirmorrie (21 turbines at 146.5 m 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.

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

- has a reasonably consistent and balanced relationship with the large scale and simple landform of the Site when seen from the surrounding area;
- achieves a satisfactory relationship with the adjacent operational Arecleoch Windfarm by being perceived as discrete group of larger turbines adjacent to Arecleoch Windfarm which minimises visual confusion between the different sized turbines;
- achieves a reasonable degree of setback from the adjacent Intimate Pastoral Valley landscapes to the east and north of the Site associated with the Duisk and Stinchar Rivers; and
- minimises effects on visual amenity for nearby settlements including night time (radar activated) lighting visibility from the closest settlements: Barrhill, Pinwherry: and Colmonell as well as smaller hamlets along the river valleys.

76. Other objectives were to maximise the use of existing infrastructure on the Site including existing forestry and windfarm access tracks; laydown areas; and borrow pits.

77. Throughout the design evolution process there have been several proposed layouts. Four of the key layouts (**Figure 2.3**) considered, including the final design layout are detailed in the following paragraphs. The following paragraphs include the rational for the redesign of each layout and ultimately the agreed layout for the proposed Development. **Figures 2.4a-b** to **2.9b** show a selection of wirelines from various viewpoints illustrating the evolution of the design for each viewpoint.

2.7.1.1 Layout A (Figures 2.4a, 2.5a, 2.6a, 2.7a, 2.8a, 2.9a)

78. An initial review of previously commissioned Landscape and Visual Feasibility work was carried out which concluded that the layout comprising turbines located to the west and south of Shiel Hill at the north east edge of the Site, was the most satisfactory of the various feasibility layouts considered from landscape and visual amenity perspectives.

79. This layout, comprising 13 turbines at 200 m height to blade tip, was taken forwards as the Initial Scoping stage layout presented in the Scoping Report issued in October 2018. This layout was also presented and illustrated by photomontages at the first round of Public Information Days held in November 2018 in the villages of Barrhill and Colmonell. The Scoping Report states that the proposed Development would be likely to consist of up to 15 turbines at a maximum blade tip height of 200 m.

80. The layout consisted of four turbines to the north of the overhead transmission line that bisects the Site north east to south west; five turbines to the north west of the Girvan to Stranraer railway line and four turbines to the south of this railway line.

81. During October and November 2018, further environmental baseline studies were carried out which informed the design iteration process with the generation of an amalgamated constraints plan. This process identified 'no go' areas within the Site, where turbines should not be located, these areas included:

- A 50 m set back from water courses on the Site;
- A set back from various terrestrial ecology species/habitats;
- Peat depths greater than 3 m;
- Slopes of greater than 12 degrees;
- A set back from the operational turbines at Arecleoch and consented Chirmorie turbines;
- Buffers from existing onsite infrastructure including the railway line and overhead transmission lines;and
- Other constraints were identified as areas where turbines could be placed, but where caution would be required. These included areas with a peat depth of between 1 m and 3 m and areas with slopes of up to 12 degrees.

82. Subsequent layout iterations were generated that respected the 'hard' 'no go' constraints with further field work being carried out where necessary in respect of turbines located in the 'soft' 'proceed with caution' areas.

83. Additionally, SPR provided input in respect of the anticipated yield from various layouts explored.

84. The Initial Scoping layout achieved satisfactory set back from the Duisk River valley but encroached northward with turbines visible from the Stinchar valley to the north.

2.7.1.2 Layout B (Figures 2.4a, 2.5a, 2.6a, 2.7a, 2.8a, 2.9a)

85. A layout consisting of 15 turbines at 200 m to blade tip was generated to achieve increased efficiency in use of the Site and a higher energy yield. This consisted of seven turbines to the north of the overhead line; seven to the south of this line and north west of the railway line and one turbine to the south of the railway line.

86. This layout, although slightly more compact when viewed from the north east, introduced turbines closer to the Duisk River valley and retained turbines which encroached northward to the Stinchar valley, which was less satisfactory than layout A in respect of landscape and visual considerations.

2.7.1.3 Layout C (Figures 2.4b, 2.5b, 2.6b, 2.7b, 2.8b, 2.9b)

87. A Design Workshop was held on 4th December 2018 to progress the layout. A maximum layout was generated that consisted of 19 turbines. The aim of this process was to thoroughly test the ability of the Site to accommodate a maximum number of turbines which would maximise energy yield. This layout consisted of seven turbines to the north west of the overhead line; eight turbines between the overhead line and the railway line and four turbines located to the south east of the railway line.

88. The increased number of turbines resulted in higher density and wider spread of turbines in predicted views from the surrounding area, with multiple overlapping turbines and a less satisfactory relationship with the operational Arecleoch turbines than either Layout A or B.

89. During the Design Workshop the then T12 was dropped due to noise concerns and the then T15 was dropped in order to move T14 further west and keep turbines to the west of Shiel Hill.

90. A further Design Workshop was held on 29th January 2019 which further developed the layout achieved at the end of the first Design Workshop. During this Workshop, the then T1 was dropped in respect of landscape and visual considerations because it encroached northward towards the Stinchar valley and resulted in turbine visibility from settlement to the north of the site including the village of Colmonell, as well as being prominent in views from nearby individual properties to the north of the Site. Other turbines (the then T9 and T13) were dropped in order to minimise noise impacts and landscape and visual impacts from the village of Barrhill. Turbine 11 was also removed in order to achieve more satisfactory spacing and relationship between the turbines located between the railway line and the overhead transmission line.

91. The layout that emerged from the second Design Workshop consisted of 13 turbines at 200 m to blade tip. Further site work was carried out to test this layout in the field in respect of hydrology and peat.

2.7.1.4 Layout D (Figures 2.4b, 2.5b, 2.6b, 2.7b, 2.8b, 2.9b)

92. Subsequent layouts consisting of 13 turbines at 200 m to blade tip were considered, in particular from a landscape and visual perspective, as well as taking account of further data obtained following detailed peat probing on site and to achieve maximum distance from the unscheduled Standing Stone in the northern part of the Site (close to turbine 4).

93. The Final Layout consists of 13 turbines at 200 m to blade tip with five turbines to the north of the overhead transmission line; seven turbines between the overhead transmission line and the railway line and one turbine to the south of the railway line. This layout achieves a reasonably balanced relationship with the landform of the Site and a more satisfactory set back from the Duisk valley to the east and the Stinchar valley to the north. It also achieves a reasonably satisfactory relationship with the adjacent operational Arecleoch Windfarm, appearing as a discrete group of turbines at a larger size adjacent to the operational Arecleoch Windfarm from more of the most sensitive viewpoints in the surrounding area.

2.7.2 Other site infrastructure

2.7.2.1 Site access

94. 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 at Wheeb Bridge. 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.

95. HGV construction vehicles would mainly use the access from Wheeb Bridge, however it is anticipated that the Site entrance at Bents Farm may be used for some construction traffic and also used for Light Goods Vehicle (LGV) during operation. It is also proposed that the unclassified Barrhill to New Luce road may be used for some LGV traffic during construction and operation.

2.7.2.2 Site tracks

96. 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, amount of material required for construction, loss of sensitive habitats and landscape and visual effects, particularly during construction.

97. 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.

2.7.2.3 Borrow pits

98. Borrow pits would be 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 by a geological specialist. The location of each was considered and refined with respect to the Site infrastructure and environmental constraints.

99. 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 of the tracks, hardstandings and foundations.

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

2.7.2.4 Temporary construction compound

101. The temporary construction compound would be located in the same position as the former Arecleoch Windfarm construction compound to the north of the Site. This location is considered most appropriate as it:

- is largely already suitable for use;
- is already known to be a workable location;
- it has appropriate topography;
- is located in an area of shallow peat and low peat slide risk; and
- avoids sensitive habitat areas.

2.7.2.5 Substation compounds and battery storage

102. The proposed substation compound would be located on land which avoids sensitive habitats areas, deep peat and steep slopes. NGR NX 20706, 80590 has been selected as an appropriate location for the proposed substation compound.

103. Ancillary grid service equipment, including the potential for battery storage units would form part of the substation compound.

104. The control building, within the substation compound, 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.

2.7.2.6 Permanent anemometer masts

105. The permanent anemometer mast would be located on a flat area of ground to ensure it would be relatively unaffected by wake effects from surrounding terrain, ensuring a clean flow of wind to the mast for calibration purposes and long term correlation of wind data at the Site. The anemometer mast would be 125 m and be located at NGR NX 17678, 81873.

2.8 Micrositing

106. 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 7 to 16**) 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).

2.9 Conclusion

107. The final layout of the proposed Development is described in detail in **Chapter 3: Description of the Development** and shown on **Figure 3.1**.

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

109. The assessment of potential effects of the resulting layout is addressed in **Chapters 7 to 16** of the EIA Report.

2.10 References

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