ScottishPower Renewables

Harestanes West Windfarm

Environmental Impact Assessment Report

Volume 2

Chapter 2: Site Description and Design Evolution

December 2024

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Abbreviations

AIL	Abnormal Indivisible Load
BESS	Battery energy storage System
DGC	Dumfries and Galloway Council
ECoW	Environmental Clerk of Works
EIA	Environmental Impact Assessment
FLS	Forestry and Land Scotland
ha	Hectares
HES	Historic Environment Scotland
km	kilometres
NGR	National Grid Reference
NSA	National Scenic Area
RSA	Regional Scenic Area
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SPA	Special Protection Area
SSSI	Sites of Special Scientific Interest
UNESCO	United Nations Educational, Scientific and Cultural Organization

2. Site Description and Design Evolution

2.1. Executive Summary

1. Harestanes West Windfarm (hereafter 'the proposed Development') is located northwest of the village of Ae, approximately 1.3 kilometres (km) to the Application Boundary and 2.2 km to the nearest proposed turbine, and approximately 13 km north of Dumfries. The Site (the area within the Application Boundary) is located wholly within the Dumfries and Galloway Council (DGC) administrative area. The turbine area lies to the west of the Water of Ae and the Windy Hill Burn runs through the centre of the turbine area from north-west to south-east. The Site is made up of undulating hills that form part of the upland plateau or range of hills between Annandale to the east and Nithsdale to the West.

2. The turbine area met numerous criteria that SPR hereafter ('the Applicant') use to select renewable energy development projects. Importantly, the turbine area offers good wind potential for wind turbines, it also can accommodate wind turbines and associated infrastructure without affecting sites designated for their natural or heritage interests such as Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Special Protection Area (SPA) and designated and undesignated heritage assets. As most of the Site is a commercial forest, there is good access and an existing network of forestry tracks that could be incorporated into the proposed Development.

3. The Applicant designed the proposed Development taking into account operational requirements and environmental and landscape constraints. In particular, landscape studies and proximity to residential receptors. As information on the environmental, landscape and technical constraints has been collected by the Environmental Impact Assessment (EIA) team through site surveys, technical studies and consultation, this information has been used to review and refine the design of the proposed Development. The location and sensitivity of relevant identified environmental receptors have been mapped, and appropriate buffers were agreed between the technical specialists and project engineers, which allowed the design of the Site to be finalised. This approach has ensured the proposed Development would avoid the most valuable environmental areas and significantly reduce potential impacts through design-based mitigation.

4. The Applicant initially investigated development scenarios up to 14 turbines, and with turbines up to 220 m to tip height prior to detailed EIA studies. These were subsequently modified to a 13-turbine layout of up to 220 m to tip during the scoping phase. The current and final layout comprises up to 12 wind turbines, six with a maximum tip height of 220 metres (m) and six with a maximum tip height of 200 m, , along with locations of associated infrastructure, substation and access tracks. The final layout was informed by detailed multidisciplinary assessment and considered environmental constraints, balanced by technical requirements.

5. Taking these constraints into account and considering the construction requirements of such a project, the Applicant has developed a design which it believes is best suited to the Site and its surroundings.

6. The final design layout comprises a layout of 12 turbines, six with a maximum height of 220 m and six with a maximum height of 200 m (to vertical turbine blade tip), hardstandings, 31.5 km of access track (10.5 km of which is new), and associated infrastructure.

2.2. Introduction

7. This Chapter provides a description of the Site. This description covers the Site context and outlines how alternatives have been considered for the proposed Development. It describes the site selection process and outlines the site design process.

8. The principles of the EIA process require that site selection and project design should be iterative and constraints-led, to ensure that potential negative environmental impacts, as a result of the proposed Development, are avoided or minimised where reasonably possible. Schedule 4 (2) of the EIA Regulations, requires the consideration of reasonable alternatives in terms of development design, technology, location and the size and scale of the proposed Development. Regulation 5 (2)(d) of the EIA Regulations requires that an EIA report should include: "*a description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment*.".

9. This Chapter draws on issues considered in more detail in the relevant technical Chapters (**Chapters 7 to 15**). However, it does not pre-empt the conclusions of the later Chapters. Instead, it explains how potential environmental effects, which have emerged early in the EIA process and through the studies by the EIA team, have informed the design of the proposed Development.

10. This Chapter of the EIA Report is supported by the following figures provided in Volume 3a: EIA Report Figures:

- Figure 2.1: Environmental Designations;
- Figure 2.2a: Design Iterations: Turbine Area;
- Figure 2.2b: Design Iterations: Access Track;
- Figure 2.3a: On-Site Constraints - Heat Map;
- Figure 2.3b: On-Site Constraints – Ecology;
- Figure 2.3c: On-Site Constraints – Ornithology;
- Figure 2.3d: On-Site Constraints - Cultural Heritage;
- Figure 2.3e: On-Site Constraints – Hydrology; and
- Figure 2.4: Site Infrastructure and Peat Depth.

11. The final design for the proposed Development is described in **Chapter 3: Proposed Development** and is shown on **Figure 3.1.**

2.3. Site Context

2.3.1. Site Description

12. The Site is situated north-west of the village of Ae, approximately 1.3 km to the Site and 2.2 km to the nearest proposed turbine, and approximately 13 km north of Dumfries. The Site location is shown in **Figure 1.1** and the Application Boundary covers the area shown on **Figure 1.2.**

13. The Site is comprised of two principal components. The 'turbine area' comprises the proposed turbines, crane hardstandings, substation, meteorological mast, network of connecting tracks and associated infrastructure. The centre of the turbine area is at NX 9599 391814. The 'access track to the turbine area' consists of the proposed access track leading from the A701 public road to the turbine area within the Site. Separate to these, there is also a proposed area for habitat improvement located to the east of the access track to the turbine area. The turbine area and access track to the turbine area are shown in **Figure 1.4.**

14. The turbine area lies to the west of the Water of Ae and the Windy Hill Burn runs through the centre of the turbine area from north-west to south-east. The turbine area is made up of undulating hills that form part of the upland plateau or range of hills between Annandale to the east and Nithsdale to the West.

15. The A76 lies approximately 4.5 km to the west of the turbine area and the A701 lies approximately 5 km to the south-east, which connects to a minor road that then runs north through the village of Ae and north to south through the centre of the Site.

16. The area of Forest of Ae within which the turbine area is located, is managed by Forestry and Land Scotland (FLS) as a commercial forestry and has recreational facilities including car parking facilities and the Forest of Ae Café and Bike Shop located on the outskirts of the village of Ae. There are several waymarked walking routes and mountain bike trails within the Forest of Ae. Several core paths extend through the turbine area including one in the southern area which provides a circular walking path around Windy Hill. There is also an outer bend of a mountain bike path called Andy Hopkins in the north-eastern section of the Site going around Morins Hill. The immediate area surrounding the Site is rural with land used predominantly for agriculture and commercial forestry purposes. There is a relatively low population density within the vicinity, with few properties located within 1 km of the Site. The proposed Development would require forest restructuring works to enable construction and operation of the proposed Development.

17. The access track to the turbine area leads from the A701 4.6 km east of the village of Ae, largely following a network of existing access tracks built for the operational Harestanes Windfarm and forestry tracks forming part of the Forestry and Land Scotland estate. It follows the 'Romans and Reivers Route', one of Scotland's Great Trails, for a distance of 5.2 km, partly through the operational Harestanes Windfarm before crossing the Water of Ae.

18. There is one designation within the Site: the Galloway and Southern Ayrshire UNESCO Biosphere Reserve which stretches along the western edge of the Site Boundary and crosses into the turbine area in the north-west corner. There are no Sites of Special

Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protection Areas (SPA), or Listed Buildings within the Site.

19. The Site comprises an area of approximately 1,242 hectares (ha), with the Site location and wider context shown in **Figure 1.1**.

2.3.2. Surrounding Area

20. The Site primarily comprises commercial forestry. In contrast, the area to the south includes areas of pasture around the A701 and the village of Ae, as well as open moorland around Whitestanes Moor.

21. The operational 15-turbine Dalswinton Wind Farm is located approximately 0.6 km away from the turbine area to the southwest. The access track to the turbine area crosses through the operational Harestanes Windfarm, a 68-turbine wind development located approximately 3.1 km away from the turbine area.

22. The closest environmental designations within 10 km of the turbine area are shown in Figure 2.1 and summarised in **Table 2.1**, **Table 2.2**,and **Table 2.3**.

Table 2.1 Summary of Ecological and Geological Designated Sites within 10 km of the turbine area

Type of Designated Site	Name	Distance from Site
Site of Special Scientific Interest	Black Loch Shiel Dod Locharbriggs Quarry	2.3 km to the southeast 6.0 km north 8.1 km southeast
Geological Conservation Review site	Glenkiln Burn Locharbriggs North Quarry	3.5 km southeast 8.1 km southeast
Ancient Woodland Inventory site	509 individual parcels	Closest is 47 m southeast

Table 2.2 Summary of Cultural Heritage and Landscape Designated Sites within 10 km of the turbine area.

Type of Designated Site	Name	Distance from Site
Gardens and Designed Landscapes	Dalswinton Drumlanrig Castle Raehills Cowhill Tower	4.2 km south 8.8 km northwest 8.7 km east 6.0 km south
Scheduled Monuments	63 within 10 km, of which the nearest is Gawin Moor	614 m west
Conservation areas	Carronbridge Thornhill Kirkton East and West Cluden	8.9 km northeast 7.1 km northeast 7.3 km south 9.4 km south
Properties in Care of Scottish Ministers	Morton House	8.0 km northwest
Listed buildings	308 within 10 km	Closest of which is Gubhill 1.0 km east
Regional Scenic Areas	Thornhill Uplands	1.0 km west

2.4. Site Selection

23. The Applicant uses a range of criteria to select sites for the development of renewable energy projects. As part of the growth plans for the development of renewable energy projects, the Applicant is continually assessing sites. This pipeline of potential sites, which is commercially sensitive, are not considered to be alternative sites to this proposed Development. Alternative sites are not considered further in the EIA Report.

24. However, in selecting sites, the criteria used by the Applicant to develop commercially viable projects include the following:

- suitable wind conditions for the installation of wind turbines;
- availability of nearby grid connection with available capacity to accept new renewable energy generation;
- favourable topography and access to enable the construction of projects;
- planning policies which support the development of renewable energy;
- avoidance of significant environmental constraints (in particular, the factors highlighted in regulation 4(2) and 'sensitive areas' identified in Schedule 2 of the EIA Regulations) where possible onsite and/or immediately surrounding, including protected sites for conservation and heritage, protected species and their habitats and deep peatlands;
- avoidance of the most sensitive landscapes; and
- areas that are sparsely populated to protect the residential amenity of residential areas and households.

25. A review of the site selection requirements for the Site found the following:

- initial desk-based assessments onsite suggest that there is likely to be a good wind resource and the turbine area is available for a renewable energy development;
- the site itself has open and expansive characteristics considered appropriate for wind turbine development;
- Construction of a commercial scale renewable energy development is technically feasible within the context of the topography of the Site;
- there are no planning policies which, in principle, preclude wind energy or renewable energy development;
- the Site has reasonably good access from the public road network for construction traffic and wind turbine deliveries via an existing network of forestry haul roads for construction traffic and wind turbine deliveries, particularly for longer blades which allows consideration of larger turbines to make the best use of the expected wind resource;
- there are no national or international nature designations within the area identified for development; and
- the distances from the nearest residential properties are such that undue noise or visual impacts from on visual amenity can be avoided.

2.5. Technology, Size and Scale

26. As a basis of the design of the proposed Development, it was considered that it would comprise three-bladed horizontal axis turbines. Other technologies such as solar photovoltaic (PV), run of river hydropower and a battery energy storage system were explored but not considered suitable for this application.

2.5.1. Wind Turbines

27. Allied to a significant resource availability in the Dumfries and Galloway region, onshore wind continues to be the cheapest form of renewable energy and the Site has been predominately selected for its potential to generate energy from wind turbines. Additional to this, the challenge is to meet the Scottish Governments target within a context of limited Government support mechanisms for onshore wind. The supply of smaller wind turbines across Europe is already reducing, due to a lack of demand as manufacturers are recognising the world market is shifting to larger machines with development work focussing on larger turbines to secure higher yield. The tendency is to install wind turbines at higher tip heights (e.g. 175 – 240 m to blade tip). Therefore, it is highly unlikely that a range of small turbines (e.g. 150 m) would be available at competitive prices by the time the proposed Development is ready to be constructed, if consented.

28. 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, particularly the recent announcement of net zero CO_2 emissions by 2045. The Scottish Government's Onshore Wind Policy Statement (December 2022) acknowledges the benefits of the integration of onshore wind development in forested areas which can only be possible if taller, more efficient turbines are installed.

29. Through the design and consultation process, it was determined that a turbine tip height of six turbines to be a maximum of 200 m to tip, and six turbines at a maximum of 220 m to tip represents the best balance of tall turbines and design in the landscape.

2.6. Layout and Design Constraints

30. The proposed Development, which is described in detail in **Chapter 3: Proposed Development**, is the result of the previously described design evolution process. This section describes in more detail how this layout and design has been determined and outlines the environmental and technical constraints which have been taken into account.

2.6.1. Legislation

2.6.1.1. Schedule 9 of the Electricity Act 1989

31. This EIA Report has been prepared in respect of a development which will be applied for in the context of section 36 of the Electricity Act 1989:

"The Applicant holds a Generation Licence and is required to have regard to the matters set out in Schedule 9 of the Electricity Act in formulating relevant proposals. Paragraph 3(1)(a) of Schedule 9 require the Applicant to consider the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiological features of special

interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest"

32. In addition, under Schedule 9, paragraph 3(1)(b): "*the Applicant must do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects*". Through the EIA process the Applicant has sought to develop a design that in accordance with the duties set out in Schedule 9 of the Electricity Act. The matters that are raised in Schedule 9 have been considered in the EIA process and the findings are presented in this EIA Report. Scottish Ministers are then required, under Schedule 9, paragraph 3(2) to assess whether the Applicant has fulfilled its duties as set out in Schedule 9, paragraph 3(1). 30.

33. Schedule 9 also sets out requirements for the protection of fisheries by generating licence holders whereby paragraph 3(3) states that*: "in exercising any relevant functions each of the following, namely, a licence holder, a person authorised by an exemption to generate or supply electricity and the Secretary of State shall avoid, so far as possible, causing injuries to fisheries or to the stock of fish in any waters."*. The assessment of impacts on fish is addressed in **Chapter 10: Hydrology, Hydrogeology, Geology and Soils**, **Chapter 8: Ecology and Biodiversity**, **Technical Appendix 8.3: Aquatic Ecology Report – Turbine Area** and **Technical Appendix 8.4: Aquatic Ecology Report – Access Track**.

34. The key features relating to "*the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects"*, are detailed further in Sections 2.6.3 to 2.6.12; considerations during the design process included:

- identified landscapes and visual constraints;
- location of residential properties – proximity to noise-sensitive receptors, visual amenity effects and potential for shadow flicker effects;
- ground conditions (including peat);
- forestry;
- access feasibility;
- presence of power lines and telecommunications links;
- presence of ornithology, protected habitats and species;
- area topography, including gradients, exposure, watercourses and land use;
- presence of cultural heritage features;
- compatibility with aviation interests; and
- key recreational and tourist routes.

2.6.2. Key Constraints

35. The key constraints which were considered during the design process include:

- identified landscape and visual constraints;
- presence of ornithology, protected habitats and species;

- presence of cultural heritage features;
- location of residential properties – proximity to noise sensitive receptors and visual amenity effects;
- ground conditions (including peat);
- forestry;
- access feasibility;
- presence of power lines and telecommunications links;
- area topography, including gradients, exposure, watercourses and land use;
- aviation;
- compatibility with aviation interests; and
- key recreational and tourist routes.

36. The constraints analysis was undertaken using Geographical Information Systems (GIS). A project-specific workspace based on ArcGIS Online was developed specifically for the proposed Development. This allowed base-mapping to be overlaid with spatial data, such as environmental constraints and protected sites, and project-specific data to provide the project team with a means of interrogating environmental and project details in a single place at technical meetings and design workshops. In order to progress the design of the renewable energy development, a 'heat map' styled constraints plan **Figure 2.3a** was developed whereby each constraint was assigned a red, amber or green category depending on their significance. This provided a graphic indication of overall receptor sensitivity across the Site so that the design could take these into consideration. On site constraints can be seen in further detail in **Figures 2.3b** to **2.3e.**

37. 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 (**Chapters 7 to 15**).

2.6.3. Wind Analysis

38. Wind analysis and efficiency modelling has been carried out by the Applicant from project inception and throughout the design evolution process of the wind turbines to identify the parts of the turbine area likely to produce the highest yields and ensure the commercial viability of the scheme.

39. 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 wind turbines located on the upwind edge of the array will create turbulent air for the next row and so on through the array, reducing overall energy output. Additionally, turbulent air increases the strain placed on the turbines, which could shorten the lifespan of the turbines. Conversely, if wind turbines are located too far apart the opportunity to maximise the capacity and, thereby, electricity generation from a site is reduced.

40. 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 diameter cross wind (5D x 3D) 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. Therefore, a more flexible methodology utilising wind yield modelling was used to find the right balance of turbine efficiency and productivity over a wide variety of potential rotor diameters.

2.6.4. Landscape Character and Visual Amenity

41. The landscape and visibility effects of a wind farm are strongly influenced by the design of the wind turbine layout. Its appearance considered on its own in the context of the surrounding landscape and cumulatively were important considerations. Landscape and visual input to the design was informed by NatureScot's (then SNH) Siting and Designing Wind Farms in the Landscape Version 3a (2017), experience and drawing on fieldwork observations. In addition to those general design principles, the following key landscape and visual sensitivities and design objectives were identified as key factors for consideration in the design:

- minimise prominence of the proposed Development in views from the Dumfries and Galloway Thornhill Uplands Regional Scenic Area (RSA) and the Nith Estuary National Scenic Area (NSA);
- reduce the prominence of the proposed Development in views from nearest residents and settlement including the village of Ae, in the Windyhill Burn valley and recreational users in the area;
- consider the impacts with nearby cumulative developments including operational Dalswinton and Harestanes, as well as other proposals such as Harestanes South Windfarm Extension;
- reduce the prominence of the proposed Development in views from key transport routes including the A76 and A701; and
- avoid Significant impacts upon most valued landscape features on Site and seek enhancements where possible.

42. The final proposed Development layout has sought to achieve the following:

- reasonably consistent and balanced relationship when seen from the surrounding area, particularly when seen in views from the village of Ae to the south as well as locally prominent locations such as Queensberry to the north; and
- Where possible, proposed excavation for access tracks and other infrastructure has been minimised and the location of the substation and construction compound have been reviewed, and the selected option has been chosen in order to minimise visual effects.

43. The landscape and visual effects of the proposed Development are addressed further in **Chapter 7: Landscape and Visual Impact Assessment**. **Section 7.6.4** details the key landscape and visual design principles that were adopted during design evolution to mitigate against impacts on the key sensitive receptors above.

2.6.5. Ecology and Ornithology

44. Ecological surveys have been carried out across the Site since 2022, including a UK habitats survey, a National Vegetation Classification (NVC) survey and protected species surveys (including bats, pine marten, badger, otter, water vole, red squirrel and aquatic species). Sensitive ecological features, including habitats present within the Site and species which use the Site and appropriate buffers, have been avoided as far as possible. The proposed Development avoids ecological features of greatest sensitivity, such as Annex 1 peatlands. In addition, 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.

45. Ornithology surveys have been carried out across the Site and surrounding area over a 24-month period between September 2019 and August 2021, 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.

46. Suitable buffers were considered during the design evolution process and areas have been specifically avoided to minimise the impact on sensitive species.

47. The ecology and ornithology effects of the proposed Development are addressed further in **Chapter 8: Ecology and Biodiversity**, and **Chapter 9: Ornithology**.

2.6.6. Hydrology and Hydrogeology

48. In accordance with good industry practice, a 50 m buffer zone has been applied around all watercourses on the Site for wind turbines. This reduces the risk of runoff, loose sediment and potential pollutants entering watercourses. In some cases, the use of existing tracks, already within 50 m of drainage ditches, have been identified as the best option for design, minimising the need for new tracks. In a few other locations, the balance of constraints has required use of a narrower buffer zone. Watercourse crossings have been minimised as far as practicable; and where possible, existing crossings would be used. Existing crossings may be upgraded or replaced as appropriate.

49. Data on private water supplies (PWS) within 10 km of the Site were obtained from DGC. No PWS are present within the Site and linkages up to 5 km downstream were assessed. PWS are not identified as a constraint to development.

50. Areas with potential to be Groundwater Dependent Terrestrial Ecosystems (GWDTE) were also examined. Several areas of GWDTE were identified within the Application Boundary. All potential GWDTE were considered to be sensitive and have been avoided as far as practicable by careful design.

51. The hydrology and hydrogeology effects of the proposed Development are addressed further in **Chapter 10: Hydrology, Hydrogeology, Geology and Soils**.

2.6.7. Peat Depth

52. The majority of the Site is underlain by Class 4 soils; which are areas unlikely to be associated with peatland habitats and are unlikely to include carbon-rich soils (NatureScot, 2016). The Site is also underlain by Class 5 soils, these represent areas of commercial forestry plantation on peat soils and have a lack of peatland vegetation. The remainder of the Site is underlain by Class 0 mineral soils.

53. Site visits have confirmed the presence of peat (**Chapter 10**) and peatland habitats (**Chapter 8**). Peat probing and habitat surveys were undertaken in 2023 and 2024 and show that the peat is of variable condition and depth across the Site, with deeper peat occurring at Glenmaid Moor, Peat Moss, Dry Rig and to the north of Gubhill Rig (see **Figure 2.4**). Other areas of the Site are characterised by peaty soils and mineral soil. The peat probing data is discussed in **Technical Appendix 10.1**.

54. A review of the peat depth data and habitat mapping, in conjunction with slope gradients, allowed areas of deep peat (typically greater than 1.5 m) and those areas of less modified peat to be avoided where possible through the evolution of the design. Where possible, proposed wind turbines and site infrastructure would be located within areas with no peat or with peat less than 1.0 m deep. Where access tracks cannot avoid areas of deep peat, floating tracks have been incorporated into the design (see **Figure 3.1** as well as **Figure 10.8**). Further details of peatland habitat loss and habitat management proposals for restoring modified peatland habitat can be found in **Chapter 8: Ecology and Biodiversity**.

55. **Figure 2.4** shows proposed site infrastructure along with peat depth information and aims to show that wind turbines and infrastructure have been carefully designed to avoid areas of deep peat.

56. The proposed Development has also been designed to avoid any areas which may be subject to peat slide risk. The ground condition constraints that were considered 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.

2.6.8. Archaeology and Cultural Heritage

57. Archaeology and cultural heritage constraints were identified at an early stage of the design process, and hard and soft buffers were established around them based on their relative importance/sensitivity, so that they could be avoided during the design process.

58. The buffers and interpretation of heritage assets' importance/sensitivity were further assessed during the course of the design and EIA process, in particular informed by

archaeological site visits undertaken to establish the quality of the preservation of the remains within the Site.

59. Through the EIA scoping process and subsequently, the EIA team engaged with key heritage consultees such as Historic Environment Scotland to agree a basis for the assessment. Key messages arising from the consultations undertaken were fed back to the design team so that amendments could be made to address the feedback were possible. In particular, the Applicant modified the design between Layout A and Layout B (see **Table 2.3)** by removing Turbine 11 from Layout A (located at NGR NX96380 94373) so that a greater level of separation was maintained to the scheduled monument of Poldivan Bridge Cairn, thereby reducing the impact on the setting of this designated asset (see **Figures 2.2a** and **3.1**).

60. The archaeological and cultural heritage effects of the proposed Development are addressed further in **Chapter 11: Archaeology and Cultural Heritage**.

2.6.9. Noise Sensitive Receptors

61. For the purposes of early constraints mapping, avoidance buffers of 1 km were applied to inhabited residential properties in the vicinity of the turbine area. These buffers were refined further during the design process based on expert noise advice in order to reduce the risk of impacts on inhabited residential receptors.

62. An initial review of the baseline data surveyed for other windfarm schemes, and which are publicly available in the assessments for those schemes, suggests that existing baseline levels have been sufficiently defined for the purposes of an assessment of operational noise in accordance with ETSU-R-97 and best practice. Noise modelling was undertaken using this data 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.

63. 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 ensures that no exceedances of acceptable noise levels would occur for the proposed Development.

64. The noise effects of the proposed Development are addressed further in **Chapter 13: Noise**.

2.6.10. Forestry

65. The current land use of the Site is predominantly commercial forestry and existing forestry management plans for felling and planting across the Site have been considered in the design of the proposed Development. Forestry forms an integral part of the proposed Development as some trees would need to be felled, before planned plantation felling, around infrastructure positions to allow for construction of the proposed Development. **Technical Appendix 14.1** has been developed to show which areas of forestry that would be felled to facilitate the proposed Development, which of the felled areas can be restocked and the plans for Compensatory Planting.

66. This Site is largely stocked with middle aged conifers and the aim will be to carry out keyhole felling to accommodate the turbines wherever possible to avoid adverse

environmental impacts; this will also minimise both the amount of felling and the area of Compensatory Planting that may be required, while at the same time incorporating areas of new native woodland and riparian planting. It is thought that keyhole felling as opposed to the alternative of clear felling would not have too great an impact on turbine efficiency. Keyhole felling aims to avoid woodland loss wherever possible and where this is not achievable, to have the smallest possible keyhole and associated felling within afforested areas.

67. Further details on the proposed approach towards forestry management is provided in **Technical Appendix 14.1**.

2.6.11. Telecommunications

68. Consultation was undertaken with the relevant telecommunication link operators to inform the telecommunications links within the vicinity of the Site and to advise their position with respect to the proposed Development.

69. Consultation with Arqiva, Atkins, British Telecom (BT), the Joint Radio Company (JRC), Mobile Broadband Network Limited (MBNL) and Virgin Media O2 raised no issues which could have potentially affected the proposed Development.

70. Airwave (Motorola Solutions) confirmed that they have an objection to the proposed Development as it would potentially interfere with a telecommunications link that they operate, which traverses the Site, and the location of a single turbine (Turbine 10 in Layout B, located at NX96331, 92180) had the potential to interfere with the link.

71. The proposed Development layout was amended to avoid impacts to an identified Airwave telecommunications link through the turbine area.

72. The effects of telecommunications on the proposed Development are addressed further in **Chapter 14**.

2.6.12. Shadow Flicker

73. As stated for noise in Section 6.9 above, avoidance buffers of 1 km were applied to inhabited residential properties in the vicinity of the turbine area. This also served to reduce the frequency and likelihood of shadow flicker effects being encountered by residents. Further information on shadow flicker effects can be found in **Chapter 14.**

2.7. Design Evolution

74. This section of the EIA Report addresses the consideration of alternatives and evolution of the design that the Applicant has gone though from inception to arriving at the proposed layout and scale of the proposed Development.

2.7.1. Consideration of Alternatives

75. According to the EIA regulations, the EIA Report should include: "*a description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment.*"

76. With respect to the proposed Development the alternatives considered were as follows:

- different turbine and infrastructure layouts/locations within the Site;
- different turbine heights/dimensions; and
- different routes between the public road and development infrastructure within the Site, such as for the delivery of abnormal loads.

77. The proposed design and layout was adapted and altered in response to environmental constraints and consultation feedback. The proposed Development went through a series of four broad design iterations. Changes to the layout included decreasing the number of turbines, changing turbine position, routing of access tracks and the Application Boundary.

2.7.2. Design Evolution Approach

78. The layout and design of the proposed Development follows an iterative design and environmental constraints led process aimed at optimising a renewable energy development that minimises environmental impacts but meets the commercial requirements of the Applicant. An iterative design approach works in tandem with the EIA process, whereby the design process facilitates incremental changes in layout and design resulting from a continually developing understanding of environmental constraints. This iterative approach allows potential environmental constraints, as they are identified, to be avoided or minimised through alterations in design. This approach is referred to within this EIA as mitigation 'embedded' into the proposed Development or simply 'embedded mitigation'. Further information on embedded mitigation is explained within each technical Chapter of this EIA Report (**Chapters 7-15**).

79. As part of the approach numerous design principles and environmental measures have been implemented and incorporated into the proposed Development as standard practice, including the following:

- consideration of the underlying character and scale of the landscape;
- layout and spacing of wind turbines relative to key viewpoints;
- minimising impacts on peat;
- 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 and proximity to residential areas;
- minimising removal of plantation/tree cover to accommodate renewable energy infrastructure;
- seeking opportunities within the Site to provide biodiversity enhancements;
- consideration of re-using existing onsite infrastructure;
- consideration of winning rock and aggregate from within the Site 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 detailed Site investigation.

80. 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 and the cumulative pattern of development. Particular regard has been given to evaluating the scale and number of turbines proposed with the proportions of the existing landscape. The landscape and visual effects potentially caused by the proposed Development have been considered extensively from key receptors throughout the design process. Siting and Designing Windfarms in the Landscape (Version 3a) SNH (now 'NatureScot') 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.*"

81. Other key drivers throughout the design evolution of the proposed Development layout were the consideration of sensitive ecological habitats and species, presence of pockets of deep peat, noise impact on the nearest noise sensitive receptors, and of cultural heritage. The location/distribution, sensitivity and extent of sensitive ecological habitats and species were identified through site surveys, and appropriate buffers established around key receptors. The entirety of the Site was subject to detailed peat probing, so that areas of identified peat could be avoided where possible. Consideration of noise involved an analysis of the noise and limits at the nearest properties at key stages throughout the design process to ascertain what implications there might be and if any embedded mitigation may be required. Consideration of cultural heritage included designing the layout to ensure that no element of the proposed Development physically affected any known identified heritage assets, and amending the layout to ensure that impacts on the setting of sensitive cultural heritage assets outwith the Site were minimised.

82. The substation area has been selected using a similar approach to the wind turbine layout by applying technical and environmental constraints to the Site. A location was selected in the south of the Site in order to reduce the potential length of the grid connection. The principal criteria for the substation were the identification of flat land and avoiding sensitive habitat areas and deep peat. The same is true for the construction and maintenance compound but with its position ideally located as near as possible to the entrance and location of the first wind turbine on entering the Site.

83. The access tracks have been designed to use existing tracks where possible; whilst minimising cut and fill requirements in order to reduce the amount of ground disturbance, volume of materials required for construction, loss of sensitive habitats and landscape and visual effects, particularly during construction.

84. Borrow pits were also considered to be required as a source of rock to be used in the construction of the tracks, hardstandings and foundations. Several borrow pits and quarries exist within the Application Boundary, and the Applicant has reached agreement with the landowner to use these. In utilising existing borrow pits/quarries, the Applicant has reduced the environmental impact of the proposed Development, as fewer deliveries of materials to the Site and less new ground disturbance will be required to accommodate the proposed Development infrastructure.

85. Where felling is required to accommodate the proposed Development infrastructure, this has been minimised by taking a 'keyholing' rather than 'clear-felling' approach. Reducing the amount of felling to accommodate the proposed Development would also minimise the production of waste materials and potential sources of pollution. The access track itself in certain locations would also act as the firebreak and therefore obviate the need to cutting firebreaks elsewhere.

2.7.3. Development of Preferred Option: Turbine Area

86. The Applicant has been investigating the potential for renewable energy development at the Site since 2019. The key points of this design evolution process are presented in this section.

87. The proposed Development has gone through four principal iterations of the layout, which have been developed at different stages in the project design process. Layouts A to D are shown on **Figure 2.2a**, and illustrate the four interim layouts and visually illustrates how the design and Application Boundary have evolved through the design stages of the EIA process. Layout D is shown in **Figure 3.1**. A summary of the evolving layouts and design and the reasons for the changes are presented in **Table 2.3** below.

Table 2.3 Description of Turbine Area Design Evolution Stages

Layout	Number of Turbines	Tip height (m)	Comments
Layout A: Scoping Layout	13	220	Feasibility studies were undertaken in February 2023, prior to detailed surveys necessary for the EIA commencing. This layout formed the basis of the EIA Scoping Report submitted in March 2023.
Layout B: Design Workshop Layout	14	220	Informed by environment constraints data and wind turbine parameters instructed by the Applicant.
Layout C: Chilled Layout	13	220	A 13-turbine layout of up to 220 m to tip, responding to field data collated for the Site up to November 2024, scoping and public consultation responses, alongside further advanced onsite environmental surveys and visual analysis
Layout D: Frozen Layout	12	200 – 220	12-turbine layout of up to six turbines of up to 200 m to tip and six of up to 220 m to tip, informed by detailed multidisciplinary assessment, and including locations of ancillary infrastructure.

2.7.4. Layout A: Scoping Layout

88. In February 2023, a feasibility study was undertaken on behalf of the Applicant which concluded that the turbine area had a potential to accommodate up to 13 turbines of a tip height of up to 220 m. This considered identified on-site constraints such as proximity to the village of Ae and associated, scattered inhabited residential properties, the degree of slope (avoiding areas over 14%), visibility of the turbine area, watercourse buffers (50 m), telecoms link buffers (100 m) crossing the Site, public road buffers to the east, and the RSA to the north-west.

89. The feasibility study layout formed the basis of the layout presented for the EIA Scoping Request for the proposed Development, which was published by the ECU on 16th March 2023, and presented in the public information events held in June 2023. The EIA Scoping Report that accompanied the request also identified that the Site had the potential to accommodate a battery energy storage system (BESS) in addition to the onshore wind turbines and associated infrastructure.

90. This design is shown in **Figure 2.2a**.

2.7.5. Layout B: Design Workshop Layout

91. Following EIA scoping, an initial constraints assessment and updated design was prepared, consideration of candidate turbine design parameters, energy yield, and a variety of environmental assessments undertaken from 2022 through the summer of 2023. The environmental assessments included but were not limited to:

    – ornithological and bat surveys;
    – environmental data provided by the landowner, Forestry and Land Scotland;
    – establishing a 2 km buffer from the village of Ae to the turbines;
    – ecological habitat surveys;
    – phase 1 peat depth probing;
    – telecommunications assets; and
    – initial consideration of the impacts on the setting of cultural heritage assets in the vicinity of the turbine area.

92. As a result, the proposed layout was amended in the summer of 2023. Initially, potential locations for up to 19 turbines were identified. Through a process of collaboration and review, the design was refined to 14 turbines of up to 220 m to tip, as presented in **Figure 2.2a** as Layout B. The turbines were not renumbered to reflect the reduced number of turbines until later in the design evolution. The Application Boundary was amended at its north-western end so that it was not located within Dumfries and Galloway Thornhill Uplands RSA.

2.7.6. Layout C: Chilled Layout

93. Following the identification of a potential 14-turbine layout in June 2023, the project team consulted with consultees such as HES, SEPA and NatureScot. The team also considered feedback from public consultations held in June and July 2023, engaged with local community councils in autumn 2023, and reflected on the EIA Scoping Opinion and individual responses from consultees. The suite of surveys committed to within the EIA Scoping Report continued through the summer and autumn of 2023 and informed the updated layout. Particular considerations included:

- Groundwater Dependent Terrestrial Ecosystems;
- the results of fish surveys;
- a site visit undertaken by the lead archaeologist to ascertain the level of preservation of known assets within the turbine area;

- exploring opportunities to reduce potential impacts on the settings of the Scheduled Monument of Poldivan Bridge Cairn;
- private water supplies;
- consideration of landscape and visual effects from key views;
- an Airwave emergency telecommunications link; and
- noise modelling.

94. A second design workshop was undertaken in November 2023. Its purpose was to identify suitable locations for both the proposed turbines as well as the related infrastructure such as connecting access tracks, the substation, and construction compounds, in the light of the further information gathered. The outcome of the chilled design was a 13-turbine layout, with connecting new and upgraded access tracks, construction compounds, a substation and meteorological mast location. This is shown as Layout C in **Figure 2.2a**.

2.7.7. Layout D: Frozen Layout

95. A frozen design was achieved in July 2024 following Phase 2 peat probing of the whole of the chilled design footprint, further amendments to the design to avoid localised areas of deep peat, adjusting construction compound locations to reflect the proposed access track to the turbine area, confirmation of a roads design specification, and negotiation and agreement with Forestry and Land Scotland over the use of its existing quarries within the Site for the purposes of construction of the proposed Development.

96. Following further fieldwork and collaboration, it was decided to remove the most northerly turbine ("T12" as shown in Layout C) from the design so that the proposed Development would appear as a more coherent whole in views towards the Site and to reduce landscape and visual impact. The Application Boundary was amended so that the Galloway and Southern Ayrshire Biosphere Reserve in the north-western portion of the Site was removed, the Scheduled Monument of Poldivan Bridge Cairn in the north-eastern area was omitted from the Site, and a proposed area of riparian planting to the east of the access track to the turbine area was added (see **Figure 3.1**).

97. To further reduce impacts on nearby residential and landscape receptors, the maximum height of the turbines was also reduced, with turbine T1, T2, T5, T6, T9 and T10 to be a maximum of 200 m to tip and the remaining turbines T3, T4, T7, T8, T11 and T12 at a maximum of 220 m to tip.

98. The turbines were renumbered at this stage to run sequentially from 1 to 12. The frozen design and finalised turbine numbering are shown in **Figure 3.1** as well as in Layout D – Frozen Layout on **Figure 2.2a**.

2.7.8. Development of Preferred Option: Access Track to the Turbine Area

99. During the design evolution of the proposed Development, four options for the delivery of abnormal indivisible loads (AILs) were considered for the proposed Development. These are presented in **Figure 2.2b.**

100. The four options considered were as follows:

- Option 1: Ae Village;

- Option 2: Craigshields;
- Option 3: Capel Water; and
- Option 4: Capel Water with Shortcut.

101. The key points of these are summarised below.

2.7.9. Access Track Option 1: Ae Village

102. This option led from the A701 south of the village of Ae at Ae Bridgend, coming through Ae and accessing the turbine area north of Windyhill. This option was discounted at an early stage of the design process due to the potential disruption it would cause to local residents in the village of Ae.

2.7.10. Access Track Option 2: Craigshields

103. This option led from the A701 public road at the existing Harestanes Windfarm access point to the east of Ae village, through part of the operational Harestanes Windfarm, crossing the Water of Ae and close to the Forestry and Land Scotland (FLS) properties of Craigshields and Knockenshang. Following detailed environmental and engineering surveys, this option was not taken forward due to the extensive new watercourse crossing within challenging terrain that would have been required over the Water of Ae, and the recreational interests of FLS and the public near the proposed route.

2.7.11. Access Track Option 3: Capel Water

104. This option led from the A701 public road at the existing Harestanes Windfarm access point to the east of the village of Ae, through the operational Harestanes Windfarm, along the existing FLS forestry access tracks north of Muir Hill, Hareshaw Rig and Queensberry before extending southwards to cross the Bran Burn and Capel Water. Following an assessment of Options 1, 2 and 3, this route was not taken forward due to the length of the delivery route in comparison with Options 1 and 3, which would have required a more extensive network of access tracks and existing watercourse crossings to be upgraded and pose logistical and health and safety challenges during construction due to the time and distance required to access the Site.

2.7.12. Access Track Option 4: Capel Water with Shortcut

105. This option led from the A701 public road at the existing Harestanes Windfarm access point to the east of Ae village, through the operational Harestanes Windfarm, along the existing FLS forestry access track east of Muir Hill, before crossing the Water of Ae, Bran Burn and Capel Water. This option was selected for the 'frozen' design shown in **Figure 3.1** as the disruption to local residents would be less than for Option 1, and the environmental, engineering and health and safety factors were assessed as being less challenging than would be the case for Options 2 and 3. Following confirmation of the proposed access track to the turbine area, the location of a construction compound and an opportunity to use an existing FLS quarry were identified along its route, as shown in **Figure 3.1.**

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 all infrastructure. The technical assessments (presented in **Chapters 7** to **14**) have considered the potential for micrositing. During construction of the proposed Development, the need for any micrositing would be assessed and agreed with the onsite Environmental Clerk of Works (ECoW).

2.9. Conclusion

107. In summary, the application design and layout represent a proposed Development which achieves the following:

- introduces development into a large-scale modified landscape where it can be accommodated with less impact on landscape character;
- introduces development into an area where wind energy development is present and with which it integrates reasonably well;
- minimises impacts on key views;
- minimises impacts on settlements and residents of scattered dwellings;
- is in accordance with Dumfries and Galloway Council Climate Emergency Declaration, National Planning Framework 4 (NPF4) and Onshore Wind Policy Statement;
- minimises and, where possible, avoid the loss of priority habitats and species, and creates opportunities for habitat enhancement, which will be delivered by a Habitat Management Plan, including an area of proposed riparian planting;
- protects watercourses and fish from the potential impacts of constructing the proposed Development;
- can be engineered and constructed safely;
- uses as much existing forestry road as possible, reducing the amount of new track and water crossings required for the construction of the proposed Development;
- avoids known designated assets through applying suitable buffers;
- respects the setting of historical assets; and
- minimises disturbance to and removal of carbon stores, such as trees and peat, to improve the carbon balance.

108. The final layout of the proposed Development is described in detail in **Chapter 3: Proposed Development** and shown on **Figure 3.1**. The potential effects of the resulting layout are addressed throughout **Chapters 7** to **14** of the EIA Report.

References

Dumfries and Galloway Local Development Plan 2: Dumfries and Galloway Council: 2019. Available at: https://www.dumgal.gov.uk/ldp2 [Accessed September 2024].

ETSU-R-97: The Assessment and Rating of Noise from Wind Farms: Department for Trade and Industry (DTI): 1996.

NatureScot 2016 Carbon and Peatland 2016 map. Available at: https://www.nature.scot/professional-advice/planning-and-development/planning-and-development-advice/soils/carbon-and-peatland-2016-map [Accessed September 2024].

Onshore Wind Policy Statement: Scottish Government: 2022.

Scottish Government 2023. National Planning Framework 4. Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2023/02/national-planning-framework-4/documents/national-planning-framework-4-revised-draft/national-planning-framework-4-revised-draft/govscot%3Adocument/national-planning-framework-4.pdf [Accessed September 2024].

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

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.