Chapter 2

Site Description and Design Evolution

SCOTTISHPOWER RENEWABLES

Table of Contents

2.1	**Introduction**	**3**
2.2	**Site Context**	**3**
2.2.1	Site Description	3
2.2.2	Surrounding Area	3
2.3	**Site Selection**	**4**
2.4	**Technology, Size and Scale**	**4**
2.4.1	Wind Turbines	4
2.4.2	Solar Array	4
2.4.3	Battery Energy Storage System (BESS)	4
2.5	**Layout and Design Constraints**	**5**
2.5.1	Legislation	5
2.5.1.1	Schedule 9 of the Electricity Act 1989	5
2.5.2	Key constraints	5
2.5.2.1	Wind Analysis	5
2.5.2.2	Landscape Character and Visual Amenity	5
2.5.2.3	Ecology and Ornithology	5
2.5.2.4	Hydrology and Hydrogeology	6
2.5.2.5	Peat Depth	6
2.5.2.6	Noise-Sensitive Receptors	6
2.5.2.7	Forestry	6
2.5.2.8	Existing Infrastructure and Services	6
2.5.2.9	Telecommunications	6
2.5.2.10	Shadow Flicker	6
2.6	**Design Evolution**	**7**
2.6.1	Consideration of Alternatives	7
2.6.2	Design Evolution Approach	7
2.6.3	Development of Preferred Option	8
2.7	**Micrositing**	**9**
2.8	**Conclusion**	**9**
2.9	**References**	**10**

Figures
Figure 2.1: Environmental Designations
Figure 2.2: Onsite Constraints – Site Specific Constraints
Figure 2.3: Proposed Site Infrastructure and Peat Depth
Figure 2.4: Design Iterations

Chapter 2
Site Description and Design Evolution

2.1 Introduction

1. This Chapter of the Hollandmey Renewable Energy Development (RED) (hereafter the 'proposed Development') Environmental Impact Assessment (EIA) Report outlines the Site context and the alternatives considered for the proposed Development by ScottishPower Renewables (UK) ltd (SPR) (hereafter 'the Applicant'). It details the site selection and design processes and describes the renewable energy technology alternatives considered.

2. The principles of the EIA process require that site selection and project design should be iterative and constraint-led, to ensure that potential negative environmental impacts, resulting from the proposed Development, are avoided or minimised as far as reasonably possible. Schedule 4 (2) of The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 ('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*.". This Chapter fulfils these requirements of the EIA Regulations.

3. 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.

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

- Figure 1.1: Site Location Plan;
- Figure 2.1: Environmental Designations;
- Figure 2.2: Onsite Constraints – Site Specific Constraints;
- Figure 2.3: Proposed Site Infrastructure and Peat Depth; and
- Figure 2.4: Design Iterations.

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

2.2 Site Context

2.2.1 Site Description

6. The Site is located approximately 8 km south west of John o' Groats and 16 km east of Thurso, situated within the north eastern part of the Caithness area of the Scottish Highlands. The Site is privately owned and covers an area of approximately 1195 ha and is centred on NGR ND 29621 69892 as shown on **Figure 1.1**. The Site lies wholly within the administrative boundary of the Highland Council (THC).

7. The Site is moorland with commercial forestry, open ground between forested areas and woodland grazing. The landform is gently undulating sloping from an altitude of approximately 79 m AOD in the north east of the Site to 36 m AOD in the north west. Several minor watercourses drain the Site including Burn of Ormigill, Burn of Hollandmey and Link Burn in addition to extensive drainage ditches that connect to these watercourses. There are small lochans in the northern area of the Site including a group of lochans in the north east in Phillips Mains Mire Site of Special Scientific Interest (SSSI).

8. There are agricultural buildings in the centre of the Site, tracks within and on the edges of the application boundary, and three abandoned buildings within the south area of the Site. There are four non-designated heritage assets including two farmsteads and a fish house in the centre of the Site and a shieling in the south.

9. Access to the Site is from the existing land access entrance to the north of the Site via the C1033 Everly-Crockster Toll Road which runs north west of Phillips Mains. Abnormal loads would be transported from the A836 to the C1033 Everly-Crockster Toll Road by way of the U1633 East Lodge Road and Charleston Farm Road (not a public road).

2.2.2 Surrounding Area

10. The immediate area surrounding the Site is rural with land used predominantly for agriculture and commercial forestry purposes. The operational Lochend Windfarm, comprising four wind turbines, each with a tip height of 99.5 m, is located approximately 1.5 km to the south west of the Site centre. The operational Stroupster Windfarm is located approximately 5.3 km to the south east from the Site centre. The largest settlement within the surrounding area is Wick, 20 km to the south of the Site, while the smaller settlements of Castletown and Halkirk are located 10 km to the west and 19 km to the south west respectively.

11. There is a relatively low population density within the immediate vicinity with few properties located within 1 km of the application boundary

12. The closest environmental designations and heritage assets within 5 km of the application boundary are shown on **Figure 2.1** and summarised in **Table 2.1** and **Table 2.2**.

Ecological Designated Sites

Table 2.1: Ecological designated sites within 5 km of Site

Ecological Designated Sites	Name	Distance from Site
Ancient Woodland Inventory	Site ID 3 Site ID 2 Site ID 4	0.6 km north 1.4 km north 4.6 km south
Nature Reserve	Dunnet Forest	4.6 km west
SSSI	Phillips Mains Mire Stroupster Peatlands Loch of Mey Loch Heilen Dunnet Links	Onsite 10 m south 1.7 km north west 1.7 km west 3 km west
Special Area of Conservation (SAC)	Caithness and Sutherland Peatlands	10 m south
Special Protection Area (SPA)	Caithness and Sutherland Peatlands Caithness Lochs (Loch of Mey) Caithness Lochs (Loch Heilen) North Caithness Cliffs (Stroma) North Caithness Cliffs (Dunnet Head)	10 m south 1.5 km north 2 km west 3.5 km north east 5 km north west
Proposed Special Protection Area	Pentland Firth	3.5 km north east
Wetland of International Importance (Ramsar)	Caithness and Sutherland Peatlands Caithness Lochs (Loch of Mey) Caithness Lochs (Loch Heilen)	10 m south 1.5 km north 2 km west

Heritage Assets

Table 2.2: Heritage assets within 5 km of Site

Heritage Asset	Name	Distance from Site
Scheduled Monuments	Thomsonsfield Broch Earl's Cairn Mey Battery St John's Point Scarfskerry Kirkstones Ham	1.5 km east 1.6 km west 2 km north 2.9 km north 3.4 km north 3.7 km south 4.6 km north west
Category A Listed Building	Castle of Mey and Garden Walls Canisbay Parish Church	1.6 km north 3 km north east
Category B Listed Building	Castle of Mey Gate Lodge and Gate Piers Dunnet Free Church Gate Piers and Enclosure Wall West Canisbay Rattar House Canisbay Old Manse Steading Ham Girnal and Corn Mill	1.5 km north 2.2 km west 2.6 km east 3.2 km north west 3.2 km east 4.4 km north west
Category C Listed Building	Barrock House Gate Lodge	4.7 km south
Garden and Designed Landscape	Castle of Mey	1.4 km north

2.3 Site Selection

15. The Applicant uses a range of criteria to select sites for the development of renewable energy projects and is continually assessing sites as part of its renewable energy development growth plans.

16. 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;
- suitable solar irradiance for the installation of solar arrays;
- availability of nearby grid connection capability 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 on the Site 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.

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

- initial desk-based assessments and wind monitoring onsite suggest that there is good wind and solar resource, and the Site is available for a renewable energy development;
- the Site itself has open and expansive characteristics considered appropriate for renewable energy development;
- there are no planning policies which, in principle, preclude windfarm or renewable energy development. The Site is partly located within an area which is considered to have potential for a windfarm or a renewable energy development subject to other policy considerations. Further information on this is provided in **Chapter 4: Renewable Energy and Planning Policy**;
- there are several areas of flat/gently sloping south facing land that are suitable for ground mounted solar panels;
- the Site has reasonably good access from the public road network 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;
- site infrastructure has been sensitively designed to ensure that it avoids direct and indirect impacts on the Phillips Mains Mire SSSI which is designated for its nationally important blanket bog habitat; and within the Site; and
- the distances from the nearest residential properties are such that undue noise or visual impacts from on visual amenity can be avoided if practicable.

2.4 Technology, Size and Scale

18. As a basis of the design of the proposed Development, it was considered that it would comprise three-bladed horizontal axis turbines, with the incorporation of a ground mounted solar array and battery energy storage system (BESS). Other technologies such as Hydrogen Storage (storage and fuel) and Hydro Power were also considered but were not deemed suitable for the purpose of this development at the moment. The opportunity for electric vehicle (EV) Charging facilities is not being considered as part of this proposed Development., however the Applicant is committed to providing funding to support THC's EV strategy. Further information is provided in **Chapter 14: Socio-Economics, Recreation and Tourism.**

2.4.1 Wind Turbines

19. Allied to a significant resource availability in the Highland region, onshore wind continues to be the cheapest form of renewable energy generation, and the Site has been predominantly selected for its potential to generate energy from wind turbines. The supply of smaller wind turbines across Europe is already reducing due to lack of demand, as manufacturers are recognising the world market is shifting to larger more efficient machines with development work focussing on larger turbines to secure higher yields. The tendency is to install wind turbines at higher tip heights). Therefore, it is highly unlikely that a range of smaller turbines (e.g., 120 m) would be available at competitive prices by the time the proposed Development is ready to be constructed, if consented.

20. Larger turbines need to be considered if onshore wind development is to continue to make a significant contribution to both the UK and Scottish Government's renewable energy targets, particularly regarding the recent announcement of Net Zero CO_2 emissions by 2045. The Scottish Government's Onshore Wind Policy Statement (December 2017) also challenges the industry to develop the first 'subsidy free onshore windfarm', which would only be possible if taller turbines are installed.

21. The final selection of the turbine tip height of up to 149.9 m was considered to represent the best balance of tall turbines and design in the landscape. Furthermore, by limiting the wind turbines to 149.9 m tip height, it negates the need for visible lighting imposed by the Civil Aviation Authority for structures over 150 m.

2.4.2 Solar Array

22. The global horizontal irradiation for the general location of the Site is calculated to be around 850 kWh/m^2 which although is slightly less than the UK average of 1,000 kWh/m2, is still within levels considered viable for the proposed Development.

23. Five areas of the Site were found to be suitable for the installation of ground mounted solar panels, and also presented a block area large enough for a minimum of 5 MW installed Photovoltaics. It was considered that a solar array should be investigated further and could coexist with the proposed wind turbines and BESS. Key to investigating the positioning of solar panels, were the suitability of ground conditions, the presence of peat, landscape and visual impacts, ornithological activity and the quality of habitats on the Site. An environmental and technical review of potential solar array locations identified on the Site was undertaken and a preferred area best suited to the Site and its surrounding areas was selected.

2.4.3 Battery Energy Storage System (BESS)

24. There is a national requirement to balance the peaks and troughs associated with electricity supply along with demand to avoid strains on transmission and distribution networks, and to keep the electricity system stable. A BESS is therefore proposed at the Site to support the flexible operation of the National Grid and decarbonisation of electricity supply.

25. The BESS facility would store electrical energy through the use of batteries, contained alongside inverters within a self-contained building, adjacent to the onsite control building to allow easy connection to the grid.

2.5 Layout and Design Constraints

26. This Section outlines the environmental and technical constraints which were taken into account during the design evolution described in **Section 2.6**.

2.5.1 Legislation

2.5.1.1 Schedule 9 of the Electricity Act 1989

27. 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 requires 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."

28. 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".

29. 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. 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."

31. The assessment of impacts on fish is addressed in **Chapter 10: Hydrology, Hydrogeology, Geology and Soils**: **Chapter 8: Ecology and Biodiversity**, and **Technical Appendix 8.4: Fish Habitat Survey**.

32. The key constraints relating to "*the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects"*, are detailed further in **Sections 2.5.2.1** to **2.5.2.10**, considerations during the design process included:

- identified landscapes and visual constraints;
- location of residential properties – proximity to noise-sensitive receptors 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

2.5.2 Key constraints

33. 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 project. 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.

Onsite constraints can be seen in further detail on the onsite Constraints Plan (**Figure 2.2** and **2.3**). In addition to the application of GIS, Infraworks, a 3D civil infrastructure design service, was used to assist in the constraints mapping and design of the proposed Development. This allowed for greater inspection of topography and visual aspects.

34. All constraints were assigned a traffic light rating (red, amber, green) 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.

2.5.2.1 Wind Analysis

35. 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 areas of the Site likely to produce the highest yields and ensure the commercial viability of the scheme.

36. 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 would 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 their operational lifespan. Conversely, if wind turbines are located too far apart, the opportunity to maximise the capacity and, thereby, electricity generation from a site is reduced.

37. There is no industry standard for spacing, only manufacturer recommendations, computer modelling and professional judgment. Six times rotor diameter on the predominant wind direction against four times rotor diameter 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. 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.

2.5.2.2 Landscape Character and Visual Amenity

38. The design of the wind turbine layout is a vital part of the landscape and visibility effects of a renewable energy development. Its appearance considered on its own, and its appearance in the context of Stroupster Windfarm, Lochend Windfarm and other cumulative sites were important considerations. Landscape and visual input to the design was informed by SNH's Siting and Designing Wind Farms in the Landscape Version 3a (2017), the decision notice from the refusal of the Lyth windfarm appeal (November 2013), the THC pre-application advice for Hollandmey (March 2019), and drawing on fieldwork observations. The following key landscape and visual sensitivities were identified in the vicinity of the Site:

- proximity to Dunnet Head and Duncansby Head special landscape areas (SLAs);
- potential visibility from nearby settlements such as Wick, Castletown and Halkirk, the A836, A99, NC500, ferries to Orkney; and
- proximity to adjacent operational Lochend Windfarm and Stroupster Windfarm, as well as other cumulative windfarms in the wider surrounding area.

39. The landscape and visual effects of the proposed Development are addressed further in **Chapter 7: Landscape and Visual Impact Assessment. Table 2.3** details the key landscape and visual design principles that were adopted during design evolution to mitigate against impacts on the key sensitive receptors above.

2.5.2.3 Ecology and Ornithology

40. Ecological surveys have been carried out across the Site over the last year, including a Phase 1 habitat survey, a National Vegetation Classification Survey and protected species surveys (including bats, pine marten, badger, otter, water vole, red squirrel). Sensitive ecological features, including habitats present within the Site and species which use the Site and appropriate buffers, have been avoided. Of most significance were areas of Annex 1 peatlands and these areas have been avoided. 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.

41. Ornithology surveys have been carried out across the Site and surrounding area since December 2017 (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 areas have been specifically avoided owing to the presence of geese.

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

2.5.2.4 Hydrology and Hydrogeology

43. In accordance with good industry practice, a 50 m buffer zone was applied around all watercourses on the Site for wind turbines, access tracks, solar array and all ancillary infrastructure (including BESS) except where crossings are required. 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.

44. Data on private water supplies (PWS) was obtained from THC and was not identified as a constraint to development. No PWS were identified within 5 km of the Site. A number of wells marked on the OS mapping, within 2 km of the Site, were assessed as a matter of good practice to identify if there was any potential linkage to development at the Site. No links were identified.

45. 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.

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

2.5.2.5 Peat Depth

47. Much of the Site lies within an area identified as being peatland of national importance (Class 1) on the SNH Carbon and Peatland database, with the remainder of the Site mainly having the potential for peat with a mixture of peat soil and mineral soil from Classes 4 and 5. The Soils map of Scotland further identifies that the Site has mainly dystrophic blanket peat soils with some noncalcareous gleys and alluvial soils.

48. Site visits have confirmed the presence of peat and peatland habitats. Peat probing and habitat surveys were undertaken between May and November 2020 and show that the peat is of variable condition and depth across the Site, with deeper peat occurring around Phillips Mains Mire SSSI and Hollandmey Moss. Other areas of the Site are characterised by peaty soils and mineral soil.

49. A review of the peat depth data and habitat mapping, in conjunction with slope gradients, allowed areas of deep peat (typically greater than 2 m) and those areas of less modified peat to be avoided where possible through the evolution of the design. Where possible, proposed wind turbines, ground mounted solar panels and site infrastructure would be located within areas with no peat or with peat less than 1.0 m deep. Further details of peatland habitat loss and habitat management proposals for restoring modified peatland habitat can be found in **Chapter 8: Ecology**.

50. **Figure 2.4** shows proposed site infrastructure along with peat depth information, and clearly demonstrates that wind turbines and infrastructure have been carefully designed to avoid areas of deep peat. **Chapter 3: Proposed Development**, introduces the layout for the proposed Development and describes the way in which it would be constructed, including a general description of the proposed renewable energy technologies (i.e., wind turbine, solar array and BESS) and their associated infrastructure.

51. 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.

52. The peat probing data is discussed in **Technical Appendix 10.1: Peat Landslide Hazard and Risk Assessment**.

2.5.2.6 Noise-Sensitive Receptors

53. 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.

54. 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.

55. 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, 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.

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

2.5.2.7 Forestry

57. 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. The areas of forestry that would be felled to facilitate the proposed Development are shown on **Figure 15.1**. Additionally, **Chapter 15: Other Issues** details the plans for Compensatory Planting.

58. This Site is largely stocked with middle-aged conifers, and the aim would be to carry out keyhole felling to accommodate the turbines wherever possible to avoid adverse environmental impacts; this would also minimise both the amount of felling and the area of Compensation Planting that may be required. 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.

2.5.2.8 Existing Infrastructure and Services

59. Scottish and Southern Energy (SSE) operate a powerline connecting Lochend Windfarm which runs through the southern portion of the Site. This is co-located with a fibre optic cable and both follow the same route. A suitable buffer (50 m) was included to ensure that no turbines were placed in the vicinity of the cable line and the Site tracks would pass over the cables. A proposed 132 kV transmission line, connecting a proposed substation at Thurso South with a proposed switching station at Gill's Bay, that would dissect the northern part of the Site, has been consented. The section where the line would cross the Site would be buried, SSE requested a setback buffer of 25 m from the proposed buried cable and any Hollandmey RED infrastructure. There is a setback of c.90 m to the nearest turbine.

2.5.2.9 Telecommunications

60. 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.

61. Consultation with Arqiva, Airwaves, Atkins, BT, Ericsson, Joint Radio Company Ltd (JRC) and Vodafone raised no issues which could have potentially affected the proposed Development. Telefonica 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. Telefonica operate a telecommunication link that crosses the Site, and the location of a single turbine (Turbine 8) had the potential to interfere with the link. Discussions were held with Telefonica to explore possible technical solutions, including re-networking the telecommunications link via an alternate mast or replacing the affected link with a leased line or fibre optic cable, but there were no viable options. As a result, Turbine 8 was relocated outside of the telecommunication link exclusion zone after due environmental and technical consideration.

2.5.2.10 Shadow Flicker

62. It is common to use ten rotor diameters as a maximum limit at which shadow flicker effects can occur and this is the expected separation distance identified in THC Interim Supplementary Guidance: Onshore Wind Energy (March, 2012) between the

proposed turbines and any regularly occupied buildings. During the design process, a study area of ten rotor diameters was applied to the turbines for proposed design schemes to test for potential shadow flicker effects. Turbines in the final proposed layout would not be within a ten rotor diameter distance of regularly occupied buildings; however, a complete assessment was conducted regardless. The potential shadow flicker effects of the proposed Development are addressed further in **Chapter 16: Other Issues**.

2.6 Design Evolution

63. The proposed Development, which is described in detail in **Chapter 3**, is the result of the evolution of the design, including consideration of alternatives, that the Applicant has gone through to reach the final proposed design.

2.6.1 Consideration of Alternatives

64. According to the EIA regulations, 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*."

65. 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;
- different access routes to and from the Site in terms of delivery of abnormal loads; and
- different access routes from the application boundary to and between the proposed Development infrastructure within the Site.

66. The design of the proposed Development 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 positions, siting of ancillary infrastructure, and routing of access tracks.

67. In considering turbine heights and dimensions, a maximum turbine tip height and rotor diameter has been selected for the purposes of design and assessment of impacts. However, it should be noted that a single candidate model of the turbine has not been specified. For the purposes of assessment therefore, where relevant for each technical assessment, turbine models that adhere to the limits of stated dimensions and provide the realistic relevant worst-case impact have been assumed.

2.6.2 Design Evolution Approach

68. 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, in accordance with Schedule 9, paragraph 3(1) of the Electricity Act. 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** to **15**).

69. 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;
- re-using existing forestry tracks as much as possible to access proposed turbine locations;
- design of the tracks to minimise cut and fill, reducing landscape and visual effects as well as costs;
- inclusion and design of borrow pit(s) to minimise the amount of the material required to be imported to the Site; and
- potential for up to 50 m micrositing of infrastructure during construction, to ensure the best possible location is chosen based on detailed Site investigations.

70. There has been a consistent level of windfarm activity across Caithness over the last decade, including operational, consented, application and scoping stage sites. This meant that consideration of cumulative issues was an important factor in the design process.

71. 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. Consideration was given to how the scale and number of turbines would affect the visual association with cumulative sites, including Lochend Windfarm (0.1 km west of the application boundary), Stroupster Windfarm (2.9 km south east) and Slickly windfarm (1.7 km south east). The landscape and visual effects potentially caused by the proposed Development have been considered extensively from key receptors during the iterative design process.

72. Siting and Designing Windfarms in the Landscape (Version 3a) Scottish Natural Heritage (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.""

73. Another key driver throughout the design evolution of the proposed Development layout was the consideration of noise on the nearest noise-sensitive receptors. This 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.

74. The solar array area has been selected using a similar approach to the wind turbine layout, by applying technical and environmental constraints to the Site. The principal criteria for solar array development have been the identification of flat land and/or ideally south-facing slopes. The general design parameters used have been as follows:

- slope (less than five degrees for north-facing slopes and no more than ten degrees for south-facing slopes);
- watercourses (20 m buffer);
- availability of visual screening;
- avoidance of significant shading;
- avoidance of the need for tree removal as far as is practicable;
- availability of suitable access to site;
- potential synergies with the proposed windfarm and supporting site infrastructure; and
- avoidance of sensitive habitats and deep peat.

75. The substation and BESS also require to be positioned on 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 Site entrance and the development of the first wind turbine on entering the Site. The proposed Development also required a second temporary construction compound located within the solar array area, for the purposes primarily of construction of the solar infrastructure.

76. 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, reduce the amount of material required for construction and minimise the loss of sensitive habitats and landscape and visual effects particularly during construction. The use of fire breaks in the forest have been incorporated where reasonably possible into the access track layout to minimise felling. Where felling is required to accommodate the access corridor, then effort has been made to extend the access corridor to the downwind edge of neighbouring forestry to avoid the creation of new wind exposed edges. This approach should ensure that felling is minimised and the future health and productivity of tree crop is protected. Reducing the felling 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.

77. Although the use of existing tracks onsite minimised the need for new tracks, 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. The locations of borrow pits took due cognisance of onsite constraints, targeting areas where the most suitable and accessible deposits of rock are likely to be available, and in locations with closest proximity to proposed infrastructure. The total number and size of borrow pits was selected to make a valid contribution to the estimated volume of rock required to construct the tracks, hardstandings and foundations.

2.6.3 Development of Preferred Option

78. The Applicant has been investigating the potential for a renewable energy development at Hollandmey since 2014. In that time, the area available for development has expanded from the land at Hollandmey, covering an area of 912 ha, to a wider area including land to the immediate south east of the original boundary and a section of the local road network to the north west of the original Site, resulting in total area of 1195 ha, as shown in **Figure 2.2**.

79. Within that context, the proposed Development has undergone four principal iterations of the layout (the initial layout and three subsequent iterations), which have been developed at different stages in the project design process. Layouts A to D, shown on **Figure 2.2**, outline the four layouts and visually illustrates how the design and application boundary have evolved through the design stages of the EIA process.

80. The layout of wind turbines at the site has evolved through a process of iterative design. It has considered the potential impacts on landscape and visual receptors in the surrounding area in addition to key constraints such as peat, noise and ecology. Overall generation capacity, wind resource and operational requirements of the proposed Development have also been a consideration in design. Working within these constraints the project has sought to design a layout that avoids or reduces impacts on key receptors balanced with the need to avoid increasing significant impacts on other receptors or generating significant impacts where previously there were none.

Table 2.3: Summary of iterations of design

Layout	Description	Design Rationale
A	Initial Layout – First Design Workshop (11 turbines)	RSK conducted a preliminary design study that focussed on potential noise limit constraints associated with nearby residential properties and potential visual impacts. The design study considered THC 'Onshore Wind Energy Supplementary Guidance (2016) and Part 2b (2017)', the decision notice from the refusal of the Lyth Windfarm appeal (November 2013) and the THC pre-application advice for Hollandmey (March 2019). This led to the establishment of the following key design principles: • sculptural, linear design; • permeable and rhythmic layout; • avoid northern part of Site because of Site constraints including watercourses and an area with Special Protection Area connectivity; • allow forestry to be retained assisting in low level screening from north; • achieve separation between the windfarm and smaller scale seaboard landscapes; • achieve visual association with Lochend and Stroupster Windfarms; • minimise increase in turbine envelope when viewed from Dunnet Head SLA viewpoint; and • compact layout in distant views. Early on in the design process, turbines at the greater height of 179 m were considered in detail with comparative visual appraisals made to determine what was considered to be the best balance, taking into account other environmental, technical and commercial constraints. It was decided, as a result of this exercise, that 149.9 m tip height would be the preferred option. The preliminary study yielded a 11 turbine layout. A co-located feasibility study identified potential locations for a solar array and BESS. Following the establishment of the preliminary layout, an internal design workshop was held whereby the layout was scrutinised considering site-specific field data and desk-based environmental studies relating to peat, ecology, ornithology, archaeology and forestry. The evolving design was then subject to an appraisal of potential visual effects and a number of variants of the design considered. Each variant was reviewed against the design principles using wirelines from key viewpoints to further refine the layout. The outcome of the design workshop was an 11 turbine layout (Layout A). This layout formed the basis of direct EIA scoping.
B	Design Iteration 1 – Public Information Event 1 (10 turbines)	Following the first design workshop a landscape appraisal was completed, which included a site visit by the landscape specialist. The findings of the landscape appraisal were considered in combination with further noise assessment to create a preferred ten turbine layout of up to 149.9 m tip height. The decision to remove a single turbine compared to Layout A, was to facilitate a reduction in potential impacts on deep deposits of peat, and to allow re-alignment of the remaining turbines to further reduce such impacts whilst also maintaining the design principles as outlined above. The removal of this turbine also provided additional flexibility to minimise impacts with respect to noise. The preferred layout was then approved by the Applicant's wind yield team. An environmental appraisal of potential solar locations was conducted and a preferred option area for a solar array and solar compound, and battery storage compound and substation were identified in the north of the Site. This area was chosen because it: • is located on flat terrain; • is a location that avoids and/or minimises potential impacts on known environmental resource; • lies in close proximity to the Site entrance and turbine related access track infrastructure. In formulating Layout B, as the turbine locations were becoming more 'definitive' in light of emerging constraints. Layout B was used for the first public information event (PIE).
C	Design Iteration 2 – Public Information Event 2 (10 turbines)	Following the establishment of Layout C, with all key constraints identified and turbine locations largely fixed as a result of both these and consultation responses, two key exercises were completed as follows: • Appraisal of solar array, battery storage compound and substation area (and land-take) to select preferred locations; and • Design of ancillary infrastructure including access tracks, crane hardstandings, construction compounds, substation and borrow pits.

Layout	Description	Design Rationale
		With respect to the solar infrastructure, BESS and substation the locations identified on **Figure 2.4c** were selected for potential development. The locations were chosen because they: • allows for avoidance of deep peat deposits and need for forestry plantation removal; • is afforded significant screening by onsite vegetation/forestry plantation; • would be affected by minimal shadowing from both vegetation and proposed turbines; and With respect to ancillary infrastructure, a key focus was the access track design/layout, as well as the number and positioning of borrow pits, construction compounds, and substation. Prior to, and as part of, a second design workshop these elements were designed in accordance with the following design principles: • utilising existing forestry access tracks as far as practicable; • utilising forestry 'breaks' and 'rides' as far as practicable for access tracks; • minimisation of forestry plantation removal; • restricting any effects on plantation to their leeward side as far as practicable to minimise potential for windblow; • minimisation and/or avoidance of deep deposits of peat; • where deep peat cannot be avoided by access tracks, adoption of 'floating road' design; • minimisation of water crossings; • avoidance or minimisation of impacts on environmental resources; • location of borrow pits where rock resource is most evident at surface and/or making use of existing ones; • reduce potential 'trafficking' across Site with placement of borrow bits and construction compounds; and • select optimal location for substation taking account of turbine and solar array infrastructure. A second design workshop was held in order to verify the turbine layout, location and land-take of the solar array infrastructure, and also the ancillary infrastructure supporting both BESS and solar array technologies. The resultant design was then subject to a targeted peat depth investigation, along with a joint site visit to all locations by a project engineer and principal hydrogeologist to take account of local ground conditions, peat depth, topography and the presence of bedrock at or near the surface. Consultations with Scottish Environmental Protection Agency (SEPA) resulted in further alterations to access track design in order to minimise the number of watercourse crossings required and to further minimise impacts on peat. This design is seen as Layout C in **Figure 2.4c**, which was used for the second PIE.
D	Design Iteration 3 – Final Site Layout (10 turbines)	The telecommunications impact assessment (TIA) and scoping consultation with Telefonica had indicated that Turbine 8 (T8) had the potential to impact a microwave link crossing the Site. The TIA had identified mitigation measures which were discussed during further consultation with Telefonica. Feasibility studies including a Line of Sight Assessment and consultation with BT regarding installation of fibre optic cables were undertaken to explore whether the link could be rerouted. The findings of the feasibility studies showed that there was not a technical or commercially viable form of secondary mitigation, so it was decided to mitigate by design. An environmental appraisal was conducted to find an alternative location for T8 and subsequently T8 was moved c.50 m south. Telefonica have confirmed that this location is acceptable. The application boundary was also refined at this stage following provision of information not previously available and also to include some of the local road network where works may be required. Minor amendments were made to the location of the proposed temporary solar construction compound and the proposed substation and BESS were subsumed into a control compound with an increased footprint to include a control building and associated parking bays. This design is seen as Layout D in **Figure 2.4d**, which constitutes the final 'Design Freeze' or application layout that forms the basis of this application for consent. Individual assessment chapters will report their design input in further detail and respond to specific matters, in particular pertaining to the scale of the proposed turbines, the landscape fit of the layout and Criterion 4 to 10 of Highland Council's Onshore Wind Energy Supplementary Guidance.

2.7 Micrositing

111. In order to be able to address any localised environmental sensitivities, unexpected ground conditions or technical issues that are found during detailed intrusive Site investigations and construction, it is proposed that agreement is sought for a 50 m micrositing allowance around all infrastructure. The technical assessments (presented in **Chapters 7** to **15**) have considered the potential for micrositing. It is considered that the proposed infrastructure could be microsited within 50 m without resulting in any potential new effects. During construction, the need for any micrositing would be assessed and agreed with the onsite Environmental Clerk of Works (ECoW).

2.8 Conclusion

112. The design process has been an iterative one, which has taken into account the identification of all technical and environmental constraints determined through the Environmental Impact Assessment (EIA) process, through consultation with statutory and non-statutory organisations and members of the local community.

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

- maximises the renewable energy potential through the development of different co-located renewable technologies;
- 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 windfarm development is present and with which it integrates reasonably well;
- minimises impacts on key views to and from Dunnet Head;
- minimises impacts on settlements and residents of scattered dwellings;
- is in accordance with the Highland-wide Local Development Plan (HwLDP) 2012; Caithness and Sutherland Local Development Plan (2018) (CaSPlan), and relevant supplementary guidance, particularly the OWESG (2016) and 'Part 2b' of the Supplementary Guidance (2017).
- reduces the amount of felling and can be accommodated within the Forest Design Plan for the area;

- minimises and, where possible, avoids the loss of priority habitats and species, and creates opportunity for habitat enhancement, which would be delivered by a Habitat Management Plan;
- protects watercourses from the potential impacts of constructing the proposed Development;
- can be engineered and constructed safely;
- the road layout 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 sites through applying a buffer;
- minimise impacts on cultural heritage; and
- minimises disturbance to and removal of carbon stores, such as trees and peat, to improve the carbon balance.

114. The final layout of the proposed Development is described in detail in **Chapter 3** and shown on **Figure 3.1**. The potential effects of the resulting layout are addressed throughout **Chapters 7** to **15** of the EIA Report.

2.9 References

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