3 SITE SELECTION & DESIGN

3.1 INTRODUCTION

This Chapter of the Environmental Impact Assessment Report (EIA Report) contains a description of the land within the site boundary (the Site), the consideration of alternatives and site selection process, and the design process and evolution that led to the final design of the proposed Ackron Wind Farm (the Development).

The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017[1] (the EIA Regulations) state in Schedule 4, Paragraph 2 that an EIA Report must include:

> *"A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."*

This Chapter of the EIA Report details why the Site, as shown on Figure 1.1, has been selected and summarises the layout options that were considered by Ackron Wind Farm Ltd (the Applicant) during the evolution of the Development.

This Chapter of the EIA Report is supported by the following figures provided in Volume 2a Figures excluding Landscape and Visual:

- Figure 3.1a to f: Design Evolution;
- Figure 3.2a: VP3 A836 Reay with Original Scoping Layout;
- Figure 3.2b: VP3 A836 Reay with Final Layout;
- Figure 3.3a: VP5 A836 Melvich with Original Scoping;
- Figure 3.3b: VP5 A836 Melvich with Final Layout;
- Figure 3.4a: VP6 Portskerra with Original Scoping;
- Figure 3.4b: VP6 Portskerra with Final Layout;
- Figure 3.5a: VP8 Strath Halladale with Original Scoping; and
- Figure 3.5b: VP8 Strath Halladale with Final Layout.

3.2 SITE SELECTION

The selection of an appropriate site which has the potential to support a commercial wind farm development is a complex and lengthy process. It involves examining and balancing a number of environmental, technical, planning and economic issues. Only when it has been determined that a site is not subject to major known environmental, technical, planning or economic constraints, is the decision made to invest further resources in developing the proposal and conducting an EIA.

In accordance with the EIA Regulations, the design alternatives need to be studied with key reasoning, taking into account the potential environmental effects. The Site was first identified for wind farm development by Airvolution, who undertook a comprehensive site selection exercise to identify potential wind farm locations throughout Scotland. Airvolution identified multiple sites during a site search exercise throughout Scotland. The Site was taken forward as there were previous environment reports covering the Site which indicated:

- A sufficiently high annual mean wind speed across the Site;

[1] Scottish Government (2017) the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 [Online] Available at: http://www.legislation.gov.uk/ssi/2017/102/contents/made (Accessed 06/08/2020)

- Viable grid connection in close proximity to the Site;
- Suitable and proven port of delivery and road access for delivery of large components;
- Limited populated areas and transport routes within the zone of theoretical visibility;
- The Site is sufficiently distant from the nearest residential properties to ensure compliance with appropriate noise limits, as well as to reduce adverse residential visual amenity and shadow flicker effects;
- The Site itself supports no international or national ecological, landscape or cultural heritage designations; and
- Small portions of the Site characterised as within a Group 3 area in Scottish Planning Policy (2014)[2] with the majority in Group 2 due to peatlands though initial peat and ecology surveys indicated peat was not extensive across the Site.

3.3 SITE DESCRIPTION

The land within the Site which contains the turbines and associated infrastructure covers an area of approximately 662 hectares (ha), centred on National Grid Reference (NGR) 291200, 962500, approximately 18 kilometres (km) west of Thurso and approximately 2 km south-east of Melvich in Sutherland as shown on Figure 1.1, and wholly located within the administrative boundary of Highland Council (the Council).

The Site predominately comprises of open moorland used for rough grazing. There is a small area of improved pasture in the north-west and a woodland grant scheme (WGS3[3]), comprising 13 ha along the lower elevations in the west of the Site which extends outwith the Site Boundary on its north-east edge between the Site and the A897. RDC-Woodland planted in 2013 covers portions of the Site; however, this appears only marginally successful, with further details in **Chapter 7: Ecology**.

There is an existing farm tracks within the Site connecting to the A897. Located along the existing track to the west of the Site is a small quarry.

The topography of the Site and its immediate vicinity generally slopes westward, as shown in Figure 1.2. The elevation of the Site ranges from approximately 163 metres (m) Above Ordnance Datum (AOD) in the north-east of the site near Caol Loch and falls to 30 m AOD along the A897. There are two named knolls: Golval Hill (127 m AOD) and Cnoc an Achadh (123 m AOD).

The Site lies within the Halladale River catchment with Giligill Burn, Akran Burn and an unnamed watercourse flowing from south-east to north-west through the Site. Caol Loch, Loch Akran and Loch Earacha lie outwith the Site, located to the east, south-east, and south-west respectively.

No public roads are located within the Site. The A836 (part of the promoted North Coast 500 [NC500]) lies adjacent to the northern boundary of the Site with the A897 forming the western boundary. An overhead transmission line transects the south-east corner of the Site connecting Connagill Substation in the south-west to Dounreay in the north-east.

There are no residential properties within the Site. The closest residential properties are Ackron Farm and Golval (both financially involved), located 0.9 km west and 1 km south-west of the nearest turbine, respectively.

[2] Scottish Government (2014) Scottish Planning Policy [Online] Available at: https://www.gov.scot/publications/scottish-planning-policy/ (Accessed 07/08/2020)
[3] Scottish Government (2020) Woodland Grant Scheme 3 [Online] Available at: https://data.gov.uk/dataset/1a0f08ac-e8ba-4de5-b934-cc27e6eed0c7/woodland-grant-scheme-3#:~:text=The%20Woodland%20Grant%20Scheme%20(WGS,looking%20after%20woodlands%20and%20forests.&text=It%20was%20then%20replaced%20by,Forestry%20Grant%20Scheme%20(SFGS). (Accessed 07/08/2020)

There are no designations within the Site; however, two Natura 2000 Sites are located adjacent to the east of the Site; the Caithness and Sutherland Peatlands Special Protection Area (SPA)[4] and Special Area of Conservation (SAC)[5]. The Site is also adjacent to the Caithness and Sutherland Peatlands Ramsar Site, and the East Halladale Site of Special Scientific Interest (SSSI)[6].

These designations are recognised for a variety of habitats features, including blanket bog and wet heathland habitat with wet mire, acid peat-stained lakes and ponds, clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels, and depressions on peat substrate. There are a number of qualifying species including otter, dunlin, black-throated diver, common scoter, grey lag goose, and golden plover.

3.4 SITE POLICY CONTEXT

Scottish Planning Policy (SPP) (June 2014) provides support for wind development in principle and encourages local authorities to guide developments towards appropriate locations. Paragraph 161 highlights the requirement for planning authorities to define a *'spatial framework identifying those areas that are likely to be most appropriate for onshore wind farms'* whilst stating that spatial frameworks must be based on the following criteria (set out in SPP Table 1, Page 39):

- **Group 1: Areas where wind farms will not be acceptable**
  - National Parks and National Scenic Areas.
- **Group 2: Areas of significant protection:**
  - Recognising the need for significant protection, in these areas wind farms may be appropriate in some circumstances. Further consideration will be required to demonstrate that any significant effects on the qualities of these areas can be substantially overcome by siting, design or other mitigation.
  - Group 2 areas include World Heritage Sites; Natura 2000 and Ramsar sites; Sites of Special Scientific Interest; National Nature Reserves; Sites identified in the Inventory of Gardens and Designed Landscapes; Sites identified in the Inventory of Historic Battlefields; areas of wild land as shown on the 2014 NatureScot[7] map of wild land areas; carbon rich soils, deep peat and priority peatland habitat; and an area not exceeding 2km around cities, towns and villages identified on the local development plan.
- **Group 3: Areas with potential for wind farm development:**
  - Beyond groups 1 and 2, wind farms are likely to be acceptable, subject to detailed consideration against identified policy criteria.

The Site does not lie within a 'Group 1' area and is not covered by any national or international designation in respect of ecology, ornithology or cultural heritage, and lies outside of any Wild Land Area, defined within Group 2 as a *'nationally important mapped environmental interest'*,

However, a proportion of the Site occupies areas identified as Carbon Rich Soil, Deep Peat and Priority Peatland Habitat (CPP) by the NatureScot Carbon and Peatland Map (2016) which is a high level evaluation for spatial frameworks. On this basis SPP and The

[4] SNH (n.d.) Caithness and Sutherland Peatlands SPA [Online] Available at: https://sitelink.nature.scot/site/8476 07/08/2020
[5] SNH (n.d.) Caithness and Sutherland Peatlands SAC [Online] Available at: https://sitelink.nature.scot/site/8218 (Accessed 07/08/2020)
[6] SNH (n.d.) East Halladale SSSI [Online] Available at: https://sitelink.nature.scot/site/585 (Accessed 07/08/2020)
[7] Scottish Natural Heritage (SNH) rebranded in August 2020 as NatureScot. Where relevant reference is still made to SNH within this chapter in respect of guidance which remains valid and is yet to be republished etc.

Highland Council Onshore Wind Energy Supplementary Guidance (2016, and addendum 2017)[8] defines the Site as largely consisting of Group 2: Areas of Significant Protection[9] due to these nationally mapped indications of where carbon rich soil, deep peat, and priority peatland habitat may be found.

In 2017 the Scottish Government published the Onshore Wind Policy Statement (OWPS) (2017)[10] and Scottish Energy Strategy (SES) (2017)[11] which recognise that increased efficiency and power output in wind turbine technology, has resulted in increases in the size and scale of wind turbines (e.g. increased turbine blade length and resultant increases in overall tip heights). For example, paragraph 23 of the OWPS states that *'we acknowledge that onshore wind technology and equipment manufacturers in the market are moving towards larger and more powerful (i.e. higher capacity) turbines, and that these – by necessity – will mean taller towers and blade tip heights'.*

Whilst the ministerial foreword of the OWPS (page 3) and the SES (page 43) also state that *'increasingly – the extension and replacement of existing sites, where acceptable, with new and larger turbines, based on an appropriate, case by case assessment of their effects and impacts'* as onshore wind continues to play an important role in meeting Scotland's energy generation and climate change goals.

The Highland Council Onshore Wind Energy Supplementary Guidance (2016, and addendum 2017) includes a potential strategic capacity for wind energy development of different scales within each of the defined landscape character areas. The majority of the Site, including the extent of which is occupied by the proposed turbines, is located within Sweeping Moorland and Flows (LCT 134) landscape character area in Central Caithness (CT4). The landscape character sensitivity of CT4 to large scale wind farm development is identified as being '3' out of a scale of 1-4, 1 being the most susceptible to change[12], with some limited scope for larger turbines.

The Supplementary Guidance indicates that there remains some capacity for larger turbines, noting that: *'Turbines should concentrate and consolidate with existing development; maintain open, clear and direct views, which allow the appreciation of the wild landscape, in particular from the A9; and be designed so that the logical relationship between development scale and landscape character is maintained.'*

3.5 SITE DESIGN CONSIDERATIONS

The design of a wind energy development is driven by the key objective of positioning turbines so that they capture the maximum energy possible within a suitable area determined by environmental and technical constraints.

The key constraints to onshore wind farm site design which need to be taken into account during the design process include:

- Visibility from sensitive receptors, including nearby properties and landscape designations;
- Presence of sensitive habitats and protected species;

[8] The Highland Council (2016, and addendum 2017) Onshore Wind Energy Supplementary Guidance. [Online] Available at: http://www.highland.gov.uk/download/downloads/id/16949/onshore_wind_energy_supplementary_guidance-_currently_adopted_suite.pdf (Accessed 10/09/2020)
[9] The Highland Council (2016) Spatial Framework for Onshore Wind Energy - Inner Moray Firth LDP Area Map. [Online] http://www.highland.gov.uk/download/downloads/id/22788/framework_map_-_inner_moray_firth.pdf (Accessed 11/09/2020)
[10] Scottish Government (2017) Onshore Wind Policy Statement. [Online] https://www.gov.scot/publications/onshore-wind-policy-statement-9781788515283/ (Accessed 11/09/2020)
[11] Scottish Government (2017) Scottish Energy Strategy. [Online] https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/ (Accessed 11/09/2020)
[12] Ibid, page 100.

- Presence of sensitive ornithological species;
- Presence of watercourses, private water supplies, and related infrastructure;
- Presence of cultural heritage features;
- Proximity to noise sensitive receptors;
- Presence of peat;
- Ground conditions and topography; and
- Key recreational and tourist routes.

The studies undertaken for the Development indicate that the key site constraints are:

- Visibility to key visual receptors including nearby properties and settlements as well as statutory and non-statutory landscape and visual designations;
- Areas of steep slope unsuitable for construction;
- Proximity to recorded sensitive ornithological receptors;
- Watercourses, waterbodies, and drains;
- Consideration of wind conditions across the Site;
- Pockets of deep peat and other sensitive habitats; and
- Noise at nearby properties.

These constraints were identified through desk study, site survey, and analysis including consideration of the responses received from consultees during the EIA process, predominantly at Scoping.

The principles of the design were to maximise the number of turbines and wind energy capture, whilst minimising significant adverse environmental effects. Therefore, some of these constraints were given a 'hard' constraint value in design that was not breached and others were assigned a 'soft' constraint value that could be impinged with sufficient justification that effects were still acceptable. This led to a comprehensive process of constraints mapping. This EIA Report and its conclusions constitute the outcome of the application of the design principles adopted for the Development.

Embedded mitigation was used to minimise any predicted environmental effects, and where applicable to a specific technical assessment, such mitigation is detailed in the relevant technical chapter within this EIA Report. This was particularly relevant to the avoidance of direct effects, e.g. on known protected species. By employing an iterative design process, undertaken in conjunction with the EIA process, a number of potential effects were minimised. Mitigation through design was employed to ensure effects such as landscape and visual and indirect heritage effects were minimised.

3.5.1 Site Specific Environmental Constraints

The specific environmental factors considered in the design of the Development are set out in the following sections, with their influence on the design discussed.

3.5.1.1 Landscape and Visual

NatureScot guidance Siting and Designing Wind Farms in the Landscape - Version 3a (2017)[13] notes that *'Design is a material consideration in the planning process and good siting and design helps to produce development which is appropriate for a landscape whilst delivering renewable energy'.*

In accordance with this guidance, the landscape and visual impact of the Development has been a key consideration throughout the design process. Landscape architects worked closely with the project team to achieve a scale and a design that minimises the potential landscape and visual effects, and utilises maximum wind resource at higher elevations while still maintaining economic viability. The landscape and visual effects

[13] Siting and Designing Wind Farms in the Landscape - Version 3a https://www.nature.scot/siting-and-designing-wind-farms-landscape-version-3a (accessed 07/08/2020)

have been a focus of discussions with the Council and NatureScot[14] following the scoping process. Three design workshops were undertaken which sought to create a balanced layout without excessive overlapping or outlier turbines, and to reduce landscape and visual effects as far as possible.

Landscape character is defined as a distinct, recognisable, and consistent pattern of elements in the landscape that makes one tract of land different from another. Landscape Character Types (LCT) refer to distinct tracts of land that are relatively homogenous in character. They are generic in nature and can occur more than once in different parts of the country. Landscape character areas are particular geographical examples of a landscape type[15].

The LCTs of the Study Area are identified in the Scottish Landscape Character data as shown on Figure 6.6. In the interests of proportionality and best practice, the focus of the character assessment is on those LCTs lying within 15 km of the Site, as agreed at scoping. This is because, taking into account both the Development and its landscape context, it is judged that significant effects on landscape character are unlikely to extend beyond approximately 10 km from the Site. This judgement is in keeping with assessment findings and planning decisions relating to similar types and scales of wind energy development in Highland, for example Lairg 2 Wind Farm[16].

The LCTs listed below are included in the detailed assessment of landscape effects:

- Sweeping Moorland and Flows in which the Site is located;
- Rocky Hills and Moorland;
- Sandy Beaches and Dunes;
- High Cliffs and Sheltered Bays;
- Strath – Caithness and Sutherland;
- Farmed Lowland Plain; and
- Coastal Crofts and Small Farms.

The landscape around the Study Area is one of open moorland and agricultural land, with occasional subtle ridges and low hills to the coast which has rocky shores or cliffs. Views are therefore, generally panoramic and long ranging, although coniferous plantations and subtle ridges and valleys can contain views. Along the coast, for example from along the A836, views are more varied, but dominated by views out to sea or along the coast.

The design has sought to increase the separation of the Development from the coastal landscapes and NC500 with the closest turbine located approximately 2.4 km from the coast and 1 km from the NC500. Two access options from the A836 (NC500) and A897 were examined, with the A897 option selected as it did not require an access junction off the NC500 and minimised visibility of the access track through open moorland from the NC500. Additionally, the design has sought to create a balanced, cohesive layout from nearby communities of Melvich and Portskerra to the north-west and Reay to the north-east as well as in views from the south along Strath Halladale and from within the East Halladale Flows WLA.

A number of viewpoints have been used to inform the layouts during the iterative design process. These viewpoints are listed below and accompanying wirelines have been prepared to illustrate how the design evolved by comparing the original scoping layout to the final layout:

[14] Scottish Natural Heritage (SNH) rebranded in August 2020 as NatureScot. Where relevant reference is still made to SNH within this chapter in respect of guidance which remains valid and is yet to be republished etc.
[15] The Countryside Agency and SNH (2002) Landscape Character Assessment – Guidance for England and Scotland [Online] Available at: https://www.nature.scot/sites/default/files/2018-02/Publication%202002%20-%20Landscape%20Character%20Assessment%20guidance%20for%20England%20and%20Scotland.pdf (Accessed 07/08/2020)
[16] Lairg 2 Wind Farm, Highland Council planning reference 19/01096/FUL.

- Viewpoint 3: Reay (Figure 3.2a-b);
- Viewpoint 5: A836 Melvich (Figure 3.3a-b);
- Viewpoint 6: Portskerra (Figure 3.4a-b); and
- Viewpoint 8: Strath Halladale (Figure 3.5a-b).

The landscape and visual effects are fully assessed within **Chapter 6: Landscape and Visual**.

3.5.1.2 Ecology

Both desk-based research and site based surveys were undertaken as part of the ecology baseline studies which were key to informing the final design of the Development. Desk-based research determined the nearby ecological designations and identified historical information relating to the ecological resources within the study area and Site. Site based surveys were completed in 2019 and included the following:

- Extended Phase 1 habitat survey in June and September 2019;
- National Vegetation Classification (NVC) survey in June and September 2019;
- Otter survey between May and September 2019;
- Bat habitat suitability survey between April and October 2019;
- Bat activity survey between April and October 2019;
- Wildcat survey in January 2019;
- Pine Martin survey between May and September 2019;
- Water vole survey between May and September 2019;
- Fisheries habitat survey in September 2019;
- Red squirrel survey between May and September 2019; and
- Badger survey between May and September 2019.

The purpose of these surveys was to identify sensitive habitats and species within the Site that should be avoided and subsequently ensure the Development could be designed sensitively to the ecological receptors located within and nearby the Site.

Peatland habitat was the most widely recorded habitat type, and the most abundant peatland habitat recorded was blanket bog. Other peatland habitats included, wet heath, wet heath mosaics, wet modified bog mosaic, and wet modified bog and their mosaics. Water draining across the peatland areas meant that small patches of acid/neutral flush were frequently recorded, and areas of flush and spring habitat were also recorded.

Small areas of marshy grassland habitat were recorded in areas associated with surface water, and the steepest slopes and mounds or ridges were associated with patches of dry heath across. On the lower ground, habitats were dominated by acid grassland and bracken, with small areas of neutral grassland also recorded.

Some small areas of woodland were recorded and included planted conifer plantation, scrub and broadleaved woodland, and scattered scrub and trees recorded amongst the other habitats. Areas of hard surfacing associated with tracks and a quarry were also recorded in the western half of the Site.

Five potential Groundwater Dependent Terrestrial Ecosystems (GWDTEs) and associated NVC communities were recorded: MG10, M25, M15, M6, and M32.

The final layout was informed by the aforementioned surveys, which ensured that the Development avoided the most sensitive habitats, including areas of deep peat and highly sensitive Groundwater Dependent Terrestrial Ecosystems, as shown in Figure 7.3.

The effects on ecological receptors are fully assessed within **Chapter 7: Ecology**.

3.5.1.3 Ornithology Receptors

Surveys were completed over two periods:

- **2014-16**: initial Baseline Ornithology Surveys were completed by RPS between April 2014 and March 2016 (inclusive); and
- **2018 breeding season**: update Baseline Ornithology Surveys were completed by Avian Ecology between February 2017 and August 2018 (inclusive), thus covering early spring as well as the full breeding season (April to August).

The survey programme included the following:

- Year-round Flight Activity Surveys;
- Winter bird surveys (2014-16); and
- A range of breeding bird surveys (2014, 2015 & 2018).

In addition to the field surveys, desk-based studies and consultations were undertaken which also informed the assessments.

The results of the ornithology assessments fed into the site design process with the removal of turbines to the north of Giligill Burn and south of Akran Burn to avoid disturbance of known sensitive ornithology receptors either during construction or operation.

The effects on ornithological receptors are fully assessed within **Chapter 8: Ornithology**.

3.5.1.4 Water Environment

The Site in its entirety lies within the Halladale River catchment. Akran Burn runs from Loch Akran to the south-east to the north-west across the centre of the Site, Giligill Burn runs from just north of Caol Loch south-east to north-west in the northern part of the Site, and an unnamed watercourse flowing from south-east to north-west towards Golval Farm. Loch Akran and Loch Earacha lie outwith the Site at its south-east and south-west corners corner, respectively.

During the EIA process, desktop and site-based surveys were carried out to inspect and identify all water features including private water supplies within the area with potential to be impacted by the Development.

The aim of the design process was to achieve a layout that avoids effects on sensitive hydrological receptors including private and public water supplies.

The majority of turbines have been sited a minimum of 50 m from the banks of watercourses or water bodies, with the exception of T7 where the crane hardstanding infrastructure extends 8.2 m into the Akran Burn watercourse buffer and maintaining a distance of 41.8 m from the watercourse itself. This is to avoid placing T7 infrastructure within an area of deep peat (> 2 m depth).

The location of private water supplies and source water has influenced the location of the substation and access track arrangement; however, effects upon one of the financially involved property's private water supply is anticipated. Following implementation of mitigation measures and agreed provision of an alternative temporary or permanent alternative supply, that is comparable or better in quality and quantity to the current supply, the magnitude of effects on the private water supply is not significant. Consultation with residents of properties supplied by private water supplies has fed into the site design process and an agreement regarding alternative temporary or permanent water supplies agreed.

The effects on the hydrology environment are fully assessed within **Chapter 12: Hydrology and Hydrogeology.**

3.5.1.5 Archaeological Features

There are no designated heritage features within the Site; however, there are 22 non-designated features which have been established through a desk-based assessment and site walkover. These are largely concentrated at lower elevations along the waterways, and the design has avoided crossing both Akran and Giligill Burns where the majority of known archaeological features are located. The design has avoided all known archaeological features within the Site, as well as taken consideration of the archaeological potential which is greatest at lower elevations along the waterways, avoiding the key burns of Akran and Giligill.

The proposed layout has taken into account the consultation responses received from Historic Environmental Scotland (HES) and the Council and has sought to reduce changes to the setting of nearby heritage assets through embedded design. This includes locating the access track away from A837 to the north of the Scheduled Halladale Bridge Hut Circles (SM3304) to maintain the setting of the designation. The access will be taken from the A897 further to the south of the monument where existing screening would be maintained to create a visual barrier between the access junction/track and the monument.

Additionally, turbines have not been placed in the northern section of the Site to increase the separation distances from the scheduled Halladale Bridge Hut Circles (SM3304) and listed buildings along the coastal route such as those at Bighouse, Sandside and Reay.

The effects on cultural heritage assets is fully assessed within **Chapter 9: Archaeology and Cultural Heritage**.

3.5.1.6 Noise Sensitive Receptors

A key consideration in the design of the Development was the proximity of the turbines to nearby residential properties, and the noise levels that the Development may generate both in isolation and with known cumulative developments. The turbines were sited in locations that would ensure the Development would not generate noise emissions that would exceed limits advised in national guidance as appropriate, being the limits advised in ETSU-R-97.

The effects on the noise environment are fully assessed within **Chapter 10: Noise**.

3.5.1.7 Peat

British Geological Survey (BGS) survey high level mapping indicates superficial soils underlying the site are dominated by Glacial deposits, comprising of sand, gravel and boulders. Bedrock geology mapping indicated that the site was underlain by Migmatitic Psammite with Migmatitic Semipelite of Portskerra Psammite formation.

A peat depth survey was undertaken across the Site to establish a more localised and site-specific baseline for the Development. Peat was found to be deepest in the flatter, topographically low-lying areas of the Site where depths extended to 3.5 m and 4.1 m in the north-west and south-east respectively, while much of the remainder of the Site had recorded peat depths of between 0.1 m and 1.0 m. Turbines were sited in the shallowest areas of peat where possible with eight turbines located in peat ranging between 0 and 0.5 m, and four turbines in peat ranging between 0.5m and 1.0m.

The effects of the Development on peat deposits are fully assessed within **Chapter 13: Geology and Peat.**

3.5.2 Turbine Constraints

Specific technical factors considered in the design of the Development are set out in the following subsections, with their influence on the design discussed.

3.5.2.1 Wind Resource

A key element to the design process is the wind resource of the Site; the availability of wind resource is affected by various issues such as wind speed, the prevailing wind direction, and local topography. The wind resource has been recorded via a temporary mast and subsequently modelled across the Site which fed into the design process. In summary, the wind resource is deemed suitable for a commercial wind farm, with the more elevated areas of Site receiving the greatest wind resource, which required balancing against the increased landscape and visual effects at higher elevations as discussed in Section 3.5.1.1.

3.5.2.2 Turbine Spacing

The spacing of the turbines is a key consideration in wind farm layout design; turbines need to be arranged a minimum distance apart such that turbulence from a specific turbine does not unduly affect the operation of a turbine which is downwind. The spacing for turbines needs to be larger in the prevailing wind direction and will vary from site to site and between different turbine models. The spacing is directly proportional to the size of the wind turbine rotor, whereby the larger the rotor the larger the spacing between turbines, and the fewer turbines that may be accommodated within a specific area.

The spacing chosen for the Development has been selected based on modelling assumptions and is designed to maximise the energy yield from the Development whilst keeping fatigue loads, caused by turbulence, within the turbine manufacturer's design tolerances.

3.5.2.3 Topography and Ground Conditions

The suitability of ground conditions was considered during the design of the Development, which principally considered areas of steep slope and peat.

Where gradients of greater than 14% were identified, these areas were not considered suitable for wind turbines. The presence of steep slopes also presented a key element to the design of the site infrastructure including access tracks and hardstanding areas, particularly the banked slopes of watercourse, namely Akran Burn and Giligill.

As noted in Section 3.5.1.7, the presence of peat has been assessed and avoided where possible both from an environmental and technical perspective.

3.6 TURBINE LAYOUT DESIGN ITERATIONS

The final layout as presented in the EIA Report has been the subject of a number of iterations and refinements which mitigate by design predicted adverse effects as far as reasonably practicable. The resultant proposal balances the environmental and technical constraints, whilst producing an economically viable project. Design changes made as a consequence of the key constraints are considered to be mitigation which is 'embedded' in the design.

The key iterations are described below, and are shown in Figure 3.1a-f; which demonstrates how the layouts have evolved throughout the EIA process.

3.6.1 *Figure 3.1 a - Pre-Application Layout (January 2019): 10-15 Turbines (Tip Height Up to 149.9 m)*

The initial site area for the development covered 413 ha ranging from approximately 186 m AOD in the east of the Site, generally sloping westward to 30 m AOD along the A897.

The initial layout maximised potential turbine numbers reflective of known constraints at the time, which were not necessarily subject to detailed site work. The principal constraints during pre-application included the avoidance of known sensitivities i.e. East Halladale SSSI/Caithness and Sutherland Peatlands SPA/SAC/RAMSAR, 50 m buffers around watercourses, and avoidance of areas of steep terrain whilst ensuring suitable separation distances between the turbines to prevent issues associated with turbulence.

At this time, initial consideration was given to the cumulative visibility of the turbines with the Drum Hollistan scheme, which was awaiting decision following a Public Inquiry[17].

The result of taking these constraints into account was a potential 10 - 15 turbine wind farm with a 10 turbine layout shown in Figure 3.1a.

3.6.2 *Figure 3.1b - Scoping Layout (April 2019): Up to 14 Turbines (Tip Height Up to 149.9 m)*

Between the pre-application and scoping layouts, the biggest layout change was the reduction of the site boundary (by 315 ha) to exclude the Caithness and Sutherland Peatlands SPA/SAC/RAMSAR and East Halladale Flows SSSI to the east.

The original Scoping Layout (shown on Figure 3.1b) consisted of 14 turbines with a tip height of up to 149.9 m. The layout was based on 5 x 3 rotor spacing requirements, a prevailing wind of south-west (approximately 225 degrees), and the turbines positioned to avoid immediately apparent constraints (such as 50 m watercourse buffers) listed in Section 3.5.1.

The Development was scoped under the EIA Regulations on the April 2019 layout (Appendix A5.1) with the layout as shown on Figure 3.1b, and a Scoping Opinion (Appendix A5.2) was received from the Council in June 2019.

3.6.3 *Figure 3.1c - Design Day 1 and Updated Scoping Layout (October 2019): 12 Turbines (Tip Height Up to 149.9 m)*

Following refusal of the Drum Hollistan Wind Farm by Scottish Ministers on 21st June 2019, which lies adjacent to the north of the Site, the Applicant undertook a detailed review of the decision, and in turn carried out an early stage design review of the Development.

The Drum Hollistan decision found that the proposed Drum Hollistan wind farm would have a significant, adverse effect "*by virtue of its prominent, elevated location*". The Drum Hollistan decision also highlighted the impacts upon the coastal landscapes, seascapes and tourism routes as key in the determination of the proposal.

To provide further opportunity for design changes necessary to address effects identified within the Drum Hollistan decision, the site boundary for the Development was extended to the south and west to encompass a total of 662 ha whilst excluding the designations to the east (i.e. Caithness and Sutherland Peatlands SAC/RAMSAR and East Halladale Flows Wild Land Area).

A design workshop was held in October 2019, after most of the EIA baseline survey work had been completed and the environmental constraints digitised and analysed by the

[17] Scottish Government, Planning and Environmental Appeals Department reference: WIN-270-9

technical assessors. The purpose of this workshop was to refine the design to incorporate the findings of the Drum Hollistan design review.

This design workshop included consideration of extended area added to the Site and aimed to move the turbine array further south. This increased separation from the A836, which is a main tourist route and part of the NC500, and the north coast; two receptors highlighted within the Drum Hollistan decision.

Following the above considerations, the Design Day 1 layout comprised of 12 turbines, with an increased setback from 1.7 to 2.4 km from the coast and 300 m to 1 km from the A836 (an increase of 0.7 km). This layout is shown in Figure 3.1c.

Due to the changes in the site boundary, the Development was re-scoped in October 2019 under the EIA Regulations (Appendix A5.3), and an Updated Scoping Opinion (Appendix A5.4) was received from the Council in December 2019.

3.6.4 Figure 3.1d - Design Day 2 (December 2019): 12 Turbines (Tip Height Up to 149.9 m)

A second design workshop was held in December 2019. The key considerations for the design workshop were landscape and visual; focusing upon the aesthetic of the Development from key visual receptors, most notably the settlements of Melvich, Portskerra, and Reay, as well as views from within Strath Halladale and the wild land area.

The turbines were realigned to prevent stacking and create a balanced visual design from the above receptors. The turbine locations selected also considered hard constraints such as hydrological buffers, avoidance of known heritage assets, and peat depths, with the turbines located in areas of < 1.0 m of peat as per the Phase 1 peat survey. These turbine locations were then chilled subject to further detailed peat probing.

Phase 2a peat surveys then took place in December 2019 comprising targeted probing at the chilled turbine locations at 10 m centres as a cross-hair. Following the 2a peat depth survey, turbines were repositioned no more than 40 m from the chilled turbine position to lie on lesser extents of peat whilst avoiding hydrological constraints of 50 m watercourse buffers. This layout is presented as Design Day 2 (December 2019) as shown on Figure 3.1d.

3.6.5 Figure 3.1e - Design Day 3 (March 2020): 12 Turbines Design Chill (Tip Height Up to 149.9 m)

A third design workshop was held in March 2020 to consider moving T8 north of Akran Burn in order to avoid a long 1.5 km access track crossing the burn for one turbine. The key considerations for the design workshop were focused on peat as well as landscape and visual and considering how the Development would be viewed from the same key visual receptors listed in 3.5.1.1.

The main changes from Design Day 2 included relocating T8 to the north and minor adjustments to all other turbines to reflect a more cohesive visibility with consideration for avoiding areas of deep peat and still incorporating the findings and objectives found in the Drum Hollistan review. This layout is shown on Figure 3.1e.

3.6.6 Figure 3.1f - Final Turbine Design Based on Phase 2 Peat

At the end of May 2020, Phase 2b peat surveys were undertaken over the Design Day 3 (DD3) layout. Peat Phase 2b peat surveys focussed on probing the chilled infrastructure layout by probing 50 m internals, plus. This resulted in the refinement of several turbine positions to minimise crane hardstanding in peat. This included:

- Relocation of T2 slightly to the north-east to move the southern area of the crane hardstanding out of deep peat;
- Relocation of T3 slightly to the west so that associated earthworks were further from an area of the deep peat to the east;
- Relocation of T5 slightly to the west to avoid localised pockets of deep peat within the crane hardstanding;
- Relocation of T6 slightly to the west as a deep pocket of peat lies to the south-east in order to minimise peat slide risk;
- Relocation of T7 to the south-west to avoid the deepest areas of peat with part of the hardstanding within the watercourse buffer;
- Amendment to access track and orientation of the crane hardstanding of T8 to limit effects upon a pocket of deep peat to the east;
- Relocation of T10 slightly to the south-east and re-orientation of crane hardstanding as a deep pocket of peat lies to west; and
- Relocation of T12 slightly to the north-east to avoid localised small areas of deeper peat to the west.

This iteration was re-examined by the technical consultants with no further re-positioning required. This layout was then fixed as the final turbine layout comprising of up to 12 turbines with a maximum tip height of 149.9 m. The final turbine layout is shown in Figure 3.1f.

3.6.7 Turbine Evolution Summary

Plate 1 below provides a summary of each layout iteration.

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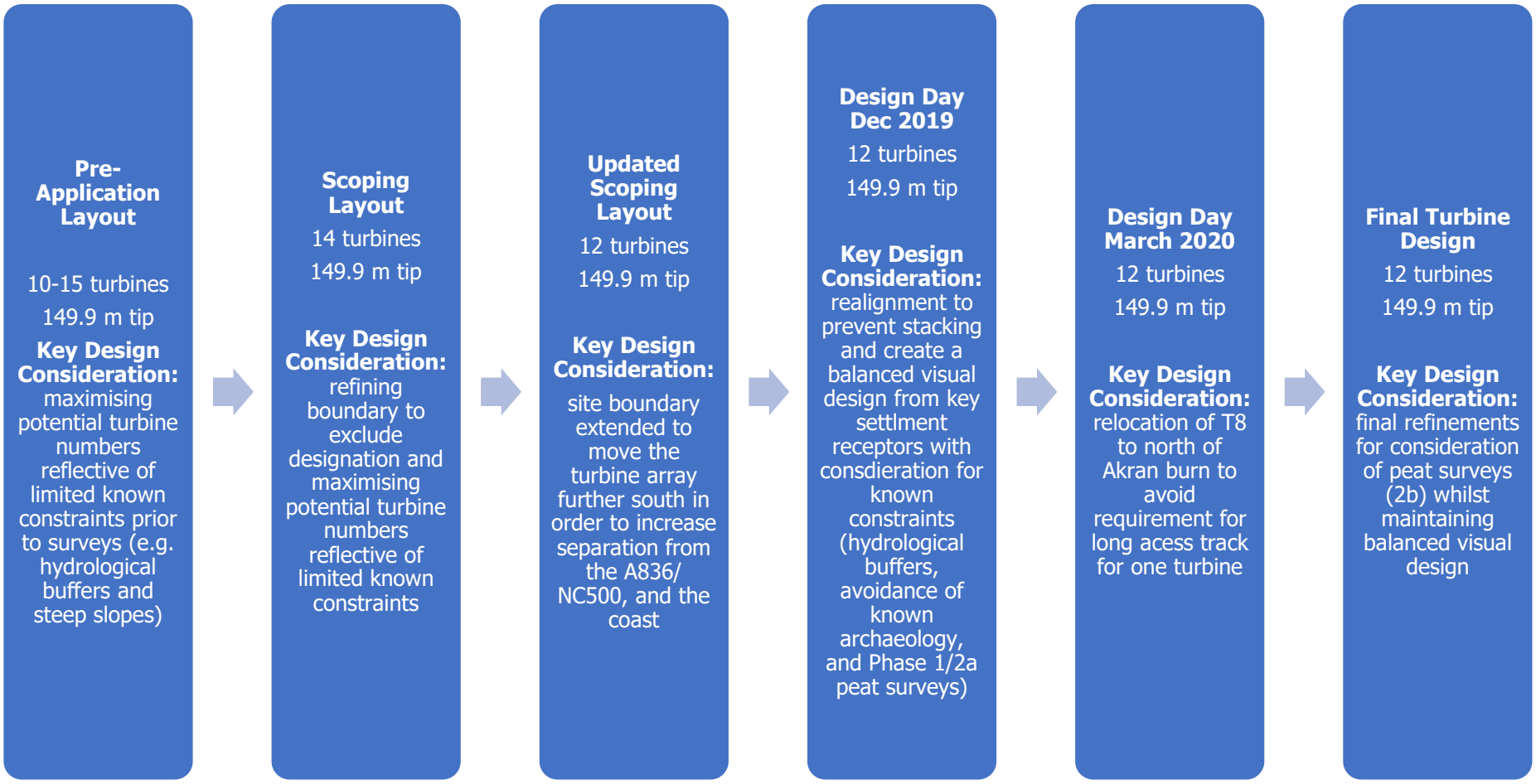

Plate 1: Summary of Key Layout Iteration

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3.7 INFRASTRUCTURE DESIGN

3.7.1 Access Junction Location

Two main access junction options were considered from project inception.

Initial consideration was given to access from the north of the Site where the site boundary borders the A836; however, during turbine iterations, turbines were sited further to the south within the Site to minimise effects upon the coastal landscape and A836 (NC500). In order to further alleviate impacts to these areas and minimise the length of track required on site; a second access option was considered from the west via the A897.

Two access options from the A836 (NC500) and A897 were examined with the A897 option selected as it did not require an access junction off the NC500 and minimised visibility of the access track through open moorland from the NC500.

The proposed access junction for the Development is approximately 200 m from the junction with the A836. The A897 becomes a single-track road with passing places approximately 100 m from its junction with the A836. The second option also allows the main access into the Site to utilise an existing track.

Consultation with the Council's Transport Planning was undertaken during the preparation of the EIA Report to confirm the viability of the second access option. The Council responded that they had no objection in principle to the revised access location proposed, subject to detailed information to demonstrate that the safety and free flow of main road (A897) traffic will not be adversely affected by operation of the new access.

3.7.2 Internal Track Layout

The internal track layout for the final turbine arrangement was developed so that it meets the following criteria:

- Upgrade of existing tracks where possible (with main access into the upper elevations of the Site via an existing track);
- Minimisation of the variation in the vertical alignment of the tracks;
- Minimising the overall length of tracks;
- Ensuring a safe and efficient layout to facilitate wind farm construction;
- Minimisation of incursion into environmental constraint areas (e.g. deep peat, sensitive habitats, watercourse buffers);
- Minimisation of the number of watercourse crossings and alignment of tracks so that crossings are approximately at right angles;
- Minimisation of tracks through areas of peat greater than 0.5 m in depth. Floating tracks used in areas of deep peat (greater than 1.0 m) that cannot be avoided; and
- Consideration of alignment of tracks up the hill slopes when viewed from Melvich.

3.7.3 Construction Compound Location

The location of the main construction compound, adjoining the main access track into the Site, was selected for the following reasons:

- It is beneficial to have the compound adjacent to the site entrance to reduce the length of delivery vehicle trips and manage deliveries;
- Peat is shallower (>1 m) than the other land available near the access track; and
- The land is an existing hardstanding area associated with the nearby quarry so that it minimises the need for new infrastructure.

3.7.4 Substation

The location of the substation compound, adjoining the main the access track to the west of the Site, was selected for the following reasons:

- Existing woodland provides aids in screening visibility from Melvich;
- Peat is shallower (>1 m) than the other land available near the access track; and
- Relatively flat location.

3.7.5 Met Mast Location

A 250 m buffer was added to the three turbine locations in the south-west of the Site. As prevailing wind is west-south-west direction, it was favourable for the met mast to be located south-west of the test turbines and to the north of Akran Burn. The depth of peat within this buffer was examined and a suitable location determined.

3.7.6 Borrow Pits

The borrow pit locations have been selected to avoid known environmental constraints and were identified following a review of geological data and topography to determine where extractable rock of suitable quality is to be found. Borrow Pit 1 is located north-west of Akran Burn and was selected due to it being adjacent to proposed onsite tracks and situated on a topographically steep area. Borrow Pit 2 is located north-east of Golval Hill and was selected due its proximity to a proposed track leading to T6 and being located in a topographically steep area.

3.8 SUMMARY

Various economic, technical and environmental factors were all considered in the iterative design process. These were informed through a variety of baseline surveys and consultation with a range of stakeholders.

The final design assessed in this EIA Report has been carefully developed taking these factors into account and is shown on Figure 4.1 which accompanies **Chapter 4: Development Description**.

The final design is considered to meet the balance of increasing the renewable energy generation capacity of the Site whilst minimising the introduction of new environmental effects.