



# Chapter 3

## Site Selection & Design

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# Chapter 3

## Site Selection & Design

### 3.1 Introduction

1. This chapter outlines the process undertaken in selecting the Site as a potential location for a wind and solar energy development, provides a description of the Site and surrounding area, and discusses the design evolution process.
2. The application for the proposed Development requires to be considered under the terms of the Electricity Act 1989, in particular Schedule 9 because it would exceed 10 MW in generating capacity. Key to this is the need to have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and the reasonable mitigation of any effect which the proposed Development would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects. There is also a requirement to avoid, in so far as possible, causing injury to fisheries or to the stock of fish in any waters.
3. A key benefit of the Environmental Impact Assessment (EIA) process is the opportunity it gives to integrate environmental considerations into the careful, iterative design of a project. This allows potential environmental effects to be considered and minimised so that the environment is considered in the proposed Development design from the earliest stage.
4. This chapter draws on issues considered in more detail in the relevant technical Chapters (**Chapters 6 to 14**). This chapter does not pre-empt the conclusions of the later chapters, but rather explains how potential environmental effects have informed the design of the proposed Development.
5. The final design for the proposed Development is described in **Chapter 4: Development Description** and is shown on **Figure 4.1a**.

### 3.2 Site Selection & Consideration of Alternatives

#### 3.2.1 Site Context

6. The proposed Development Site was included within the original Operational Kilgallioch Windfarm application in February 2010, but later removed from the revised scheme and addendum submitted to the Scottish Government for determination, following consultee responses to the initial layout. The Operational Kilgallioch Windfarm received consent in 2013 and been operational since 2017, with a capacity of up to 236 megawatts (MW) across 96 wind turbines.
7. The matters raised in relation to the Site in response to the original Operational Kilgallioch Windfarm application were principally:
  - Potential landscape effects on the wildness characteristics of the non-forested area to the south east of the Operational Kilgallioch Windfarm, including the Site;
  - Potential visual effects from the Southern Upland Way near Knockniehourrie, in views east towards the Galloway Hills; and
  - Potential hydrological effects on the Kirkcowan Flow Special Area of Conservation (SAC), due to potential hydrological connectivity between areas proposed for construction activity and land within the SAC.

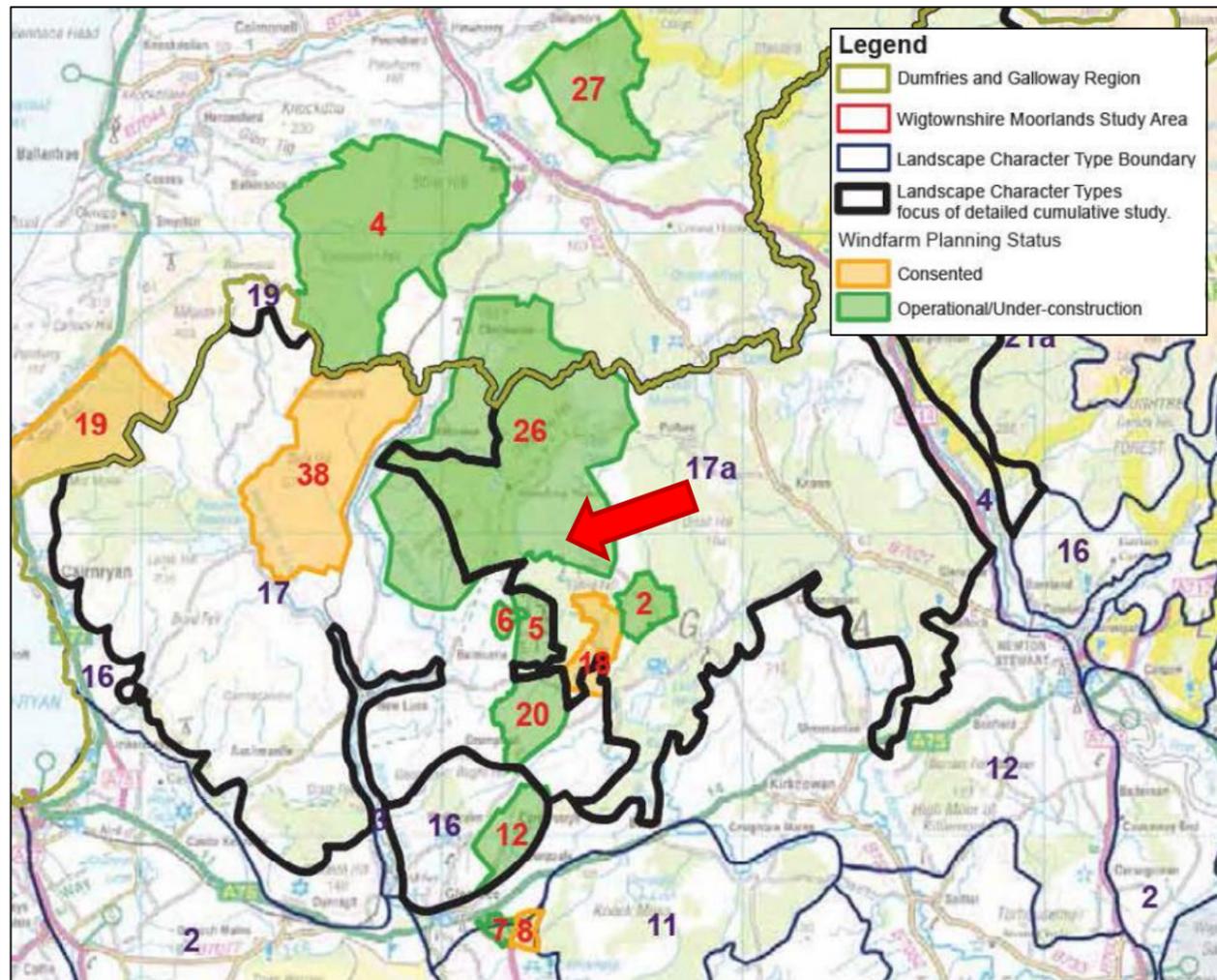
8. Following the construction and operation of the Operational Kilgallioch Windfarm it is the opinion of SPR and its technical advisor that the matters raised to the original application can now be successfully addressed through changes to the baseline environment, careful design and best practice construction practices. These changes are addressed further within the relevant technical Chapters (**Chapters 6 to 14**) and summarised here:

- Cumulative developments, most notably the Operational Kilgallioch, Airies and Balmurrie Fell Wind Farms, have been built since the original application for Kilgallioch Windfarm, and are now operational. These, in combination with the older Artfield Fell and Arecleoch windfarms, have reduced the wildness characteristics of the moorland area in which the site is located, and hence the sensitivity of the area to the addition of further wind turbines. Whilst the potential for significant cumulative effects increases the susceptibility of the Site area, on balance, the widespread existing baseline of operational development close to the Site reduces the potential for significant effects.
- Careful design of turbines within the Site has avoided locating turbines on the more distinctive Eldrig Fell which is more elevated and serves to maintain a degree of separation between the existing Aries and the proposed Development from key views such as from Knockniehourrie to the west and Hill of Ochiltree to the east.
- Further surveys of peat and vegetation have provided a more detailed picture of hydrological connectivity with the Kirkcowan Flow SAC. Turbines and associated infrastructure have been purposefully designed to avoid areas and habitats with hydrological connectivity, limiting the potential for effects on the Kirkcowan Flow SAC.

#### 3.2.2 Location

9. The proposed Development application boundary is located across two local authorities - South Ayrshire Council and Dumfries and Galloway Council (DGC). The main development area, which is where all new infrastructure is proposed is located solely within DGC area. The proposed Development is located approximately 9.5 km to the north west of Kirkcowan in Dumfries and Galloway, centred on British National Grid (BNG) reference BNG (223950, 570150), and as shown within **Figure 1.1**. The proposed access route onto the Site would be from the A714, heading south along existing forestry and Operational Kilgallioch Windfarm access tracks. This access passes within the administrative boundary of South Ayrshire Council.
10. A number of factors were considered when progressing the Site as an energy development. The predominant factor was the opportunity to re-use existing infrastructure which forms part of the Operational Kilgallioch Windfarm, these include:
  - use of the Operational Kilgallioch Windfarm and forestry access tracks to access the main development area of the Site with minimal upgrades;
  - the potential for a direct connection to the Operational Kilgallioch Windfarm substation and onto the wider electrical grid system;
  - an operational development adjacent and initial onsite wind monitoring find that there is likely to be a good wind resource at the Site for wind energy development; and
  - greater understanding and appreciation of the baseline conditions at the Site as a consequence of the construction and operation of Kilgallioch Windfarm.
11. Other factors include:
  - there are no international or national statutory designations for landscape in, or within close proximity of, the main development area of the Site;
  - there are no planning policies which, in principle, preclude wind energy development. The Site is located within an area which the Local Development Plan has identified as having potential for windfarm development;
  - it has good access from the public road network particularly for longer blades which allows consideration of larger turbines to make the best use of the expected wind resource; and
  - the Site has no residential properties in close proximity.
12. In addition, Scottish Planning Policy (SPP) (June 2014) provides support for renewable energy development in principle and encourages local authorities to guide developments towards appropriate locations. Paragraph 154 states that planning authorities “*should support the development of a diverse range of electricity generation from renewable energy technologies – including the expansion of renewable energy generation capacity*”.

13. SPP Paragraph 155 also states that “development plans should seek to ensure an area’s full potential for electricity and heat from renewable sources is achieved, in line with national climate change targets.” In response to these policy requirements DGC undertook a wind capacity study (2017) to identify those landscapes which, in principle, have the capacity to accommodate wind turbines. The proposed Development is located within the Plateau Moorlands with Forest (17a) LCT, Glentroot unit, which is assessed as having High sensitivity to very large typology development (>150 m high). The proposed Development site is located adjacent to the Operational Kilgallioch Windfarm turbines and is considered to fit with the ‘clear pattern of wind farm development’ described within the capacity study. The map of the existing Operational Kilgallioch Windfarm on *Figure 8* of the capacity study includes all of the proposed Development site area. In this way the DGC wind capacity study has acknowledged that the proposed Development site area lies within the ‘successfully sited’ Operational Kilgallioch Windfarm area (refer to **Graphic 1** below). The iterative design process, informed by this EIA, helps to ensure that the Site’s full potential for electricity generation is achieved.



Graphic 1: Extract from *Figure 8* of the *Dumfries and Galloway Wind Farm Landscape Capacity Study* (DGC, 2017). Proposed Development location shown by red arrow.

### 3.2.3 Alternatives

14. 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, as a result of the proposed Development, are avoided or minimised, as far as reasonably possible. Schedule 4 (2) of the EIA Regulations, requires the consideration of reasonable alternatives in terms of site location and characteristics of the proposed Development. Regulation 40 (2)(c) of the EIA Regulations requires that an EIA report should include (in respect of alternatives studied by an

applicant): “The main alternatives studied by the applicant and the main reasons for his choice taking into account the effects on the environment.”

15. The main alternatives including design, turbine specification, location, size and scale have been considered for the Site. This Chapter explores these options and explains how the final design of the proposed Development has evolved.

### 3.2.4 Technology Size & Scale

16. SPR is at the forefront of the development of the renewables industry in the UK through pioneering ideas, forward thinking and outstanding innovation. SPR are looking at ways to incorporate a mix of renewable energy technologies into future developments as well as maximising the efficiency of operational sites through co-location of other renewable energy and storage technologies.

17. Onshore wind continues to be one of the cheapest forms of renewable energy; however, the challenge is to meet the Scottish Government targets for net-zero greenhouse gas emissions by 2045, within a context of limited Government support mechanism for onshore wind. The supply of smaller turbines across Europe is reducing due to lack of demand as manufacturers are recognising the world market is shifting to larger machines and are focussing their development work on larger turbines which secure the highest yield. The onshore wind industry has experienced a reduction in supply of smaller wind turbines due to lack of demand from mainland Europe, where the tendency is to install wind turbines at higher tip heights (e.g. 175 – 240 m to blade tip). Therefore, it is highly unlikely that a range of smaller turbines would be available at competitive prices by the time the proposed Development is ready to be constructed, if consented.

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

19. In May 2019, a co-located technologies workshop was held for the project to explore the feasibility of co-locating other renewable generating or storage technologies at the site. The workshop was attended by representatives from the EIA project team, grid specialists, renewables consultants and the SPR project team to consider five different renewable technologies: solar; hydro; biomass; hydrogen fuel cells and energy storage technologies.

20. The benefits of each technology were outlined and their suitability to the proposed Development Site discussed supported by known environmental baseline information for the Site and a feasibility assessment undertaken for ground mounted solar photovoltaic development by an independent consultant. As a result of the desk-based assessments and workshop, solar energy was considered an appropriate technology to include as part of the project proposals to maximise the efficiency and output of the site grid connection.

21. The proposed Development would comprise 11 three-bladed horizontal axis turbines up to 180 m tip height with a combined rated output in the region of 62 MW and the potential for approximately 20 MW of installed solar photovoltaic arrays. The proposed Development includes associated infrastructure including:

- turbine foundations;
- crane hardstandings;
- transformer/switchgear housings located adjacent to turbines and solar arrays;
- solar photovoltaic modules
- access tracks (existing, upgraded or new as required);
- watercourse crossings (existing, upgraded or new as required);
- underground electrical cabling to the Operational Kilgallioch Windfarm substation;
- permanent anemometer mast and Lidar compound;
- close circuit television mast(s);
- communication mast(s);
- permanent operations building;
- up to two borrow pit search areas; and
- a temporary construction compound area.

22. The proposed Development would also require a small amount of forestry felling (5.87ha) to enable connection from the Operational Kilgallioch Windfarm to the proposed Development main development area.

### 3.3 Site Description

23. The main development area of the Site is mainly comprised of a mixture of peat bog and grassland, reflecting the patchy distribution of peat soils across the Site, and current land use by humans is limited to low-density sheep grazing. Derelict farm buildings and steadings, at High Eldrig, are located within the eastern extent of the Site. The northern boundary of the Site is adjacent to the Kirkcowan Flow SAC/SSSI and a scheduled monument, Wood Cairn, is located on the summit of Eldrig Fell, in the south east of the Site. The Tarf Water, which is part of the River Bladnoch SAC (designated principally for its populations of Atlantic Salmon) flows south and east along the western and southern boundaries of the Site.
24. There are also a number of non-designated heritage features within the Site and its surroundings.

#### 3.3.1 Surrounding Area

25. The surrounding area is rural, with the land predominantly used for agriculture and commercial forestry purposes. There are also several consented and operational wind energy developments in the local areas, refer to **Section 3.3.2** below. The nearest sizeable settlements to the main development area of the Site are; New Luce located approximately 7.0 km to the south west, and Kirkcowan located approximately 9.5 km to the south east and Barrhill located approximately 10 km to the north.
26. The proposed Development is within the peripheral zone of a Biosphere Reserve which is a non-statutory designation that aims to ensure sustainable development. The peripheral zone is referred to as the 'Transition Area' and is detailed within the Biosphere Reserve's website (UNESCO, 2019), as an area "where the greatest activity is allowed, fostering economic and human development that is socio-culturally and ecologically sustainable".
27. Between the main development area and up to 5 km from the main development area, the relevant designations are as follows:
- various tributaries of the River Bladnoch SAC to the south, south east and north east of the Site;
  - 56 scheduled monuments, two of which lies within 500m of the existing Operational Kilgallioch Windfarm access tracks, the remainder are located to the west of the Site, many on the south west facing slopes of Quarter Fell;
  - An Archaeologically Sensitive Area, approximately 1.8 km to the west of the Site, designated on the Proposed Dumfries and Galloway Local Development Plan (2019); and
  - four C-listed buildings or structures, located between 2.7 and 5 km from the Site.

28. **Figure 3.1** shows sites with environmental designations within 5 km of the proposed Development main development area. A brief summary of these is provided below with full descriptions provided in the relevant technical chapters of the EIA Report.

#### 3.3.2 Relevant Developments within 10 km

29. The proposed Development site is surrounded by a number of either operational or consented windfarms. It is considered to be a suitable site for wind energy development, making use of some existing site infrastructure and recognising the accepted principle of wind energy generation within the local landscape.
30. **Figure 3.2** shows the locations of other relevant commercial windfarms in planning, consented/under construction, and operational within 10 km of the proposed Development turbines at the time of writing (refer to **Table 3.1**). A cumulative 'cut-off date' was set in September 2019 to allow the required visualisations to be prepared prior to submission of the application. Potential cumulative effects with these developments have been assessed throughout the EIA Report, where there is sufficient information.
31. Further detailed discussion on the approach to cumulative assessment is presented in each technical assessment chapter as relevant.

Development*	Status	Number of Turbines	Direction from Site	Approx. Distance to Nearest Turbine
Kilgallioch Windfarm	Operational	96	North / West	0.58 km
Airies Windfarm	Operational	14	South east	2.06 km
Artfield Fell Windfarm	Operational	15	South	2.23 km
Balmurrie Fell Windfarm	Operational	7	South	2.58 km
Glenchamber Windfarm	Operational	11	South	4.51 km
Stranoch Windfarm (Stranoch 2 Windfarm)	Consented (In Planning)	24 20	West / North west	6.80 km
Chirmorie Windfarm	Consented	21	North west	6.10 km
Arecleoch Windfarm	Operational	60	North west	7.65 km
Carscreugh Windfarm	Operational	18	South	7.97 km
Arecleoch Windfarm Extension	In Planning	13	North west	8.89 km

Table 3.1: Cumulative Developments within 10 km of the Proposed Development Turbines

\* Note: Gass Windfarm, consented in August 2015 but not built, was removed from the cumulative baseline on the advice of DGC.

### 3.4 Design Concept & Approach

32. In EIA, the identification of constraints should continue throughout the design process as more detailed surveys reveal additional constraints to development. In this way, the findings of the technical and environmental studies can be used to inform the design of a development, and hence achieve a 'best fit' within the environment of the proposed Development Site.
33. This approach has been adopted in respect of the Site; where potentially significant effects have been identified, efforts have been made to avoid these through evolving the design of the proposed Development. This is referred to within this EIA as mitigation embedded in the proposed Development layout and design, or simply 'embedded mitigation'. Further information on embedded mitigation is explained within each technical Chapter of this EIA Report as appropriate. A number of design principles and environmental measures have also been implemented and incorporated into the proposed Development as standard practice.
34. 'Embedded mitigation' includes but is not limited to:
- sensitive siting of the proposed infrastructure incorporating appropriate buffer distances from environmental receptors to avoid or reduce effects on the environment;
  - considering the size and scale of the proposed Development appropriate to the location;
  - considering the appearance, finish and colour of wind turbines and the control building in accordance with SNH Guidance 'Siting and Designing Wind Farms in the Landscape', V3a (SNH, 2017);
  - re-using existing infrastructure as much as possible to access the Site;
  - design of the tracks to minimise cut and fill, reducing landscape and visual effects;
  - inclusion and design of borrow pit(s) to minimise the amount of the material required to be imported to the Site; and
  - potential for up to 50 m micrositing of infrastructure during construction to ensure the best possible location is chosen based on Site investigations.
35. Throughout the design evolution of the proposed Development layout, a key driver was the consideration of potential landscape and visual effects on receptors and how the proposed Development would relate to the existing landscape character as well as existing windfarms in the landscape. In particular, regard was had to the scale and number of turbines proposed, cumulatively with existing windfarms in the area, in particular the adjacent Operational Kilgallioch Windfarm. The landscape and visual effects potentially caused by the proposed Development has been considered extensively from key receptors. The resulting analysis has been an important input into the design evolution process of the proposed Development and in particular to the layout design of proposed turbines.

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

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

37. The layout and design of the proposed Development were considered as part of an iterative design process aimed at reducing the potential landscape and visual effects of the windfarm whilst taking into account other Site constraints and technical requirements.
38. An iterative design approach works in tandem with the EIA process and allows a receptive design process where incremental changes in layout and design result from a continually developing understanding of environmental considerations. This iterative approach allows potential environmental effects, as they are identified, to be minimised through alterations in design. Those effects which have not been mitigated through embedded mitigation are assessed with the technical chapters of this EIA Report.
39. It is considered that the design respects the form of the underlying landscape and its scale. Wind energy development is clearly a key defining characteristic of the baseline landscape and visual context, and it is expected to continue to be so for the foreseeable future; this has been an important consideration in the design of the proposed Development.

## 3.5 Design Objectives

40. The landscape and visual design strategy for the proposed development has taken into account and sought to balance the following objectives:
- to ensure so far as possible, the turbine layout expresses as clear and simple a form as possible when seen in key viewpoints and which logically relates to the character and scale of the site and its surroundings, including the operational windfarm developments in the area;
  - to ensure so far as possible, that the design and layout of the turbines avoids visual complexity and confusion in key views from the surrounding landscape;
  - to ensure so far as possible, a visually balanced composition of turbines is achieved within the pattern of the plateau moorland with forest landscape of the site area and also as experienced from the surrounding landscapes of the plateau moorland landscape character type (LCT) and plateau moorland with forestry and windfarms LCT; and
  - to take account of the various other environmental and technical constraints identified within the site.
41. The key design objectives for the development of the proposed Development, which were agreed with ScottishPower Renewables (SPR) were as follows:
- avoid the higher elevated landforms of Eldrig Fell;
  - to minimise effects on the Southern Upland Way as far as possible;
  - limit the degree of turbine stacking from key receptors;
  - avoid the creation of distinct turbine outliers by arranging them as a cohesive grouping that sits comfortably with the existing Kilgallioch windfarm turbines;
  - limit proximity to closest residential receptors;
  - limit impacts on priority peatland and carbon areas;
  - limit impacts upon known archaeological assests;
  - respect other onsite environmental constraints;
  - create a scheme which maximises the potential of the Site to generate renewable energy; and
  - use of the existing infrastructure as far as practicably possible.

## 3.6 Constraints Identification and Mapping

### 3.6.1 Introduction

42. The design of any windfarm is driven by the key objective of positioning turbines (and in this case solar modules) so that they capture the maximum energy possible within a suitable area further informed by environmental and technical constraints.
43. The designations within the Site and surrounding area were identified as the first part of the constraints mapping process. These are shown on **Figure 3.2**.
44. The known environmental and technical constraints within the Site were identified as part of the early stage constraints mapping. It is important to note that the identification of a constraint does not necessarily result in the exclusion of that area from the potential development envelope; rather it means that careful thought and attention was paid to the constraint and the design altered appropriately. The key constraints which were considered during the design process included:
- topography;
  - identified landscapes and visual constraints;
  - presence of ornithology;
  - protected habitats and species;
  - ground conditions (including peat);
  - presence of watercourses;
  - presence of cultural heritage features;
  - location of residential properties – potential impacts on residential visual amenity, and proximity to noise sensitive receptors;
  - aviation;
  - telecommunications links;
  - key recreational and tourist routes; and
  - forestry.
45. The identification of constraints continued throughout the design evolution process as more detailed surveys refined the development envelope.
46. A description of how the various environmental and technical disciplines have contributed to the design through detailed assessment is described below. Information in respect of the survey work undertaken is provided in the technical chapters of this EIA Report.
- ### 3.6.2 Wind Analysis
47. Wind analysis and efficiency modelling has been carried out by SPR at key stages throughout the design evolution process to identify the areas of the Site likely to produce the most yield and ensure the commercial viability of the scheme.
48. For turbines to work as effectively as possible, they must be suitably spaced relative to the predominant wind direction. If they are too close together in this direction, the wake effects from the turbines located on the upwind edge of the array will create turbulent air for the next row and so on through the array. A high wake effect (expressed as a percentage) is disadvantageous to overall Site productivity. Conversely if turbines are located too far apart the opportunity to maximise the capacity and thereby electricity generation from the Site is reduced.
49. There is no industry standard for spacing, only manufacturer recommendations and operational experience. Referring to onsite wind measurement data it was determined that there was no predominant wind direction at the Site and therefore the common practice of spacing turbines six times rotor diameter on the predominant wind direction against four times rotor diameter cross wind was not appropriate for the proposed Development. The

decision was made to use five rotor diameter circles for turbine spacing at the Site, to ensure good separation distances between the turbines and reduce wake disturbance.

50. The wind analysis has also been used to determine the location of a permanent anemometer mast within the Site. This mast would be used to independently monitor turbine performance in operation, supplemented by Lidar located adjacent to the operations building.

### 3.6.3 Topography

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

### 3.6.4 Landscape Character and Visual Amenity

53. Potential effects on the landscape and visual resource have been an important factor in this iterative process, with both the appearance of the proposed Development considered on its own, and its appearance within the context of the Operational Kilgallioch, Aries, Artfield Fell and Balmurrie Fell Windfarms being considered. This was carried out through the repeated testing of layout iterations as seen from agreed design viewpoint locations representing key local landscape and visual receptors around the Site (refer to **Figures 3.5a to 3.8b**).
54. The design of the windfarm layout is a vital part of the EIA process, as it is the stage where the biggest contribution can be made to mitigate potential effects. Due to the generally high visibility of windfarms, landscape and visual aspects are particularly important, and have therefore driven the layout design from an early stage.
55. The final turbine layout has been optimised for landscape and visual reasons as far as possible using the agreed viewpoints.
56. Where possible, proposed excavation for access tracks and other infrastructure has been minimised and the location of the tracks, solar array search areas, borrow pits and construction compounds has been reviewed to minimise visual effects as well as impact on habitats, cultural heritage assets and peat.

### 3.6.5 Ecology and Ornithology

57. Ecological surveys have been carried out across the Site throughout 2019, including a National Vegetation Classification (NVC) Survey and protected species surveys (including bats, badger, otter, water vole, pine marten and red squirrel), in order to identify broad areas of constraint to windfarm development. Constraint mapping included the identification of sensitive ecological features, including habitats present within the Site and species which use the Site. Standard buffers were then placed around these sensitive features and the design of the Site was amended accordingly.
58. Areas with potential to be true Groundwater Dependent Terrestrial Ecosystems (GWDTEs) were found to be limited in extent across the Site and mainly confined to areas around watercourses traversing the Site. These areas were avoided as far as possible in the turbine layout designs. As the design evolved, these areas were further investigated to establish whether they were confirmed GWDTEs. Where considered to be truly groundwater fed, such areas were avoided.
59. Ornithology surveys have been carried out across the Site continuously from April 2018 to August 2019, including vantage point watches; scarce breeding birds (for raptors, divers and any other species listed in *Schedule 1* of the *Wildlife and Countryside Act 1981*); and winter walkovers for non-breeding birds. Black grouse surveys have also been completed, as well as focal watches for hen harrier roosts during the non-breeding season. Suitable buffers were considered during the design evolution process and no turbines are proposed within 250 m of known nest sites or winter roost locations.

### 3.6.6 Peat Habitat and Depth

60. Parts of the west, central, and far southeast Site areas are identified as being within areas of Class 1 Peat based on the SNH Carbon and Peatlands Map (2019). This is defined as “*nationally important carbon-rich soils, deep peat and priority peatland habitat; areas likely to be of high conservation value.*” A small area of Class 2 Peat (“*nationally important carbon-rich soils, deep peat and priority peatland habitat; areas of potentially high conservation value and restoration potential*”) is identified west of Eldrig Loch, mostly offsite but encroaching slightly into the eastern Site boundary.
61. Peat probing was undertaken in 2019 to supplement and update the existing database created as part of the assessment for the Operational Kilgallioch Windfarm application. A review of this data in conjunction with slope gradients allowed areas of deep peat (typically greater than 2.5 m) to be avoided for development at an early stage.
62. The peat data is discussed in **Technical Appendix 7.2: Peat Landslide Hazard Risk Assessment**. As part of the proposed Development all turbine locations, access tracks, solar search areas, operations building, construction compound and borrow pits have been designed to avoid any areas of which may be subject to peat slide risk.
63. The ground condition constraints that were taken into account in the design of the proposed Development were:
- identification of peat depths in excess of 1.5 m – to minimise incursion, protect from physical damage, minimise excavation and transportation of peat, reduce potential for peat instability and minimise potential soil carbon loss;
  - identification of slope angles greater than 5° - to minimise soil loss and potential instability; and
  - avoidance of areas where initial peat stability concern was identified where possible – to avoid areas with possible instability issues and associated indirect effects on surface water.

### 3.6.7 Hydrology and Hydrogeology

64. A 50 m buffer zone has been applied around all watercourses which traverse the Site. These buffers were used to ensure that turbines and infrastructure, other than tracks, were not located in close proximity to hydrological features in accordance with windfarm construction best practice guidelines (SNH, 2019). This reduces the risk of run off and water pollution into existing watercourses.
65. There would be 21 watercourse crossings within the Site, however watercourse crossings have been minimised as far as possible. Nine of these watercourse crossings would be new, eleven are existing and can be used without modification and one is an upgrade of an existing watercourse crossing.
66. Data on private water supplies was requested from DGC which confirmed that there were no private water supplies within the 1 km study area of the main development area of the Site.
67. Development on peatland has been largely avoided based on the peat probing data collected historically at the site and supplemented by further probing in 2019. Peat depth was fully considered as part of optimizing the design and in recognition of peat as a carbon sink and also in establishing possible connectivity, through habitats and peatland areas, with the Kirkcowan Flow SAC. A carbon balance assessment has been undertaken to determine the payback period for the windfarm (refer to **Chapter 14: Other Issues**).

### 3.6.8 Cultural Heritage Features

68. There is one scheduled monument within the site boundary, as noted above. As part of assessment both a desk-based assessment, which looked at the latest Historic Environment Records (HER) dataset for the Site, and a Site survey were undertaken. This revealed a number of known non-designated cultural heritage assets across the main development area of the Site.
69. The scoping responses received from consultees and comments raised at Public Information Days (PIDs) noted matters in connection with the historical landscape at the Site and known features within the main development area.
70. Mapping the various constraints as well as the professional opinion on the sensitivity of the assets and interrelationship between them, played an integral role in the design development of the proposed Development. Infrastructure was moved to avoid and/or minimise, through design, any direct impact on the known heritage assets.

### 3.6.9 Noise Sensitive Receptors

71. The closest residential property is located approximately 2.96 km to the north of the nearest turbine in the proposed Development (Turbine 7). All other noise sensitive receptors are located greater than 3 km from the proposed turbine locations. High Eldrig, is a derelict property which is located within the site boundary approximately 480 m to the east of the Turbine 11. These receptors are shown on **Figure 10.1**.
72. In agreement with the DGC Environmental Health Officer (EHO), no baseline noise monitoring was required to be undertaken for the proposed Development as it would not be possible to establish background noise levels in the absence of existing windfarm noise accurately.
73. Given the distance between the main development area and the closest noise sensitive receptors, turbine location in relation to noise sensitive receptors was not a principal consideration for the constraints mapping and design iteration process.

### 3.6.10 Other Factors

74. Shadow flicker has the potential to be an issue for properties which are closer to a wind turbine than a distance of ten times the diameter of the turbine's blade length. There are no properties within 10 rotor diameters (1,500 m) from the proposed turbine locations therefore shadow flicker was not a consideration for the constraints mapping process.
75. There is no forestry within the main development area of the Site. A section of access track and cable route connecting the main development area to the existing Operational Kilgallioch Windfarm infrastructure will require passing through an area of commercial plantation forestry. Reference to the local topography, existing forestry infrastructure, the forestry plan and maximising the use of existing windfarm infrastructure was considered in routing the access track through this parcel of land.
76. Consultation with telecommunication providers and stakeholders identified no links which could potentially be affected by the proposed Development.

## 3.7 Design Evolution

### 3.7.1 Design Guidance

77. The proposed Development turbines and infrastructure would be located in the 'Plateau Moorland with Forest' Landscape Character Type (LCT) (17a) as defined in *Dumfries & Galloway Landscape Wind Capacity Study, 2017* (DGWLCS).
78. The DGWLCS 'Guidance for Development' section of this LCT is summarised as follows. The design of the proposed Development has had consideration of this guidance and the design response is included below in bold:
- 'All development typologies should avoid impacting on the setting and views to small lochs, on areas of more complex landform, including small but pronounced hills such as Glenvernoch Fell, and on archaeological features as these enrich the landscape of this character type and often provide a focus in views.'
- The proposed Development has sought to avoid encroachment on small pronounced hills in the immediate vicinity of the site such as Eldrig Fell and Craigmodie Fell. Direct impacts to archaeological features on the site have been avoided as far as turbine placement and the locations in the surrounding landscape in which these features are seen along with the proposed Development are limited to a few elevated positions within the immediate context of the site.**
- 'Intrusion on key views to the Galloway Hills, for example from the A714 and the Cree valley, should be avoided.'
- The proposed Development does not intrude on views to the Galloway Hills from the A714 and Cree valley.**
- 'Potential cumulative landscape and visual effects with other operational and consented wind farms would need to be carefully considered as this landscape is considered to be close to reaching capacity for additional development.'
- Cumulative and landscape and visual effects have been considered in full. Significant effects (including cumulative with operational windfarms) have been found within a localised area (2-3 km) of the Plateau Moorland with Forest LCT (17a) and the addition of the proposed Development is considered to increase the extent of a**

'landscape with windfarms' characteristic for the immediately surrounding landscape context, reducing the area of open moorland within the host LCT. However, it is considered that the proposed Development in itself would not alter the current perception of a 'landscape with windfarms' characteristic within the immediate landscape and visual context of the Site in the southern part of the plateau.

- 'Key cumulative sensitivities are likely to include effects on smaller scale settled landscapes on the outer fringes of this landscape, on the Merrick Wildland Area and on views from the south-eastern coast of the Rhins, parts of the Machars, the Galloway Hills and the A75 and A714.'
- The proposed Development has been designed to fit with the existing pattern of windfarm development, in particular with the southern part of the existing Operational Kilgallioch Windfarm turbine layout. From the surrounding landscape, the proposed Development would appear on the skyline, in a similar way to the existing windfarm development and would therefore relate to the same pattern of development and characteristic of the plateau landscape, creating a consistent image that limits visual confusion and reinforces the appropriateness of the location for windfarm development.**

### 3.7.2 Engineering Design Evolution

79. In addition to the landscape and visual considerations in the Site layout design approach, the following technical, engineering and environmental objectives were developed:
- Maximise wind energy yield from the turbines as far as possible;
  - Maximise solar energy yield from the site;
  - Avoidance of slopes in excess of 12 degrees for site tracks;
  - Avoid areas of peat and known wet/boggy areas;
  - Reduce requirement for watercourse crossings and maintain a buffer of 50m from watercourses; and
  - Maintain appropriate buffers from ecological, ornithological and cultural heritage features.
80. Other objectives were to maximise the use of existing infrastructure on the Site including existing forestry and farm tracks. The changes to the layout, during the design process are described below.

## 3.8 Layout Evolution

81. As a consequence of the EIA process, there have been nine main design iterations to the infrastructure layout of the proposed Development in order to avoid, reduce or offset the potential environmental effects associated with the proposed Development as well as maintaining a financially viable development proposal. In addition to these nine main design iterations there has been additional micro-siting to refine the design.
82. Overall, changes to the proposed Development layout were made as a result of the findings of the baseline survey work, and consultation undertaken with the consultees and the public. The baseline conditions on site were collated and mapped within a comprehensive Geographical Information System (GIS) model, specific to the proposed Development.
83. Two formal design iteration workshops were held in June and August 2019 with members of the EIA environmental technical advisors, design engineers as well as SPR construction and wind yield engineers in attendance. The workshops provided a forum whereby all the known environmental constraints could be discussed, and infrastructure appropriately designed to maximise the viability of the development with minimal impacts to the local environment, drawing on the wealth of technical and practical experience of the project team.
84. A summary of the main turbine layout iterations for the Proposed Development is provided in **Table 3.2** below. The following figures illustrate the changes to the design as described in **Table 3.2**:
- Figure 3.3** – design iteration of turbine layouts A, C, E & F (from **Table 3.2**);
  - Figures 3.5 a and b** – wirelines illustrating turbine layouts A, C, E & F from Viewpoint 2, located along the Southern Upland Way, at Knockniehourie;
  - Figures 3.6 and b** – wirelines illustrating turbine layouts A, C, E & F from Viewpoint 3, located along the Southern Upland Way, at Craig Airie Fell;

- **Figures 3.7 a and b** – wirelines illustrating turbine layouts A, C, E & F from Viewpoint 7, at Mains of Larg, New Luce;
- **Figures 3.8 a and b** – wirelines illustrating turbine layouts A, C, E & F from Viewpoint 3, located along the Southern Upland Way, at Craig Airie Fell;
- **Figure 3.9** – design iteration of associated onsite infrastructure; and
- **Figure 3.10** – design iteration of solar search areas.

Design Iteration	Date	Description
A (V1)	February 2019	<b>Initial Layout</b> - designed to maximise capacity and turbine separation across the main development area of the Site.
B (V2)	March 2019	Turbines moved to reflect known environmental constraints such as onsite watercourses.  A technical landscape review was also undertaken of Layout B which looked at two maximum tip heights, 175m and 180m, as detailed above. The conclusion was to proceed with the 180m to tip parameter given that it has minimal additional impacts and provided a greater choice in terms of candidate turbine.
C (V3)	April 2019	<b>Scoping Layout</b> – used to inform the scoping request and EIA assessment methodologies. Turbines moved internally to maximise separation distances while taking into account known onsite constraints (no updated surveys had been undertaken at this point).  Initial infrastructure layout drawn up for internal comment and solar search areas established following feasibility study (see <b>Section 3.8.3</b> below). In the Scoping Report, a Turbine Developable Area was identified which included the western flank of Eldrig Fell. Being the most elevated location on site, turbine T1 located towards the high point on Eldrig Fell was predicted to perform well with respect to energy yield.
D (V5)	June 2019	<b>Design Workshop 1</b> - following the completion of many of the onsite environmental surveys, including NVC, protected mammals, geological walkover as well as previous survey data with regards to cultural heritage and peat depth, a design workshop was held.  The focus of the workshop was siting of the turbines within the main development area of the Site to minimise environmental impacts and improve the visual design from several of the proposed landscape viewpoints. The potential to include a turbine on Eldrig Fell was debated at the workshop. Advice from cultural heritage specialists (citing the proximity to the scheduled monument), and the landscape architect (highlighting the prominence of this turbine from several viewpoints), led to a decision to relocate this turbine. The turbine developable area was revised to exclude the area to the east of High Eldrig.  At this stage, sufficient wind data had been obtained from the temporary onsite met mast to better understand the wind conditions on the site. Review of the wind data led to the decision to amend turbine spacing to five times the rotor diameter in all wind directions. This turbine spacing requirement led to some amendment to turbine positioning.
E (V7)	July 2019	Turbines micro sited from positions at design workshop following SPR internal review on turbine yield, projected financial modelling, constructability and movements away from/out of environmentally sensitive areas.  Initial associated development infrastructure (construction compounds, operations buildings, crane hardstands and access tracks) included for first time to the layout ahead of the second design workshop. The infrastructure layout allowed for access to the site both from the north (via the Operational Kilgallioch Windfarm) and the south (via High Eldrig).  Solar search areas updated to reflect latest baseline mapping of onsite environmental constraints. Six areas of search identified.

Design Iteration	Date	Description
F (V8)	August 2019	<b>Design Workshop 2</b> – turbines were micro-sited following the advice of the project landscape architect to improve the layout design from local key viewpoints, particularly to create as cohesive a grouping as possible within the Turbine Developable area established during Design Workshop 1. Changes to the layout included: <ul style="list-style-type: none"> <li>- T1: moved north to improve views from the east and west of the site.</li> <li>- T5: moved east to improve spacing with T7.</li> <li>- T7: moved north west to improve spacing with T6.</li> <li>- T10: moved north east to avoid areas of deep peat.</li> <li>- T9: moved south east accommodate movements at T10.</li> <li>- T11: moved to accommodate movements to T9.</li> </ul> <p>As a result, tracks and crane hardstands were moved to suit the revised turbine locations, whilst also taking cognisance to avoid areas of deeper peat. The crossing point of Black Burn was amended to approximately 90 m to the north east of the previous iteration. The revised crossing location was selected to minimise engineering works in the crossing, minimise impact on GWDTEs and to improve the approach to the construction compound with respect to peat. The access from the south east past High Eldrig was re-sited on the advice of the project cultural heritage advisor.</p> <p>The two construction compounds were also reduced in size to 100m x 50m following input from SPR construction engineers and the northern operations building was moved to suit new track location and avoid sensitive habitats and areas of peat. The southern operations building was deleted and an additional borrow pit search area was included near T2 following discussions on potential volume of rock required during construction and potential geological conditions at the site.</p>
G (V9)	August 2019	<b>Design Chill</b> – changes were made to the solar search areas. Areas F and D were deleted as they were no longer considered to be viable locations given the total size and orientation of the unconstrained areas as well as proximity to ornithological sensitive areas. Also, to maximise the potential usable areas within solar search areas C and A2, minor realignments to the access tracks were made. Turbine locations were not amended further.
H (V10)	September 2019	Decision made on the access route to the Site: construction traffic to come from the A714 through the Operational Kilgallioch Windfarm. The application boundary was therefore updated to show access from the main development site all the way to the public road (A714).  Following 'design chill' of the main onsite infrastructure more detail was added to the layout this included: <ul style="list-style-type: none"> <li>- Permanent met mast plus track (3m wide) and crane hardstanding (25m x 25m), located outwith any sensitive habitats and areas of deep peat, with a requirement for limited new access footprint and outwith wake disturbance from proposed turbine locations.</li> <li>- Layby added on the connecting track between the proposed Development and the Operational Kilgallioch Windfarm to comply with candidate turbine manufacturer's specifications. Elsewhere on site, hardstands, junctions etc. can act as passing places.</li> <li>- Indicative solar layout added, which maximise coverage of the 4 solar search areas and include 'power units' approximately for every 2 MW of installed capacity.</li> </ul> <p>Confirmatory detailed peat probing within proposed infrastructure footprint was undertaken on the basis of this layout.</p>
I (V11)	September 2019	<b>Design Freeze</b> – final amendments to the onsite infrastructure: the southern construction compound was removed from the layout and access track removed from the southernmost borrow pit to the site boundary in the south east. This was in response to concerns raised by local residents regarding the transport routes proposed, as well as technical and operational considerations.

Design Iteration	Date	Description
		Final peat probing information was used to review whether tracks may be cut or floating, which in turn allowed the final borrow pit yield requirements to be determined.

Table 3.2: Design Iterations for the Proposed Development

85. **Figure 3.4** shows the final Proposed Development layout overlaid onto the known environmental constraints identified within the main development area.

### 3.8.1 Site Access

86. It is proposed that the wind turbines would be likely delivered to the King George V Dock in Glasgow. The turbines would be moved from the port of entry to the Site under escort. The port of Cairnryan is much smaller, however this will also be considered as a potential alternative port of entry, and from here turbines would be moved south along the A77, A751, A75 and then the unclassified road past Newton Stewart and then north along the A714 to the Site entrance. In the case of King George V Dock, the turbines would be moved along the A74 (M) to the M6 where they would be turned northwards at junction 44, along the A75 to the unclassified road past Newton Stewart where they would join the A714. This route has previously been used during the construction of Arecleoch and Kilgallioch Windfarms and would minimise the amount of new and upgraded track required as part of the proposed Development.

87. HGV construction vehicles would access the Site from the A714, travelling south to the proposed Development main development area.

### 3.8.2 Site Tracks

88. The onsite access tracks have been designed to use existing Operational Kilgallioch Windfarm and onsite farm tracks as far as possible; whilst minimising cut and fill requirements in order to reduce the amount of ground disturbance, amount of material required for construction, loss of sensitive habitats, landscape and visual effects as well as minimising impacts to onsite farming practices. **Figure 3.9** provides the changes to the site access tracks through the design process.

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

### 3.8.3 Borrow Pit Search Areas

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

91. During design optimisation, the locations of infrastructure and track design was refined in order to minimise the amount of earthworks and cut and fill required to construct the proposed Development. The total number and size of borrow pit search areas was selected to meet the estimated volume of rock required to construct the tracks, crane hardstands and foundations.

92. If the proposed Development was consented, further intrusive geotechnical investigation would be carried out at the two borrow pit locations to establish whether they would yield the required quality of rock for each aspect of the infrastructure. It is unlikely that the full areas of the borrow pits as shown on **Figure 4.1a** would be required, but this gives flexibility in case there is low yield/quality identified at any location.

### 3.8.4 Temporary Construction Compound

93. A temporary construction compound has been located with the aim of limiting the effects on sensitive habitats and deep peat. Steep areas have been avoided to reduce the requirement for cut and fill. The construction compound has also been located for practical purposes; to control traffic entering the site, to be located close to the wind turbines and to facilitate construction of the substation.

94. At the beginning of the EIA process access to the Site was being considered from both the north west, through the Operational Kilgallioch Windfarm, and to the south east, from the C22W road, past the operational Airies Windfarm. Therefore, earlier infrastructure iterations looked at having two construction compounds; one in the north west and one in the south east. Once access to the Site was established as coming through the Operational Kilgallioch Windfarm, the compound to the south east was deleted.

### 3.8.5 Operations Building

95. The proposed operations building hosting the control room, and welfare and office facilities would be located on land which avoids sensitive habitats areas, deep peat and steep slopes. The location is shown on **Figure 4.1a**.

96. The operations building would be located greater than topple distance from the proposed turbines. The internal site grid connection cables would be undergrounded within the Site from each turbine to the operations building and on to the Operation Kilgallioch Windfarm substation, therefore having no visual impact.

### 3.8.6 Solar Search Areas

97. In April 2019, Arcus, on behalf of SPR, provided a feasibility assessment for ground mounted solar photovoltaic development across the proposed Development site. The assessment reviewed the known onsite constraints from a desk-based assessment in addition to solar irradiance at the site and site topography to establish the most suitable areas for ground mounted solar. The constraints included review of solar irradiance, topography, land use, hydrology, ecology and cultural heritage features.

98. The feasibility assessment arrived at six potential development areas (A to F) as shown on **Figure 3.10**. As the EIA has progressed and the baseline constraint mapping for the proposed Development has been updated through more detailed studies and site visits, the solar search areas were reviewed again and updated to six amended search areas. Once the turbine and associated infrastructure was determined, the six search areas were revisited, and viability assessed. Two search areas were removed from further consideration (D and F), due to their size, shape and location, leaving the four larger search areas in the northern extent of the site, also shown on **Figure 3.10**.

### 3.8.7 Application Boundary

99. Within the Kilgallioch Windfarm Extension *Scoping Report* (2019) the Site boundary was defined as an area approximately 550 ha (as shown in *Figure 1.2* of the report), encompassing the main development area of the Proposed Development Site. The Site boundary did not extend to the public road network as studies were still ongoing to determine the best access route to Site. Two route options were identified within the Scoping report (*Section 4.5*):

- 1: from the south east of the Site, along the A75 and the C22W road from near Kirkcowan, the same route that was used for construction of the Airies Windfarm; or
- 2: from the north west, from the A75 and A714, through Operational Kilgallioch Windfarm haul road through Forestry and Land Scotland land.

100. Following, detailed assessment and the consideration of concerns raised by local residents to the south of the Site, a decision was made to restrict construction traffic, including the transportation of the abnormal loads, to Option 1 above. The decision also removes construction traffic from the C22W, which was noted as a consultation route with regards to forestry extraction operations within in Dumfries and Galloway Council's Scoping Response.

101. As such, prior to submission of an application the Site boundary was amended to the Application boundary, shown in **Figure 1.1**. The revised boundary shows access from the main development site of the proposed Development to the public road network, at the A714. The Section 36 Application boundary has been extended into the administrative area of South Ayrshire Council. South Ayrshire Council and the ECU were notified of this in September 2019.

## 3.9 Micrositing

102. 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, a 50 m micrositing allowance is proposed around windfarm infrastructure. The technical assessments (presented in **Chapters 6 to 14**) have considered the potential for micrositing and it is considered that the proposed infrastructure could be microsited within 50 m without resulting in potential new environmental effects. During construction, the need for any micrositing would be assessed and agreed with the onsite Environmental Clerk of Works (EcoW).

## 3.10 Conclusion

103. The final layout has been informed by a robust EIA and design iteration process, taking into account potential environmental impacts and their effects, physical constraints, and health and safety considerations. The information used to inform the design iteration process included consultation responses received, extensive baseline data and the impact assessment undertaken. The final layout of the proposed Development is described in detail in **Chapter 4: Development Description** and shown on **Figure 4.1a**.
104. The principles of the EIA process, that Site selection and project design should be an iterative constraint-led process, have been followed as part of the proposed Development. This has ensured that potential adverse impacts, as a result of the proposed Development, have been avoided or minimised as far as reasonably possible.
105. The assessment of potential effects of the resulting layout is addressed in **Chapters 6 to 14** of the EIA Report. The effects remaining after mitigation and good practice have been applied are provided in **Chapter 15: EIA Summary**.

## 3.11 References

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