Document history

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Issue	Date	Revision Details
A	02/04/2025	Initial draft
B	30/04/2025	Update

Appendix 5.5

Night-time Landscape and Visual Impact Assessment of Aviation Lighting

Contents

5.5.1. Introduction

5.5.1.1. This report provides a Night-time LVIA of the proposed aviation lights (or 'Aviation Lighting Impact Assessment') which provides an assessment of the landscape, visual and cumulative effects of the aviation warning lights, required on five of the 11 turbines within the proposed development.

5.5.1.2. The visibility of aviation lights and the proposed Aviation Lighting Strategy is detailed in the *Visibility of Aviation Warning Lights, Report* (2024), prepared by Dr Stuart Lumsden (EIAR Volume 3 Technical Appendix 5.6) and illustrated in Figure 5.4.a.

5.5.2. Methodology

5.5.2.1 This assessment accords with the NatureScot (NS) *Guidance on Aviation Lighting Impact Assessment*, November 2024 and follows the same LVIA methodology used for the assessment of day-time landscape, visual and cumulative effects, set out in Appendix 5.1. The main difference being the night-time assessment period which covers the periods between dusk and dawn. Additionally, the assessment follows the NS, *General pre-application and scoping advice for onshore wind farms Guidance, Annex 2* (February 2024).

5.5.2.2 In broad terms the NS *Guidance on Aviation Lighting Impact Assessment* advises three steps as follows:

- Step 1: Defining the lighting proposal;
- Step 2: Understanding the baseline; and
- Step 3: Assessing the effects of the aviation lighting.

5.5.2.3 Importantly, the night-time assessment is not a technical lighting impact assessment based on quantitative measurement of light levels. Rather, the assessment relies on professional judgement and combines both qualitative analysis of what the human eye can reasonably perceive and quantitative analysis of the proposed light intensity at different distances and angles of elevation relative to the source, taking into account a range of factors such as meteorological conditions and the perception of darkness at the viewpoint or receptor location. As with the day-time landscape and visual assessment, the sensitivity of the receptor to the proposed development (aviation warning lights) and the magnitude of change are combined to determine the level of effect likely to result from the aviation warning lights. The evaluation of significance and the nature of these effects is also described following the methodology used for the assessment of landscape, visual and cumulative effects.

Defining the Study Area

5.5.2.4 The NS *Guidance on Aviation Lighting Impact Assessment* advises a study area of between approximately 10-20 km. Drawing from the receptor baseline a maximum study area of 20 km has been selected which includes most of the core area of the *Galloway Forest Dark Sky Park* as well as the park boundary and buffer zone.

5.5.2.5 Figure 5.4b provides a baseline of the night-time satellite imagery within 20 km of the proposed development, indicating areas of visible light and viewpoint locations. Further reference is made to this figure in section 1.4 'Step 2: Understanding the Baseline'.

Production of ZTV Plots

5.5.2.6 Night-time ZTVs of the proposed aviation warning lights were calculated using ReSoft Wind Farm computer software to produce an area of potential visibility of the aviation warning lights, calculated at hub height. The ZTV plots provide an indication of the areas from where the aviation warning lights may be theoretically visible. It does not take account of intervening screening from localised landform, buildings or vegetation. The ZTVs therefore provide a starting point in the assessment process and accordingly tend towards giving a 'worst-case' or over-estimated scenario of the potential visibility.

- **Figure 5.4c** provides a hub height ZTV within 20 km for the five turbines which would be lit by aviation warning lights positioned on their nacelles or hubs. The figure indicates the areas from which these lights would be theoretically visible and the number of lights visible.
- **Figure 5.4d.(Pages 1-2**) provides a light intensity ZTV (illustrated at 20 km to 15 km) indicating the variable light intensity likely to be perceived as a result of angle intensity mitigation, explained further section 1.3.
- **Figures 5.4e.(Pages 1-3**) provides cumulative ZTVs within 20 km indicating theoretical visibility of lit turbines including the proposed development and other wind farms with consented or proposed, visible aviation warning lights.

Consultation and Night-time Viewpoint Selection

5.5.2.7 A total of 20 viewpoints have been selected to represent a range of receptor groups, viewing from different directions over varying distances. Of these, three night-time viewpoints (Nos 7, 13 and 14) were selected for illustration as photomontages and more detailed night-time assessment which is set out in Annex 1 and summarised in Table 5.5.1. These night-time viewpoints are illustrated in Figure 5.20 and Figures 5.26-27. The remaining viewpoints have also been used in the night-time assessment as they represent locations where people are most likely to be present at night, for example in settlements / residential properties or on roads.

5.5.2.8 Viewpoint N7 was selected due to its location as the former Dark Sky Observatory which was destroyed by fire. The new site for the Dark Sky Observatory has been confirmed at the former Clatteringshaws Visitor Centre on the A712 near Clatteringshaws Loch[1]. This location is outwith the blade tip and the hub height ZTV and would have no visibility of the proposed development during either day or night. Viewpoint N7 however, retains some relevance due to its location on a forest track, within the Craigengillan Estate and Garden and Designed Landscape (GDL) which is open to the public.

Table 5.5.1 Night-time Viewpoint Selection

Viewpoint Selection	Distance (km)*	Comments
N7. Craigengillan Estate (former Dark Sky Observatory)	5.9km	This viewpoint is no longer representative of the former Dark Sky Observatory, due to the planned new location at Clatteringshaws Loch. The viewpoint is however located within the Craigengillan Estate GDL.
N13. Cairnsmore of Carsphairn	9.2km	Hill summit to the southeast.
N14. Blackcraig Hill	10.7km	Hill summit to the east.

*Note: *Distance to nearest proposed turbine within the proposed development.*

[1] https://www.bbc.co.uk/news/articles/c0mzppkw8pyo

Photography and Photomontage Production

5.5.2.9 The methodology used for viewpoint photography and photomontage production accords with the NS *Guidance Visual Representation of Wind Farms*[2]. Further guidance is provided by the Landscape Institute's Technical Guidance Note, *Visual Representation of Development Proposals*[3]. The baseline photography is recorded during the twilight period, which corresponds with periods when people are more likely to be outside at night and allows a visible horizon which is required in order to correctly render the photomontages.

5.5.2.10 To accord with NS *Guidance on Aviation Lighting Impact Assessment* the photomontage visualisations illustrate the maximum case lighting intensity scenario (e.g. 200 cd where dimming of aviation lights proposed as embedded mitigation, and 2000 cd only where this mitigation is not proposed). Therefore, in this case the photomontages for the three viewpoints show the reduced number of aviation warning lights, illustrated at 200 cd only. The images do not attempt to show angle intensity mitigation and consequently may, in some cases of lower elevation relative to the aviation warning lights, over-estimate the light intensity.

5.5.2.11 The photomontages are considered useful when combined with objective data illustrated in the ZTV plots and wireline figures. However, whilst the aim is to provide a reasonably realistic image of the proposed development, the NS guidance recognises the limitations of both night-time photography and photomontages. These limitations include multiple variables of distance, partial screening, atmospheric conditions, time of night and darkness for example. Therefore, the photomontage production has relied on professional judgement and an 'artistic impression' and has drawn from our experience, noting previous consultee comments and comparison of previous photomontages with other lit onshore wind turbines post construction.

5.5.2.12 Each of the photomontages has the following limitations as advised in the NS guidance Visual Representation of Wind Farms:

- "*A visualisation can never show exactly what the wind farm will look like in reality due to factors such as: different lighting, weather and seasonal conditions which vary through time and the resolution of the image;*
- *The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate;*
- *A static image cannot convey turbine movement, or flicker or reflection from the sun on the turbine blades as they move;*
- *The viewpoints illustrated are representative of views in the area, but cannot represent visibility at all locations;*
- *To form the best impression of the impacts of the wind farm proposal these images are best viewed at the viewpoint location shown;*
- *The images must be printed at the right size to be viewed properly (260mm by 820mm);*
- *You should hold the images flat at a comfortable arm's length. If viewing these images on a wall or board at an exhibition, you should stand at arm's length from the image presented.*
- *The ZTV presented here takes no account of the screening effects of vegetation or buildings*."

5.5.3. Step 1: Defining the Lighting Proposal

5.5.3.1 The proposed Aviation Lighting Strategy is illustrated in Figure 5.4.a. It meets the mandatory requirements of civilian and military aviation whilst minimising the effects of the aviation warning lights on the surrounding environment. In this regard, account has also been taken of EAC's *Local Development Plan 2*, Policy TOUR 4: The Dark Sky Park and *Supplementary Guidance on Dark Sky Park Lighting*, 2024.

Aviation Lighting Requirements

5.5.3.2 The requirements for turbine lighting are dictated by Civil Aviation Authority (CAA) policy and the Ministry for Defence (MOD) to ensure aviation safety in accordance with Article 222 of the *UK Air Navigation Order* (ANO) 2016.

5.5.3.3 It should be noted that aviation warning lights provided for onshore wind farms are different from other lights and should not be compared to lights on other wind turbines, offshore turbines, buildings or masts as the specification and mitigation employed is likely to be different. For example, further guidance is provided in the CAA policy statement '*Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in excess of 150m Above Ground Level'* which interprets the regulations in relation to wind turbines and the need for aviation warning lights. In addition, there may be other site-specific mitigation approved by the CAA and the local planning authority.

5.5.3.4 The CAA policy statement advises that steady medium intensity, 2000 candela (cd) red, aviation warning lights are fitted as close as possible to the top of all fixed structures which have a total height of ≥150 meters above ground level as follows:

- *"(a) The person in charge of the wind turbine generator must ensure that it is fitted with a medium intensity (2000 candela) red light, positioned as close as practicable to the top of the fixed structure. A second light serving as an alternative should be provided in case of failure of the operating light.*
- *(b) The lights required by paragraph (a) must be so fitted to show when displayed in all directions without interruption.*
- *(c) Additionally, at least three (to provide 360 degree coverage) low-intensity Type B6 lights (32 candela) lights should be provided at an intermediate level of half the nacelle height.*
- *(d) Subject to sub-paragraphs (e) and (f), the person in charge of a wind turbine generator must ensure that any light required to be fitted by this article is displayed.*
- *(e) Lights should be operated by an acceptable control device (e.g., photocell, timer, etc.) adjusted so the lights will be turned on whenever illuminance reaching a vertical surface falls below 500 LUX. The control device should turn the lights off when the illuminance rises to a level of 500 LUX or more.*
- *(f) In the event of the failure of any light which is required by this policy statement to be displayed, the person in charge of a wind turbine generator must repair or replace the light as soon as practicable. For any outage that is expected to be or is greater than 12 hours, the operator shall request a NOTAM to be issued by informing the NOTAM section (operating 24 hours) of the UK Aeronautical Information Service (AIS) by telephoning +44(0) 1489 61 2488 / 2489 as soon as possible. This NOTAM is to specifically state (with justification) if the repair/replacement of the light will exceed 72 hours. AIS will copy the details of the NOTAM to the operator and to the CAA.*
- *(g) If the horizontal meteorological visibility in all directions from every wind turbine generator in a group is more than 5km, the intensity for the light positioned as close as practicable to the top of the fixed structure required to be fitted to any generator in the windfarm and displayed may be reduced to not less than 10% of the minimum peak intensity specified for a light of this type*."

5.5.3.5 The ANO also requires aviation warning lighting are fitted to cranes, which would be relevant to the construction period.

- "*Away from the immediate vicinity of an aerodrome and where the maximum crane height is less than 150 meters aviation warning lighting is not a legal requirement. However, given the likelihood that such cranes will be amongst the tallest structures in any given location the CAA recommends that, in order to ensure that*

[2] Scottish Natural Heritage (February 2017). Visual Representation of Wind Farms, Version 2.2.

[3] Landscape Institute (September 2019). Visual Representation of Development Proposals, Technical Guidance Note 06/19

the crane operator fulfils his duty of care towards others, the crane user (contractor) considers using aviation warning lighting in line with the following: - Cranes that are between 90 meters and 150 meters (approximately 300 – 500 feet) high being equipped with medium intensity steady red lighting positioned at the highest point and both ends of the jib, such that the lighting will provide an indication of the height of the crane and the radius of the crane jib. Such lighting, which should be displayed at night, should be positioned so that when displayed it is visible from all directions. - Cranes that are 60 meters to 90 meters (approximately 200 – 300 feet) high being equipped with low intensity steady (generically 32 candela) red lighting positioned as close as possible to the highest point and, for tower cranes, to the top of the fixed structure. Such lighting, which should be displayed at night, should be positioned so that when displayed it is visible from all directions."

Local Plan Policy and Supplementary Guidance

5.5.3.6 The proposed development is approximately 15km distance from the core area of the Galloway Forest Dark Sky Park and beyond the buffer zone, although it is within the wider 'transition zone'. EAC's *Local Development Plan 2*, Policy TOUR 4: The Dark Sky Park advises "*the Council will encourage developers to take account of the Dark Sky Park designation and take measures to limit light pollution, in line with the measures set out in the Dark Sky Park Lighting Supplementary Guidance.*"

5.5.3.7 The *Supplementary Guidance on Dark Sky Park Lighting*, 2024 does not offer specific advice on aviation warning lights for onshore wind turbines and the checklist on page 8 is largely aimed at domestic or business development. The guidance does however "*encourage developers to take account of the Dark Sky Park designation and take measures to limit light pollution*" which has been included in the proposed development as evidenced by the Aviation Lighting Strategy. The Aviation Lighting Strategy has been approved by the CAA and includes a range of mitigation that comprises the 'best currently available'[4] and as far as possible follows the Good Lighting Practice Guidance set out on pages 10-11 and Appendices 3-4 of the Supplementary Guidance. This includes reference to the 'angle of light' which has been included in the Aviation Lighting Strategy as 'angle intensity mitigation'. Appendix 3 of the Supplementary Guidance refers to wind turbines and advises "*preferable for maximum of infrared lights to be used*" within the transition zone. This advice however does not accord with the mandatory requirements of the CAA policy for visible aviation warning lights to ensure aviation safety in accordance with Article 222 of the UK Air Navigation Order (ANO) 2016.

5.5.3.8 All of the mitigation measures included within the Aviation Lighting Strategy have been embedded into the proposed development and as such is termed 'embedded mitigation'.

Embedded Mitigation

5.5.3.9 Mitigation embedded into the Aviation Lighting Strategy entails the following:

- Reduced number of aviation warning lights:

  The number of lights has been reduced from 11 to five (T1, T4, T5, T9 and T10) and the need for mid-tower lights (three on each turbine to provide 360° coverage) has been removed.

- Dimming of aviation warning lights to 10%:

  The proposed lights will dim to 10% of the light intensity (2000 cd reducing to 200 cd) during periods of clear visibility (>5km from the wind farm), increasing to 2000 cd when the visibility sensors detect poor visibility (<5km from the wind farm).

  The lights are designed to accord with CAA SARG Policy Statement (g)[5] "*If the horizontal meteorological visibility in all directions from every wind turbine generator in a group is more than 5km, the intensity for the light positioned as close as practicable to the top of the fixed structure required to be fitted to any generator in the windfarm and displayed may be reduced to not less than 10% of the minimum peak intensity specified for a light of this type*."

  NS *Guidance on Aviation Lighting Impact Assessment, Appendix 3*, November 2024, advises that the frequency of dimming will typically occur "*90% to 95% of the time*". This observation is supported by the *Visibility of Aviation Warning Lights, Report* (2024), prepared by Dr Stuart Lumsden (EIAR Volume 3, Technical Appendix 5.6) which also notes that "*most of the time when the lights will operate at 2000 candela will be in conditions where they will not be seen beyond 5km" due to the effects of cloud cover*."

- Angle intensity mitigation

  Also described as 'vertical directional intensity mitigation'). The design of aviation warning lights must also comply with the International Civil Aviation Organisation (ICAO) specification as set out in Annex 14 Table 6-3. This limits the 2000 / 200 cd light emission to a narrow 'beam spread' with a vertical angle of between 0° to +3° and creating a 'horizontal beam of light' that extends out in all (360°) directions. This form of mitigation can be very effective for those receptors located in valleys or low-lying areas relative to the elevation of the aviation warning lights as illustrated in Plate 1 and explained further below.

  This reduction in light intensity is illustrated via the ZTV shown in Figure 5.4d.

5.5.3.10 The aviation warning lights proposed as part of the Lighting Strategy are automated products (operating with visibility sensors, GPS / timers and / or light sensor combinations) that are designed to automatically control the light intensity between 2000 / 200 cd according to the meteorological conditions. These lights can also be operated remotely 'on' / 'off', 'emergency flash', 'maintenance off' and 'test on' for example. There are a range of manufacturers such as CEL, Luxsolar, Quantec, and Delta.

Angle intensity mitigation

Angle intensity mitigation is further illustrated in Plate 1.

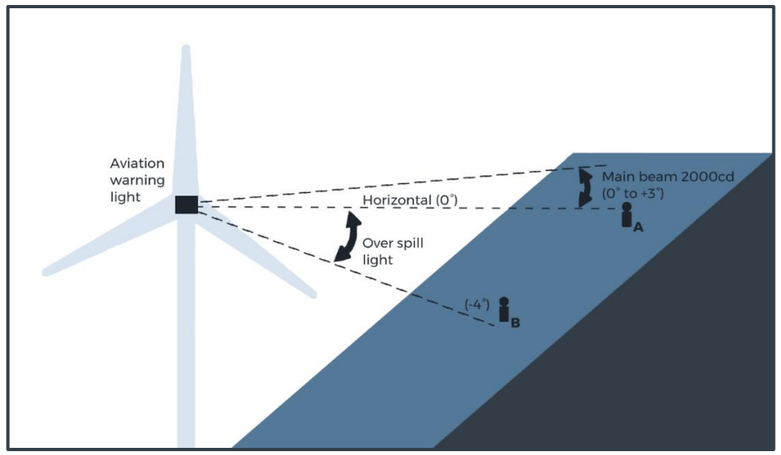

Plate 1: Diagram of aviation warning light operating with a narrow horizontal beam (not to scale).

[4] 'Best currently available' refers to the embedded mitigation that has been approved by the CAA and the use of lights that will provide reduced angle intensity mitigation, noting that the specification and performance of these lights has improved in recent years. Other forms of mitigation such as aircraft detection lighting systems (ADLS) are not currently permitted in the UK.

[5] CAA, Safety and Airspace Regulation Group (SARG) dated 1/6/2017, Policy Statement, *Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in excess of 150m Above Ground Level*.

5.5.3.11 The diagram shows an aviation warning light positioned on the turbine hub or nacelle and emitting a focused or narrow horizontal beam of light at between 0° (horizontal) and +3° in all directions (360°) from the light position. The light intensity within the beam (0° to +3°) is 2000 / 200 cd[6]. A small amount of over spill light is unavoidably emitted outwith this beam and has a lower intensity than the horizontal or 'direct beam' of light. The reduced angle intensity mitigation for angles below 0° (e.g. 0° to -4°) is set out in Table 5.4.2.

5.5.3.12 Person 'A' standing on a hillside for example, Enoch Hill (approximately 2 km to the west of the proposed development with a summit of 569 m AOD), would be almost level with the horizontal beam of light with the lit turbines located between 360 m and 469 m AOD. They would therefore see the full intensity of the lights at either 2,000 cd (when the light sensors detect that visibility from the lit turbines is < 5 km) or 200 cd (when the light sensors detect that the visibility in all directions is >5 km from the lit turbines). Figure 5.4d indicates that the light intensity on top of Enoch Hill would range between 2,500 to 2200 cd (when the light sensors detect that visibility from the lit turbines is <5 km) reducing to 250 to 220 cd (when the light sensors detect that the visibility in all directions is >5 km from the lit turbines).

5.5.3.13 Person 'B' located lower down in the landscape, for example at Viewpoint 20: B741 east of Dalmellington (Figure 5.33a-f) would be below the horizontal beam of light (less than -3°) which would appear at a reduced intensity (over-spill light). Figure 5.4d indicates that the light intensity along the B741 between Dalmellington and Nith Lodge would range between 220 to <170 cd (when the light sensors detect that visibility from the lit turbines is <5 km) to as little as 22 to <17 cd (when the light sensors detect that the visibility in all directions is >5km from the lit turbines).

5.5.3.14 People located outwith the ZTV (in the 'non-coloured' areas of the ZTV) shown in Figure 5.4c, for example much of Dalmellington and Bellsbank, would have no view of the lights.

Table 5.5.2 Intensity of turbine light shown in candelas (cd)

Angle of light	Example light specification based on NS Guidance: CEL MI-2KR		Example light specification: LuxSolar Medium Intensity Obstruction Light CAP 168 MIOL-C	
Light intensity:	2000 cd	200 cd	2000 cd	200 cd
+3° to 0°	2500 / 2200	250 / 220	2000	200
0° to -1°	2200 to 980	220 to 98	2000 to 750	200 to 75
-1° to -2°	980 to 420	98 to 42	750 to 80	75 to 8
-2° to -3°	420 to 220	42 to 22	80 to 40	8 to 4
-3° to -4°	220 to 170	22 to 17	40 to 10	4 to 1
Below -4°	Below 170	Below 17	Below 10	Below 1

5.5.3.15 NS's *Guidance on Aviation Lighting Impact Assessment, Appendix 3*, November 2024, Table 4 provides an example of the range of light intensity according to the angle of light projected from the light source. It ranges from maximum light intensity within the horizontal beam (+3° to 0°) to the lower intensity or 'over spill' light outside the horizontal beam. The NS example in Table 4 of the guidance is repeated in Table 5.5.2 (shown in the key for Figure 5.4c) and is based on light specification CEL MI-2KR. It has been used as the basis for this night-time LVIA of the aviation warning lights, although the model has since been superseded and equivalent or improved lights would be specified post application.

5.5.3.16 By way of comparison, Table 5.4.2 also sets out the specification for the angle intensity mitigation for the more recently availiable LuxSolar Medium Intensity Obstruction Light CAP 168 MIOL-C.

Further Mitigation Measures for Aviation Lighting

Other alternative forms of mitigation include the use of various forms of aircraft detection lighting systems (ADLS). However, although used in Europe and elsewhere, it is not currently permitted in the UK.

Summary of Proposed Aviation Lighting Strategy

5.5.3.17 The proposed Lighting Strategy has been approved by the CAA under the provisions of the Air Navigation Order (ANO) Article 222 section 6 as follows:

- "*Medium intensity, steady red (2000) lights fitted to the nacelles of five turbines (T1, T4, T5, T9, and T10);*
- *a second 2000 candela light on the nacelles of the above turbines to act as alternate in the event of a failure of the main light (note that both lights should not be lit at the same time);*
- *lights capable of being dimmed to 10% of peak intensity when the lowest visibility (as measured at suitable points around the wind farm by visibility measuring devices) exceeds 5 km*".

5.5.3.18 The CAA approval also refers to infra-red lighting (not visible to the human eye and therefore not relevant to this assessment) and confirms that mid-tower, intermediate 32 cd lights are not required to be fitted on the turbine towers. If the proposed design of the wind farm changes (other than variations due to micro-siting etc.) this is likely to require a revision to the CAA approved Aviation Lighting Strategy.

Notably the CAA approval does not refer to angle intensity mitigation and the exact specification is a matter for the developer and the planning authority. Accordingly, the developer is willing to accept a planning condition to secure angle intensity mitigation (equal or better than the CEL MI-2KR light specification example in Table 5.4.1) as advised in the NS Guidance although this is not a mandatory requirement.

Annual and Night-time Operation of Aviation Warning Lights

5.5.3.19 The aviation warning lights will operate automatically via a light sensor or timer and will generally 'switch on' 30mins after sunset (when the disc of the sun has passed below the horizon) and 'switch off' 30 m before sunrise. Table 5.5.3 sets out the annual and night-time operation of the aviation lights between dusk and dawn, which can be used to compare periods when people are most likely to be outdoors and coinciding with when the aviation lights would be switched on.

5.5.3.20 During the summer months, most people, including hill walkers are unlikely to experience the aviation warning lights. For example, during the summer solstice 2024 the aviation warning lights would switch on at 22.33 and switch off at 04.00 in the morning. Local residents and local road users are more likely to experience the aviation warning lights during the winter months. For example, during the winter solstice 2024 the lights would come on at 16.17 and switch off at 08.13 in the morning. It is also reasonable to expect that most people would be commuting or indoors during these periods of colder weather, during the twilight and night, and would experience the aviation warning lights incidentally to their main activity.

[6] NS *Guidance on Aviation Lighting Impact Assessment*, Appendix 3, November 2024, paragraph 9 advises "*In reality, 2000 cd branded lights are actually brighter in the middle of the beam (at +1 degree) than 2000 cd, as it is difficult to meet the average intensity requirement without exceeding it at some point in the beam spread. A modern light may for example be 2500 cd in the centre of the beam, and some older lights may be even brighter. For the sake of relative simplicity, however, and noting that there is also a degree of inaccuracy inherent when illustrating lighting, '2000 cd' is referred to as the worst case (or 200 cd where dimming is proposed).*"

Table 5.5.3 Annual and Night-time Operation of Aviation Warning Lights

Time **periods between Sunset and Sunrise in Dalmellington**	**Spring Equinox** 20 Mar 24	**Summer Solstice** 20 June 24	**Autumn Equinox** 22 Sept 24	**Winter Solstice** 21 Dec 24
Astronomical twilight begins (full darkness ends)	04:12	N/A	04:56	06:23
Nautical twilight begins (First light)	04:58	N/A	05:42	07:08
There is some lightening of the sky which may be pale or reddish at the eastern edge. Trees and buildings can be seen sharply against the sky, but it's still very dim on the ground - it would be easy to step into a hole, and pedestrians would be carrying torches / head torches. Cyclists would need lights.				
Dawn - Civil twilight begins (~1hour before sunrise)	05:41	03:33	06:26	07:57
At the start of civil twilight, the sky tends to be light blue and colours of objects are easier to detect. By the midpoint, you can read a newspaper outside under open sky. Pedestrians no longer need torches but would wear reflectors or bright clothing if they're near traffic, especially on an overcast day.				
Aviation warning lights switch off ~30m before sunrise.				
Sunrise (Sun disk passes above the horizon)	06:18	04:33	07:03	08:43
Daytime	-	-	-	-
Sunset (Sun disk passes below the horizon)	18:31	22:03	19:14	15:47
Aviation warning lights switch on ~30m after sunset, subject to visibility				
Dusk - Civil twilight ends (~1hour after sunset)	19:08	23:04	19:51	16:33
Reverse of the morning progression. Sky starts out pale but dusky, often pinkish. Streetlights come on. Good visibility for exercising outside, but towards the end of this period pedestrians may wear reflectors if near vehicle traffic.				
Nautical twilight ends (Nightfall)	19:52	N/A	20:34	17:22
Reverse of the morning progression. The brightest planets become visible, all but the most vibrant colours are muted to shades of grey. Walkers would need head torches, particularly in trees. By the end of nautical twilight, it is night for most purposes.				
Astronomical twilight ends (full darkness starts)	20:38	N/A	21:20	18:07
Midnight (darkest skies)	-	-	-	-

5.5.4. Step 2: Understanding the Baseline

5.5.4.1 The night-time assessment or 'darkness survey' is supported by baseline observation of the existing night-time environment or 'darkness' whilst on site and observation of existing lights / lit structures visible at night from the viewpoint locations and associated landscape and visual receptors. The night-time assessment is also supported by baseline photography, wirelines, and photomontages from selected viewpoints. These visualisations help to assess both the level of night-time visual impact for receptors and focus the assessment.

5.5.4.2 The night-time assessment involves visiting the viewpoint locations during periods of twilight and viewing visualisations prepared for each viewpoint location. The fieldwork is conducted in periods of fine weather with clear skies and considers seasonal changes such as reduced leaf cover or hedgerow maintenance. A range of viewpoints were examined in detail and analysed to determine whether a significant visual effect would occur. By arranging the viewpoints in order of distance it is possible to define a threshold or outer limit, beyond which there would be no further significant effects.

5.5.4.3 The following site observations are considered during the night-time assessment:

- Areas of darkness with no artificial light;
- Direct artificial lighting (where the light source is directly visible from the viewpoint);
- Indirect artificial lighting (where the light source is not visible but the light emanating from the light source is visible as in the case of 'sky glow');
- Static lighting, for example emanating from a residential property or streetlight; and
- Mobile or transient lighting, for example associated with moving vehicles, trains, or aircraft.

5.5.4.4 Baseline photographs at each of the Night-time Assessment viewpoints are recorded for each of the night-time visualisations.

5.5.4.5 Figure 5.4b shows a night-time satellite image of the 20 km study area and provides an indication of the existing baseline, visible light sources within the study area. Most of the existing light sources are located in the northern part of the study area and focused on the settlements of Dalmellington, Burnton, Bellsbank, Patna, Cumnoch, New Cumnock, Drongan and Ochiltree. The site area and surroundings, and areas further to the south, in the southern part of the study area are unlit and dark.

5.5.4.6 It should be noted that there are no existing wind farms with aviation warning lights within the 20 km Study Area. There are however known to be three consented wind farms with proposed aviation warning lights at Overhill, Windy Standard Phase III and Sanquhar II.

5.5.5. Step 3: Assessing the effects of the aviation lighting

5.5.5.1 This part of the Night-time LVIA of Aviation Lights comprises ZTV and Viewpoint analysis and two further sections setting out the night-time assessment of landscape effects and the night-time assessment of visual effects.

Night-time ZTV Analysis

5.5.5.2 The Night-time Assessment is supported by Zone of Theoretical Visibility (ZTV) plots that illustrate the areas from where in theory, the aviation warning lights would be visible as follows:

- **Figure 5.4.c:** Aviation Lighting (Hub Height) ZTV with Viewpoints

  Provides a hub height ZTV of the five lit turbines within 20 km. It indicates where the lit turbines would be theoretically visible (subject to the screening of landform, buildings and vegetation) but not the light intensity.

It indicates that all five of the lit turbines would tend to be most visible to the north, west and southwest of the proposed development.

- **Figure 5.4.d** (**Pages 1-2**): ZTV of Aviation Lighting Angle Intensity Mitigation

  Provides a light intensity ZTV for both the 2000 cd and 200 cd scenarios across the study area, illustrated at 15 km and 20 km radius. It indicates where the lit turbines would be theoretically visible (subject to the screening of landform, buildings and vegetation) and the light intensity. The areas of lowest light intensity correspond with the low-lying areas along the Doon Valley to the west and areas along the B741 to the north of the proposed development. These areas coincide with the majority of the receptors within settlements / residential properties and on roads. Conversely hill summits (the closest being to the south and east) would experience the greatest light intensity.

- **Figure 5.4.e** (**Pages 1-3**): Cumulative night-time ZTV with Viewpoints

  Provides a cumulative ZTV for other lit turbines associated with consented wind farms and other wind farm applications within 15 km of the proposed development as follows:

- **Figures 5.4e** (**Page 1)** illustrates the cumulative ZTVs for the proposed development and the consented schemes within 15 km:
  - Windy Standard Phase III to the south (12No. turbines lit);
  - Sanquhar II to the southeast (19No. turbines lit); and
  - Overhill to the north (7No. turbines lit).
  - None of the existing wind farms within 20 km have visible aviation warning lights.
- **Figures 5.4e** (**Page 2**) illustrates the cumulative ZTVs for the proposed development and other application schemes:
  - Windy Standard Repower to the south (5No. turbines lit);
  - Quantans to the south (5No. turbines lit);
  - Knockkippen to the northwest (7No. turbines lit); and
  - Scienteuch to the northwest (8No. turbines lit).
- **Figures 5.4e** (**Page 3**) illustrates the cumulative ZTVs for the proposed development and other application schemes:
  - Euchanhead to the southeast (all 21No. turbines lit);
  - Lorg Variation to the southeast (5No. turbines lit);
  - Carrick to the north (all 13No. turbines lit); and
  - Knockcronal to the north (6No. turbines lit).

5.5.5.3 The ZTVs do not take account of the screening effects of buildings, localised landform, and vegetation. As a result, there may be roads, tracks, and footpaths within the study area which, although shown as falling within the ZTV, are screened or filtered by built form and vegetation. It is also important to note that the light intensity ZTVs do not take account of distance or other factors such as atmospheric conditions, cloud obscuration or partial vegetation screening.

Night-time Viewpoint Analysis

5.5.5.4 Analysis of the number of aviation warning lights theoretically visible from each viewpoint in accordance with the NS advice (*General Pre-application and Scoping Advice for Onshore Wind Farms, Annex 2* – SNH, August 2022) is provided in Table 5.5.4.

Table 5.5.4 Summary of Night-time Viewpoint Analysis

Viewpoint No. and Title	T1	T4	T5	T9	T10
1. Picnic area off the A713	-	✓	-	-	-
2. Bellsbank	-	-	-	-	-
3. Dalmellington Church	-	-	-	-	-
4. A713 West of Dalmellington	✓	✓	✓	✓	✓
5. Bogton Loch*	✓	✓	✓	✓	✓
6. Craigengillan House (Front Door)*	-	-	-	-	-
7. Craigengillan Estate (former Dark Sky Observatory)*	✓	✓	✓	✓	✓
8. Berbeth*	✓	✓	✓	✓	✓
9. South of Beoch House Loch Doon*	-	-	-	-	-
10. Auchenroy Hill*	✓	✓	✓	✓	✓
11. B741 West of Dalmellington	✓	✓	✓	✓	✓
12. B741 Bankglen	-	-	-	✓	-
13. Cairnsmore of Carsphairn	✓	✓	-	✓	✓
14. Blackcraig Hill	✓	✓	✓	✓	✓
15. New Cumnock	-	-	-	✓	-
16. Patna Memorial	✓	✓	-	-	✓
17. A76 South of Mauchline	✓	✓	✓	✓	✓
18. Merrick Summit **	✓	✓	✓	✓	✓
19. Carrick Hills	✓	✓	✓	✓	✓
20. B741 East of Dalmellington	✓	✓	✓	-	✓

** The viewpoint located within the buffer zone of the Galloway Forest Dark Sky Park.*

*** The viewpoint located within the core area of the Galloway Forest Dark Sky Park.*

5.5.5.5 More detailed analysis of the viewpoints is provided in Table 5.5.5. Each of the three night-time viewpoints are analysed further in Annex 1, which includes a darkness survey describing the baseline night-time environment. Other cumulative wind farm applications within the 45 km study area that require aviation warning lights (turbines ≥150 m to blade tip height) are illustrated in the wirelines where visible.

5.5.5.6 Allowing for the embedded mitigation and the influence of existing lights from settlements in the Doon Valley, the viewpoint analysis has determined that none of the viewpoints would be significantly affected by the proposed

aviation warning lights. This includes six viewpoints which are located within the buffer zone of the *Galloway Forest Dark Sky Park* (Viewpoints 5 to 10) and one viewpoint (Viewpoint 18. Merrick Summit) which is located within the core area of the *Galloway Forest Dark Sky Park*.

5.5.5.7 Off the six viewpoints within the buffer zone of the *Galloway Forest Dark Sky Park*, two would have no view of the proposed lights due to landform screening.

5.5.5.8 The remaining four viewpoints include Viewpoint 5: Bogton Loch – located on a minor road and Scottish hill track; Viewpoint 9: Berbeth – located on a core path; Viewpoint N7: Craigengillan Estate (former Dark Sky Observatory) – located on a forest track; and Viewpoint N10: Auchenroy Hill located on a hill summit that is well walked.

5.5.5.9 All of these viewpoints are representative of views that may be experienced by walkers albeit in low numbers at night. None of these locations are *Galloway Forest Dark Sky Park* recommended night-time viewpoints although they have all been assessed as of High sensitivity. All of these viewpoints would view west across the Doon Valley, out of the *Galloway Forest Dark Sky Park*, and away from the core zone. In all cases the views towards the Doon Valley at night include views of multiple existing lights from roads and settlements at locations such as Burnton, Bellsbank, and Dalmellington. The addition of up to four aviation warning lights visible from these locations would appear as points of light above the settlements / horizon and the magnitude of change has been assessed as Low, resulting a Moderate effect due to the high sensitivity of the receptor. Taking account of all these factors together and noting the low magnitude of change affecting views 'out' of the *Galloway Forest Dark Sky Park* (as opposed to views 'into' the Park) it is considered that the Moderate level of night-time effects at these viewpoints would not be significant.

5.5.5.10 Views from elevated areas in particular (e.g. Viewpoints N10: Auchenroy Hill, N13 Cairnsmore of Carsphairn and N14: Blackcraig Hill) are likely to be significant when considering the combined cumulative effects of multiple lit wind farms, particularly if a worst case of no mitigation is assumed for other wind farm applications. Notably the proposed development would have a non-significant contribution from the proposed development.

Table 5.5.5 Summary of Night-time Viewpoint Analysis

Viewpoint No. and Title	Distance (km)	Sensitivity	200cd Intensity		Comments
			Magnitude	Level of Effect	
1. Picnic area off the A713	3.2km	High (tourists / walkers)	Low to Very Low	Moderate to Minor	One light would be viewed from the road junction / entrance and exit to car-parking area with picnic area set further back. The angle intensity mitigation would also reduce the lights to 42-22 cd.
2. Bellsbank	3.9km	Low (residents[7])	Zero	No View	-
3. Dalmellington Church	3.6km	Low (residents)	Very Low	Negligible	Viewed from within the settlement with multiple light sources resulting in low sensitivity and limited (Very Low) magnitude. The angle intensity mitigation would reduce the lights to between 22-17 cd.
4. A713 West of Dalmellington	4.9km	Medium to Low (road users)	Low	Minor to Negligible	Viewed from road towards Dalmellington with multiple light sources reducing the effect of the five lights. The angle intensity mitigation would reduce the lights to between 42-22 cd.
5. Bogton Loch*	5.2km	High (walkers)	Low	Moderate	The viewpoint is located within the buffer zone of the *Galloway Forest Dark Sky Park*, viewing across the Doon Valley towards Dalmellington and away from the Park. There are multiple existing light sources from settlements viewing in this direction and (discounting vegetation screening) the angle intensity mitigation would further reduce the lights to 42-22 cd. For all these reasons it is considered that the Moderate visual effects would not be significant.
6. Craigengillan House (Front Door)*	5.5km	High (resident)	Zero	No View	-
N7. Craigengillan Estate* (former Dark Sky Observatory)	5.9km	High (tourists / walkers)	Low	Moderate	See Annex 2. The viewpoint is located within the buffer zone of the *Galloway Forest Dark Sky Park*, viewing across the Doon Valley and away from the core area of the *Galloway Forest Dark Sky Park*. Lights from settlement at Bellsbank (further to the north) would be clearly visible in the context of these lights and are a characteristic of the view in this direction. Views in other directions (viewing into the Park) are foreshortened by landform and although dark there is limited connection with the core area of the *Galloway Forest Dark Sky Park* at this location. For all these reasons it is considered that the Moderate visual effects would not be significant.
8. Berbeth*	5.4km	High (walkers)	Low	Moderate	The viewpoint is located within the buffer zone of the *Galloway Forest Dark Sky Park*, viewing across the Doon Valley towards Bellsbank and away from the *Galloway Forest Dark Sky Park*. There are however multiple existing light sources from settlements viewing in this direction and (discounting vegetation screening) the angle intensity mitigation would further reduce the lights to 42-22 cd. For these reasons it is considered that the Moderate visual effects would not be significant.
9. South of Beoch House Loch Doon*	8.3km	High (resident)	Zero	No View	-
10. Auchenroy Hill*	6.7km	High (walkers)	Low	Moderate	The viewpoint is located within the buffer zone of the *Galloway Forest Dark Sky Park*, viewing across the Doon Valley towards Dalmellington and Bellsbank from the hill summit and away from the *Galloway Forest Dark Sky Park*. There are multiple light sources from roads and settlements, viewed in numerous locations along the Doon valley and away from the core zone of the Park. Although the angle intensity mitigation would have a limited effect (with the lights appearing at 200 cd and elevated above the settlement) the

[7] Residents within settlements are judged as of low sensitivity due to the higher number of existing light sources within built-up areas as set out in Table 1 of the NS *Guidance on Aviation Lighting Impact Assessment*, November 2024.

Viewpoint No. and Title	Distance (km)	Sensitivity	200cd Intensity		Comments
			Magnitude	Level of Effect	
					lights from the settlements would remain the main characteristic of this view in this direction. Views towards the *Galloway Forest Dark Sky Park* in the other directions would not be affected. For all these reasons it is considered that the Moderate visual effects would not be significant.
11. B741 West of Dalmellington	7.2km	Medium (road users)	Low	Minor	Viewing across the Doon Valley towards Bellsbank with multiple light sources. The lights would appear along the horizon, above the valley, in the direction of travel. The angle intensity mitigation would reduce the lights to 98-42 cd. The lights from the settlements would remain the main characteristic of this view from the road, appearing in the direction of travel.
12. B741 Bankglen	7.8km	Medium (road users)	Very Low	Negligible	One light viewed from the road with scatted lowland light sources from farms and residents. The angle intensity mitigation would reduce the lights to 42-22 cd.
N13. Cairnsmore of Carsphairn	9.2km	High (walkers)	Low - Very Low	Moderate to Minor	See Annex 2. The lights would be viewed at 200 cd in the context of other distant light sources from settlements and theoretically other consented / application wind farms.
N14. Blackcraig Hill	10.7km	High (walkers)	Low - Very Low	Moderate to Minor	See Annex 2. The lights would be viewed at 200 cd in the context of other distant light sources from settlements and theoretically other consented / application wind farms.
15. New Cumnock	10.8km	Low (residents)	Very Low	Negligible	Viewed at distance from within the settlement with multiple light sources.
16. Patna Memorial	11.6km	High (walkers)	Low - Very Low	Moderate to Minor	Viewed from monument on hillside, at distance from above valley settlement with multiple light sources visible along the Doon Valley.
17. A76 South of Mauchline	19.7km	Low (residents)	Very Low	Negligible	Viewed at distance from within the settlement with multiple light sources.
18. Merrick Summit**	22.2km	High (walkers)	Very Low	Minor	Viewed from within the core area of the Galloway Forest Dark Sky Park. The lights would appear in the far distance, viewed at 200 cd, alongside the backdrop of lights from settlement in the Doon Valley and cumulatively with consented lights at Overhill. Theoretically the proposed lights would also appear cumulatively beyond other consented wind farm lights at Windy Standard III.
19. Carrick Hills	23.8km	High (walkers)	Very Low	Minor	Viewed at distance beyond scatted lowland light sources from farms and residents.
20. B741 East of Dalmellington	1.3km	Medium (road users)	Low	Minor	The aviation warning lights would be viewed from the road appearing above the sky. The angle intensity mitigation would reduce the lights to <17 cd (Very Low magnitude), viewed from a road with occasional light sources.

** The viewpoint located within the buffer zone of the Galloway Forest Dark Sky Park.*

*** The viewpoint located within the core area of the Galloway Forest Dark Sky Park.*

5.5.6. Night-time Landscape Effects

5.5.6.1 Drawing from the night-time viewpoint analysis (which identifies no significant effects) the night-time LVIA has focused on the following landscape receptors within the study area:

- *Southern Uplands with Forest* LCT (20c);
- Surrounding LCTs within 5 km;
- *Doon Valley* LLA;
- *Merrick* WLA; and
- *Galloway Forest Dark Sky Park*.

5.5.6.2 In summary, there would be no significant night-time effects on the host *Southern Uplands with Forest* LCT, due to the Medium sensitivity of this area and the presence of forestry. There would be no significant night-time effects on the surrounding LCTs due to the intervening distance, embedded mitigation and the existence of other existing light sources from roads and settlements, notably within the Doon Valley. For combinations of similar reasons there would be no significant night-time effects on the *Doon Valley* LLA (including its special qualities), the *Merrick* WLA (including its wild land qualities) or the *Galloway Forest Dark Sky Park* (including its qualities of darkness and remoteness).

Night-time Landscape Effects: During Construction / Decommissioning

5.5.6.3 During the construction and decommissioning periods some limited health and safety lighting would be required at the site entrance, temporary construction compounds and substation. There would also be lights from vehicles moving around the site during periods of darkened daylight hours such as heavy rain / dark skies. Cranes may also carry unmitigated safety and aviation warning lights. The ground-based construction lights would be screened by landform and forestry as indicated by Viewpoint 20: B741 East of Dalmellington (Figure 5.33). Additionally, the nature of any effects would be localised and temporary. The lights from up to two mobile cranes are therefore unlikely to have a significant characterising effect on the landscape character.

Night-time Landscape Effects: During Operation

Southern Uplands with Forest LCT (20c)

5.5.6.4 The proposed development would be located within an undesignated and forested area of the *Southern Uplands with Forest* LCT. The LCT is bounded to the north by the B741 and extends south to the boundary with Dumfries and Galloway. The settlement of Dalmellington is located to the west and Enoch Hill Wind Farm and an unforested area of *Southern Uplands* LCT (20a) is located to the east. Within this LCT the proposed development, is also bounded to the north, west and southwest by pylons, and an existing electricity substation is located to the north, visible from the B741. The southern part of the proposed development is bounded to the south by the existing South Kyle I Wind Farm.

5.5.6.5 The landscape is not designated and includes a number of utility and commercial land uses (forestry, grid and wind farm development) indicating a Medium to Low value. The area is however relatively dark as indicated by the satellite image in Figure 5.4.b, indicating a Medium susceptibility to the introduction of aviation warning lights. The sensitivity of the site area and the LCT is therefore assessed as Medium.

5.5.6.6 The period within which landscape character can be discerned and experienced at night is limited between the periods of dusk and dawn (during civil twilight) and may only occur for half an hour before the onset of nautical twilight and then astronomical twilight when any discernment of the landscape or 'nightscape' would be limited to the shapes of hills, buildings and vegetation, subject to the availability of moonlight. Many of the key characteristics discerned in daylight, including the colour, texture, pattern and detail of the landscape would not be visible. In this sense, the baseline landscape character at night has a reduced relevance and the perception of naturalness is limited by existing forestry covering much of the LCT. It is worth noting that there is no mention of night-time characteristics in relation to this LCT.

5.5.6.7 During periods of twilight the landscape and the turbines themselves would still be visible in the fading light and the aviation warning lights would appear faint (because the sky would not be completely dark). During the night (beyond twilight when the sky is at its darkest) the lights would appear most visible but the landscape character itself would not be visible although the horizon may be discernible with moonlight (increasing in full moon conditions) and the shapes of objects may also just be visible. The area would appear as an unlit area with occasional lights from residential properties / farms and occasional traffic on roads and in clear / cloud free conditions 'starry nights' would be experienced.

5.5.6.8 The ZTV extends to between 1-2 km distance from each of the turbines and overlaps with existing (un-lit) wind farm development to the south at South Kyle I and to the east at Enoch Hill. The existing forestry is of variable height and forestry screening is also likely to be variable across the site such that up to five aviation warning lights may be visible as indicated in Viewpoint 20: B741 East of Dalmellington (Figure 5.33). Where visible the 200 cd lights (dimmed to 10% of peak intensity when visibility in all directions from the turbines is >5 km) would extend across the site. They would be sufficient in number and spread to create a new although localised key characteristic or element of the LCT.

5.5.6.9 In some instances, within 500 m -1 km of the turbines, reflected light may be visible as the turbine blades pass behind the light source. This effect is subject to the wind direction but generally occurs at locations upwind of the turbines. The lights may also appear intermittently when viewed from downwind locations as the turbine blades pass in front of the lights (between the light source and the viewer).

5.5.6.10 The magnitude of change would be Medium to Low and the level of effect would be Moderate to Minor and not significant. The nature of these effects would be direct, long-term (reversible) and negative. Angle intensity mitigation would reduce the light intensity to between 200-17 cd with the greatest area of reduction (22-17 cd) affecting the northern part of the site and the LCT area as indicated in Figure 5.4d. This may reduce the level of effect in some areas to Minor.

Cumulative Effects: Existing + Consented Wind Farms:

5.5.6.11 None of the existing wind farms within 15 km of the proposed development have visible aviation warning lights and there are no other existing or consented wind farms with lit turbines within the host LCT.

5.5.6.12 The nearest consented wind farms with lit turbines are Overhill(7No lit turbines) approximately 5km to the north, beyond forestry and Windy Standard Phase III (12No lit turbines) approximately 5 km to the south, beyond forestry and the existing South Kyle I Wind Farm (unlit). These schemes would have limited intervisibility across the LCT and limited influence on the landscape character. This is due to the screening effects of forestry and intervening wind farm development, which although unlit, has some limited visibility at night, particularly in moonlit conditions. Therefore, the additional and combined effect of the proposed development would be the same as the stand-alone effect, Moderate to Minor and not significant.

Cumulative Effects: Existing + Consented + Application Wind Farms:

5.5.6.13 The nearest wind farm applications with lit turbines are Windy Standard Repower (5No lit turbines) approximately 7 km to the south, beyond forestry, landform and the existing South Kyle I Wind Farm (unlit); and Knockkippen (7No lit turbines) approximately 8 km to the northwest, beyond forestry and landform. These schemes would have

very limited or no influence on the host landscape character and there would be no additional or combined cumulative effects.

Other Landscape Character Types

Southern Uplands with Forest LCT (19a)

5.5.6.14 The *Southern Uplands with Forest* LCT extends further south into Dumfries and Galloway. This wider area is characterised by existing and consented windfarm development which includes 12No. consented aviation warning lights at Windy Standard Phase III. This indicates a Low sensitivity. Hub height ZTV coverage is fragmented and further screened by forestry such that the magnitude of change from within this area is likely to be Very Low and the landscape effects would be to Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and neutral. Angle intensity mitigation as illustrated in Figure 5.4d.1-2 would reduce the effects further by reducing the light intensity from lower lying areas to between 42-17 cd.

Foothills with Forest & Opencast Mining LCT (17a)

5.5.6.15 Similarly, the *Foothills with Forest & Open Cast Mining* LCT to the north is also characterised by existing windfarm development (which includes 7No. consented aviation warning lights at Overhill, indicating Low sensitivity.) and forestry separating and screening, such that the landscape effects would also be to Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and neutral. Angle intensity mitigation would also tend to further reduce the effects by reducing the light intensity to between 42-17 cd.

East Ayrshire Southern Uplands LCT (20a)

5.5.6.16 The *East Ayrshire Southern Uplands* LCT at Enoch Hill to the east is more open although the unforested areas beyond the existing Enoch Hill Wind Farm has limited hub height ZTV coverage indicating Very Low magnitude. Even allowing for Medium sensitivity (the LCT is not designated) the landscape effects would remain Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and neutral. Angle intensity mitigation would be less effective from this area which tends to be more elevated.

Rugged Uplands Lochs and Forests LCT (21)

5.5.6.17 Similarly, the *Rugged Uplands Lochs and Forests* LCT to the south and southwest also has limited hub height ZTV coverage, much of this overlapping with forested areas. Allowing for a High to Medium sensitivity on account of the *Doon Valley* LLA and dark areas around Loch Doon (the area is not within the *Galloway Forest Dark Sky Park*) the landscape effects would be no more than Minor to Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and neutral. Angle intensity mitigation would further reduce the effects by reducing the light intensity to between 98-42 cd from most of this area excepting the hill summits.

Upland River Valley LCT and Doon Valley LCA (10)

5.5.6.18 The *Upland River Valley* LCT and *Doon Valley* LCA are located to the west of the proposed development and designated *Doon Valley* LLA. Assuming an appreciation of dark skies may form part of the LLA's special qualities the area is assessed as of High to Medium sensitivity. The closest areas have limited hub height ZTV that is mostly overlapped by forestry and bounded by settlement. Much of the Doon Valley is influenced by existing lights from roads and settlement that would intervene and appear 'in the foreground' of the proposed development from most views such that the additional effects of five lights above the valley sides would be of Low - Very Low magnitude and lead to a Moderate to Negligible level of effect on the landscape character that would not be significant. The nature of these effects would be indirect, long-term (reversible) and neutral. Angle intensity mitigation would further reduce the effects by reducing the light intensity generally to between 98-17 cd.

5.5.6.19 The proposed development would not significantly contribute to additional or combined cumulative effects on other LCTs and these have therefore been excluded from further cumulative assessment.

Upland Basin LCT (15)

5.5.6.20 The *Upland Basin* LCT to the northeast skirts the 5 km buffer with fragmented ZTV and views to the west and south are characterised by existing windfarm development (which includes 7No. consented aviation warning lights at Overhill). Further east, within the Upland Basin, there are a number of existing light sources from roads and settlement, indicating Medium to Low sensitivity. It is likely that the magnitude of change would be Very Low and any effects on landscape character would be Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and neutral. Angle intensity mitigation would also tend to further reduce the effects by reducing the light intensity to between 42-22 cd.

Doon Valley LLA

5.5.6.21 As noted above, and taking a precautionary approach, the sensitivity of the *Doon Valley* LLA has been judged as High to Medium on the assumption that an appreciation of dark skies may form part of the LLA's special qualities. This High to Medium assessment of landscape value includes areas of high values attributed to the area's partial overlap with the *Craigengillan* GDL and the *Galloway Forest Dark Sky Park*. The susceptibility of this area is however more variable. In the south the landscape is dark and unpopulated as indicated by the satellite image in Figure 5.4.b as well as being partly overlapped by the *Galloway Forest Dark Sky Park*, with the Loch Doon area also a destination for tourists. This indicates a high susceptibility to the introduction of aviation warning lights. In the northern areas the landscape is more populated and the existence of lights from roads and settlements indicate a medium to low susceptibility, particularly areas close to existing light sources.

5.5.6.22 Much of the Doon Valley is influenced by existing lights from roads (A713) and settlement at Dalmellington, Burnton, Bellsbank, Waterside and Patna. The hub height ZTV overlaps with areas west of the proposed development including the areas west and north of Bellsbank and Dalmellington, and west of Brunton, and south of Waterside, and including the hills of Keir's Hill and Auchenroy Hill. Viewed from these areas, the visibility of existing lights from roads and settlement would limit the effects of up to five lights from the proposed development, which would appear as points of light above and beyond the groups of multiple lights from settlements in the valley. Assuming a high sensitivity (some areas overlapping with the *Galloway Forest Dark Sky Park*) the magnitude of change would range between Low to Very Low. The level of effect would be Moderate to Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation as illustrated in Figure 5.4d.1-2 would reduce the effects further by reducing the light intensity from the summit of Auchenroy Hill to between 200-98 cd, and from the remaining areas to between 98-17 cd.

5.5.6.23 From areas further south and along Loch Doon, the hub height ZTV is absent from much of the loch side with some visibility corresponding with the Loch Doon Caravan Park (itself a source of light during the holiday seasons). Other areas overlap with forestry or open hillsides and summits to the west of Loch Doon including the hills of Glenmount and part of *Craigengillan* GDL further north and overlapping with the Galloway Forest Dark Sky Park. Lights influencing the view from Bellsbank are still visible in these views as illustrated in Viewpoint N7: Craigengillan Estate (former Dark Sky Observatory). Assuming a high sensitivity, the magnitude of landscape change from this area would be Low-Very Low. The character and quality of the area overall (accounting for 360° views) would remain relatively dark and unlit with the level of effect on the LLA, Moderate to Minor and not significant. The nature of these effects would be indirect, long-term (reversible) and negative. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation as would reduce the effects in this area further by reducing the light intensity to between 200-42 cd.

5.5.6.24 Further south, when not screened by forestry, up to five lights would be visible from the hills of Craiglee and Wee Hill of Craigmulloch and part of the end of Loch Doon at Starr where up to 1-2 lights would be visible subject to forestry screening. Although the skies to the north are likely to appear dark and unlit, the intervening distance (beyond 10 km) would reduce the magnitude to Low-Very Low from those areas where there is visibility. Assuming a high sensitivity, the level of effect would be Moderate to Minor and not significant. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation would have little effect on the hill summits but would reduce the light intensity at Starr to between 98-42 cd.

5.5.6.25 Further north, beyond Waterside and Patna the hub height ZTV is fragmented or overlapping with forestry and the valley would continue to be influenced by lights from road sand settlements such that the magnitude of change would be Very Low. The level of effect would be Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and neutral.

5.5.6.26 Taking account of these different areas and levels of effect there would be no significant effects on the *Doon Valley* LLA or its assumed special landscape quality of 'dark skies'.

Cumulative Effects: Existing + Consented Wind Farms:

5.5.6.27 None of the existing wind farms within 15 km of the proposed development have visible aviation warning lights and there are no consented wind farms with lit turbines within the *Doon Valley* LLA.

5.5.6.28 The nearest consented wind farms with lit turbines are Overhill (7No lit turbines) and Windy Standard Phase III (12No lit turbines). The lights from these schemes would have very limited or no influence on *Doon Valley* LLA, due to landform screening (as indicated by viewpoints 1-11 and 16) and there would be no additional or combined cumulative effects.

Cumulative Effects: Existing + Consented + Application Wind Farms:

5.5.6.29 The nearest wind farm applications to the Doon Valley LLA with lit turbines are Knockkippen (7No lit turbines) approximately 2 km to the east of Patna and Scienteuch (8No. turbines lit) approximately 2km to the south of Patna. Both these schemes would be clearly visible at night from much of the *Doon Valley* LLA (as indicated by viewpoints 1-11 and 16) sometimes viewing in the context of relatively unlit sections of the valley. The additional cumulative effect of the proposed development (assuming the consented and application schemes are operating) would remain Moderate to Negligible and not significant and may reduce slightly due to the increased number of lit turbines and potentially reduced sensitivity of the valley to further light.

5.5.6.30 The combined cumulative effect of the proposed development (assuming the consented and application schemes are operating) would however increase and is likely to be significant as a result of both the Knockkippen and Scienteuch applications (and not the proposed development), particularly if a worst case of no mitigation is assumed for these applications. The nature of these effects would be indirect, long-term (reversible) and negative and cumulative.

Merrick WLA

5.5.6.31 The *Merrick* WLA is just over 15 km distance to the south of the proposed development. A WLA assessment covering both the daytime and night-time effects of the proposed development is provided in Technical Appendix 5.4 as requested by NS in their scoping consultation. A summary of that assessment is provided below.

5.5.6.32 The nearest areas of hub height ZTV coverage includes the summit and northern slopes of the Shalloch of Minnoch (768 m AOD) at just over 15km distance, with ZTV coverage extending south along the Awful Hand Ridge to the summit of Merrick (843 m AOD) at 22.2 km distance from the proposed development. Whilst it would be impractical to walk these areas at night, the assessment has assumed that walkers may occasionally camp here overnight.

5.5.6.33 The value and susceptibility of the *Merrick* WLA and its wild land qualities of 'wildness', 'darkness' and 'remoteness' have been assessed as High. The visibility of up to five 200 cd lights, would however, appear distant and well beyond the boundary of the WLA as well as being seen against a wider backdrop of lights from settlement in the lowland landscape beyond. The magnitude therefore would be Very Low and the level of effect would be Minor and not significant. The nature of these effects would be indirect, long-term (reversible) and neutral.

5.5.6.34 The proposed development would not significantly contribute to additional or combined cumulative effects and therefore the *Merrick* WLA has been excluded from further cumulative assessment.

Galloway Forest Dark Sky Park

5.5.6.35 The Forestry and Land Scotland website explains that the *Galloway Forest Dark Sky Park* is an international designation, forming part of the *Galloway and Southern Ayrshire UNESCO Biosphere* and made special because of its remoteness and rare stargazing conditions. The designation is also referenced in EAC's *Local Development Plan 2*, Policy TOUR 4 as noted previously in section 1.3 a main aim of the designation is to protect the dark sky and limit light pollution. The boundary of the *Galloway Forest Dark Sky Park* includes a core area and a buffer zone as illustrated in Figures 5.4b-e.

5.5.6.36 The value and susceptibility of the *Galloway Forest Dark Sky Park* and its qualities of 'darkness' and 'remoteness' have been assessed as High.

5.5.6.37 Areas of note within the *Galloway Forest Dark Sky Park* include the new site for the Dark Sky Observatory at the former Clatteringshaws Visitor Centre on the A712 near Clatteringshaws Loch[8] and viewing areas recommended by the Dark Sky Rangers on the Forestry and Land Scotland website[9] at Stroan Loch and Glentrool. All of these areas are outwith the blade tip and hub height ZTV and would have no view of the proposed development.

5.5.6.38 The proposed development is 15 km distance from the core area of the *Galloway Forest Dark Sky Park* and beyond the buffer zone, which forms the Park boundary.

Galloway Forest Dark Sky Park: Core Area

5.5.6.39 The core area of the *Galloway Forest Dark Sky Park* is similar in geographical extent to the Merrick WLA. The theoretical visibility of up to five aviation warning lights would also affect the same views from the edge of this area, including Shalloch of Minnoch, Awful Hand Ridge and the Merrick summit at between 15 km and 22.2 km distance from the proposed development. The 200 cd lights would appear very distant and well beyond the Park boundary, viewed against a wider backdrop of lights from settlement in the lowland landscape beyond. The magnitude therefore would be Very Low and the level of effect on the Park and its qualities of 'darkness' and 'remoteness' would be Minor and not significant. The nature of these effects would be indirect, long-term (reversible) and neutral.

5.5.6.40 The proposed development would not significantly contribute to additional or combined cumulative effects and therefore the core area of the *Galloway Forest Dark Sky Park* has been excluded from further cumulative assessment.

Galloway Forest Dark Sky Park: Buffer Zone

5.5.6.41 The closest area of the *Galloway Forest Dark Sky Park* is the northern most part of the buffer zone which appears as a boundary extrusion, extending north beyond forestry near Dersalloch to include Auchenroy Hill, much of the *Craigengillan* GDL, and extending east to the settlement edges of Dalmellington and Bellsbank. This area is also overlapped by the *Doon Valley* LLA.

5.5.6.42 At a distance of between approximately 8-4 km (with 4 km being the closest point on the Park boundary to the proposed development) the hub height ZTV is widespread and six viewpoints are located within this area to support

[8] https://www.bbc.co.uk/news/articles/c0mzppkw8pyo

[9] https://forestryandland.gov.scot/visit/forest-parks/galloway-forest-park/dark-skies.

this assessment (a summary of those assessments is provided in Table 5.4.5). As noted previously, much of the Doon Valley and this part of the Park's buffer zone is influenced by existing lights from roads and settlement at Dalmellington, Burnton and Bellsbank, diminishing the qualities of 'darkness' and 'remoteness' in these areas when compared the core areas of the Park for example. Areas within the Park boundary overlapped by the hub height ZTV include Auchenroy Hill, Dalnean Hill, Bogton Loch, Balbeth, open areas within *Craigengillan* GDL to the west of Ness Glen and areas close to roads, settlement and or woodland. Viewing 'out' from the buffer zone and Park boundary, the visibility of lights from roads and settlement and the screening effects of trees and woodland in some cases would limit the effects of up to five lights on the dark skies, appearing as points of light above and beyond existing groups of multiple lights from settlements in the valley. The magnitude of change affecting views 'out' of the *Galloway Forest Dark Sky Park* (as opposed to views 'into' the *Galloway Forest Dark Sky Park*) would be Low to Very Low and the level of effect on the Park and its relative qualities of 'darkness' and 'remoteness' would be Moderate to Minor and not significant. Further angle intensity mitigation as illustrated in Figure 5.4d.1-2 would reduce the effects by reducing the light intensity from the summit of Auchenroy Hill to between 200-98 cd, and from the remaining areas to between 98-17 cd.

5.5.6.43 At 8-10 km from the proposed development and further southwest within the Park the ZTV overlaps with forestry soutn of Dersalloch and to the north of the hill at Craiglee. The hub height ZTV is absent from the shoreline of Loch Doon and the properties at Lambdoughty Farm and Beoch on the Park boundary would not view the aviation warning lights.

5.5.6.44 At 15-10 km the hub height ZTV is fragmented and when not overlapped with areas of forestry, up to five aviation warning lights would be theoretically visible, to the north from the hill summits of Craiglee and Wee Hill of Craigmulloch and the picnic site at Loch Bradan. From the end of Loch Doon at Starr, 1-2 lights would be visible at 200 cd, subject to forestry screening across the loch and out from the boundary. Although the skies to the north are likely to appear dark and unlit, the intervening distance (beyond 10km) would reduce the magnitude to between Low to Very Low. Assuming a high sensitivity, the level of effect on the Park and its qualities of 'darkness' and 'remoteness' would be Moderate to Negligible and not significant. Further angle intensity mitigation as illustrated in Figure 5.4d.1-2 would reduce the effects by reducing the light intensity from most of these areas to between 200-98cd and at Starr to between 98-42 cd.

5.5.6.45 Elsewhere, the shoreline of Loch Doon and the properties at Craigmalloch and Loch Doon Castle on the Park boundary are outwith the blade tip and hub height ZTVs and would not view the proposed development.

5.5.6.46 To conclude, there would be no significant night-time effects on the *Galloway Forest Dark Sky Park* including its qualities of 'darkness' and 'remoteness' within the core area and buffer zone.

Cumulative Effects: Existing + Consented Wind Farms:

5.5.6.47 None of the existing wind farms within 15km of the proposed development have visible aviation warning lights and there are no consented wind farms with lit turbines within the *Galloway Forest Dark Sky Park*.

5.5.6.48 The nearest consented wind farms with lit turbines are Overhill(7No lit turbines) and Windy Standard Phase III (12No lit turbines). The lights from these schemes would have very limited or no influence on the Galloway Forest Dark Sky Park and its qualities of 'darkness' and 'remoteness', due to landform screening (as indicated by viewpoints 1-11 and 16) and there would be no additional or combined cumulative effects.

Cumulative Effects: Existing + Consented + Application Wind Farms:

5.5.6.49 The nearest wind farm applications to the *Galloway Forest Dark Sky Park* with lit turbines are Knockkippen (7No lit turbines) approximately 3.5km to the north of the Park and Scienteuch (8No. turbines lit) approximately 2km to the north of the Park. Both of these schemes would be clearly visible at night from the northern most part of the *Galloway Forest Dark Sky Park* buffer zone (as indicated by viewpoints 1-10) viewing to the north and 'out' of the Park. The additional cumulative effect of the proposed development (assuming the consented and application schemes are operating) would remain Moderate to Minor and not significant and may reduce slightly due to the increased number of lit turbines and potentially reduced sensitivity of this part of the buffer zone.

5.5.6.50 The combined cumulative effect of the proposed development (assuming the consented and application schemes are operating) would however increase and is likely to be significant as a result of both the Knockkippen and Scienteuch applications (and not the proposed development), particularly if a worst case of no mitigation is assumed for these applications. These schemes are closer to the Park boundary and often align with relatively unlit backdrops when compared to the proposed development. The nature of these effects would be indirect, long-term (reversible) and negative and cumulative.

5.5.7. Night-time Visual Effects

5.5.7.1 The night-time visual assessment considers the likely effects of the proposed aviation warning lights on the views and visual amenity experienced by people in the landscape between the periods of dusk and dawn. Drawing from the night-time viewpoint analysis which identifies no significant effects, the LVIA has focused on those areas within 10 km of the Proposed Development and the *Galloway Forest Dark Sky Park* within 20 km.

5.5.7.2 The assessment has included those receptors that are likely to be visited by people at night such as settlements, roads and recreational routes that follow minor roads that could reasonably be walked at night. Whilst hill walking routes on footpaths (uneven ground) are less likely to be accessed at night for practical reasons (navigation would be difficult and the walkers themselves would need to carry torches) an allowance has been made for the possibility that people may camp overnight in these locations.

5.5.7.3 Some tourist, recreational and visitor attractions have been excluded from the night-time assessment because they would be closed at night (e.g. the Round House Café at Loch Doon) and otherwise are outwith the hub height ZTV.

5.5.7.4 In summary, there would be no significant night-time effects on the views from the settlements of Dalmellington Bellsbank and Burnton, roads (A713 and B741) and recreational routes (Core Paths, Heritage Paths and Scottish hill tracks) and tourist / visitor locations (including Bogton Loch, *Craigengillan* GDL, Bellsbank Picnic Spot, Loch Doon and Loch Doon Caravan Park, and the hill walking summits of Auchenroy Hill, Cairnsmore of Carsphairn and Blackcraig Hill.

5.5.7.5 During the summer months, most people, including hill walkers are unlikely to experience the aviation warning lights. For example, during the summer solstice 2024 the aviation warning lights would switch on at 22.33 and switch off at 04.00 in the morning. Local residents and local road users are more likely to experience the aviation warning lights during the winter months. For example, during the winter solstice 2024 the lights would come on at 16.17 and switch off at 08.13 in the morning. It is reasonable to expect that most people would be commuting or indoors during these periods of colder weather, during the twilight and night, and would experience the aviation warning lights incidentally to their main activity.

5.5.7.6 Operation of the aviation warning lights would have no adverse effect on periods of sunrise (when the sun disk passes above the horizon and the period just after this) and sunset (the period just before the sun disk passes below the horizon) as the operation is programmed to switch off 30 mins before sunrise and switch on 30 mins after sunset, respectively.

Night-time Visual Effects During Construction / Decommissioning

5.5.7.7 During the construction and decommissioning periods, some limited health and safety lighting would be required at the site entrance office and temporary construction compounds and there would also be lights from vehicles moving around the site during periods of darkened daylight hours such as heavy rain / dark skies. A crane may also carry unmitigated aviation warning lights in accordance with Article 222 of the UK ANO 2016. Due to the landform and forestry across the site area and the limited number of visual receptors close to the site, the visual effects during construction and decommissioning are unlikely to be significant with most views of ground-based construction lights screened by landform and forestry as indicated by Viewpoint 20: B741 East of Dalmellington (Figure 5.33). Additionally, the nature of any effects would be localised and temporary. The lights from up to two mobile cranes are therefore unlikely to have a significant night-time visual effect on views from the nearest receptors including road users on the B741 and local residents.

Night-time Visual Effects During Operation

Settlements and Residential Properties

5.5.7.8 The settlements of Dalmellington, Bellsbank, Burnton, Burnside and Connel Park and located within 5 km of the proposed development and both are included in this assessment. In summary there would be no significant night-time effects on the views from either of these settlements. Both settlements have been assessed as of Low susceptibility in accordance with the NS *Guidance on Aviation Lighting Impact Assessment*, November 2024.

5.5.7.9 The night-time assessment concludes all of the properties would potentially view one or more of the aviation warning lights subject to intervening screening, although none of the properties within 3km would experience significant night-time visual effects. This is due to the proposed lighting mitigation which would reduce the number of visible aviation warning lights, and the likely low level of perceived light intensity experienced from each property. This is in part due to the low-lying nature of the residential properties within the upper reaches of the River Nith valley and along the B741 road corridor in relation to the elevation of the proposed aviation warning lights on the turbine hubs, which is a key mitigating factor.

5.5.7.10 Subject to the wind direction some of the closest properties may view a small amount of light reflecting off the turbine blades as they slowly rotate to pass behind the aviation warning light. Alternatively, there may be a 'slow blink' or 'on / off' effect when the turbine blade passes in front of the aviation warning light.

Dalmellington and Bellsbank

5.5.7.11 The value of views from 'lit' settlements at night and their susceptibility to light intrusion from visible aviation warning lights beyond the settlement is assessed as Low.[10] This is because of the presence of widespread street lighting and other light sources within Dalmellington and Bellsbank that would limit the ability of people to observe and appreciate night-time views and dark skies from within the settlement.

5.5.7.12 The hub height ZTV (Figure 5.4.c) indicates limited theoretical visibility of the 200 cd aviation warning lights from within the settlement and much of this would be screened by buildings and vegetation as indicated in Viewpoint 3 (Figure 5.16) and Viewpoint 2 (Figure 5.15). Where visible it is considered that the magnitude of change would be Zeron to Very Low and the level of visual effect would be None to Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and neutral.

5.5.7.13 Angle intensity mitigation would reduce the light intensity from 200 cd to between 22-17 cd as indicated in Figure 5.4d.

5.5.7.14 Up to seven lights would be theoretically visible at Knockkippen and eight lights at Scienteuch to the northeast along the Doon Valley. However, the proposed development would not significantly contribute to additional or combined cumulative effects.

Burnton

5.5.7.15 Although a small settlement, Burnton has street lighting which together with the lights from residential properties would reduce the overall sensitivity as in the case of Dalmellington. However, the smaller size of the settlement means that a larger number of properties would view out from the edge of the settlement and consequently there may be a high value and susceptibility attached to the night-time views from this location. The sensitivity has therefore been judged as Medium.

5.5.7.16 The hub height ZTV (Figure 5.4.c) indicates that the settlement would theoretically view 3-5 of the aviation warning lights subject to the screening effects of buildings and vegetation. Viewpoint 4: A713 west of Dallmellington (Figure 5.17) provides a reasonable indication of the likely views. At night, the 200 cd aviation warning lights would in most cases be visible beyond streetlights at Burnton, appearing along the horizon, above and slightly left of the settlement lights of Dalmellington. The magnitude of change would be Low and the level of visual effect would be Minor and not significant. The nature of these effects would be indirect, long-term (reversible) and negative.

5.5.7.17 Angle intensity mitigation would reduce the light intensity from 200 cd to between 22-17 cd as indicated in Figure 5.4d.

5.5.7.18 Up to seven lights would be theoretically visible at Knockkippen and eight lights at Scienteuch to the northeast along the Doon Valley. However, the proposed development would not significantly contribute to additional or combined cumulative effects.

Burnside and Connel Park

5.5.7.19 The small settlements of Burnside and Connel Park are located on the B741 towards New Cumnock and are represented by Viewpoints 12 and 15, both of which indicate Negligible levels of effect. Both areas of settlement have been afforded Medium sensitivity due to the existence of other light sources in and around the settlement. The hub height ZTV (Figure 5.4.c) indicates that the settlements would theoretically view 1-2 of the aviation warning lights subject to the screening effects of buildings and at Connel Park vegetation. The magnitude of change would be Very Low and the level of visual effect would be Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and negative.

5.5.7.20 Angle intensity mitigation would reduce the light intensity from 200 cd to between 42-22 cd as indicated in Figure 5.4d.

5.5.7.21 Up to seven lights would be theoretically visible at Overhill to the west, beyond forestry. However, the proposed development would not significantly contribute to additional or combined cumulative effects.

Transport Routes

5.5.7.22 Three transport routes are included in the assessment, the A713 Galloway Tourist Route between Waterside and Dalmellington, B741 between Gass and Maneight, and the Loch Doon Road. The latter of these, Loch Doon Road is overlapped by a number of recreational routes including Core Path D11, Loch Doon Road Heritage Path and Scottish hill tracks 77a / 78a / 79. It has therefore been assessed under recreational routes which is most representative of the road user and likely to ensure a 'worst case' assessment.

[10] NS, *Guidance on Aviation Lighting Impact Assessment*, Table 1, November 2024.

5.5.7.23 In summary there would be no significant night-time effects on the views from these roads. This is due to the lower susceptibility of the road user at night, the screening effects of landform and roadside vegetation and the baseline of other light sources notably within the Doon Valley.

A713 Galloway Tourist Route between Waterside and Dalmellington

5.5.7.24 The value of this road and national tourist route at night is limited as tourists are unlikely to view the scenery at night and the susceptibility of road uses on this route is assessed as Low.[11] There is limited traffic on the road at night however and outwith settlements the Doon Valley is relatively dark. For these reasons the sensitivity of the road users on this route is assessed as Medium to Low.

5.5.7.25 The hub height ZTV (Figure 5.4.c) indicates 3-5 of the aviation warning lights would be theoretically visible to southeast bound traffic for approximately 3 km to the northwest of Dalmellington, subject to the screening effects of buildings and vegetation. Viewpoint 4: A713 west of Dalmellington (Figure 5.17) provides a reasonable indication of the likely day-time views. At night, the 200 cd aviation warning lights would be visible along the horizon, above and slightly left of the settlement lights of Dalmellington. The magnitude of change would be Low and the level of visual effect would be Minor to Negligible and not significant. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation would further reduce the light intensity from 200cd to between 42-22 cd as indicated in Figure 5.4d.

5.5.7.26 Viewpoint 1: Picnic area off the A713 (Figure 5.14) provides glimpsed view of one light, perpendicular to the road. The magnitude viewed from the road would be Very Low and the level of visual effect would be Negligible and not significant. Angle intensity mitigation would further reduce the light intensity from 200 cd to between 22-17 cd as indicated in Figure 5.4d.

5.5.7.27 Elsewhere there would be no views of the aviation warning lights and theoretical visibility south of Waterside would be screened by mature roadside trees.

5.5.7.28 Up to seven lights would be cumulatively and sequentially visible at Knockkippen and eight lights at Scienteuch to the northeast along the Doon Valley. However, the proposed development would not significantly contribute to additional or combined cumulative effects from this route.

B741 between Gass and Maneight

5.5.7.29 The value of this road at night is limited, although it passes through a relatively dark landscape, with limited traffic, between the main settlements of Dalmellington and New Cumnock. The susceptibility of road uses on this route is assessed as Low. However, considering the unlit and ‘less busy’ nature of the route the sensitivity of road users has been assessed as Medium.

5.5.7.30 The views from two sections of the B741, to the east and west of Dalmellington would be affected.

5.5.7.31 To the east of Dalmellington the hub height ZTV (Figure 5.4.c) indicates 3-5 of the aviation warning lights would be theoretically visible for approximately 8.5 km of the route between Maneight and Dalmellington (experienced for approximately 4 km in each direction). These views would be subject to some intermittency from localised landform and roadside vegetation.

5.5.7.32 Viewpoint 20: B741 East of Dalmellington (Figure 5.17) provides a reasonable indication of the likely day-time views from the closest point on the road to the proposed development. At night, the 200 cd aviation warning lights would be visible on three turbines (T1, T5 and T10) with the other two screened by vegetation. Considering the whole of this part of the route, the lights would generally appear along the horizon and in the sky at between approximately 1.3 km to 3.5 km distance from this section of the road, east of Dalmellington. Assuming a southwest prevailing wind direction, reflected or intermittent light effects would be unlikely. The magnitude of change from the closest point along this route would be Low and the level of visual effect would be Minor and not significant. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation would further reduce the light intensity from 200 cd to between 22-17 cd or less from much of this part of the route as indicated in Figure 5.4d. This would potentially reduce the magnitude to Very Low and the level of effect to Negligible.

5.5.7.33 Up to seven lights would be cumulatively and sequentially visible at Overhill to the north, subject to forestry screening. However, the proposed development would not significantly contribute to additional or combined cumulative effects from this route.

5.5.7.34 To the west of Dalmellington, the hub height ZTV (Figure 5.4.c) also indicates 3-5 aviation warning lights would be theoretically visible for approximately 6.5 km of the route (east bound road users) between Dalmellington and Gass.

5.5.7.35 Viewpoint 11: B741 West of Dalmellington (Figure 5.24) provides a representative view from an elevated section of the road above the Doon Valley with the proposed development appearing straight ahead, in the direction of east bound travel. This part of the route boarders the buffer zone of the *Galloway Forest Dark Sky Park* boundary. At night, all five of the 200 cd aviation warning lights would be visible appearing along the horizon and above the groups of multiple lights from settlements in the valley. West of Dalmellington, the views from approximately 6.5km of the route would be affected at distances of between 4-10 km from the proposed development. These views would be subject to some intermittency from localised landform (notably west of Auchenroy) whilst the screening effects of roadside vegetation are more prevalent to the east of Auchenroy. Viewpoint 5: Bogton Loch (Figure 5.18) is representative of these lower views.

5.5.7.36 The magnitude of change from areas of this route with an open view of the proposed development would be Low and the level of visual effect would be Minor and not significant. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation would further reduce the light intensity from 200cd to between 98-17 cd as indicated in Figure 5.4d. This would potentially reduce the magnitude to Very Low and the level of effect to Negligible.

5.5.7.37 Up to seven lights would be theoretically visible at Overhill to the west, beyond forestry. However, the proposed development would not significantly contribute to additional or combined cumulative effects.

Recreational Routes

5.5.7.38 The views from six recreational routes, mostly located within the Doon Valley and Loch Doon area within 10 km of the proposed development, are included in the assessment.

5.5.7.39 In summary there would be no significant night-time effects due to a number of factors such as the limited ZTV, low light intensity resulting from the low-lying nature of these valley routes, levels of intervening vegetation screening, the baseline of other light sources and the limited extent of the effects experienced sequentially whilst travelling along these routes.

5.5.7.40 There would be no view of the proposed development at night from Core Paths D12 between Dalmellington and Ness Glen, D14 along Ness Glen and D15 south of Bellsbank, and D17 Eriff to Ness Glen.

Loch Doon Road:

Core Path D11, Loch Doon Road Heritage Path and Scottish hill track 77a / 78a / 79

5.5.7.41 The value of this minor road is high due to its scenic location along the western side of Loch Doon and its regular use by a range of road users (cars / cyclists / walkers etc) such that it can be accessed at night to appreciate

[11] NS, *Guidance on Aviation Lighting Impact Assessment*, Table 1, November 2024.

moonlit views across water for example. Walkers in this area are therefore likely to be of high susceptibility and the sensitivity is assessed as High.

5.5.7.42 The hub height ZTV (Figure 5.4.c) indicates limited theoretical visibility affecting up to 1km of the route at approximately 6-7 km distance from the proposed development. This section of the route is outwith the *Galloway Forest Dark Sky Park*. Wireframe analysis confirms that one 200 cd aviation warning light would be theoretical visible on the horizon which is likely screened by forestry also on the horizon. Further analysis confirms that up to three 200 cd aviation warning lights would be theoretical visible on the horizon for approximately 300m of the route, subject to forestry screening. This section of the route coincides with the Loch Doon Caravan Park with lights from caravans likely to appear in the foreground of views and / or adjacent to the road. The area is also well used for wild camping with associated lights and campfires common during the holiday seasons. The magnitude of change would be Low-Very Low and the level of visual effect would be Moderate to Minor and not significant. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation would further reduce the light intensity from 200 cd to between 98-22 cd as indicated in Figure 5.4d.

5.5.7.43 Some distant lights from the consented Windy Standard Phase III would be theoretically visible from part of this route to the east. However, the proposed development would not significantly contribute to additional or combined cumulative effects.

Core Path D13: Dalcairnie / Auchenroy Hill circuit and Scottish hill tracks 78b / 81

5.5.7.44 This core path overlaps with Scottish hill tracks and a minor road between Bogton Loch and Dalcairnie. The value of this route is high due to its status as a core path that is well walked and its location within the buffer zone of the *Galloway Forest Dark Sky Park*. The eastern minor road section between Bogton Loch and Dalcairnie would be more easily accessed at night, whilst the western section (crossing rough ground on Auchenroy Hill) would be difficult to navigate at night and in comparison, to Loch Doon the area is not generally used for camping. Walkers in this area are likely to be of high to medium susceptibility and the sensitivity is assessed as High.

5.5.7.45 The hub height ZTV (Figure 5.4.c) indicates much of this route would have theoretical visibility of the proposed development at between approximately 5-6.7 km distance.

5.5.7.46 Viewpoint 5: Bogton Loch (Figure 5.18) provides an open view from the eastern section of this route on the minor road between Bogton Loch and Dalcairnie. At night, all five of the 200 cd aviation warning lights would be visible appearing along the horizon and above the lights from settlement in the valley. The magnitude of change would be Low and the level of visual effect would be Moderate and not significant due to the viewing direction 'out' of the *Galloway Forest Dark Sky Park* and towards the settlement lights within the Doon Valley. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation would further reduce the light intensity from 200 cd to between 42-22 cd for the lower half of this route near Bogton Loch as indicated in Figure 5.4d.

5.5.7.47 Viewpoint 10: Auchenroy Hill (Figure 5.23) provides 360° views from the hill summit and views across the Doon Valley. At night, all five of the 200 cd aviation warning lights would be visible appearing along the horizon and above groups of lights from multiple settlements in the valley. The magnitude of change would be Low and the level of visual effect would be Moderate and not significant due to the viewing direction 'out' of the *Galloway Forest Dark Sky Park* and towards the settlement lights within the Doon Valley. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation would have little or no effect on the light intensity viewed from the hill summit.

5.5.7.48 Multiple lights from other consented wind farms (Overhill, Windy Standard Phase III and Sanquhar II) would be theoretically visible from the summit of Auchenroy Hill to the northeast and east, beyond the proposed development, all Low to Very Low magnitude. The additional and combined magnitude of change resulting from the proposed development would be Low and the level of effect Moderate and not significant due to the viewing direction 'out' of the *Galloway Forest Dark Sky Park* and towards the settlement lights within the Doon Valley.

5.5.7.49 In terms of other applications, lights from Windy Standard Repower and Quantans (Low to Very Low magnitude) would be visible to the southeast, and Carrick and Knockcronal to the southwest (Low-Very Low magnitude). The most visible applications from this location would be Knockkippen (up to seven lights) and Scienteuch (up to eight lights) to the north and west (Low magnitude). The additional magnitude of change resulting from the proposed development would remain Low and the level of effect Moderate and not significant due to the viewing direction out of the *Galloway Forest Dark Sky Park* and towards the settlement lights within the Doon Valley. However, the combined cumulative effect would be Moderate and significant due to the overall increase in the surrounding lights, some of which are not viewed in the context of lights from existing roads and settlements although they view 'out' of the *Galloway Forest Dark Sky Park*. The proposed development would not significantly contribute to the combined cumulative effects from this route.

D16: Bellsbank to Barbeth and Little Shalloch - Scottish hill track 78b / 81

5.5.7.50 The core path overlaps with Scottish hill tracks linking Dalmellington with Craigengillan Home Farm, Barbeth, Dalcairnie Burn and Little Shalloch. The value of this route is high due to its status as a core path that is well walked and its location within the buffer zone of the *Galloway Forest Dark Sky Park* and the *Craigengillan* GDL. The tracks would be more easily accessed at night and walkers in this area are likely to be of High susceptibility and the sensitivity.

5.5.7.51 The hub height ZTV (Figure 5.4.c) indicates much of this route would have theoretical visibility of the proposed development at between approximately 5-7 km distance.

5.5.7.52 Viewpoint 8: Barbeth (Figure 5.21) provides an open view of the proposed development an at night all five of the 200cd aviation warning lights would be visible appearing along the horizon and above the multiple groups of lights from Bellsbank settlement in the valley. The magnitude of change would be Low and the level of visual effect would be Moderate and not significant due to the viewing direction 'out' of the *Galloway Forest Dark Sky Park* and towards the settlement lights within the Doon Valley. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation would further reduce the light intensity from 200 cd to between 42-22 cd as indicated in Figure 5.4d.

5.5.7.53 Limited lights from other consented wind farms (Overhill) may be theoretically visible from elevated parts of this route subject to vegetation screening (Very Low magnitude). The additional and combined magnitude of change resulting from the proposed development would be Low and the level of effect Moderate and not significant due to the viewing direction 'out' of the *Galloway Forest Dark Sky Park* and towards the settlement lights within the Doon Valley.

5.5.7.54 In terms of other applications, lights from Knockkippen (up to seven lights) would also be theoretically visible to the north beyond Bogton Loch (Low magnitude). The additional magnitude of change resulting from the proposed development would remain Low and the level of effect Moderate and not significant due to the viewing direction out of the *Galloway Forest Dark Sky Park* and towards the settlement lights within the Doon Valley. However, the combined cumulative effect would be Moderate and significant due to the overall increase in lights visible along the valley although they also affect views 'out' of the *Galloway Forest Dark Sky Park*. The proposed development would not significantly contribute to the combined cumulative effects from this route.

D18: Carmlarg Plantation, northeast of Dalmellington

5.5.7.55 The core path provides a circular route and also connects the cemetery with the B741 at Dalmellington. The value of this route is high due to its status as a core path that is well walked and overlapped by the *Doon Valley* LLA. The tracks and footpaths would be more easily accessed at night and walkers in this area are likely to be of High susceptibility and the sensitivity.

5.5.7.56 The hub height ZTV (Figure 5.4.c) indicates much of this route would have theoretical visibility of the proposed development at between approximately 2.5-3 km distance, viewing up to two of the 200cd aviation warning lights, subject to the screening of intervening mature trees and vegetation along this route. The lights would appear beyond the forested hillside to the east and adjacent to influences of settlement lights from Dalmellington to the south. The magnitude of change would be Low-Very Low and the level of visual effect would be Moderate to Minor and not significant due to the influence of the settlement lights at Dalmellington. The nature of these effects would be indirect, long-term (reversible) and negative. Angle intensity mitigation would further reduce the light intensity from 200 cd to between 22-17 cd or less as indicated in Figure 5.4d and may reduce the overall level of effect to Minor.

5.5.7.57 There would be no cumulative visibility with lights from other consented wind farms. Aviation warning lights would be theoretically visible from the Knockkippen application (up to seven lights) and Scienteuch (up to eight lights) to the northwest (Low magnitude). The additional magnitude of change resulting from the proposed development would remain Low-Very Low and the level of effect Moderate to Minor and not significant. However, the combined cumulative effect would be Moderate and significant due to the other schemes and not the proposed development which would not significantly contribute to the combined cumulative effects from this route.

Recreational and Tourist / Visitor Attractions

5.5.7.58 The views from two recreational / visitor attractions and two hill summits have been include in the assessment. Each of these is represented by viewpoint assessment and / or already assessed as part of roads or recreational route assessments. In summary there would be no significant effects on these receptors. The nature of all these effects would be direct, long-term (reversible) and neutral to negative.

5.5.7.59 The visual effects of the proposed development, viewed from these locations, would not significantly contribute to additional or combined cumulative effects.

Bogton Loch

5.5.7.60 The night-time visual effects experienced by walkers and visitors to Bogton Loch would be Moderate and not significant as represented by Viewpoint 5: Bogton Loch (Figure 5.18) and also assessed under Core Path D13 and road B741. The loch is located within the buffer zone of the *Galloway Forest Dark Sky Park*, viewing across the Doon Valley towards Dalmellington and away from the Park. There are multiple existing light sources from settlements, viewing in this direction and (discounting vegetation screening) the angle intensity mitigation would further reduce the lights to 42-22 cd. For all these reasons it is considered that the Moderate visual effects would not be significant.

Craigengillan GDL

5.5.7.61 The grounds of *Craigengillan* GDL are open to the public and include an area bounded to the north by the B741 and to the west by Dalmellington. It extends south to include the site of the former Dark Sky Park Observatory (Viewpoint 7) and west to include to the summit of Auchenroy Hill. The whole area is overlapped by the Doon Valley LLA and the buffer zone of the *Galloway Forest Dark Sky Park*. The GDL includes a number of listed buildings and the main house and stables and notable landscape features including but not limited to Dalcairnie Glen, Bogton Loch and Ness Glen. Consequently, the value of this receptor is high and the susceptibility and sensitivity is assessed as High.

5.5.7.62 Viewpoints 5, 6, 7, 8, 10 and 11 are located either within or in the boundary of the GDL and an outline assessment of these is provided in Table 5.4.5. Additionally, the assessments of the B741 (norther boundary), Core Paths D13 (Dalcairnie / Auchenroy Hill circuit and Scottish hill tracks 78b / 81), and D16 (Bellsbank to Barbeth and Little Shalloch - Scottish hill track 78b / 81) combine to provide an overall assessment.

5.5.7.63 Although there would be no view of the aviation warning lights from the front ground floor of Craigengillan House, there would, at most, be a Low magnitude of change and Moderate level of effect from recreational routes related to Bogton Loch, the former Dark Sky Park Observatory and the summit of Auchenroy Hill. The level of effect would be Moderate and not significant, due mainly to the direction of views, viewing 'out' of the buffer zone of the *Galloway Forest Dark Sky Park,* towards multiple light sources visible at night from roads and settlements in the Doon Valley.

Bellsbank Picnic Spot

5.5.7.64 Bellsbank Picnic Spot is illustrated by Viewpoint 1 (Figure 5.14) and assessed as part of the A713 Galloway Tourist Route. In summary this receptor has been assessed as of High sensitivity with a Low to Very Low magnitude and a Moderate to Minor level of effect that would not be significant.

Loch Doon and Loch Doon Caravan Park

5.5.7.65 Loch Doon is a popular tourist and visitor attraction known for its wild camping. The area is overlapped by the Doon Valley LLA and partly included within the buffer zone of the *Galloway Forest Dark Sky Park*. Consequently, the value of this receptor is high and the susceptibility and sensitivity is assessed as High.

5.5.7.66 Views from the loch side are represented by Viewpoint 9 and further assessment is provided by the assessment for Loch Doon Road / core path D11 (which is overlapped by the Loch Doon Road Heritage Path and Scottish hill tracks 77a / 78a / 79).

5.5.7.67 The magnitude of change along the western chore of Loch Doon ranges from no view to Low-Very Low (at the caravan park). The level of visual effect ranges from No View to Moderate to Minor and not significant.

Auncheroy Hill

5.5.7.68 The view from the summit of Auncheroy Hill during the day is illustrated by Viewpoint 10 (Figure 5.23) At night, this receptor sensitivity is judged to be High due to its value, located within the buffer zone on the edge of the *Galloway Forest Dark Sky Park*. Walkers who may camp occasionally overnight on the summit are assessed as of high susceptibility as set out in the assessment for Core Path D13 which accesses the summit. There would be a Low magnitude of change and a Moderate level of effect that would not be significant due to the visual context multiple lights from settlements in the Doon Valley. Further assessment is provided in relation to Core Path D13.

Cairnsmore of Carsphairn (Corbett)

5.5.7.69 The view from the Cairnsmore of Carsphairn is illustrated by Viewpoint N13 (Figure 5.26) The viewpoint assesses this receptor sensitivity as High due to its value, located on the edge of the Galloway Hills RSA and the high susceptibility of walkers visiting this location. There would be a Low – Very Low magnitude of change and a Moderate to Minor level of effect that would not be significant due to the visual context of other wind farm development and light sources from settlements. Further assessment of this viewpoint is provided in Annex 1.

Blackcraig Hill

5.5.7.70 The view from the Blackcraig Hill is illustrated by Viewpoint N14 (Figure 5.27) The viewpoint assesses this receptor sensitivity as High due to its value, located within the Uplands and Moorlands (Glen Afton) and the high susceptibility of walkers visiting this location. There would be a Low – Very Low magnitude of change and a Moderate to Minor level of effect that would not be significant due to the visual context of other wind farm development and distant light sources from settlements. Further assessment of this viewpoint is provided in Annex 1.

5.5.8. Summary and Conclusion

5.5.8.1 A summary of the night-time assessment is provided in Table 5.5.6. No significant landscape or visual effects are predicted.

Table 5.5.6 Summary of Night-time Assessment

Landscape / Visual Receptor	Sensitivity	200cd Intensity		
		Magnitude	Level of Effect	Significance
Effects on Landscape Receptors:				
Southern Uplands with Forest LCT (Host) (20c)	Medium	Medium to Low	Moderate to Minor	Not Significant
Southern Uplands with Forest LCT (19a)	Low	Very Low	Negligible	Not Significant
Foothills with Forest & Opencast Mining LCT (17a)	Low	Very Low	Negligible	Not Significant
East Ayrshire Southern Uplands LCT (20a)	Medium	Very Low	Negligible	Not Significant
Rugged Uplands Lochs and Forests LCT (21)	High to Medium	Very Low	Moderate to Negligible	Not Significant
Upland River Valley LCT (10)	High to Medium	Low to Very Low	Moderate to Negligible	Not Significant
Upland Basin LCT (15)	Low	Very Low	Negligible	Not Significant
Doon Valley LLA	High to Medium	Low to Very Low	Moderate to Negligible	Not Significant
Merrick WLA	High	Very Low	Minor	Not Significant
Galloway Forest Dark Sky Park: Core Area	High	Very Low	Minor	Not Significant
Galloway Forest Dark Sky Park: Buffer Zone	High	Low to Very Low	Moderate to Negligible	Not Significant
Effects on Visual Receptors: Settlements				
Dalmellington and Bellsbank	Low	Very Low	Negligible	Not Significant
Burnton	Medium	Low	Minor	Not Significant
Burnside and Connel Park	Medium	Very Low	Negligible	Not Significant
Effects on Visual Receptors: Transport Routes				
A713 Galloway Tourist Route	Medium to Low	Low	Minor to Negligible	Not Significant
B741	Medium	Low	Minor	Not Significant
Effects on Visual Receptors: Recreational Routes				
Loch Doon Road: Core Path D11, Loch Doon Road Heritage Path and Scottish hill track 77a / 78a / 79	High	Low – Very Low	Moderate to Minor	Not Significant
Core Path D13: Dalcairnie / Auchenroy Hill circuit and Scottish hill tracks 78b / 81	High	Low	Moderate	Not Significant
D16: Bellsbank to Barbeth and Little	High	Moderate	Moderate	Not Significant

Landscape / Visual Receptor	Sensitivity	200cd Intensity		
		Magnitude	Level of Effect	Significance
Shalloch - Scottish hill track 78b / 81				
D18: northeast of Dalmellington	High	Low – Very Low	Moderate to Minor	Not Significant
Effects on Visual Receptors: Recreational and Tourist / Visitor Attractions				
Bogton Loch	High	Low	Moderate	Not Significant
Craigengillan GDL	High	Low	Moderate	Not Significant
Bellsbank Picnic Spot	High	Low – Very Low	Moderate to Minor	Not Significant
Loch Doon and Loch Doon Camping and Caravan Park	High	Low – Very Low	Moderate to Minor	Not Significant
Aunchenroy Hill	High	Low	Moderate	Not Significant
Cairnsmore of Carsphairn	High	Low	Moderate	Not Significant
Blackcraig Hill	High	Low	Moderate	Not Significant

Conclusion

5.5.8.2 The Lighting Strategy for the proposed development requires five of the turbines to be lit (T1, T4, T5, T9, and T10) all of which would be dimmed to 10% for approximately 90-95% of the time. This represents the greatest level of mitigation currently available and approved by the CAA. In addition, angle intensity mitigation will be provided. This would benefit most those receptors within low lying areas relative to the elevation of the lights, reducing the intensity to a low as <17 cd in some cases. The developer is willing to accept a planning condition to secure angle intensity mitigation (equal or better than the CEL MI-2KR light specification example in Table 5.4.1) although this is not a mandatory requirement.

5.5.8.3 The night-time assessment concluded that there would be no significant night-time effects on the host *Southern Uplands with Forest* LCT, due to the Medium sensitivity of this area and the presence of forestry and other wind farm development. There would be no significant night-time effects on the surrounding LCTs due to the intervening distance and the existence of other existing light sources from roads and settlements, notably within the Doon Valley and visible when viewing in the direction of the proposed development. For similar reasons there would be no significant night-time effects on the *Doon Valley LLA* (including its special qualities), the *Merrick WLA* (including its wild land qualities) or the *Galloway Forest Dark Sky Park* (including its qualities of 'darkness' and 'remoteness').

5.5.8.4 There would be no significant night-time effects on the views from the settlements of Dalmellington, Bellsbank, Burnton, Burnside and Connel Park, roads (A713 and B741) and recreational routes (Core Paths, Heritage Paths and Scottish hill tracks) or tourist / visitor locations (including Bogton Loch, *Craigengillan* GDL, Bellsbank Picnic Spot, Loch Doon and Loch Doon Caravan Park, and the hill walking summits of Auchenroy Hill, Cairnsmore of Carsphairn and Blackcraig Hill.

5.5.8.5 In assessing the *Galloway Forest Dark Sky Park* it may be noted that the core area is located between 15km and 22.2 km distance from the proposed development. The buffer zone and boundary of the *Galloway Forest Dark Sky Park* extends north along the Doon Valley to within 4km of the proposed boundary. Much of the Doon Valley and this part of the Park's buffer zone is influenced by existing lights from roads and settlement at Dalmellington, Bellsbank, and Burnton, diminishing the qualities of 'darkness' and 'remoteness' when compared the core areas. Viewing 'out' from the buffer zone and Park boundary, the visibility of lights from roads and settlement and the screening effects of trees and woodland would act to limit the effects of the aviation warning lights which would appear as points of light above groups of multiple lights from roads and settlements in the valley.

5.5.8.6 During the summer months, most people, including hill walkers are unlikely to experience the aviation warning lights. For example, during the summer solstice 2024 the aviation warning lights would switch on at 22.33 and switch off at 04.00 in the morning. Local residents and local road users are more likely to experience the aviation warning lights during the winter months. For example, during the winter solstice 2024 the lights would come on at 16.17 and switch off at 08.13 in the morning. It is reasonable to expect that most people would be commuting or indoors during these periods of colder weather, during the twilight and night, and would experience the aviation warning lights incidentally to their main activity.

5.5.8.7 Operation of the aviation warning lights would have no adverse effect on periods of sunrise (when the sun disk passes above the horizon and the period just after this) and sunset (the period just before the sun disk passes below the horizon) as the operation is programmed to switch off 30 mins before sunrise and switch on 30 mins after sunset, respectively.

Annex 1: Night-time Viewpoint Analysis

Figure 5.20	Viewpoint N7: Craigengillan Estate (former Dark Sky Observatory)	
Description and Darkness Survey	This viewpoint is located at of the site of the former Dark Sky Observatory. The new site for the Dark Sky Observatory has been confirmed at the former Clatteringshaws Visitor Centre on the A712 near Clatteringshaws Loch[12]. The viewpoint location is now representative of the view from a forest track on the lower, slopes of Rowantree Hill. The baseline level of light is assessed as dark, but not unlit, due to the visibility of lights at the settlement of Bellsbank which are visible in the valley to the left of the proposed development in the baseline photograph.	
Summary of Day-time Assessment	**Sensitivity**	High (tourists / walkers)
	Magnitude	High - Medium
	Level of Effect	**Substantial to Major and Significant**
	Type of Effect	Long term (reversible), direct and negative
Night-time Sensitivity	The viewpoint is located forest track on the lower slopes of Rowantree Hill within the Craigengillan estate and GDL which is open to the public. Although no longer the site of the Dark Sky Observatory, the value of the viewpoint remains high due to its location on the boundary of the *Galloway Forest Dark Sky Park,* and within buffer zone. Although few people are likely to visit / walk through this area the susceptibility of tourist / walkers would be high. The sensitivity has therefore been assessed as High.	
Magnitude of Change (proposed development only)	**Whilst operating at 200 cd** The nearest visible lit turbine is Turbine 1 at 5.9km distance on the other side (east) of the Doon Valley. All five of the aviation warning lights would be visible extending across approximately 18° of the horizontal FoV and appearing above the landform / horizon as points of light within a dark sky, to the right of existing lights from the settlement of Bellsbank. Viewing in other directions, the views into the *Galloway Forest Dark Sky Park* are foreshortened by landform. When visibility is >5km in all directions from the wind farm, the aviation warning lights would be dimmed to 10% and the visible light intensity would reduce to 200 cd (Low magnitude). This is likely to occur >90-95% of the time. Taking account of the lights at Bellsbank and the background contrast with the dark unlit sky beyond the proposed lights the magnitude is judged to remain Low. Turbine rotation may cause lights to appear intermittently as the turbine blades slowly rotate to pass in front of the light when the turbines are facing southwest. The magnitude of change would be Low. **Whilst Under Construction and Decommissioning:** Lights from construction vehicles along parts of the access track and a lit crane may be visible. The magnitude of change would range from Zero to Low.	
Assessment	**Light Intensity**	200 cd Lighting with angle attenuation mitigation
	Sensitivity	High (tourists / walkers)
	Magnitude	Low
	Level of Effect	**Moderate and not Significant –** due to its location on the boundary of the buffer zone to the Galloway Forest Dark Sky Park and viewing out of the Dark Sky Park towards the existing lights at Bellsbank as illustrated by Figure 5.36g. The angle intensity mitigation would further reduce the light intensity to between 98cd to 42cd.
	Type of Effect	Long term (reversible), direct and negative.

[12] https://www.bbc.co.uk/news/articles/c0mzppkw8pyo

Figure 5.20	Viewpoint N7: Craigengillan Estate (former Dark Sky Observatory)	
Cumulative Assessment (Scenarios 1 and 2): **Existing + Consented + Application wind farms within 15km with visible aviation warning lights**		
Existing:	No existing lit turbines are visible.	
Consented:	No consented lit turbines would be visible.	
Application:	**Additional Effect: Moderate and not significant** Up to seven lit turbines would be visible at the Knockkippen application, appearing further along the Doon Valley to the left of Bellsbank settlement at approximately 8km distance. The additional effect of the proposed development would remain **Moderate and not significant** due to the wider introduction of lights into this area. **Combined Cumulative Effect: Moderate and Significant** The combined cumulative effect of both developments together would collectively increase the effects on the 'darkness' of this area. The level of effect would increase to **Moderate and Significant**, assuming a worst case of no mitigation for the Knockkippen application. However, the cumulative visibility of the lights is unlikely to be particularly prominent assuming the Knockkippen application has similar mitigation to the proposed development.	

Figure 5.26	Viewpoint N13: Cairnsmore of Carsphairn	
Description and Darkness Survey	This viewpoint is located just to the north of the summit of Cairnsmore of Carsphairn and affords a panoramic view of the surrounding Southern Uplands landscape in all directions. The view towards the Proposed Development is orientated north-west and views the form of the expansive moorland hills, which along with wind farm development is just visible in the moonlit and twilight periods. Although the moorland area is dark and unlit and the existing wind farms are also unlit, there are some lights at the foot of the existing Windy Standard II turbines. There are many distant light sources from the settlements beyond the moorland hills including Dalmellington, Bellsbank and Cumnock. In the far distance, multiple lights within the Ayrshire lowlands are visible with the distinctive horizon of Arran beyond. Viewing north, two clusters of distant lights are visible from lit turbines at Kype Muir (approximately 40km) and Kennoxhead (approximately 27km).	
Summary of Day-time Assessment	**Sensitivity**	High (hill walkers)
	Magnitude	Low
	Level of Effect	**Moderate and Not Significant**
	Type of Effect	Long term (reversible), direct, and negative
Night-time Sensitivity	The viewpoint is located on the northern boundary of the locally designated *Galloway Hills* RSA (looking away from the designated RSA area). It is some distance away from the *Galloway Forest Dark Sky Park*. The RSA is not valued for its 'dark skies' officially although it is reasonable to assume this is contributary to the 'special quality' of the area and the Cairnsmore of Carsphairn is well known. Taken together the value of the viewpoint is assessed as High-Medium. The view would be experienced by occasional hill walkers who may have accessed the hill to camp overnight. The susceptibility to change, and consequently the sensitivity is assessed as High.	
Magnitude of Change (proposed development only)	**Whilst operating at 200 cd** The nearest visible lit turbine is Turbine 10 at 9.2km distance appearing beyond the existing South Kyle I and Windy Standard wind farms. Four[13] of the aviation warning lights would be visible extending across approximately 12° of the horizontal FoV and appearing against the background landscape. When visibility is >5km in all directions from the wind farm, the aviation warning lights would be dimmed to 10% and the visible light intensity would reduce to 200 cd (Low magnitude). This is likely to occur >90-95% of the time.	

[13] The light from T5 is screened by T6 in this view.

Figure 5.26	Viewpoint N13: Cairnsmore of Carsphairn	
	Angle intensity mitigation would not alter the light intensity (200 cd) due to the higher elevation of the viewpoint, although in comparison to Viewpoint N7 the lights at this viewpoint are 3.3km more distant. To conclude, although the lights would be viewed at 200 cd, they would be more distant and viewed against the wider backdrop of clusters of lights from settlements, which although at much further distance would appear more numerous in comparison to the four points of light on the turbine nacelles. The magnitude of change therefore would be Low-Very Low. **Whilst Under Construction and Decommissioning:** Lights from construction vehicles along parts of the access track and a lit crane may be visible. The magnitude of change would range from Zero to Low.	
Assessment	**Light Intensity**	200cd Lighting with angle attenuation mitigation
	Sensitivity	High (hill walkers)
	Magnitude	Low-Very Low
	Level of Effect	**Moderate to Minor and Not Significant –** due to the presence of the lights from settlements and the many existing turbines that although unlit would be partly visible in the moonlight / twilight.
	Type of Effect	Long term (reversible), direct and negative.
Cumulative Assessment (Scenarios 1 and 2): **Existing + Consented + Application wind farms within 15km with visible aviation warning lights**		
Existing:	Viewing north, two clusters of distant lights are visible from lit turbines at Kype Muir (approximately 40km) and Kennoxhead (approximately 27km). It is assumed that these lights are unmitigated. **Additional Effect: Moderate to Minor and not significant** The additional effect of the proposed development would reaming unchanged (Low - Very low) at **Moderate to Minor and Not Significant**. **Combined Cumulative Effect: Moderate to Minor and not significant** The combined cumulative effect of these developments together would increase the number of existing clusters of lights, although the level of effect would not change overall due to the wide dispersal and long intervening distances. The combined level of effect would remain **Moderate to Minor and not significant**.	
Consented:	Viewing north, 12 lights at Windy Standard III would be simultaneously visible in the fore to mid-ground. Viewing north, Seven lights at Overhill would be simultaneously visible in the distance, beyond the proposed development and are likely to be absorbed into the background pattern of existing lights from roads and settlements. Viewing east, 19 lights at Sanquhar II would be successively visible as points of light, beyond Windy Rig in the distance. **Additional Effect: Minor and not significant** The additional effect of the proposed development would be reduced to **Minor and not Significant** due to its appearance beyond the 12 lights at Windy Standard III and considering the wider introduction of lights into this area. **Combined Cumulative Effect: Substantial to Moderate and Significant** The combined cumulative effect of these developments together would increase the level of effect to between **Substantial to Moderate and Significant** assuming a worst case of no mitigation. Collectively approximately 42 lights would be visible within this landscape. Assuming similar mitigation for all the other schemes, a reduced (Moderate) although significant combined cumulative effect is still likely with a Minor contribution from the proposed development.	
Application:	Viewing simultaneously seven lights would be visible at Knockkippen and eight lights at Scienteuch, appearing beyond distant settlement lights in the Doon Valley.	

Figure 5.26	Viewpoint N13: Cairnsmore of Carsphairn	
	Viewing successively a further five lights would be visible at Windy Standard Repower (appearing to extend from Windy Standard III) with lights from Lorg Variation (five turbines) and all of the Euchanhead turbines appearing beyond. Viewing in the opposite direction Knockcronal (six turbines) and all of the Carrick turbines would appear in the distance beyond Loch Doon. **Additional Effect: Moderate and not significant** There additional effect of the proposed development would be reduced to **Minor and not Significant** as explained above. **Combined Cumulative Effect: Substantial to Moderate and Significant** The combined cumulative effect of these developments together would however increase to between **Substantial to Moderate and Significant**, assuming a worst case of no mitigation. Many lights would be visible in this landscape. Assuming similar mitigation for all the other schemes, a reduced significant combined cumulative effect is still likely with a Minor contribution from the proposed development.	

Figure 5.27	Viewpoint N14: Blackcraig Hill	
Description and Darkness Survey	This viewpoint is located on the summit of Blackcraig Hill (700m AOD) to the east of the Proposed Development site. The landform and profile of the expansive moorland hills, along with wind farm development, is just visible in the moonlit and twilight periods. The moorland area is dark and unlit and the existing wind farms are also unlit. However, clusters of lights across the settlements of Cumnock and New Cumnock are visible in the low-lying basin to the north of the hills. Viewing north, two clusters of distant lights are visible from lit turbines at Kype Muir (approximately 30km) and Kennoxhead (approximately 18km).	
Summary of Day-time Assessment	**Sensitivity**	High (hill walkers)
	Magnitude	Low
	Level of Effect	**Moderate and Not Significant**
	Type of Effect	Long term (reversible), direct, and negative
Night-time Sensitivity	The viewpoint is located on the northern boundary of the locally designated *Uplands and Moorlands* (Glen Afton) LLA (viewing across the glen within the LLA). The LLA is not valued for its 'dark skies' officially although it is reasonable to assume this is contributary to the 'special quality' of the area and the hill is well known locally. Taken together the value of the viewpoint is assessed as High-Medium. The view would be experienced by occasional hill walkers who may have accessed the hill to camp overnight. The susceptibility to change, and consequently the sensitivity is assessed as High.	
Magnitude of Change (proposed development only)	**Whilst operating at 200cd** The nearest visible lit turbine is Turbine 10 at 10.7km distance appearing beyond the existing Afton Wind Farm (on the other side of Glen Afton) and beyond South Kyle I and Enoch Hill wind farms. Five of the aviation warning lights would be visible extending across approximately 9° of the horizontal FoV and appearing along the horizon. When visibility is >5km in all directions from the wind farm, the aviation warning lights would be dimmed to 10% and the visible light intensity would reduce to 200cd (Low magnitude). This is likely to occur >90-95% of the time. Angle intensity mitigation would not alter the light intensity (200 cd) due to the higher elevation of the viewpoint, although in comparison to Viewpoint N7 the lights at this viewpoint are 4.8km more distant. To conclude, although the lights would be viewed at 200 cd, they would be more distant and are therefore likely to appear similar to the lights viewed from Viewpoint N13. The magnitude of change therefore would be Low-Very Low. **Whilst Under Construction and Decommissioning:** Lights from construction vehicles along parts of the access track and a lit crane may be visible. The magnitude of change would range from Zero to Low.	

Figure 5.27	Viewpoint N14: Blackcraig Hill	
Assessment	**Light Intensity**	200 cd Lighting with angle attenuation mitigation
	Sensitivity	High (hill walkers)
	Magnitude	Low-Very Low
	Level of Effect	**Moderate to Minor and Not Significant** – due to the presence of many existing turbines that although unlit would be partly visible in the moonlight / twilight and the successive visibility of settlement lights to the north at Cumnock and New Cumnock as illustrated by Figure 5.38g. .
	Type of Effect	Long term (reversible), direct and negative.
Cumulative Assessment (Scenarios 1 and 2): **Existing + Consented + Application wind farms within 15km with visible aviation warning lights**		
Existing:	Viewing north, two clusters of distant lights are visible from lit turbines at Kype Muir (approximately 30km) and Kennoxhead (approximately 18km). It is assumed that these lights are unmitigated. **Additional Effect: Moderate to Minor and not significant** The additional effect of the proposed development would reaming unchanged (Low - Very low) at **Moderate to Minor and Not Significant**. **Combined Cumulative Effect: Moderate to Minor and not significant** The combined cumulative effect of these developments together would increase the number of existing clusters of lights, although the level of effect would not change overall due to the wide dispersal and long intervening distances. The combined level of effect would remain **Moderate to Minor and not significant**.	
Consented:	Viewing west, 12 lights at Windy Standard III and seven lights at Overhill would be simultaneously visible in the distance. Viewing east and south, 19 lights at Sanquhar II would be successively visible in the fore to mid-ground. **Additional Effect: Moderate and not significant** The additional effect of the proposed development would be reduced to **Minor and not Significant** due to the greater prominence and wider introduction of lights into this area. **Combined Cumulative Effect: Substantial to Moderate and Significant** The combined cumulative effect of these developments together would increase the level of effect to between **Substantial to Moderate and Significant** assuming a worst case of no mitigation. Collectively approximately 43 lights would be visible. Assuming similar mitigation for all the other schemes, a reduced significant combined cumulative effect is still likely with a Minor contribution from the proposed development.	
Application:	Viewing simultaneously lights would be theoretically visible at Knockkippen, Scienteuch Knockcronal, and Carrick all appearing in the far distance beyond Loch Doon. Viewing successively to the west and south a further five lights would be visible in the distance at Windy Standard Repower (appearing to extend from Windy Standard III) with lights from Lorg Variation largely screened by landform. Viewing east (in the opposite direction) some of the Euchanhead turbines would be visible in the fore to mid-ground with Sanquhar II. **Additional Effect: Moderate and not significant** There would be no change to the additional effect of the proposed development which would be reduced to **Minor and not Significant** as explained above. **Combined Cumulative Effect: Substantial to Moderate and Significant** The combined cumulative effect of these developments together would however increase to between **Substantial to Moderate and Significant**, assuming a worst case of no mitigation. Many lights would be visible in this landscape. Assuming similar mitigation for all the other schemes, a reduced significant combined cumulative effect is still likely with a Minor contribution from the proposed development.	

Annex 2: Night-time LVIA Checklist

The NS *Guidance on Aviation Lighting Impact Assessment, Appendix 1*, November 2024 recommends the assessment should include the following information as set out in the Application Submission Checklist:

Aviation Lighting Proposals and Mitigation

Information to be provided:

- ☑ Plan showing the wind farm layout with numbered turbines and a corresponding schedule of visible lights (both nacelle and mid-tower lights where required).
- ☑ Information on proposed visible aviation lighting scheme, including a clear listing of all proposed mitigation measures.
- ☑ Information on any project-specific mitigation approvals that have been obtained or are still required from CAA.

Recommendations:

- ☑ Developers are encouraged to combine available mitigation measures into wind farm design to mitigate the lighting impacts as far as is reasonably practicable, whilst maintaining a proportionate approach.

Night-time Aviation Lighting Impact Assessment

Information to be provided:

- ☑ Plan showing the extent of the night time Study Area.
- ☑ Assessment of night-time effects for each relevant receptor, in particular where qualities of wildness, darkness, remoteness and lack of man-made elements are features or characteristics of the landscape.
- ☑ An appraisal of all viewpoints within the study area should be included where there may be significant effects and can be informed by wireline visualisations.
- ☑ Detailed assessment of, in most instances, two or three representative viewpoints accompanied by photomontage visualisations to adequately represent the key impacts.
- ☑ Assessment of any likely significant cumulative effects from visible aviation lighting, where appropriate.

Recommendations:

- ☑ Ensure that both daytime and nighttime assessments are proportionate, appropriate, comprehensive, and transparent.
- ☑ A proportionate approach, with a focus on significant effects, is required when scoping the relevant landscape and visual receptors and how they may be affected. It is worth noting that receptors and their sensitivity will not always be the same during the day and night.
- ☑ The assessment should take into account the baseline darkness / artificial lighting characteristics and people's likely use of different areas during darkness and low light (dusk / dawn) conditions.
- ☑ The extent of the lighting assessment study area for the LVIA should be informed by a hub height ZTV (to indicate the extents of aviation lighting visibility), and an understanding of the nature of the likely effects. Experience suggests a study area of 10km - 20km should be sufficient for the night-time Aviation Lighting Impact Assessment, to ensure significant effects are captured, depending on the sensitivities.

Night-time Aviation Lighting Impact Assessment cont.

- ☑ Ensure that both daytime and nighttime assessments are proportionate, appropriate, comprehensive, and transparent.
- ☑ A proportionate approach, with a focus on significant effects, is required when scoping the relevant landscape and visual receptors and how they may be affected. It is worth noting that receptors and their sensitivity will not always be the same during the day and night.
- ☑ The assessment should take into account the baseline darkness / artificial lighting characteristics and people's likely use of different areas during darkness and low light (dusk / dawn) conditions.
- ☑ The extent of the lighting assessment study area for the LVIA should be informed by a hub height ZTV (to indicate the extents of aviation lighting visibility), and an understanding of the nature of the likely effects. Experience suggests a study area of 10km - 20km should be sufficient for the night-time Aviation Lighting Impact Assessment, to ensure significant effects are captured, depending on the sensitivities.
- ☑ Viewpoint assessment should provide commentary cross referenced to lighting wirelines and photomontages.

Wireline visualisations

Information to be provided:

- ☑ Identification of turbine lighting on wireline visualisations. The turbine lighting may either be marked at the appropriate positions on the wirelines or provided as a separate note at the foot of the wirelines. This should apply to all the LVIA 53.5° (degree) wirelines (i.e. indication of visible lighting should not just be shown for the night-time photomontages).

Photomontage visualisations

Information to be provided:

- ☑ Night-time photomontage visualisations from a proportionate number of representative viewpoints (two or three should be appropriate for most projects), selected based on sensitivity of potential receptors and frequency of visitors at night or dusk/dawn, and to be agreed with the Planning Authority (in consultation with NatureScot where appropriate).
- ☑ Photomontage visualisations should illustrate the maximum case lighting intensity scenario (e.g. 200 cd where dimming of aviation lights proposed as embedded mitigation, and 2000 cd only where this mitigation is not proposed).

Recommendations:

- ☑ Whilst it is expected that two or three representative viewpoints will require a photomontage visualisation, an appraisal of all viewpoints where there may be significant effects should be included.
- ☑ In some cases, there may be the need to select night-time assessment viewpoints based on the turbine lighting impacts as opposed to the day-time visual effects, therefore the viewpoints may vary from the suite of day-time assessment viewpoints. Edge of settlement locations are likely to be better lighting assessment viewpoints, compared with locations within towns/ villages (given the influence of existing street lighting, etc.).
- ☑ Health and safety concerns exist over taking dusk/dawn photography, and associated assessment fieldwork from remote viewpoints. This should be a key consideration for all involved in agreeing the scope and undertaking aviation lighting photography/ assessment. In some cases, a more accessible proxy viewpoint may be the proportionate, alternative safe location to capture viewpoint photography at dusk/night.
- ☑ Moreover, sometimes the approach route to and from a remote hill summit is where receptors will experience a total absence of existing visible lights and may be more representative than the hill summit /ridge (where receptors are perhaps less likely to camp).
- ☑ This Guidance advises against use of manipulated day-time photography due to the risk of misrepresenting the baseline (photographs should capture the baseline situation, i.e. any other lights in the view), however, there may be instances where the approach could be used for remote locations where it can be verified that no other sources of artificial light are present in the baseline.

Annex 3: References

- Article 222 of the *UK Air Navigation Order* (ANO) 2016.
- CAA policy statement '*Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in excess of 150m Above Ground Level*' 2017.
- East Ayrshire Council, (2024) *Local Development Plan 2*.
- East Ayrshire Council, (2024), Dark Sky Park Lighting Supplementary Guidance.
- https://www.bbc.co.uk/news/articles/c0mzppkw8pyo
- International Civil Aviation Organisation (ICAO)
- Landscape Institute (September 2019). *Visual Representation of Development Proposals*, Technical Guidance Note 06/19.
- Lumsden, Dr. Stuart. (2024) *Visibility of Aviation Warning Lights*, Report for Kyle II Wind Farm, (EIAR Volume 3, Technical Appendix 5.6).
- NatureScot, (November 2024) Guidance on Aviation Lighting Impact Assessment.
- NatureScot, (2022) General pre-application and scoping advice for onshore wind farms Guidance, Annex 2.
- Scottish Natural Heritage (February 2017). *Visual Representation of Wind Farms*, Version 2.2.
- https://www.Galloway International Dark Sky Park | Forestry and Land Scotland