CARDINAL LIGHTING STRATEGY LANDSCAPE AND VISUAL ASSESSMENT

1 Introduction

1.1 In 2020 ASH design + assessment Ltd (ASH) undertook an assessment of the landscape and visual effects of the aviation lighting proposals for the Proposed Varied Development as part of the 2020 Environmental Impact Assessment Report (EIAR) (EIAR Volume 4, Technical Appendix 4.10)[1]. This assessment provides an update to the findings included in the EIAR to reflect the revised cardinal aviation lighting strategy as described below as part of the 2021 Further Information Report (FIR). This assessment is supported by a series of Zone of Theoretical Visibility (ZTV) figures illustrating the theoretical extent of visible cardinal aviation lighting (FIR Figures 1-5) and by visualisations from five of the main LVIA viewpoints as agreed with The Highland Council (THC) and NatureScot (formerly Scottish Natural Heritage (SNH))[2] (FIR Figures 6-10).

1.2 This assessment is supported by the figures listed in Table 1 below.

Table 1: Supporting Figures
FIR Figure 1a: Cardinal Aviation Lighting Strategy: Hub Height ZTV A3
FIR Figure 1b: Cardinal Aviation Lighting Strategy: Hub Height ZTV A1
FIR Figure 2: Cardinal Aviation Lighting Strategy: Landscape Character Types with Hub Height ZTV
FIR Figure 3: Cardinal Aviation Lighting Strategy: Designated and Protected Landscapes with Hub Height ZTV
FIR Figure 4: Cardinal Aviation Lighting Strategy: Visual Receptors with Hub Height ZTV
FIR Figure 5: Cardinal Aviation Lighting Strategy: Theoretical Intensity ZTV
FIR Figure 6a: VP3 Loch nan Clach Geala Baseline Photo and Wireline
FIR Figure 6b: VP3 Loch nan Clach Geala Wireline
FIR Figure 6c: VP3 Loch nan Clach Geala Photomontage
FIR Figure 7a: VP4 East of Melvich Baseline Photo and Wireline
FIR Figure 7b: VP4 East of Melvich Wireline
FIR Figure 7c: VP4 East of Melvich Photomontage
FIR Figure 8a: VP5 Strathy Baseline Photo and Wireline
FIR Figure 8b: VP5 Strathy Wireline
FIR Figure 8c: VP5 Strathy Photomontage
FIR Figure 9a: VP7 A836 west of the B871 Baseline Photo and Wireline
FIR Figure 9b: VP7 A836 west of the B871 Wireline
FIR Figure 9c: VP7 A836 west of the B871 Photomontage
FIR Figure 10a: VP10 Beinn Ratha Baseline Photo and Wireline
FIR Figure 10b: VP10 Beinn Ratha Wireline
FIR Figure 10c: VP10 Beinn Ratha Photomontage
FIR Figure 11: Cardinal Lighting Strategy: Comparative Hub Height ZTV (Strathy Wood)[3]

[1] The assessment in TA 4.10 was based on a worst case scenario in which each of the 39 turbines had a 2,000 candela red light fitted to the top of the nacelle.

[2] Scottish Natural Heritage (SNH) formally changed their name to NatureScot on 24 August 2020. Many of their documents referred to in this report were published prior to this date. As such reference is still made to SNH where appropriate.

[3] NatureScot requested a cumulative hub height ZTV with the Proposed Varied Development cardinal lighting strategy and current proposed Strathy Wood lit turbines be included with the FIR for their reference. This figure is provided for reference purposes only.

Description of Proposed Lighting

1.3 This assessment is based on the lighting scheme approved by the Civil Aviation Authority (CAA) on 18th March 2021 and on the requirements of 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 150 m Above Ground Level*[4] (the CAA policy statement).

1.4 In line with the approved CAA lighting scheme and policy statement, the assessment is therefore based on the following assumptions:

- Each of the 6 cardinal turbines (T2, T15 T26, T35, T52 and T69 (see FIR Figure 1)) would have a 2,000 candela red light fitted to the top of the nacelle (assumed to be at 119 m), visible in all directions;
- A second 2,000 candela light would be fitted to the nacelles of each of the 6 cardinal turbines (T2, T15, T26, T35, T52 and T69) to act as a back-up to be used in the event of failure of the main light;
- Lights would be switched on and off by a timer set to 'Official Night' as set out in the Air Navigation Order, i.e. switched on at 30 minutes after sunset and switched off at 30 minutes before sunrise (all times local);
- When the horizontal meteorological visibility is measured as exceeding 5km, the 2,000 candela lights will be dimmed to 10% of their nominal intensity; and
- All lights would be steady (i.e. not flashing). However, depending on wind direction, moving turbine blades seen in front of lights may give an impression of flashing lights from some locations.

Proposed Mitigation

1.5 Due to the tip height of Proposed Varied Development (turbines being above 150 m to tip), aviation lighting would be required in line with the Air Navigation Order[4]. The CAA has agreed to a lighting scheme consisting of a 2,000 candela steady red light on the nacelles of each of T2, T15, T26, T35, T52 and T69, together with infra-red lighting, not visible to the unaided human eye on the nacelles of all perimeter turbines.

1.6 The visible lights on the six cardinal turbines will be dimmed to 10% of their nominal intensity when the measured meteorological visibility exceeds 5 km. These conditions are estimated to prevail in the north of Scotland for more than 90% of the time.[5]

1.7 It is further proposed to fit the Proposed Varied Development with a transponder-based lighting activation system which will switch on the visible lighting on the six turbines only when an aircraft is detected flying within 4 km of the wind farm and 1,000 feet or less above the altitude of the highest blade tips. The CAA has stated that it is minded to accept a case for such a system to be employed at the Proposed Varied Development and the applicant is seeking confirmation from the CAA that this technology will be approved for use within the required timescales.

1.8 It is understood from the Applicant's specialist aviation consultant, that tests of a transponder-based lighting activation system at ten wind farms in Germany found that, over the course of a year, at three of the wind farms, the lights were never activated; at two of the wind farms, the lights were activated for 0.1% of the time; and at the remaining five wind farms, the lights were activated for periods varying between 1.8 and 7.3% of the time.[6] Due to the low volume of air traffic in the vicinity of the Proposed Varied Development it is expected that the lighting activation periods would be at the lower end of the examples from Germany.

[4] The Air Navigation Order 2016, S.I. 2016 No.765, Article 222.
[5] See for example Dr Stuart Lumsden, Technical Report on the Propagation of Light from the Proposed Aviation Warning Lights at the Clash Gour Wind Farm Development, CD 14.7, DPEA reference WIN-300-4, 31 July 2020, paragraph 6.5.7
[6] Lanthan SafeSky presentation, April 2021

2 Approach and Methodology

Scope

2.1 A 20 km Study Area was selected, being the area within which it is considered that significant effects from the cardinal aviation lighting could potentially be experienced. This area is consistent with the Detailed Study Area for the main LVIA of the Proposed Varied Development (Chapter 4: Landscape and Visual Amenity (EIAR Volume 2)) and the 2020 Lighting Assessment which accompanied it (EIAR Volume 4, Technical Appendix 4.10).

Methodology

2.2 The cardinal aviation lighting assessment has been prepared with reference to Guidelines for Landscape and Visual Assessment (Third Edition) (GLVIA3)[7] and broadly in line with emerging guidelines provided by NatureScot[8],[9].

2.3 GLVIA3 places a strong emphasis on the importance of professional judgement in identifying and defining the significance of landscape and visual effects. As part of this assessment, professional judgement has been used in combination with structured methods and criteria to evaluate value, sensitivity, and magnitude and significance of effect. The assessment has been undertaken and verified by two Chartered Landscape Professionals to provide a robust and consistent approach.

2.4 Methods promoted by GLVIA3 require an appreciation of the existing environment and the ability of its key components to accept the change proposed. An understanding of the potential effects which could occur and how these could affect the key components and the potential to mitigate adverse effects. The emerging NatureScot guidance broadly aligns with this, with a focus on appreciating the different sensitivities landscape and visual receptors have at night and the potential effects that turbine lighting specifically might have. There are four key stages to the assessment which are presented in the following sub-sections.

Establishing the Baseline

2.5 The baseline has been determined through a combination of desk study and site survey, taking account of the appearance and intensity of existing visible lights. Desk appraisal has involved review of the ZTV and wirelines. Site survey was undertaken at twilight and in the subsequent hours of darkness on 8th to 11th October 2019 by Chartered Landscape Architects.

Appreciation of the Proposed Varied Development

2.6 An appreciation of the proposals has been developed through building an understanding of the proposed cardinal aviation lighting requirements and the surveyors experience of existing wind turbine sites with aviation lights of a similar intensity during the hours of darkness.

Analysis of Receptors and Residual Effects

2.7 Preparation of the baseline is followed by the systematic identification of likely effects on the receptors. This is a two-fold process, giving consideration to how effects could arise from a cardinal aviation lighting strategy for the Proposed Varied Development, and how these changes could be accommodated in the existing baseline.

Sensitivity of Landscape Receptors

2.8 Landscape sensitivity is reflective of the nature of the landscape and its ability to accommodate development of the type proposed without compromising its key characteristics and components.

[7] Landscape Institute (LI) / Institute of Environmental Management and Assessment (IEMA), (2013), *Guidelines for Landscape and Visual Impact Assessment, Third Edition. Routledge.*
[8] Scottish Natural Heritage, (2017), Visual Representation of Wind Farms (Version 2.2).
[9] NatureScot, (2020), General pre-application and scoping advice for onshore wind farms.

This involves the consideration of the baseline value of the landscape and its susceptibility to change. When considering value and susceptibility in the context of aviation lighting, the degree to which the character of the area is currently characterised by artificial lighting or a lack of it is particularly important. It should be noted that some characteristics that contribute to the daytime value of a landscape may not be as relevant at night and vice versa.

2.9 Landscape sensitivity has been evaluated using a three-point scale as follows:

- High – a highly valued landscape of particularly distinctive character susceptible to relatively small changes of the type proposed;
- Medium – a reasonably valued landscape with a composition and characteristics tolerant to some degree of change of the type proposed; and
- Low – a relatively unimportant landscape which is potentially tolerant of a large degree of change of the type proposed.

Sensitivity of Visual Receptors

2.10 Sensitivity to change considers the nature and viewing expectation from the receptor and takes into account the perceived value of the existing view and the susceptibility of the visual receptor to change. The importance of the aspect of the view which would be changed contributes to the sensitivity evaluation. The sensitivity evaluation considers the value of views during low light conditions when aviation lights could be on, as well as during full darkness.

2.11 The value and susceptibility of receptors can differ at night. Features that are valued during the day may not be visible at night while other features such as the starry night sky may best be appreciated during the hours of darkness. Likewise, individuals seeking out activities that require darkness (i.e. stargazing) will have a higher level of susceptibility than others whose activities take place irrespective of the light levels (i.e. outdoor sporting clubs that gather under flood lights in the evening or commuters focused on the road).

2.12 Sensitivity to the change proposed has been evaluated using a three-point scale as follows:

- High: Where the appearance of the Proposed Varied Development would affect or alter an important part of a highly valued, impressive or well composed view obtained with no detracting features;
- Medium: Where the appearance of the Proposed Varied Development would affect or alter a fairly important part of a valued or pleasing view obtained or a notable part of a less well composed view obtained with some detracting features; and
- Low: Where the appearance of the Proposed Varied Development would affect or alter an unimportant part of the overall view obtained or would affect or alter a view obtained which is of limited value or poorly composed, with numerous detracting features.

Magnitude of Change on Landscape Receptors

2.13 Magnitude of change concerns the degree to which the Proposed Varied Development would alter the existing characteristics of the landscape. The appraisal of magnitude involves consideration of the nature and scale of the change which would occur in relation to the identified potential effects and also the duration and potential reversibility of the effect. These are used to identify a magnitude rating for the landscape receptor as a whole.

2.14 Magnitude is categorised on a four-point scale as follows:

- High – notable change in landscape characteristics over an extensive area ranging to a very intensive change over a more limited area;
- Medium – perceptible change in landscape characteristics over an extensive area ranging to a notable change in a localised area;

- Low – virtually imperceptible change in landscape characteristics over an extensive area or a perceptible change in a localised area; and
- Negligible – no discernible change in any landscape characteristics or components.

Magnitude of Change on Visual Receptors

2.15 Magnitude of change concerns the extent to which the existing view obtained would be altered by the Proposed Varied Development. The evaluation of magnitude gives consideration to factors such as the scale or extent of the changes within the view, the extent to which this could alter the composition or focus of the view and the duration and reversibility of these changes.

2.16 Magnitude of change has been evaluated using a four-point scale as follows:

- High: Where the Proposed Varied Development would result in a very noticeable change in the existing view obtained by the viewer;
- Medium: Where the Proposed Varied Development would result in a noticeable change in the existing view obtained by the viewer;
- Low: Where the Proposed Varied Development would result in a perceptible change in the existing view obtained by the viewer; and
- Negligible: Where the Proposed Varied Development would result in a barely perceptible change in the existing view obtained by the viewer.

Assessment of Significant Effects

2.17 The purpose of this assessment in the context of the FIR is to identify predicted significant effects on the landscape and visual amenity arising from the proposed cardinal aviation lighting strategy for the Proposed Varied Development. For the purposes of the assessment effects identified as being **Moderate** or above may be regarded as significant in term of The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the 2017 EIA Regulations)[10].

Level of Landscape Effects

2.18 Evaluation of the predicted significance of effects on landscape receptors has been carried out through analysis of the anticipated magnitude of change resulting from the introduction of cardinal aviation lights on the Proposed Varied Development in relation to the identified landscape sensitivity and using a degree of professional judgement. The assessment takes into account effects upon existing landscape elements, features and key characteristics and assesses the extent to which these would be lost or modified, in the context of their importance in determining the existing baseline character.

2.19 The significance of landscape effects has been evaluated using a four-point scale as follows:

- **Major** – the Proposed Varied Development is at considerable variance with the landform, scale and pattern of the landscape and would be a dominant feature, resulting in considerable reduction in scenic quality and large-scale change to the intrinsic landscape character of the area;
- **Moderate** – the Proposed Varied Development is out of scale with the landscape, or inconsistent with the local pattern and landform and could be locally dominant and / or result in a noticeable reduction in scenic quality and a degree of change to the intrinsic landscape character of the area;
- **Minor** – the Proposed Varied Development does not quite fit with the scale, landform or local pattern of the landscape and could be locally intrusive, but would result in an inappreciable reduction in scenic quality or change to the intrinsic landscape character of the area; and

[10] Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017. Available at: http://www.legislation.gov.uk/ssi/2017/101/contents/made (Accessed February 2020).

- **Negligible** – the Proposed Varied Development sits well within the scale, landform and pattern of the landscape and would not result in any discernible reduction in scenic quality or change to the intrinsic landscape character of the area.

Level of Visual Effects

2.20 The level of visual effect identified concerns the changes resulting from the introduction of cardinal aviation lights on the Proposed Varied Development. Evaluation of the visual effect is based on consideration of the magnitude of change in relation to visual sensitivity and is established using professional judgement. The assessment takes into account likely changes to the visual composition, including the extent to which new features would distract from the view or disrupt the scale, structure or focus of the existing view obtained.

2.21 The prominence of the cardinal aviation lights in the view will vary according to the prevailing weather conditions. The assessment has been carried out, as is best practice, by assuming the 'worst case' scenario. This is assumed to be in clear conditions in full darkness, unless the value of the view or effect would be greater in different lighting conditions. However, it is recognised that predicted effects could be reduced in some conditions (i.e. in the case of low cloud or haze).

2.22 Effect significance has been evaluated using a four-point scale and using the following criteria:

- **Major**: The Proposed Varied Development would become a prominent and very detracting feature and would result in a very noticeable deterioration to an existing highly valued and well composed view obtained by the viewer;
- **Moderate**: The Proposed Varied Development would introduce some detracting features to an existing highly valued view or would be more prominent within a pleasing or less well composed view, resulting in a noticeable deterioration of the quality of view obtained by the viewer;
- **Minor**: The Proposed Varied Development would form a perceptible but not detracting feature within a pleasing or valued view or would be a prominent feature within a poorly composed view of lesser value, resulting in a small deterioration to the existing view obtained by the viewer; and
- **Negligible**: The Proposed Varied Development would form a barely perceptible feature within the existing view and would not result in any discernible deterioration to the view obtained by the viewer.

Limitations of the Assessment

2.23 The use and limitations of ZTV diagrams are explained in Annex 2: Technical Methodologies for Visual Representation. The scope of assessment is defined in paragraph 1.4 where the key assumptions for the cardinal aviation lighting assessment are set out.

2.24 The appearance and brightness of the cardinal aviation lights has been estimated by the assessors, based on experience of similar intensity aviation lighting visited and observed during the hours of darkness.

3 Assessment of Effects

Existing Lighting Baseline

3.1 The site survey indicated that there were very low levels of artificial light within the 20 km Study Area. A few small settlements including Strathy, Bettyhill, Melvich and Tongue are the most notable contributors of artificial light. There are also scattered lights at individual crofts and farms. Car headlights and break lights as well as reflections of these on other road markers result in randomised bright illuminations in the landscape, however the overall sense is of a dark landscape.

3.2 At the boundary of the 20 km Study Area, car park floodlighting at the Dounreay Power Station is a notable source of artificial light, which particularly influences eastbound travellers along the A836. Located at approximately 35 km to the northeast, Thurso is also a notable source of artificial light within the wider area.

Potential Effects

3.3 Potential effects relate to the appearance of the proposed 2,000 candela nacelle lights on the six cardinal turbines. The effect of lighting on the viewer could be influenced by both the number and the intensity of the lights potentially visible and the extent to which baseline lighting is present. The following issues have been considered in the assessment of predicted effects:

- Aviation lights are typically focussed on a horizontal plane with intensity of light reducing below a specified viewing angle. Therefore, a lesser effect may be experienced by a viewer situated at increased angles below the horizontal (see FIR Figure 5). However, potential intensity at different viewing angles differs between lighting manufacturers. Therefore, this assessment is based on a worst-case scenario which does not account for variations in lighting intensity due to changes in viewing angles;
- Perceived intensity of the aviation lights would diminish with distance. However, in some instances, combinations of greater numbers of aviation lights seen from further away could counter this effect to some extent.
- The CAA Policy Statement allows for the lights to be reduced to 10% of their nominal value during periods where the measured meteorological visibility exceeds 5km (i.e. 200 candela). This means that the cardinal aviation lights will emit a maximum intensity of 200 candela approximately 90% of the time; and when the higher light intensity lights are triggered by poor visibility, the lights will appear less bright to observers due to the atmospheric conditions.
- Nacelle aviation lights could lead to illumination of turbine blades as they pass through the horizontal plane of the beam and therefore in some situations the viewer would be able to perceive the movement of the turbines during darkness; and
- In certain wind directions and viewing angles, moving turbine blades in front of the aviation light would cause a flashing effect. Where a number of different turbines were aligned, this effect could be increased to a flickering impression.

Zone of Theoretical Visibility

3.4 A hub height ZTV (119 m above existing ground level), was generated to illustrate areas where views of the cardinal aviation lights would theoretically be obtained using ArcGIS software. This is presented in FIR Figure 1a. Detailed technical information on the methods for production of ZTVs is included in the Annex 2: Technical Methodologies for Visual Representation.

Residual Lighting Effects on Landscape Receptors

3.5 The landscape receptors within the Study Area are illustrated on FIR Figure 2 and FIR Figure 3. The landscape receptors most likely to experience significant effects as a result of the introduction of aviation lighting are those directly affected by the development's location within them and those in close proximity where the aviation lighting would represent a notable change to the surrounding landscape.

3.6 The following landscape receptors within the Study Area were identified as having the potential to experience effects as a result of the cardinal aviation lighting:

- Kyle of Tongue NSA;
- Bens Griam and Loch nan Clàr SLA;
- Farr Bay, Strathy and Portskerra SLA;
- WLA 36: Causeymire – Knockfin Flows;

- WLA 38: East Halladale Flows;
- Lone Mountains LCT (138);
- Rocky Hills and Moorland LCT (136);
- Rounded Hills – Caithness and Sutherland LCT (135);
- Strath – Caithness and Sutherland LCT (142); and
- Sweeping Moorland and Flows LCT (134).

3.7 Visibility from other landscape receptors within the Study Area is either very limited and / or located at a distance at which significant effects on landscape character and qualities would be unlikely and as such these are scoped out.

Effects Likely to be Significant

3.8 Significant effects were identified for one landscape receptor. The cardinal aviation lighting on the Proposed Varied Development, would directly affect a localised part of the landscape character area within which it is located.

SWEEPING MOORLAND AND FLOWS LCT (134)

3.9 The character of this LCT during hours of darkness is not specifically discussed within the NatureScot landscape character assessment, however the LCT is generally a dark landscape with little artificial light beyond scattered crofts and farmsteads and passing vehicles. This lack of light contributes to the perception of the landscape as having a "strong sense of naturalness and remoteness, particularly at its core away from the more settled and modified outer fringes."[11] However, it should be noted that as this LCT covers extensive parts of Caithness and Sutherland, sources of artificial light in neighbouring LCTs are visible from some parts of the landscape. As a result, this LCT is considered to have a **Medium** sensitivity to the proposed turbine lights.

3.10 The introduction of six lit turbines into this LCT would result in a **Low** overall magnitude of change with localised areas immediately around the site experiencing a **Medium** magnitude of change albeit the perceived intensity of the lighting would be reduced, due the change in vertical angle. It was assessed that this would result in **Minor** (not significant) overall effects with areas of localised **Moderate** (significant) effect in the immediate area of the site. This localised variation would relate to the potential for the proposed aviation lighting to influence the perception of remoteness within the LCT at night in the immediate area of the lit turbines.

Effects Likely to be Not Significant

BENS GRIAM AND LOCH CLÀR SLA

3.11 The Bens Griam and Loch Clàr SLA has a strong sense of remoteness, wildness and space particularly in its interior. Although the characteristics of the SLA during the hours of darkness are not specifically discussed in the citation, the area's sense of isolation and remoteness are undoubtedly enhanced by the dark nature of the surrounding landscape at night. While the SLA itself would be highly sensitive to the introduction of artificial lighting within its boundaries, the cardinal aviation lighting on the Proposed Varied Development would be located approximately 7 km to the north at their closest visible point. Additionally, as shown on FIR Figure 3, theoretical visibility of the cardinal aviation lights would be limited to the north facing slopes of Ben Griam Beg, Ben Griam Mòr and Beinn a' Mhadaidh. More distant sources of artificial lighting can already be seen from within the SLA and as such, while located in closer proximity, the proposed cardinal aviation lighting would not introduce a wholly new feature into the surrounding landscape context of the SLA. As a result, the SLA has been assessed has having a **Medium** level of sensitivity. Due to

[11] Scottish Natural Heritage (2019) *Scottish Landscape Character Types Map and Descriptions – Sweeping Moorland and Flows Landscape Character Type 134 Description*. Available at: https://www.nature.scot/professional-advice/landscape/landscape-character-assessment/scottish-landscape-character-types-map-and-descriptions [accessed March 2020]

the predicted perceptible, but distant changes in very localised parts of the SLA a **Low** magnitude of change was identified.

3.12 Given the above it was assessed that the cardinal aviation lighting on the Proposed Varied Development would result in an inappreciable alteration to the intrinsic special qualities of the SLA. As shown by the ZTV on FIR Figure 3 extensive areas of the SLA would remain unaffected by the cardinal aviation lighting, allowing individuals seeking Accessible Solitude (particularly in the interior of the SLA) to find it. Likewise, the Flow Country Views would only be affected within a small part of the SLA. A **Minor** (not significant) effect was therefore identified for the SLA.

KYLE OF TONGUE NSA, FARR BAY, STRATHY AND PORTSKERRA SLA AND WLA 36: CAUSEYMIRE – KNOCKFIN FLOWS

3.13 **Negligible** overall effects with localised areas of **Minor** and therefore not significant effects were identified for the Kyle of Tongue NSA, Farr Bay, Strathy and Portskerra SLA and WLA 36: Causeymire – Knockfin Flows. As with most of the Study Area, outside of the settlements that occur along the coastline, these landscapes are generally considered to be characterised by darkness at night. While the Proposed Varied Development could increase the prominence of wind turbines in the surrounding context during the hours of daylight, given the scattered settlements and associated artificial lighting along the coast, the proposed cardinal aviation lighting would not introduce a new feature within surrounding context of the NSA or the SLA. While the parts of the WLA that fall within the Study Area are less influenced by artificial lights associated with the coastal settlement, they are generally located over 15 km to southeast of the Proposed Varied Development. The introduction of the cardinal aviation lighting was judged to represent a largely **Negligible** magnitude change across these receptors as a whole, however, it could represent a perceptible change in a few localised locations and therefore a **Low** (localised) magnitude of change. While they could be locally intrusive in a few locations, given the small areas affected within these receptors and distance to the Proposed Varied Development, the introduction of cardinal aviation lighting would be very unlikely to lead to any discernible reduction to the scenic quality or change to the intrinsic landscape characteristics or special qualities of these receptors as a whole.

WLA 39: EAST HALLADALE FLOWS

3.14 This WLA is located to the east of the site. The Proposed Varied Development would appear larger and closer than Strathy North wind farm during the hours of daylight and would affect a new part of the context where little perceived contemporary land use or development is present. The areas towards the western and northern boundaries of the WLA, have a lower sensitivity due to increased influence of existing features and contemporary land use. Although it would affect a new part of the view, the Proposed Varied Development would be seen as more a part of the surrounding context from these areas and less associated with the WLA and therefore the effect would be seen as more indirect. Theoretical visibility is more limited in the eastern part of the WLA where intervening landform starts to interrupt the views westward and therefore the Proposed Varied Development does not appear to decrease the extent of the WLA in the same way. In their response dated 17th November 2020, NatureScot confirmed that they "*do not consider that these* [daytime effects] *will raise issues of national interest*."

3.15 The Key Qualities of the WLA do not include reference to dark skies nor do they describe the landscape during hours of darkness, (apart from reference to lights from passing trains at night). While some of the WLA's key qualities, particularly the *Strong Sense of Solitude* within the remote interior will be intensified by the dark, the exterior parts of the WLA already experience some degree of artificial light. These take the form of settlements along the coast including Strathy, Melvich and Reay, scattered farmsteads, passing headlights along the A836 to the north and A987 to the west and Dounreay to the northeast. The key qualities of *Remarkably Open Landscape* and *Wide Skies with Few Foci* would be less readily apparent at night, although they would be somewhat sensitive to the introduction of tall lit structures. The *Rugged and Complex Local*

Pattern key quality would be largely imperceptible at night. Therefore, while there is limited influence of artificial light within the WLA, there are also areas and key qualities which would have a reduced sensitivity to the introduction of distant artificial lights. The WLA is considered to have a **Medium-Low** sensitivity to the type of development proposed.

3.16 The introduction of cardinal aviation lights on six turbines in the adjacent landscape would result in theoretical visibility focused along the western edge of the WLA, approximately 10 – 15km from the Proposed Varied Development (FIR Figure 3). The theoretical intensity ZTV (FIR Figure 5) indicates that, with the exception of a small area on the slopes leading down into Strath Halladale, the cardinal aviation lights would be experienced at a vertical angle of between 0° to -1°. This means they would largely be perceived at a consistent intensity across the area of theoretical visibility.

3.17 The six cardinal lights could influence the perception of the open landscape westward across to Ben Hope and Ben Loyal particularly at twilight. While the six turbines would suggest the presence of nearby human development, they would represent a small and distant change to one part of the open and dark landscape approximately 10 – 15 km to the west. Uninterrupted dark skies would still be experienced in other directions, but there would be a small reduction in the extent of the landscape perceived to be undeveloped to the west. Elsewhere within the WLA, visitors could still experience a strong sense of seclusion and remoteness. This localised area along the western 6-7 km of the WLA would therefore experience a small and distant perceptible change to some of the Key Qualities, particularly the *Wide Skies with Few Foci*, *Remarkably Open Landscape*, and *Strong Sense of Solitude* associated with the remote interior and therefore **Low-Medium** magnitude of change. Beyond 15 km from the Proposed Varied Development, the ZTV shows that (FIR Figure 3) theoretical visibility would become much more scattered and intermittent, with large expanses experiencing no theoretical visibility. As such the remainder of the WLA would experience a **Negligible-Low** magnitude of change.

3.18 The six cardinal aviation lights located approximately 10-15 km away from the WLA would be unlikely to result in a noticeable change to the key qualities of the WLA. This is consistent with NatureScot's 17th November 2020 consultation responses for the Strathy Wood wind farm, which stated that while the introduction of 13 lit turbines at that development would result in some significant "*effects on wild land qualities* [they would be] *unlikely to raise issues of national interest*."[12] While this response was not made directly in relation to the Proposed Varied Development, it illustrates NatureScot's view of the potential effects of a small number of lit turbines in the area to the west of the WLA. This opinion was reiterated in their consultation response dated 3rd March 2021 which does refer to the Proposed Varied Development and states that:

"*Should eight turbines at Strathy Wood be lit, and four turbines at Strathy South* [the Proposed Varied Development]*, we advise that the lights would highlight human development in an otherwise dark and undeveloped sky, introducing an element of both scale and orientation thereby reducing the sense of remoteness (and resulting risk). In addition, the nature of the lighting as obvious human development would affect the current sense of sanctuary and solitude that arises in this vast open and remote landscape. The cumulative effects of these two schemes would result in some significant effects on the responses that underpin Quality 2 'A remote, discrete interior, with limited access and a strong sense of solitude'.* ***However, these effects will not be to the degree that the wild land qualities will be materially affected***."[13]

[12] NatureScot, (2020), Letter regarding Section 36 Wind Farm: Strathy Wood Wind Farm Land at Strathy Forest, South of Strathy Sutherland sent to the Scottish Government Planning and Environmental Appeals Division on 17 November 2020. Available at: https://www.dpea.scotland.gov.uk/CaseDetails.aspx?id=121110&T=66

[13] NatureScot, (2021), Letter regarding Section 36 Wind Farm: Strathy Wood Wind Farm Land at Strathy Forest, South of Strathy Sutherland sent to the Scottish Government Planning and Environmental Appeals Division on 3 November 2021. Available at: https://www.dpea.scotland.gov.uk/CaseDetails.aspx?id=121110&T=66

3.19 Although the perceived extent of the WLA to the west may be somewhat reduced, the distance at which the cardinal aviation lights would be experienced, along with the lack of other artificial lighting in other directions, would mean that the impression of an extensive undeveloped area would remain. It was therefore assessed that this would result in a localised **Minor-Moderate** (not-significant) effect to the western part the LCT. The remainder of the WLA where theoretical visibility is very limited, would likely experience either no discernible or an inappreciable reduction in scenic quality or change to the key qualities of the WLA. Largely due to the limited theoretical visibility and distance at which the cardinal aviation lights would be experienced it, was assessed that the effect on the remainder of the WLA would therefore be **Negligible-Minor** (not significant).

ROUNDED - HILLS - CAITHNESS AND SUTHERLAND LCT (135)

3.20 This LCT occurs extensively across Caithness and Sutherland. The rolling hills form broad rounded summits that often form the side slopes containing straths. Closer to the coast, the slopes are often steeper than in the more inland areas. These hills are incised by narrow burns and small lochans on the plateau summits. Wind farms are present within some units of the LCT and therefore the turbines of the Proposed Varied Development, whilst not within this LCT, would not represent a new feature within the daytime context of the LCT. The key characteristics of the LCT as described in the character assessment do not describe the landscape during hours of darkness. However, where it occurs within the Study Area, this LCT can be characterised as a dark landscape with little influence of artificial light. This landscape is considered to have a **Low-Medium** sensitivity to the type of development proposed.

3.21 Within the Study Area the magnitude of change to the LCT resulting from the cardinal aviation lighting would range from virtually imperceptible to locally perceptible with a small area to the immediate south-west experiencing notable changes due to proximity and therefore an overall **Low-Medium** magnitude of change. While they could be locally intrusive due to their proximity, it is unlikely that the proposed cardinal aviation lights would affect the intrinsic landscape character of the area. As a result, it was assessed that this would result in **Minor** (not significant) overall effects with areas of Localised **Minor – Moderate** (not significant) effect on this LCT within the Study Area.

ROCKY HILLS AND MOORLAND LCT (136)

3.22 **Minor** and therefore not significant effects were identified for this LCT which is located approximately 4 km northwest of the Proposed Varied Development turbines at its closest point. The LCT is considered to have a **Low-Medium** sensitivity to cardinal aviation lighting on the Proposed Varied Development largely due to its proximity to other sources of artificial light (i.e. passing vehicles and dwellings) and the scattered pattern of theoretical visibility.

3.23 While aviation lighting on the Proposed Varied Development would not directly affect the distinctive dips, straths and glens and knolls of the LCT, it could result in minor perceptible changes to the sense of seclusion within localised areas and therefore a **Low** magnitude of change. Although the cardinal aviation lights would introduce a new feature in views to the southwest, given that the majority of the LCT is over 5 km from the Proposed Varied Development, they would result in an inappreciable alteration to the intrinsic landscape character of the area. There would therefore be a **Minor** and thus not significant effect to the LCT.

LONE MOUNTAINS LCT (138)

3.24 The Lone Mountains LCT (138) is characterised by isolated mountains that are the dominant focus within open lower-lying moorland surroundings. Their distinctive profiles are visible from many parts of Caithness and Sutherland. The Ben Griam unit is located closest to the Proposed Varied Development turbines, at just over 7 km to the south. The cardinal aviation lights could indirectly affect the perception of the profiles and ridges of the western units of this LCT around Ben Loyal in views where the ridgelines would be back lit as the sun sets. However, once it is completely dark

the profiles of the Lone Mountains and their relationship to the cardinal aviation lights would be much less apparent. As a result, this LCT is considered to have a **Medium** sensitivity to the proposed cardinal aviation lights.

3.25 The introduction of six lit turbines to the north in the adjacent LCT would result in a perceptible, but distant change within a localised part of the Ben Griam unit of this LCT and therefore a **Low** magnitude of change. It was therefore assessed that while the proposed cardinal aviation lighting could result in a slight, localised alteration to the sense of isolation of the Ben Griam unit of the Lone Mountains LCT at twilight this would represent a small deterioration overall and would therefore be a **Minor** and thus not significant effect to the LCT.

STRATH – CAITHNESS AND SUTHERLAND LCT (142)

3.26 The Strath – Caithness and Sutherland LCT (142) includes all of the major straths in Caithness and Sutherland. Within the Study Area this includes Strathy Halladale and Strathnaver. These straths create linear spaces, with open floors containing rivers. While the straths are relatively well-settled, they are dark landscapes at night with a distinctly rural sense. The main sources of artificial light come from the scattered dwellings and passing vehicles.

3.27 The ZTV indicates that the visibility of cardinal aviation lighting on the Proposed Varied Development within this LCT would largely be limited to localised parts of the upper slopes. Given the presence of existing artificial lights within the LCT, the sensitivity was assessed to be **Medium**. The introduction of cardinal aviation lighting approximately 8 km to the east and 6 km to the west at the closest visible points and its limited theoretical visibility across the two units of the LCT within the Study Area was judged to represent a **Low** magnitude of change. It was assessed that the cardinal aviation lighting would result an inappreciable change to the intrinsic landscape character of the area and a **Minor** and therefore not significant effect to the LCT.

Residual Lighting Effects on Landscape Receptors Summary

3.28 Anticipated effects on designated and protected landscapes and LCTs are summarised in Table 2 below. For the purposes of this assessment, effects with a **Moderate** rating or greater are considered to be significant.

Table 2: Residual Lighting Effects on Landscape Receptors Summary

	Not Significant				Significant		
	Negligible	Negligible - Minor	Minor	Minor - Moderate	Moderate	Moderate - Major	Major
Lone Mountains LCT (138)			**x**				
Rocky Hills and Moorland LCT (136)			**x**				
Rounded Hills – Caithness and Sutherland LCT (135)				**x**			
Strath – Caithness and Sutherland LCT (142)			**x**				
Sweeping Moorland and Flows LCT (134)			**x**		**(L)**		
Kyle of Tongue NSA	**x**		**(L)**				
Farr Bay, Strathy and Portskerra SLA	**x**		**(L)**				
Bens Griam and Loch nan Clar SLA			**x**				

Table 2: Residual Lighting Effects on Landscape Receptors Summary							
WLA 36: Causeymire – Knockfin Flows	**x**		**(L)**				
WLA 39: East Halladale Flows WLA		**x**		**(L)**			
(L) – Denotes that the effect would be localised to only part of the landscape receptor within the Study Area.							

Residual Lighting Effects on Visual Amenity

3.29 The visual receptors within the Study Area are illustrated on FIR Figure 4. Areas with theoretical visibility of the cardinal aviation lighting are illustrated through the use of a hub height ZTV. The receptors most likely to experience effects as a result of the introduction of the cardinal aviation lighting are those in close proximity where the lighting would represent a perceptible to notable change to the view.

3.30 The following receptors within the Study Area were identified as having the potential to experience effects as a result of the cardinal aviation lighting. Visibility from other visual receptors within the Study Area is either very limited and / or located at a distance at which significant effects on visual amenity would be unlikely and as such these are scoped out.

Viewpoints

3.31 Ten of the viewpoints included in the LVIA (Chapter 4: Landscape and Visual Amenity (EIAR Volume 2)) fell within the study area for the cardinal aviation lighting assessment. These are detailed in Table 3 below. These VPs were considered to be representative of the range of views likely to be obtained during low light or dark conditions. While all of the viewpoints were visited during the hours of daylight, due to health and safety concerns only roadside viewpoints were visited during the hours of darkness. In consultation with NatureScot and THC, five of these viewpoints were selected as the locations for visualisations of the aviation lighting[14] (see Table 3 below).

Table 3: Turbine Lighting Assessment Viewpoints			
LVIA Viewpoint Number	**Location**	**Grid Reference****	**Receptor Type**
VP1	Ben Griam Beg	283185, 941167	SLA / Viewpoint
VP2	Cnoc Riabhach	292003, 937695	WLA 36
VP3*	Loch nan Clach Geala	295343, 957116	WLA 39
VP4*	View from east of Melvich	291980, 964461	Route
VP5*	View from Strathy	284166, 965031	Settlement
VP6	View from Bettyhill viewpoint	274862, 961925	Route
VP7*	View from A836 west of the B871 (nr Borgie)	269489, 957272	Route
VP8	Sgor Chaonasaid	257961, 949822	NSA / WLA 38
VP10*	Beinn Ratha	294954, 960923	WLA 39
VP11	Forsinard	288982, 942360	Settlement / Route
* Photomontage provided: Photographs taken at twilight as per current good practice, Visual Representation of Wind Farms Guidance (Version 2.2)[8]. The photomontages for VP3 and VP10 are based			

[14] A visualisation from VP10: Beinn Ratha was not included in the 2020 EIAR lighting assessment. NatureScot requested its inclusion in this 2021 FIR lighting assessment through the consultation process.

Table 3: Turbine Lighting Assessment Viewpoints
on a manipulation of the daytime photograph to match the conditions of the other baseline twilight photographs. **Turbine lighting assessment viewpoints have been located as close as possible to those for the main LVIA. However, some have been slightly relocated for safety reasons.

Routes

3.32 Based on the hub height ZTV, the following receptors within the Study Area were identified as having the potential to experience effects as a result of the cardinal aviation lighting (see FIR Figure 4):

- A836 (Tongue – eastern edge of Study Area) (NC500/ Cycle Route 1);
- A836 Tongue to edge Study Area;
- A897;
- B871 (North);
- Far North Railway;
- Scottish Hill Track 344: Strath Halladale (Trantlebeg) to Strathy;
- Scottish Hill Track 343 Halkirk to Forsinain or Braemore;
- Core Path SU04.04 – Clachan Burn (Bettyhill to Bettyhill Community Turbines Loop);
- Core Path SU04.05 – Kirtomy – Cnoc Mor circuit; and
- Core Path SU24.05 – Ben Tongue Circuit.

Settlements

3.33 Of the 11 settlement receptors identified for inclusion in the LVIA, eight were identified as having the potential to experience effects as a result of the cardinal aviation lighting based on the hub height ZTV (see FIR Figure 4). The hub height ZTV shows no potential visibility of the proposed cardinal aviation lighting from, Melvich or Tongue and a very small pocket of potential visibility on the outskirts of Bettyhill. Artificial lighting is already present in each of these communities in the form of streetlights, domestic lights and other lights such as at the local hotels. While these are not overly bright landscapes it is unlikely that the introduction of the proposed cardinal aviation lighting would be perceptible even on the outskirts. As such, these communities are scoped out of further assessment.

3.34 The following receptors within the Study Area were identified as having the potential to experience effects as a result of the cardinal aviation lighting on the Proposed Varied Developments:

- Strathy (North of the A836 and East of the River Strathy);
- Strathy (South of the A836 and East of the River Strathy);
- Strathy (West of the River Strathy);
- Strathy Point;
- Lednagullin;
- Crask / Farr;
- Skelpick; and
- Forsinard.

Effects Likely to Be Significant

SCOTTISH HILL TRACK 344: STRATH HALLADALE (TRANTLEBEG) TO STRATHY

3.35 This recreational route passes through a changeable landscape. Large parts of the surrounding coniferous planting have been felled, opening up daytime views to the surrounding 'Flow Country' moorland and bog as part of nature conservation efforts. The Bens Griam dominate views from the

southern portion of the route. Strathy North wind farm is prominent in daytime views obtained along much of the route, particularly the northern section that passes very close to it and would continue to be at dusk and dawn. Visual sensitivity of the route is therefore considered to be **Medium-High**. The introduction of six lit turbines would represent a perceptible to noticeable change to views obtained from this route, particularly along the middle stretch where it passes through the site, albeit the perceived intensity of the lighting would be lower through this stretch due the change in vertical angle (see FIR Figure 5). This would lead to a **Medium** magnitude of change leading to a **Moderate** (significant) visual effect. This is largely due to the potential for the cardinal aviation lighting to influence the perception of remoteness along this otherwise dark route at night.

Effects Likely to be Not Significant

VIEWPOINT 1 – BEN GRIAM BEG

3.36 VP1, from the summit of Ben Griam Beg, to the south of the site, 360˚ panoramic views can be obtained across the landscape during the daytime. Much of the detail of this surrounding landscape would be lost during the hours of full darkness. However, as the sun sets Ben Graim Mòr and Meall a' Bhuirich to the south and the distinctive western mountain ranges would likely still be influential on perceptions of the surrounding landscape. Existing artificial light is limited to the settlement clusters along the coast, scattered farmsteads along the straths and the lights of passing cars. Given the presence of other artificial lights in the surrounding landscape, sensitivity is considered to be **Medium**. The changes to views northward would represent a distant, but perceptible change to one part of the wider view and therefore a **Low-Medium** magnitude of change was identified. Given that the wider surrounding landscape would remain largely dark and that other artificial lighting is already present, a **Minor-Moderate** (not-significant) effect was identified.

VIEWPOINT 2 – CNOC RIABHACH

3.37 Daytime views obtained from VP2: Cnoc Riabhach are extensive towards the west and southwest, if somewhat more constrained by undulating moorland in other directions. The simple landscape has few existing sources of artificial light to interrupt the otherwise dark expanse at night. As such, it was identified to have a **Medium** sensitivity to the introduction of aviation lighting in the distance. Given the distance (16.5 km) and direction of the proposed cardinal aviation lighting, it was considered that their introduction would result in a **Low** magnitude of change but would not result in a deterioration to the wider view and therefore a **Negligible-Minor** (not significant) effect.

VIEWPOINT 3 – LOCH NAN CLACH GEALA

3.38 This viewpoint is representative of views from the interior part of the East Halladale Flows Wild Land Area. During the day, views outward are largely restricted by the surrounding rolling moorland. Somewhat more open views are available towards the west where the Ben Hope / Ben Loyal range can be seen in the distance with Strathy North in the midground. While these would be backlit as the sun sets, their definition would fade with the setting sun. Ben Griam Beg would likewise be visible at twilight over the intervening ridgeline to the southwest. Given the lack of other sources of artificial lighting, the sensitivity of this view is considered to be **Medium**. Although the cardinal aviation lighting would be perceptible in views to the west, given the distance (approximately 14.8 km), it is anticipated that this would lead to a **Low-Medium** magnitude of change. While perceptible, the cardinal aviation lights would appear distant and would lead to a minor deterioration to the quality of the view. It was judged that there would be a **Minor** (not significant) visual effect.

VIEWPOINT 4 – VIEW FROM EAST OF MELVICH

3.39 This viewpoint is located in a layby on the A836 to the northeast of the site. It is representative of middle to longer distance views that users including commuters travelling westward along this road

could experience as they pass from Caithness into Sutherland. During daylight hours, this viewpoint offers views of the A-road and over the surrounding area with a number of power lines crossing the view and with Strathy North wind farm visible over the horizon line. Similar to the daytime baseline, views obtained during the hours of darkness are channelled along the road eastward and westward, with the ridgeline of the distant hills prominent at twilight. Travellers are unlikely to stop at this viewpoint or along this stretch of road at night. As such, their views are likely to be focussed on and along the road, particularly as views to the north and south are somewhat restricted by the surrounding rolling moorland landscape. The baseline view at night is one with limited artificial light. The lights at Dounreay Power station can be made out in the distance to the east as a regularly spaced grouping.

3.40 The photomontage for this viewpoint (FIR Figure 7c) indicates that one of the hub mounted cardinal aviation lights would be seen against the sky over the ridge to the southwest in the middle distance. The introduction of the cardinal aviation lighting into the baseline view would therefore result in a **Negligible - Low** magnitude of change to a viewpoint with **Medium** visual sensitivity. It was assessed that this would result in a **Negligible - Minor** and therefore not significant effect to the view obtained from the viewpoint.

VIEWPOINT 5 – VIEW FROM STRATHY

3.41 This viewpoint is located on the A836 within Strathy near Cnoc Tuthcaid and is representative of worst-case scenario views obtained from the settlement and nearby areas. It is also representative of the view drivers could get as they pass through the settlement. Daytime views are focused along the A836 towards the east and west with distant views restricted by the rolling hills. There are open views to the south over low lying grassland before the ground slopes up towards the hills. Strathy North wind farm is visible over the ridgeline. Residential properties form a linear feature along the single-track road to the south defining the edge of the foreground field system. As the light faded, the details of this part of the settlement would fade and views would become more focused on the road and ridgelines against the sky. The scattered farmsteads and dwellings provide some baseline artificial light in addition to the cars passing through. FIR Figure 8c shows that two cardinal aviation lights would be seen in the distance to the south over the ridgeline against the sky in a relatively dark part of the surrounding landscape.

3.42 The introduction of cardinal aviation lighting on the Proposed Varied Development would result in a **Low** magnitude of change to a viewpoint with **Medium** visual sensitivity. It was assessed that this introduction would form a perceptible, but small and not detracting feature within the view and result in a **Minor** and therefore not significant effect to the viewpoint.

VIEWPOINT 6: BETTYHILL VIEWPOINT

3.43 This viewpoint is located at the marked Bettyhill viewpoint and car park on the A836 (NC500) to the south of Kirtomy. It is representative of sections of this road where the proposal would be visible and is a popular daytime stopping point. The main view during the day is directed towards the southeast and Loch Meadie, however as the light fades views are likely to become more focused westward towards Ben Hope and Ben Loyal beyond the operational Bettyhill wind farm. Rocky moorland and rolling hills restrict more distant views in other directions. The sensitivity of this view is considered to be **Low-Medium** due to the regular presence of vehicle traffic and associated headlights and break lights along the relatively busy road.

3.44 The ZTV indicates that three of the proposed cardinal aviation lights on the Proposed Varied Development would be visible to the southeast over the ridge and against the skyline resulting in a **Low** magnitude of change. As these would be seen in the context of the regular vehicle lights along the road it was determined that this would lead to a **Minor** (not significant) visual effect.

VIEWPOINT 7 – VIEW FROM A936 WEST OF THE B871 (NR BORGIE)

3.45 This viewpoint is found in a passing place on the A836 to the northwest of the proposal. While travellers are unlikely to stop at this viewpoint or along this stretch of road at night, it is representative of middle-distance views drivers would get from this stretch of the A-road and potential worst case scenario views on the descent into Strathnaver from the west. The main views obtained from this viewpoint regardless of the time of day are along the A836 towards the east and west generally obtained from moving vehicles. Views to the north and south are restricted by the simple rolling moorland covered in low level vegetation. Longer distance views are largely restricted by the intervening topography with some rolling hills seen in the distance to the south and east. While these views are generally of a dark landscape, the presence of regular passing of vehicle headlights introduces a source of artificial lighting.

3.46 The introduction of cardinal aviation lighting on the Proposed Varied Development to this **Medium** sensitivity viewpoint would result in a **Low** magnitude of change. Four of the six lit turbines would be visible in the distance to the southeast over the ridgeline against the sky (see FIR Figure 9c). It was assessed that the resulting effect would be **Minor** and therefore not significant. While the change would be perceptible and would be within the main view of those travelling eastward, it would brief and would represent a small, distant and not detracting change to only one part of the much larger dark surroundings seen in the context of passing vehicle headlights.

VIEWPOINT 8 – SGOR CHAONASAID

3.47 This viewpoint is representative of elevated views from the NSA and from the eastern side of the WLA 38: Ben Hope – Ben Loyal. During daylight hours it provides 360˚ panoramic views across the dramatic mountainous landscape of the National Scenic Area. However, as the sun sets the main view is likely to be focused to the west as other features fade. The settlement at Tongue is visible to the north and at twilight and during the hours of darkness, artificial lighting from the settlement and the roads leading to it would become more visible as lights and headlights are turned on. Given that there are already artificial lights visible in the distance, this viewpoint was identified as having a **Medium** sensitivity to distant artificial lights.

3.48 The cardinal aviation lights would be seen in the distance to the east over 19 km away. While they may be perceptible, at this distance and given other baseline artificial lights, they would represent a **Negligible-Low** magnitude of change. The introduction of the cardinal aviation lights would not result in any discernible deterioration to the view obtained from the viewpoint and therefore it was assessed that they would have a **Negligible** (not significant) effect.

Viewpoint 10 – Beinn Ratha

3.49 This viewpoint is found near the cairn on Beinn Ratha in the northern part of WLA39: East Halladale Flows and is representative of elevated views from the WLA. During the day it provides 360˚panoramic views across the surrounding landscape and open views out to the North Sea and the Ben Hope / Ben Loyal range to the west. The settlement of Melvich is visible to the northwest with Strathy Point visible beyond. As the sun sets these settlements would represent sources of artificial light as people turn their lights on. Dounreay Power Station is also visible to the northeast and would represent another source of artificial light in the surrounding landscape.

3.50 The introduction of cardinal aviation lighting on the Proposed Varied Development to this **Medium** sensitivity viewpoint would result in a perceptible but distant addition approximately 16 km to the southwest. Set against the backdrop of the distant mountains they would represent a **Low** magnitude of change. While they would represent a new feature within this part of the view, they would not be a new feature within the wider landscape. It was assessed that the introduction of the cardinal aviation lighting would represent a small, distant and not detracting change to one part of the much wider view within which artificial lighting was already present and that the resulting effect would be **Minor** and therefore not significant.

VIEWPOINT 11 - FORSINARD

3.51 This viewpoint is located near Forsinard Flows NNR at the junction of the A897 and Far North Line on the edge of the Bens Griam and Loch nan Clar SLA. It is representative of the views which could be obtained by road / rail users and visitors to the RSPB Forsinard Flows Visitor Centre to the southeast of the site. The main view during the day is to the south along the A897 across a low lying landscape to the hills in the distance. Ben Griam Beg, Ben Griam Mòr and Meall a' Bhùirich are prominent against the skyline to the southwest. Towards the west the RSPB Flows Lookout is visible standing within the peatland pools of the blanket bog landscape. Views to the north are restricted by the trees that make up the shelterbelt around the Forsinard Railway Station and surrounding buildings, while commercial forestry restricts views to the southeast. When the sun sets, this results in a dark landscape with the only artificial lights coming from the station, the small collection of buildings surrounding it and from passing vehicles.

3.52 As this viewpoint may be visited by birdwatchers walking between the RSPB carpark and the lookout at twilight with the expectation that it will be a dark landscape, it is identified to be of **High** sensitivity to the introduction of artificial light. However, as it is also representative of passing road and rail users, it is important to note that this is a conservative rating focused on one particular user. The cardinal lighting hub height ZTV (see Figure 4) indicates that two of the cardinal aviation lights would be visible from this viewpoint, approximately 11 km to the northwest over the ridge against the skyline. Their introduction against the skyline would be perceptible and would represent a **Low** magnitude of change. The cardinal aviation lighting would result in a small deterioration to part of an existing highly valued view and would have a **Minor-Moderate** (not significant) effect largely focused around the predicted effects at twilight that birdwatchers may experience while walking to or from the lookout.

A836 (TONGUE – EASTERN EDGE OF STUDY AREA) (NC500/ CYCLE ROUTE 1), A897 AND B871 (NORTH)

3.53 The three main roads within the Study Area that fall within the ZTV are the A836, the A897 and the B871. With the exception of the A836 when it passes through the settlements discussed above, these three roads are generally dark with no street lighting and limited artificial light from sources other than vehicle headlights. The roads are narrow and winding and in the case of the A897 and B871 single-track. Driving these roads during hours of darkness or even low light, requires the full attention of the driver on the road ahead. These routes are therefore considered to be of **Medium** sensitivity. Whilst cardinal aviation lighting on the Proposed Varied Development would be theoretically visible from some sections of these roads, users' attention would generally be focused on the immediate area in front of the car illuminated by the headlights. As a result, the lighting would be perceived as part of the wider background already influenced by artificial light. The cardinal aviation lights could be more perceptible in sections where they appeared in the direction of travel, however, the undulating nature of the surrounding landscape would mean that they were only visible for short stretches at a time as drivers travelled through the area. As a result, it was considered that they would result in localised **Low** magnitude of change for each of the three routes. Due to the intermittent and limited nature of visibility along the three routes, predicted effects were assessed to be **Negligible** (not significant) overall with some localised areas of **Minor** (not significant) effect.

A836 FROM TONGUE TO THE EDGE OF THE STUDY AREA

3.54 The A836 from Tongue to the edge of the Study Area travels generally north-south through an open, dark and remote landscape. Artificial lighting is largely limited to passing vehicles using the route. As such the sensitivity of this transportation route is considered to be **Medium**. Visibility of the cardinal aviation lighting on the Proposed Varied Development would be limited to distant views against the skyline to the east, obtained from a small part of the northern section of the route and up to three of the cardinal aviation lights visible in the distance across Loch Loyal from the southern part of the route. This would result in a localised, but distant (over 15 km)

perceptible change and therefore **Negligible** (Localised **Low**) magnitude of change. Given the limited visibility, visual effects would be considered to be **Negligible** (not significant) for the overall route with some localised areas experiencing **Minor** (not significant) effects.

FAR NORTH RAILWAY

3.55 Views along the Far North Railway are constrained by the direction of travel. The internal train lighting also limits visibility out of the windows and lowers the sensitivity other artificial lighting. As such the sensitivity of this route is considered to be Low. Given the constrained views and influence of internal train lighting limiting travellers' views outward obtained from the Far North Railway the magnitude of change was identified as being **Negligible**. The cardinal aviation lights would form a barely perceptible feature from the route and would not result in a discernible deterioration to the view. Therefore, effects on this route are considered to be **Negligible** (not significant).

SCOTTISH HILL TRACK 343 HALKIRK TO FORSINAIN OR BRAEMORE

3.56 Scottish Hill Track 343 Halkirk to Forsinain or Braemore is a remote recreational route through a largely dark landscape. It is likely that mature forestry would screen much of the theoretical visibility of the cardinal aviation lighting, however where visible it would represent a perceptible change within the surrounding landscape. Where visible, the addition of six lit turbines would represent a **Low** change to the **Low-Medium** sensitivity route and a small deterioration to a part of the view obtained from the route and therefore a **Minor** (not significant) effect.

CORE PATH SU04.04 – CLACHAN BURN (BETTYHILL TO BETTYHILL COMMUNITY TURBINES LOOP), CORE PATH SU04.05 – KIRTOMY – CNOC MOR CIRCUIT AND CORE PATH SU24.05 – BEN TONGUE CIRCUIT

3.57 The three core paths leading off of the A836 to the northwest of the site (Core Path SU04.04 – Clachan Burn (Bettyhill to Bettyhill Community Turbines Loop), Core Path SU04.05 – Kirtomy – Cnoc Mor circuit and Core Path SU24.05 – Ben Tongue Circuit) all experience similar levels of artificial lighting. This includes lighting from nearby settlements, scattered farmsteads and passing vehicles on the A836. As such, all three are considered to have a **Low-Medium** sensitivity. The addition of cardinal aviation lighting on the Proposed Varied Development to the south-east would represent localised perceptible changes to parts of the routes, over 8 km away for Core Path SU04.04 – Clachan Burn, nearly 10 km away for Core Path SU04.05 – Kirtomy – Cnoc Mor circuit and approximately 17.5 km away for Core Path SU24.05 – Ben Tongue Circuit at the nearest visible points. Therefore a **Negligible** (localised **Low)** magnitude of change in views obtained was identified for these routes. This addition when seen in the context of other artificial light in the surrounding area could represent a small deterioration to the view from to localised parts of the wider routes and therefore a **Negligible** (localised **Minor**) (not significant) effect.

STRATHY – ALL PARTS (NORTH OF THE A836 AND EAST OF THE RIVER STRATHY, SOUTH OF THE A836 AND EAST OF THE RIVER STRATHY AND WEST OF THE RIVER STRATHY)

3.58 Strathy is a dispersed settlement. Existing artificial lights are largely limited to domestic lights and community amenities, such as the hall. However, it is also likely that most activities undertaken by residents after sunset will take place indoors or with the aid of outdoor artificial lighting. The ZTV shows that due to variations in topography visibility of aviation lighting on the Proposed Varied Development would be scattered and intermittent. As a result, parts of Strathy are considered to have localised **Medium** sensitivity, while the wider settlement is considered to have a **Low** sensitivity. The introduction of turbine lighting into the skies to the south would be a perceptible change seen at a distance of approximately 12-14 km. This would result in a localised **Low** magnitude of change and localised **Minor** (not significant) effect where the cardinal aviation lighting was visible. There would be a **Negligible** (not significant) effect in the wider parts of the settlement where the cardinal aviation lighting was not visible.

STRATHY POINT

3.59 Strathy Point is a linear settlement overlooking Strathy Bay. Existing artificial lights are largely limited to domestic lights within the community and it is likely that most activities undertaken by residents after sunset will take place indoors or with the aid of outdoor artificial lighting. The ZTV shows that due to variations in topography, visibility of the proposed cardinal aviation lighting would be scattered and intermittent. As a result, this settlement receptor is considered to have a **Low** sensitivity with localised areas of **Medium** sensitivity. The introduction of cardinal aviation lighting into the skies to the south could result in a small perceptible change, however given the distance, direction of the main views over the bay, intermittent visibility, and other sources of artificial light, this would be a **Negligible-Low** magnitude of change. This would not result in a deterioration to the wider view and therefore was judged to be a **Negligible-Minor** (not significant) effect.

LEDNAGULLIN

3.60 Lednagullin is located to the west of Strathy off the A836 overlooking Armadale Bay. Existing artificial lights are limited and given the dark nature of the surrounding rural landscape it is likely that most activities undertaken by residents of this settlement after sunset will take place indoors or with the aid of outdoor artificial lighting. The ZTV indicates that there would be theoretical visibility of cardinal aviation lighting from the dwellings closest to the A836. The surrounding landform slopes towards Armadale Bay and provides viewers with wide open views to the northwest and restricted views to the south. Where visible, the cardinal aviation lighting would appear in the sky over the horizon to the south. As this a less important part of the overall view, but one that would still be experienced on a regular basis by residents as the made their way towards the A836, Lednagullin was identified to have a **Low-Medium** sensitivity. Given the distance and direction of the proposed aviation lighting, it was considered that the cardinal aviation lighting would result in a **Low** magnitude of change. This would represent a perceptible, but not detracting feature within one part the wider view and therefore a **Minor** (not significant) effect.

CRASK / FARR

3.61 Crask / Farr is located to the east of Bettyhill off of the A836 to the northwest of the site. It is made up of a number of scattered properties, the majority of which are situated off a single-track road travelling east-west. During the day, Farr Bay draws viewers' attention towards the water and Ben Hope and Ben Loyal are visible in the distance to the west. As the sun sets, the main views will shift westward. Existing artificial lights are limited and given the dark nature of the surrounding rural landscape it is likely that most activities undertaken by residents of this settlement after sunset will take place indoors or with the aid of outdoor artificial lighting. The settlement was considered to have a **Medium** sensitivity. The ZTV indicates that between one and four of the cardinal aviation lights would be theoretically visible to the southeast from parts of the settlement. This would result in a perceptible change outwith the main view, and therefore **Low** magnitude of change to views. Given the distance to proposal, the introduction of the cardinal aviation lighting would likely result in a small deterioration to a small part of the much wider view and therefore a **Minor** (not significant) effect.

SKELPICK

3.62 Skelpick is located to the northwest of the site within Strathnaver. The properties along the single track road are generally well spaced with views over and along the Strath. The surrounding landform focuses views to the north and south. The ZTV indicates that one or two of the cardinal aviation lights would be theoretically visible from parts of the community. Given the dark nature of this rural landscape it is likely that most activities undertaken by residents after sunset will take place indoors or with the aid of outdoor artificial lighting. As a result, Skelpick is identified as having a **Low-Medium** level of sensitivity. As shown by the ZTV the topography of the surrounding

area will limit the extent to which the cardinal aviation lighting would be theoretically visible. Local obstructions including trees and outbuildings would further limit these views. It was therefore judged that the proposals would result in a barely perceptible to perceptible change and therefore **Negligible-Low** magnitude of change. While up to two of the lit turbine would be theoretically visible this would not result in a discernible deterioration to the view and therefore a **Negligible** (not significant) effect.

FORSINARD

3.63 Given the dark nature of the surrounding rural landscape it is likely that most activities undertaken by residents of this settlement after sunset will take place indoors or with the aid of outdoor artificial lighting. Forsinard was therefore identified as having a **Medium** sensitivity. Local obstructions including trees and outbuildings would further limit these views. It was therefore judged that the cardinal aviation lights would result in a barely perceptible to perceptible change and therefore **Negligible-Low** magnitude of change. It was considered that while up to two of the cardinal aviation lights would theoretically be perceptible from the approach to the settlement from the south, they would not lead to any discernible change to views from the settlement itself. Effects on the Forsinard residential grouping are therefore considered to be **Negligible** (not significant) largely due to the limited theoretical visibility and screening provided by the mature woodlands that surround it.

Residual Lighting Effects on Visual Amenity Summary

3.64 Predicted effects on visual receptors are summarised in Table 4 below. For the purposes of this assessment, effects with a **Moderate** rating or greater are considered to be significant.

Table 4: Residual Lighting Effects on Visual Amenity Summary

Receptor	Not Significant				Significant		
	Negligible	Negligible - Minor	Minor	Minor - Moderate	Moderate	Moderate - Major	Major
Viewpoints							
VP1: Ben Griam Beg				**x**			
VP2: Cnoc Riabhach		**x**					
VP3: Loch nan Clach Geala			**x**				
VP4: East of Melvich		**x**					
VP5: Strathy			**x**				
VP6: Bettyhill Viewpoint			**x**				
VP7: A836 west of the B871			**x**				
VP8: Sgor Chaonasaid	**x**						
VP10: Beinn Ratha			**x**				
VP11: Forsinard				**x**			
Routes							
A836 (Tongue – eastern edge of Study Area) (NC500/ Cycle Route 1)	**x**		**(L)**				
A836 Tongue to edge of Study Area	**x**		**(L)**				
A897	**x**		**(L)**				

Table 4: Residual Lighting Effects on Visual Amenity Summary							
B871 (North)	**x**		**(L)**				
Far North Railway	**x**						
Scottish Hill Track 344: Strath Halladale (Trantlebeg) to Strathy					**x**		
Scottish Hill Track 343 Halkirk to Forsinain or Braemore			**x**				
Core Path SU04.04 – Clachan Burn (Bettyhill to Bettyhill Community Turbines Loop)	**x**		**(L)**				
Core Path SU04.05 – Kirtomy – Cnoc Mor circuit	**x**		**(L)**				
Core Path SU24.05 – Ben Tongue Circuit	**x**		**(L)**				
Settlements							
Strathy – North of the A836 and east of the River Strathy	**x**		**(L)**				
Strathy – South of the A836 and East of the River Strathy	**x**		**(L)**				
Strathy – West of the River Strathy	**x**		**(L)**				
Strathy Point		**x**					
Lednagullin			**x**				
Crask / Farr			**x**				
Skelpick	**x**						
Forsinard	**x**						
(L) – Denotes that the effect would be localised to only part of the visual receptor within the Study Area.							

4 Conclusion

4.1 While the cardinal aviation lights would be theoretically visible from large parts of the Study Area, given that the majority of landscape and visual receptors are located over 5 km away, they would generally represent a small but perceptible change within the wider landscape and views. This in turn would largely result in either no discernible or an inappreciable reduction to the scenic quality for the majority of landscape receptors (not significant) and no discernible or a small deterioration to views obtained (not significant) from the majority of visual receptors. However, given the rural nature of the Study Area, there are relatively few places outside of the settlements and routes, where people would regularly be present to experience the effects of the cardinal aviation lights. Furthermore, for the vast majority of the time, the lights would only emit 200 candela rather than the potential full 2,000 candela intensity.

4.2 However, as summarised in Tables 2 and 4 above, localised parts of one landscape receptor and one visual receptor were assessed as having potential to experience significant adverse effects (i.e.

Moderate or above) as a result of the cardinal aviation lighting on the Proposed Varied Development (as described in paragraph 1.4). This would largely be due to the proximity of these receptors to the Proposed Varied Development and the absence of other artificial light within the surrounding area.

4.3 Further discussions with aviation stakeholders are also underway regarding fitting a transponder-based lighting activation system which will switch on the visible lighting on the six turbines only when an aircraft is detected flying within 4 km of the wind farm and 1,000 feet or less above the altitude of the highest blade tips. This would have the potential to considerably reduce any potential effects further.

ANNEX 1: FIR FIGURES

ANNEX 2: TECHNICAL METHODOLOGIES FOR VISUAL REPRESENTATION