Offshore Wind Power Limited

West of Orkney Windfarm EIA Report

Volume 2, Supporting Study 18: Night-time Lighting Assessment

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West of Orkney Windfarm

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18 NIGHT-TIME LIGHTING ASSESSMENT

18.1 Introduction

The requirements for WTG 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. CAA guidance requires that 'en-route obstacles' at or over 150 m above ground level are lit with visible lighting to assist their detection by aircraft. As such, there is potential that parts of the offshore Project may be visible at night. A description of the proposed lighting is found within Chapter 5: Project description.

Aviation lighting for the offshore Project would comprise:

- 2 no. medium intensity 2000 candela (cd) CAP393 lights mounted on the nacelles of the WTGs, which are located around the perimeter (61 x 2 no. lights);
- 200 cd red CAP437 & SAR implemented into a single light for helicopter winching and SAR on all WTGs
- Significant peripheral structures will be lit with lights visible from all directions in the horizontal plane. It is anticipated these lights will be synchronised to display a special mark characteristic, flashing yellow, with a range of not less than five nautical miles; and
- Intermediate structures on the periphery will be marked with flashing yellow lights which are visible to the mariner from all directions in the horizontal plane with a flash character distinctly different from those displayed on the SPS and with a range of not less than 2 nautical miles.

This assessment considers that the above lighting specifications would represent a 'worst case' in terms of aviation warning lights, subject to CAA approval. The assessment is supported by ZTVs (Figure 18.7a - 18.7c) and night-time visualisations from five viewpoints in Figure 18.VP1.f-i; Figure 18.VP6.g-j; Figure 18.VP18.f-i; Figure 18.VP21.f-i and Figure 18.VP25.f-i.

Marine navigation lights (SPS / IPS) would also be required on the peripheral WTGs. These are flashing yellow lights with a 5 nautical miles (9.26 km) nominal range, mounted at the top of the four corners of each of the WTG substructures. Other lights such as structure identifiers and those needed during search and rescue operations either emit very low light levels or would only be used very rarely and are therefore not included in the assessment.

The effect of the offshore Project at night would primarily result from visible medium intensity (2000 cd) flashing red coloured aviation light fittings located on the top of each nacelle of the peripheral WTGs and is the main focus of the assessment.

18.2 Legislation, policy and guidance

The visual assessment of WTG lighting is intended to determine the likely effects that the offshore Project would have on the visual resource i.e., it is an assessment of the effects of aviation lighting on views experienced by people at night. It should be considered that landscapes have been conceptualised primarily in terms of what is visible during daylight.

The assessment of WTG lighting does not consider effects of aviation lighting on landscape character (i.e., landscape effects). For 2000cd medium intensity steady or fixed red lights, the International Civil Aviation Organization (ICAO) indicates a requirement for no lighting to be switched on until 'Night' has been reached, as measured at 50cd/m2 or darker. This means it does not require 2000 cd medium intensity to be on during 'twilight', when landscape character may be discerned. The CAA have confirmed that UK policy broadly aligns with international standards, including the point at which lights must be switched on at 'Night' rather than 'Twilight'.

The aviation and marine navigational lights may be seen for a short time during twilight when some recognition of landscape features / profiles / shapes and patterns may be possible. It is considered however, that the level of recognition does not amount to an ability to appreciate in any detail landscape character differences and subtleties, nor does it provide sufficient natural light conditions to undertake a landscape character assessment. It is therefore considered that the proposed aviation lighting would not affect the perception of landscape character, which is not readily perceived at night in darkness. Whilst aviation lighting would be visible and result in visual effects, the effects of aviation lighting on the perception of landscape character are scoped out of this assessment. The matter of visible aviation and marine navigation lighting assessment is wholly a visual concern and the assessment presented in this supporting study focusses on that premise.

The Scottish Government's Aviation Lighting Working Group is working on guidance to streamline the process for night-time assessments. Whilst this guidance is yet to be published, there is some consensus that the perception of landform / skylines at night is a relevant consideration (with perception being a component of visual effects), however there is also widespread agreement that it is not possible to undertake landscape / coastal character assessment after the end of civil twilight, when it is technically 'dark' and wind WTG aviation lighting is switched on.

The only formal recognition of this approach to assessment is the Scottish Ministers' Decision for the Crystal Rig IV PLI. The Reporters concluded in their report at paragraph 4.141: "*It can be seen from the summaries of evidence above that the parties differ as to whether the proposed aviation lighting would be a visual impact alone. We consider that without being able to see and fully appreciate the features of the landscape and the composition of views it is not possible to carry out a meaningful landscape character assessment. On this matter, we find that the proposed lighting is indeed a visual concern, as the applicant asserts.*"

It is therefore considered reasonable, given the lack of guidance, to adopt the findings of Scottish Ministers, following a detailed Public Inquiry as this provides support for focusing on the assessment of effects of wind WTG lighting as a visual matter.

The assessment of the proposed lighting on coastal character at night is therefore focused on particular areas where the landform of the foreshore, coastal landforms and inshore islands etc may be perceived at night with lights in the background on the sea skyline i.e., where a perceived character effect may occur as a component of visual effects; and for designated landscapes where dark skies are a specific 'special quality' defined in their citation.

18.2.1 Study area

The night-time lighting assessment study area is the same as the SLVIA study area (60 km from the outer WTG positions) with a focus on the coastal area, up to 40 km measured from the lit WTGs (see section 18.4.2 presented findings by Professor P. Best).

18.2.2 Approach and methodology

The night-time assessment follows the same methodology used for the assessment of seascape, landscape and visual effects, set out in Chapter 18: Seascape, landscape and visual of the Offshore EIA Report. The only difference is that it is conducted during periods of dawn or dusk and assesses the baseline night-time environment against the offshore Project.

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 of what the human eye can reasonably perceive. As with the SLVIA, the sensitivity of the receptor to the offshore Project (aviation and marine navigational lights) and the magnitude of change are combined to determine the level of effect likely to result from the aviation and marine navigational lights. The evaluation of significance and the nature of these effects is also described following the methodology used for the assessment of seascape, landscape, visual effects.

18.2.2.1 Guidance

The Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA3)[1] recommends that 'it *may be important to carry out the night-time 'darkness' surveys of the existing conditions in order to assess the potential effects of lighting and these effects need to be taken into account in generating the 3D model of the scheme. Quantitative assessment of illumination levels, and incorporation into models relevant to visual effects assessment, will require input from lighting engineers, but the visual effects assessment will also need to include qualitative assessments of the effects of the predicted light levels on night-time visibility." (GLVIA3 page 103)*

The other relevant guidance documents are:

- Siting and Design Wind Farms in the Landscape', Version 3, Scottish Natural Heritage (SNH), February 2017 (which now has some guidance on lighting);
- Visual Representation of Wind Farms, Version 2.2, SNH, February 2017 (paragraphs 174-176 and 217-218);
- South Ayrshire Councils Supplementary Guidance: Dark Sky Lighting (adopted August 2016);
- Scottish Borders Council Draft Renewable Energy Supplementary Guidance (December 2016), in which the Council consider that permanent night-time lighting will be a "major planning consideration" to be addressed in terms of visual impact; and
- Dumfries and Galloway Council Supplementary Guidance: Dark Skies Friendly Lighting (February 2020).

NatureScot notes that '*the Night-time visual assessment has to take a proportionate and pragmatic approach to the assessment of WTG lighting, both in terms of the need to assess likely significant effects under the EIA regulations, complying with current civil aviation standards and providing mitigation on a project and site-specific basis*'[2].

[1] *The Landscape Institute with the Institute of Environmental Management and Assessment (2013). Guidelines for Landscape and Visual Impact Assessment, Third Edition*

[2] *SNH seminar on visible aviation lighting, with Scottish Renewables, on 6th November 2019 in Glasgow*

18.2.2.2 Lighting environment

It has been considered that the nature of the daytime and night-time effects from wind farms is very different, in that during day light hours visibility of the large-scale moving WTGs gives rise to effects that are very different to the pinpoint effects of aviation lighting at night. The factors weighed in reaching a decision on value, sensitivity and magnitude of change are not all applicable to night-time, in the same way they may be during the day.

"In the dark, the horizon simply marks the boundary between earth and sky, enclosing a dark largely undifferentiated realm that thwarts the usual sense that the landscape broadens out from the observer. In Galloway Dark Sky Parks, our attention thus focused primarily on the sky to the infinite, dispassionate play of innumerable stars and galaxies. The sky thus dominated the landscape in a way it rarely does during daylight" [3].

Given that the baseline assessment considers 'darkness' characteristics and what pattern of lighting exists within the study area and describes peoples' likely use of different areas during darkness and low light (dusk / dawn) conditions. A baseline areas evaluation is based on five environmental zones (see Plate 18-1 below) which were established for outdoor lighting regulations. The zones reflect the quality of the sky overhead.

Table 2: Environmental zones

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA dark sky places
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity

Plate 18-1: Extract from the Guidance on undertaking Environmental Lighting Impact Assessments[4]

The zone classification determines the appropriate lighting limits for the area. For example, the darkest skies in Scotland are associated with Dark Sky Parks (E0 zone). These have been developed with the purpose of combating

[3] *Tim Edensor (2013): Reconnecting with darkness: gloomy landscapes, lightless places, Social & Cultural Geography, 14:4, 446-465*

[4] *Professional Lighting Guide PLG 04 Guidance on undertaking Environmental Lighting Impact Assessments, Institution of Lighting Professionals (2013)*

light pollution and protecting night skies for present and future generations. Having international recognitions (value), the Dark Sky Parks are valued by the exceptional quality of the night and consequently would be the most susceptible to the introduction of any new lighting elements. Within the Dark Sky Parks (E0 zone) only infrared lights are recommended for use on wind WTGs and anemometer masts by East Ayrshire Council Supplementary Guidance (SG): Dark Sky Lighting[5] . The guidance states/stipulates that within the Transition Zone, any new external lighting should be "dark sky friendly" where possible, in order to help safeguard and enhance the quality of the Dark Sky Park.

18.3 Night-time Lighting assessment

The night-time lighting assessment is supported by baseline observation of the existing night-time environment or darkness, field observation of other similar lit structures and night-time viewpoint analysis from selected viewpoints. 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 particular receptors and focus the assessment.

The viewpoints considered within the night-time lighting assessment, were confirmed with NatureScot, The Highland Council and Orkney Islands Council through email correspondents in September 2022.

The night-time viewpoint analysis 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, where relevant. A range of viewpoints are examined in detail and analysed to determine whether a significant visual effect would occur.

During site visits a baseline night-time environment survey or 'darkness survey' is carried out at each viewpoint location. The purpose of the darkness survey is to establish the existing light levels perceived at the viewpoints and determine their sensitivity to change. The following observations are recorded:

- 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 vessels at sea, vehicles, trains, or aircraft.

18.3.1 Night-time sensitivity

In terms of visual effects, the susceptibility of the receptor is primarily influenced by the activity of the viewer and residents are generally considered to be of higher sensitivity. A number of tourist locations are likely to be closed to the public during the hours of darkness, residents are most likely to be indoors, and hill walkers and people viewing

[5] *East Ayrshire Council Supplementary Guidance: Dark Sky Lighting, Appendix 3 (Adopted August 2016);*

the landscape / seascape from recognised viewpoints are less likely or unlikely to be present at those locations during the night. Again, the susceptibility of the receptor at night is most likely to reduce from its highest or most susceptible during the day, through the twilight period, until the night under conditions of greatest darkness when it would be at its lowest, although exceptions include may locations such as Dark Sky Park viewpoints. For example, drivers using roads at night tend to be more focused on the road and the area illuminated by their headlights than during the day and may have oncoming headlights, cats eyes or other reflective signage drawing their attention, resulting in lower susceptibility. This is particularly the case on unlit rural roads that may be narrow and winding. On the other hand, people taking part in activities requiring darkness, such as stargazing, would be of higher susceptibility.

The value of the specific views and visual amenity at night is also recognised in designations that include National Scenic Areas and Dark Sky Parks but more rarely in association with OS viewpoints, and scenic qualities associated with local landscape designations or tourist routes which tend to be focused on an appreciation of the landscape during the day with consequentially a less or a lower value ascribed during the night.

Factors affecting the susceptibility and value of landscape and visual receptors are combined to determine the sensitivity of the receptor and afforded a rating of High, Medium or Low (see Table 18-1), in a similar manner to that set out in Chapter 18: Seascape, landscape and visual of the Offshore EIA Report. For all of the above reasons it is likely that in most cases the overall sensitivity of the landscape and visual receptors will tend to be reduced under night-time conditions in comparison to the day-time receptors.

Table 18-1 Night-time Sensitivity

NIGHT-TIME SENSITIVITY	DESCRIPTION
High	People within Zone E0 and E1 (Plate 1), where the lighting comprises intrinsically dark landscapes, designated landscapes, including remote rural locations, Wild Land Areas and dark sky sites where the absence of artificial lighting contributes to the feeling of remoteness or/and the direct appreciation of the night sky. Visitors to Dark Sky Parks, visitors to dark sky discovery sites or public observatories, wild campers, people engaged in night-time activity such as bat watching or residents of notably dark areas (i.e., rural locations with no street lighting) in the streets around their homes where dark skies are integral to the amenity.
Medium	People within Zone E2 and E3 (Plate 1) where the lighting comprises notably dark rural areas with a discernible level of baseline illumination, most commonly characterised on a satellite map by distinct points of white light, rather than through sky glow. Visitors to nationally important or well-known local landmarks that are illuminated at night e.g., the Kelpies, residents in urban areas or semi-urban / rural areas (where street lighting is present) in the streets around their homes, users of cycle routes and railways.
Low	People within Zone E4 (Plate 1), where the lighting comprises areas with existing baseline illumination (predominantly with sky glow), urban areas, areas in the vicinity of the larger settlements, main transport

	corridors, settlements with street lighting on, ports. Drivers using local, unlit roads, users of main roads and people at their place of work.

18.3.2 Night-time magnitude of change - perception of light over distance

In assessing the magnitude of change the assessment has focused on the size or scale of change and its geographical extent. The duration and reversibility are stated separately in relation to the assessed effects (i.e., as short / medium / long-term and temporary or permanent). The descriptions of the different magnitudes used are shown in Table 18-2.

The physics of lighting means that the amount of light reaching any given point reduces with distance. An aviation light would emit a fixed amount of light, which spreads out in all directions, expanding with distance – like an inflating balloon. The amount of light reaching an area of fixed size, such as a person's eye, is therefore markedly reduced by distance. Atmospheric conditions also play a role, with lights observably appearing brighter in drier conditions when the light is less scattered and reflected by water droplets in the air.

However, human night vision and perception is optimised to gather the available light, and notice contrast – so the perception of the brightness of a light may reduce less with distance than physics would suggest. In order to investigate potential observability of lighting placed upon offshore wind WTGs Inch Cape Offshore Limited (ICOL) commissioned a study by Professor Philip Best[6], which specifically investigated the attenuation of aviation light as detected by the human eye.

The following conclusions were presented by Professor P. Best:

- Overall, for average atmospheric conditions, it is shown that the atmosphere leads to attenuation of about 90%, 85% or 83% of the light at a distance of 20 km for a white, yellow or red light source, respectively.
- A single 2000 candela light, viewed from a distance of 20 km, will have the same apparent brightness as typical bright stars in the night sky, such as those in the constellation of Orion.
- On a moonless night, for a typical coastal location in eastern Scotland (Lothian / Fife), a 2000 cd white light would be potentially visible to a distance of around 40 km to a dark-adapted human eye. Due to the lower relative sensitivity of the eye to longer wavelengths of light at low light levels, the corresponding maximum distances to which 2000 cd yellow or red lights would be potentially visible are around 36 km in Lothian and 37 km in Fife.
- The overall background light level provided by a typical offshore windfarm (up to 150,000 candela total lighting levels), located 15 km or further from the coast, is shown to be lower even than the ambient levels delivered by starlight on a moonless night.

[6] *Professor Philip Best, Institute for Astronomy, University of Edinburgh, 7th May 2018, The Observability of Offshore Wind WTG Lighting, available at: https://marine.gov.scot/sites/default/files/volume_2b_appendices_12a-12d_and_12h.pdf*

The number of lights likely to be visible as well as their intensity can be described in objective terms and ZTVs indicating the theoretical visibility of numbers of lights and their intensity is mapped in order to assist the assessment process. Other objective factors include the HFoV and the distance over which the lights may be seen. More subjectively the offshore Project is considered against the baseline or darkness survey in terms of whether the proposed lighting would contrast with an unlit area or assimilate with other lights in a landscape or view that may already have multiple light sources. In visual terms, a further consideration is the numbers of viewers which are likely to experience the views and visual amenity at night. It is reasonable to assume that the numbers of tourists and hill walkers, viewing the landscape at night for example, will tend to be few in number or rare, with most tourist destinations closed during the hours of darkness for example. Exceptions may include specific viewpoints within a Dark Sky Park. Walkers and road users out at night, will also themselves tend to be sources of light from torches and vehicle headlights and thus affect the baseline or darkness survey.

Table 18-2 Night-time Magnitude of Change

NIGHT-TIME MAGNITUDE	DESCRIPTION
High:	Magnitude of change to the existing night-time baseline conditions, which is defined by overall darkness (as its special quality), within which the proposed lighting would have a high degree of contrast, compromising or diminishing the view of the night sky.
Medium	Magnitude of change to the existing night-time baseline conditions, which is partially defined as a landscape with darkness, within which the proposed lighting would have a low degree of integration with the level of baseline lighting in the views.
Low	Magnitude of change to the existing night-time baseline conditions, which contains lighting elements and within which the proposed lighting would be integrated into the baseline.
Negligible	Where the proposed lighting results in a largely indiscernible change to the existing night-time baseline conditions in the view.

18.3.3 Evaluation of night-time Level of effects and significance

The level of effect of aviation and navigational lighting is assessed through a combination of the sensitivity of the visual receptor and the magnitude of change that would result from the visible aviation lighting.

A significant effect occurs where the aviation and navigational lighting would provide a defining influence on a view or visual receptor. A not significant effect would occur where the effect of the offshore Project is not material, and

the baseline characteristics of the view or visual receptor continue to provide the definitive influence. In this instance the aviation and navigational lighting may have an influence, but this influence would not be definitive.

In determining the level of effect and significance, particular attention should be paid to the potential for 'Obtrusive Light' i.e., whether the lighting impedes a particular view of the night sky; creates sky glow (brightening of the night-sky); glare (uncomfortable brightness; or light intrusion (the spilling of light beyond the site or area being lit) (ILP) (2011) (GN01:201 1).

Although the assessment of effects from visible aviation and navigational lighting rests to a large extent on an individual perceptual appreciation of the lighting effects, the ratings in Table 18-3 of the significance have been applied. The determination of levels of significance requires the application of professional judgement and experience to gauge the balance of variables which, in every instance, are given different weight according to the site and its surroundings in terms of specific considerations.

Table 18-3 Night-time Level of Effect and Significance

NIGHT-TIME LEVEL OF EFFECT	DESCRIPTION
Major	Due to the proposed lights the perception of the dark sky qualities is disrupted. The lights are considered as prominent single feature against the baseline having a character changing impact. The effect would be significant.
Moderate	Due to the lights the perception of the baseline is not compromised, neither are the views of the night sky diminished by the lights, nor are they considered prominent against the baseline. The effect may be significant or not significant, based on professional judgement.
Minor	The proposed lights are perceived as part of the baseline lighting. The effect would be not significant.

18.3.4 Cumulative effects of aviation lighting

The cumulative effects of the offshore Project are assessed in terms of the additional and the combined cumulative effects taking account of other operational / under construction and consented developments and submitted wind farm planning applications that have aviation warning lights.

Operational wind farms shown within the Study Area are shown in Supporting Study 19 (SS19): SLVIA Figures, Figure 18.6, however none of them are fitted with visible aviation lighting since none of these operational WTGs are above 150 m in height and therefore, they do not require visible aviation lighting. The under-construction Limekiln Variation,

and consented Limekiln Extension and Strathy South wind farms will have aviation warning lights fitted on them as follows:

- Limekiln Extension incorporates the aviation warning lights with the under-construction Limekiln Variation with a total of 16 lit WTGs at the nacelles (11 lit WTGs of Limekiln Variation and five WTGs of Limekiln Extension); and
- Strathy South will have six lit WTGs at the nacelles.

The consented Pentland Floating Offshore Wind Farm is also proposed to have aviation and marine navigational lights at the nacelles of all seven WTGs.

The cumulative effects of aviation lighting are therefore only assessed with the under-construction Limekiln Variation, consented Limekiln Extension and Strathy South wind farms, and the consented Pentland Floating Offshore Wind Farm.

18.3.5 Production of ZTVs and night-time visualisations

18.3.5.1 ZTV Plots

Night-time ZTVs of the proposed aviation warning lights were calculated using ReSoft WindFarm computer software to produce an area of potential visibility of the aviation warning light source, calculated at hub height. These ZTVs of the WTG nacelle lighting are provided in SS19: SLVIA Figures, Figure 18.7a-18.7b. The ZTV plot provides an indication of the areas from where the aviation warning lights may be theoretically visible. It does not indicate the intensity of the lights, atmospheric conditions or take account of intervening screening from localised landform, buildings or vegetation. The ZTV therefore provides a starting point in the assessment process and accordingly tends toward giving a 'worst-case' or over-estimated scenario of the potential visibility. They also do not indicate the decrease in visibility of the lights that occurs with increased distance. The nature of what is visible from 3 km away would differ markedly from what is visible from 10 km away, although both are indicated on the Nacelle Lights ZTV as having the same level of visibility.

A further ZTV of the potential lighting intensity is provided in SS19: SLVIA Figures, Figure 18.7c which provides an illustration of the potential intensity of the nacelle aviation warning lights, shown in candelas, at different vertical angles based on a specific light manufacturer's interpretation of the requirements of the ICAO minimum standard[7] with the corresponding light intensity reductions for each of the 2,000 cd and 200 cd lighting situations shown.

18.3.5.2 Photography and photomontage

The assessment is supported by night-time visualisations, comprising baseline photo panoramas, wirelines and photomontages from selected viewpoints. The methodology used for viewpoint photography and photomontage / wireline production accords with the SNH (now known as NatureScot) guidance *Visual Representation of Wind Farms*, Version 2.2, February 2017, although NatureScot recognise that night-time assessment and the production of night-

[7] *LuxSolar Medium Intensity Obstruction Light CAP 168 MIOL-C: Data Sheet, January 2018.*

time photomontages is an emerging area of study. NatureScot have also provided further advice in their August 2022 guidance *General pre-application and scoping advice for onshore wind farms*. Further guidance is provided by the Landscape Institute, September 2019, *Visual Representation of Development Proposals*, Technical Guidance Note 06/19.

The objective for night-time viewpoint photography is to represent, as far as is practical, the lighting levels as they would be perceived by the human eye. Photography which includes temporary light sources that are not typical or representative, such as passing vehicles on quiet country lanes, have been avoided. 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.

Where existing lights are shown in the photographs, they can appear blurred in comparison to those seen by the naked eye in the field when the photographs were captured. The term used in photography to describe this effect is 'Bokeh' which describes the way the lens renders out-of-focus points of light.

18.3.5.3 Night-time photomontage: Rendering of aviation warning lights

NatureScot recognise that the illustration of technically accurate lighting proposals is difficult to achieve and that the photomontages rely on professional judgement and an 'artistic impression' due to the limitations in being able to model light intensity over distance in variable atmospheric conditions of light / darkness. Nevertheless, the photomontages are considered useful when combined with objective data illustrated in the ZTV plots and wireline figures.

The rendering or visual representation of the proposed aviation warning lights has been achieved using Adobe Photoshop and a comparative study of photography of actual WTG lighting in similar lighting conditions and viewing distances, based on other lighting sources in the study area as noted in the baseline darkness survey. The rendering of marine navigational lights is not included in the photomontages as in most of the views, these would not be visible due to the long intervening distance from locations along the coast and hinterland, and the curvature of the earth would obscure the majority of the WTG substructures and the lights.

Although aviation lighting manufacturers must meet the minimum requirements, their products may vary in relation to recommended limits set out in ICAO standards, which makes it difficult producing accurate visualisations as the lighting characteristics of different light fittings, of the same intensity, may vary outside the minimum requirements stipulated by ICAO. The night-time photomontages shown in these figures have been produced to show 2000 cd lighting, to inform the assessment of worst-case effects assessed and are likely to over-represent the visibility of aviation warning lighting experienced in reality, as they are likely to operate at reduced intensity (200cd) in clear visibility conditions.

18.4 Baseline conditions

The baseline lighting conditions across the SLVIA study area vary and there is no single data source that serves to provide a detailed or quantitative evidence base of the existing night-time lighting levels. The Campaign to Protect Rural England (CPRE) has produced interactive maps of the UK's light pollution and dark skies as part of a national

mapping project (LUC/CPRE, 2016[8]). The map is divided into pixels, 400 m x 400 m, to show the amount of light shining up into the night sky from that area. This is measured by the satellite in nanowatts, which is then used to create a measure of night-time brightness. These have been categorised into colour bands to distinguish between different light levels. The map clearly identifies the main concentrations of night-time lights, creating light pollution that spills up into the sky. The map does not show what the view of the night sky would be from the ground.

The CPRE data shows that the coastal urbanised areas of Stromness, Thurso, Castletown and Durness are the brightest light sources along the coastal edge of Caithness and Sutherland. Dounreay Power Station also appears as a contained but significant source of light along the coastal edge. Light sources along the A838 / A836 (overlapped with the North Coast (NC) 500 and Sustrans National Cycle Route 1) join up the settlements along the Sutherland and Caithness coast. Sutherland, Hoy and West Mainland Orkney feature the darkest parts of the coast which are more sparsely settled. Areas of relative darkness are also contained to the more sparsely settled agricultural landscape of Caithness and the hinterlands of both Sutherland and West of Orkney Mainland and Hoy. These are darkest parts of the study area with very little artificial light, only a few small settlements contributing notably to lighting within the night-time visual environment. The Flotta Oil Terminal is a notable night-time feature to the east of Hoy.

18.5 Embedded Mitigation

The mitigation options of aviation lighting proposed for the offshore Project are outlined in Table 18-4.

Table 18-4 WTG Lighting Mitigation Options

PROPOSED MITIGATION	JUSTIFICATION
Embedded Mitigation	
Reduced intensity aviation warning lights **The proposed perimeter lights (CAP 393) operate via a visibility sensor and will operate at a reduced intensity of 200cd during periods of clear visibility (>5 km), increasing to 2000cd when the visibility sensors detect poor visibility (<5 km).**	These lights are designed to accord with CAA SARG Policy Statement (g) *"If the horizontal meteorological visibility in all directions from every wind WTG generator in a group is more than 5 km, 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."* As an example Meteorological observations from Glasgow Prestwick Airport provide an indication of the operational frequency and duration of the reduced-intensity lights as follows: • Meteorological observations suggest that the WTG hubs will be obscured on several hundred occasions a month by clouds. (Obstruction lights not visible to the public);

[8] *Available at: https://www.nightblight.cpre.org.uk/maps/ and https://www.lightpollutionmap.info/*

PROPOSED MITIGATION	JUSTIFICATION
	• When not obscured by clouds, the visibility in the area of the WTGs can be expected to exceed 5km for up to 98% of the time. (Obstruction lights switched down to 10% power). The reduced intensity aviation warning lights are automated products (fitted 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 and Delta.

18.6 Assessment of visual night-time effects

The approach to assessing visual receptors is slightly different to that of Chapter 18: Seascape, landscape and visual of the Offshore EIA Report and focusses on visual receptor groups which include a number of receptors where effects are likely to be similar in nature and significance. This may include settlements, incorporating surrounding paths, local roads and outlying housing or transport routes at a similar distance and/or direction from the offshore Project.

The visual influence of the aviation lighting is likely to be more noticeable than the lower levels of light intensity associated with the marine navigational lighting. This is due to the higher intensity of these lights as well as their location higher on the WTGs, which results in their theoretical and actual visibility being more widespread. The marine navigational lights would also not be largely visible due to the long intervening distance from locations along the coast and hinterland, and the curvature of the earth would obscure the majority of the WTG substructures and the lights. Therefore, the assessment of night-time visual effects concentrates on the effects of the aviation lighting.

18.6.1 Night-time viewpoint selection

NatureScot *Visual Representation of Wind Farms*[9] advises that night-time viewpoints (for visualisations) are required in particular situations where the wind farm is likely to be regularly viewed at night (e.g., from a settlement, transport route) or where there is a particular sensitivity to lighting (e.g., in or near a Dark Sky Park or Wild Land Area).

Five representative viewpoints were agreed with stakeholders for night-time photomontages (via email correspondents September 2022), as listed in Table 18-5 below. The viewpoints were selected on the basis of sensitivity and / or regular usage during low-light conditions.

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

Table 18-5 Night-time Viewpoint Selection

VP REF	VIEWPOINT LOCATION	DISTANCE/ DIRECTION FROM THE OAA	LANDSCAPE DESIGNATION	VISUAL RECEPTOR
Sutherland Viewpoints				
N1	Faraid Head	26.7 km NE	Oldshoremore, Cape Wrath and Durness SLA	Local residents of Durness at a distance of 1.5 km from the VP location, small number of walkers at night-time.
N6	Strathy Point	24.3 km NW	Farr Bay, Strathy and Portskerra SLA	Lighthouse visitors at night and a few residential properties to the south of the viewpoint.
Caithness Viewpoints				
N18	A836 Between Thurso and Castletown	43.2 km NW	None	Users of the A838 and A836 (NC 500 and Sustrans National Cycle Route 1)
Orkney Viewpoints				
N21	Rackwick Bay	30.8 km W	Hoy and West Mainland NSA	Night-time visitors at bay and local residents
N25	Yesnaby - Brough of Bigging	33.2 km W	Hoy and West Mainland NSA	Residential properties and visitors at night

Photomontage visualisations for all viewpoints have been produced at least 30 minutes after sunset when the landform can still be seen. These figures (Figure 18.VP1.f-h; Figure 18.VP6.g-I; Figure 18.VP18.f-h; Figure 18.VP21.f-h and Figure 18.VP25.f-h.) are part of the overall viewpoint visualisations as set out in Supporting Study 20 (SS20): SLVIA Visualisations.

18.6.2 Night-time ZTVs

The nacelle lights ZTV (SS19: SLVIA Figures, Figure 18.7a) can be used to identify where the aviation and navigational lights may theoretically be visible and how many lights may be visible from different locations. It is based on the hub height ZTV, given the location of the aviation warning lights on the hub / nacelle of each of the WTGs. The base

mapping has been darkened to give an indication of those areas that will not be affected by visibility of the aviation lighting.

On the basis that the ZTV does not take account of distance, the ZTV indicates that areas of higher visibility of the aviation warning lights (101-125 lights) occur within 30 km, sporadically along the coast of Sutherland and Rora Head of Hoy. This ZTV pattern is more homogenous along the coast of Caithness and on the western coast of the West Orkney Mainland, however, at a distance of beyond 30 km from the offshore Project. Immediately adjacent to the higher visibility of the aviation warning lights (101-125 lights) there occurs lower visibility (1-25) colour spread; it is therefore expected that in reality only the lights of the closest WTGs to the coast would be visible.

A further ZTV of the potential lighting intensity is provided in SS19: SLVIA Figures, Figure 18.7c, which provides an illustration of the potential intensity of the nacelle aviation warning lights, at different vertical angles. It is important to note that the light intensity ZTV does not take into account the distance or other factors such as atmospheric conditions, cloud obscuration or partial vegetation screening. The lighting intensity ZTV shows that the full 2000cd light intensity would be experienced from parts of the study area that are at a similar height to the horizontal plane of the directional beam of the aviation warning lights, or on slightly more elevated terrain, where red colouring occurs. The areas of high intensity are shown in orange. All these areas are over 5 km from the offshore Project, and therefore would only afford visibility of 2000cd lighting in poor visibility conditions; and would in periods of clear visibility, experience visibility of the 200cd lights (dimmed to 10% of the 2000cd when visibility is >5 km). Due to the distance of the WTGs from the coast, the intensity of the aviation warning lights would be experienced at a reduced 200cd lighting intensity in 'clear' visibility.

According to meteorological records, poor visibility is likely to occur for 94% of the time whilst good visibility is likely to occur for 6% of the time.

In long-distance views (e.g. over 20 km) the aviation warning lights would still be visible, based on experience of other operational windfarm aviation warning lights (such as Beatrice offshore Wind Farm), however, the distance and reduced intensity are mitigating factors with increasing distance.

18.6.3 Night-time visual effects during construction (including pre-construction) / decommissioning

During construction and decommissioning, there would also be lights from construction vessels moving within the OAA during periods of darkened daylight hours such as heavy rain / dark skies. Cranes may also carry unmitigated aviation warning lights in accordance with Article 222 of the UK ANO 2016. Significant visual effects would be fairly limited and would only arise over a short duration. Such night-time effects would be short term and temporary during the construction and decommissioning stages. It is considered that, in this instance, the resultant effects on the visual resource would not result in any further significant night-time effects to those assessed and identified for the operational stage.

18.6.4 Night-time viewpoint assessment

An assessment of the visual effects of visible aviation lighting has been carried out from five representative viewpoint locations as shown in SS19: SLVIA Figures, Figures 18.7a-c. Night-time photomontage visualisations have been

produced to inform this assessment, which is set out for each these representative night-time viewpoints as follows in Table 18-6 to Table 18-10.

Table 18-6 Viewpoint N1 Faraid Head (SS20: SLVIA visualisations, Figure 18.VP1f-i)

DESCRIPTION AND ASSESSMENT	
Night-time viewpoint and its sensitivity	Viewpoint is located to the north of the Seanachaisteal promontory fort on Faraid Head, approx. 1.5 km to the north of Durness. The viewpoint location on top of the high cliff edge is not a safe spot to visit during night-time. However, the view can be representative of views as experienced by residents of Durness at a distance of 1.5 km to the south, and a small number of people camping at this location. The sensitivity of the viewpoint at night is assessed as Medium-high, reflecting a medium value and the receptors experiencing the view having medium-high susceptibility to change. There is no formal recognition of this view having value at night-time, nor does the visual context of the LCT or CCT or Oldshoremore, Cape Wrath and Durness SLA identify any defined night-time or dark sky qualities. There is generally relatively little lighting on land and at sea, apart from ships in the distance in the direction of the offshore Project and some street lighting associated with Durness to the south-east. The viewpoint is not specifically promoted to encourage visitors with the express intention of viewing the night sky, however the dark sky qualities may be more readily appreciated at this viewpoint in its more remote position than from the Durness where street lighting is evident. Given the limited number of local light sources onshore seen in close proximity this is considered to be a relatively dark location in the context of the wider settled coast.
Existing cumulative context:	No existing or consented lit WTGs would be visible.
Magnitude of change	The nacelle lights would be at a distance range of between 26.7 km to the closest light and 62 km for the most distant from this viewpoint. The red, medium intensity 2000cd lights on the nacelle of the perimeter WTGs would only be visible in poor visibility (<5 km) and would introduce new lighting in views that currently have limited visible lighting as part of the baseline. The aviation warning lights are backdropped by the sky and therefore partially interrupt the night sky, however, due to the distance of the viewpoint the lights are relatively low to the horizon and do not extend high into the sky, and would not interrupt the night sky, thus limiting the amount of night-sky that is impeded. The aviation warning lights are not expected to result in an obtrusive light that impedes the wider expanse of night sky, which can be experienced readily above the aviation warning lights, nor result in any brightening of the night sky (skyglow) that might be of detriment to the overall experience of the dark skies in this view. The magnitude of change is assessed as Medium-low. Visual effects would occur primarily due to the introduction of an array of new and unfamiliar visible lights in an otherwise mainly dark landscape and the partial interruption of the night-sky just above the sea skyline, from a viewpoint which is not specifically used for the purpose of viewing the night sky.

DESCRIPTION AND ASSESSMENT		
	The red, medium intensity 200 cd lights on the nacelles of all 125 WTGs would be visible in clear visibility (>5 km), having similar effects as described above (for 2000 cd) but at notably reduced intensity. It is considered therefore that the 200 cd lights whilst still perceptible would not form as noticeable an addition to the existing baseline as the 2000 cd lights. The magnitude of change is assessed as Low. The marine navigational lights on the closest row of WTGs would barely be perceptible at this distance with the remainder obscured by the curvature of the earth.	
	Medium intensity 2000 cd CAP393 lights	**200 cd red CAP437 & SAR lights**
Significance of Effects:	Moderate and significant	Moderate / minor and not significant.
Future cumulative context:	The Pentland Floating Offshore Wind Farm lights would not be perceivable at a distance of 50 km to the east.	
Cumulative Effects	Moderate and significant (due to the offshore Project)	Moderate / minor and not significant.
Nature of Effects:	Long term (reversible), cumulative, direct and adverse	Long term (reversible), cumulative, direct and neutral

Table 18-7 Viewpoint N6 Strathy Point (SS20: SLVIA visualisations, Figure 18.VP6g-j)

DESCRIPTION AND ASSESSMENT	
Night-time visual receptor and its sensitivity:	The viewpoint is located approximately 1.6 km to the south of Strathy Point Lighthouse on top of the cliff. As the landform of convex slopes and sheer cliffs restrict sea views from the residential properties to the south of Strathy Point, the viewpoint location mainly represents visitors to the Lighthouse who may camp overnight, and also one nearby residential property. The Dounreay Nuclear Power Station provides an artificial light source on the coast at a distance of 15 km to the east. Dunnet Head Lighthouse light is visible at a distance of 38 km. The sensitivity of the viewpoint at night is medium-high, reflecting a medium-high value of the viewpoint and the medium-high susceptibility of visual receptors. There is no formal recognition of this view having value at night-time, nor does the visual context of the LCT or CCT or Farr Bay, Strathy and Portskerra SLA identify any defined night-time or dark sky qualities. Susceptibility at night is moderated to some extent by the point sources of lighting emitted from the properties to the south-east and cars, although this is especially low level and localised, as reflected in the CPRE mapping of night light. There are no permanent light sources at sea and those associated with passing boats are either especially infrequent or distant. While the lighthouse at Strathy Point will potentially present a close-range source of light, in the direction of the offshore Project it is likely to only be used during periods of high humidity, which would also reduce visibility of the aviation warning lights on the offshore Project. Given the small number of local light sources onshore seen

DESCRIPTION AND ASSESSMENT	
	in close proximity this is considered to be a partially lit location in the context of the wider settled coast.
Existing cumulative context:	No existing or consented lit WTGs would be visible, however, there would be views of the Dounreay Power Station to the east.
Magnitude of change:	The nacelle lights would be at a distance range of between 24.3 km to the closest light and 56 km to the most distant. The red, medium intensity 2000 cd lights on the nacelle of the perimeter WTGs would only be visible in poor visibility (<5 km) and would introduce new lighting in views that currently has some visible lighting sources as part of the baseline. The nacelle lights of the closest row of WTGs would appear above the sea horizon, in an area where high levels of darkness are currently experienced, except for the lighthouse which is only used during period of high humidity. The aviation warning lights are backdropped by the sky and therefore partially interrupt the night sky, however, due to the distance of the viewpoint the lights are relatively low to the horizon and do not extend high into the sky, therefore not interrupting the sky above the viewpoint. The aviation warning lights are not expected to result in an obtrusive light that impedes the wider expanse of night sky, which can be readily experienced above the aviation warning lights, nor result in any brightening of the night sky (skyglow). The magnitude of change on the night-time view as a result of the aviation warning lights is assessed as Medium-low due to the relatively wide, 40-degree HFoV occupied by aviation warning lights. The viewpoint is closest to the offshore Project and positioned in line with the south-eastern corner of the OAA, thereby capturing the lights of both southern (T1 to T12) and south-eastern (T13 to T26) boundary WTGs of the offshore Project. However, the magnitude of change would reduce to Low when the lighthouse is switched on during periods of high humidity. Visual effects would occur primarily due to the introduction of an array of new and unfamiliar visible lights in an otherwise primarily dark landscape and the partial interruption of the night-sky just above the sea skyline, from a viewpoint which is not specifically used for the purpose of viewing the night sky. The red, medium intensity 200cd lights on the nacelles of all 125 WTGs would be visible in clear visibility (>5 km), having similar effects as described above (for 2000 cd) but at notably reduced intensity. It is considered therefore that the 200 cd lights whilst still perceptible would not form as noticeable an addition to the existing baseline as the 2000 cd lights. The magnitude of change is assessed as Low. The marine navigational lights on the closest row of WTGs would barely be perceptible at this distance with the remainder obscured by the curvature of the earth.

	Medium intensity 2000 cd CAP393 lights	200 cd red CAP437 & SAR lights
Significance of Effects:	Moderate and significant (only when the Strathy Lighthouse is switched off) reduced to Moderate and not significant (when Strathy Lighthouse is switched on).	Moderate / minor and not significant

DESCRIPTION AND ASSESSMENT		
Future Cumulative context: Medium	The lighting of the Pentland Floating Offshore Wind Farm would appear clearly at the close distance of 9 km to the east (Medium to Medium-low magnitude). The magnitude of change of the offshore Project in addition to the potential future cumulative context would remain Medium-low to low.	
Cumulative Effects:	Moderate (2000cd) and significant (only when the Strathy Lighthouse is switched off) reduced to Moderate and not significant (when Strathy Lighthouse is switched on). Significant combined cumulative visual effects would be experienced as a result of the Pentland Floating Offshore Wind Farm and the offshore Project.	Moderate / minor and not significant
Nature of Effects:	Long term (reversible), cumulative, direct and adverse	Long term (reversible), cumulative, direct and neutral

Table 18-8 Viewpoint N18 A836 Between Thurso and Castletown (SS20: SLVIA visualisations, Figure 18.VP18f-i)

DESCRIPTION AND ASSESSMENT	
Night-time visual receptor and its sensitivity:	The viewpoint is located next to the North Coast 500 / Sustrans Cycle Route 1 (A836), between Thurso Bay and Dunnet Bay. Users of North Coast 500 / Sustrans Cycle Route 1 (A836) would experience the view driving towards Thurso. The sensitivity of the viewpoint at night is Medium, reflecting a medium value of the viewpoint and the medium-low susceptibility of visual receptors. The viewpoint, however, is not located within a designated landscape. There are some readily discernible fixed light sources visible from this viewpoint caused by Scrabster Harbour and related marine traffic. There would be occasional lights from vehicles along the A836. The foreground lights will tend to limit the viewers ability to perceive the proposed aviation warning lights. Otherwise, it is semi-rural location and road users cause illumination from vehicles lights which would reduce the sensitivity of the receptor.
Existing cumulative context:	No existing or consented lit WTGs would be visible.
Magnitude of change	The aviation warning lights would potentially appear at a distance of 41 km and would be barely discernible, even with 2000 cd lights. Due to the long intervening distance, the aviation warning lights would result in a high degree of integration with the levels of baseline lighting seen in the view. The magnitude of change is considered low-negligible with both 2000 cd and 200 cd lights.

DESCRIPTION AND ASSESSMENT		
	The marine navigational lights would barely be perceptible at this distance with the remainder obscured by the curvature of the earth.	
	Medium intensity 2000 cd CAP393 lights	**200 cd red CAP437 & SAR lights**
Significance of Effects:	Minor / negligible and not significant	Minor / negligible and not significant
Future Cumulative context:	The Pentland Floating Offshore Wind Farm would not be visible in the view.	
Cumulative Effects:	Minor / negligible and not significant	Minor / negligible and not significant
Nature of Effects:	Long term (reversible), cumulative, direct and neutral.	Long term (reversible), cumulative, direct and neutral.

Table 18-9 Viewpoint N21 Rackwick Bay (SS20: SLVIA visualisations, Figure 18.VP21f-i)

DESCRIPTION AND ASSESSMENT	
Night-time visual receptor and its sensitivity:	The viewpoint is located adjacent to the Burnmouth Bothy on Rackwick Beach, on Hoy. The bothy is a facility for campers, being a traditional style bothy building, and is open for public use. The sensitivity of the viewpoint at night is **High**, reflecting a high value of the viewpoint and the medium-high susceptibility of visual receptors. There is no formal recognition of this view having value at night-time, nor does the visual context of the LCT or CCT or Hoy West Mainland NSA identify any defined night-time or dark sky qualities. However, the dark sky qualities may be more readily appreciated at this viewpoint in its more remote position. Also, given there is a bothy on the beach, it is likely to be frequented by overnight visitors, who may experience views at dusk and dawn. There are no discernible light sources visible from this viewpoint apart from any distant ships out at sea. The baseline level of light is assessed as dark and unlit.
Existing cumulative context:	The Strath South Wind Farm aviation warning lights would be barely perceptible at 56.4 km distance.
Magnitude of change	Much of the offshore Project would be screened in the view behind the coastal landform of Rora Head. The aviation warning lights of the six closest WTGs at a distance of in between 30.8 km and 35.2 km would potentially be perceivable at their highest intensity. The red, medium intensity 2000 cd lights on the nacelles of the perimeter WTGs would only be visible in poor visibility (<5 km) and would introduce new lighting to views which currently have

DESCRIPTION AND ASSESSMENT		
	almost no visible lighting sources as part of the baseline. The nacelle lights of a small number of the closest perimeter WTGs would appear above the sea horizon next to the cliff in an area where high levels of darkness are currently experienced. The aviation warning lights are backdropped by the sky and therefore partially interrupt the night sky, however, due to the distance of the viewpoint, the lights are relatively low to the horizon and do not extend high into the sky, therefore not interrupting the sky above the viewpoint. The aviation warning lights are not expected to result in an obtrusive light that impedes the wider expanse of night sky, and which can be experienced readily above the aviation warning lights, nor result in any brightening of the night sky (skyglow). The magnitude of change on the night-time view as a result of the aviation warning lights is assessed as Low due to the long distance and limited number of perceivable lights at 2000 cd. The red, medium intensity 200 cd lights on the nacelles of all of the 125 WTGs would be visible in clear visibility (>5 km), having similar effects as described above (for 2000 cd) but at notably reduced intensity. It is considered therefore that the 200 cd lights whilst still perceptible would not form as noticeable an addition to the existing baseline as the 2000 cd lights. The magnitude of change is assessed as Low-negligible. The marine navigational lights on the closest row of WTGs would barely be perceptible at this distance with the remainder obscured by the curvature of the earth.	
	Medium intensity 2000 cd CAP393 lights	**200 cd red CAP437 & SAR lights**
Significance of Effects:	Moderate and not significant.	Minor and not significant
Future Cumulative context:	The Pentland Floating Offshore Wind Farm lights would be barely perceptible at 36.5 km distance. The magnitude of change of the offshore Project, in addition to the potential future cumulative context, is considered to remain Low to low-negligible.	
Cumulative Effects:	Moderate and not significant.	Minor and not significant
Nature of Effects:	Long term (reversible), cumulative, direct and adverse	Long term (reversible), cumulative, direct and neutral

Table 18-10 Viewpoint N25 Yesnaby - Brough of Bigging (SS20: SLVIA visualisations, Figure 18.VP25f-i)

DESCRIPTION AND ASSESSMENT	
Night-time visual receptor and its sensitivity:	The viewpoint is located next to the cairn on top of the cliff edge of the Brough of Bigging in Yesnaby. This elevated coastal edge location represents a very small number of walkers / visitors at night-time either camping or to view the sunset. The sensitivity of the viewpoint at night is High, reflecting a high value of the viewpoint and the medium-high susceptibility of visual receptors. There is no formal recognition of this view having value at night-time, nor does the visual context of the LCT or CCT or Hoy West Mainland NSA identify any defined night-time or dark sky qualities. However, the dark sky qualities may be more readily appreciated at this viewpoint in its more remote position. There are no discernible light sources visible from this viewpoint apart from any distant ships out at sea. The baseline level of light is assessed as dark and unlit.
Existing cumulative context:	The Strath South and Limekiln aviation warning lights would be barely perceptible at 58 km distance.
Magnitude of change	The nearest WTGs to the viewpoint are those along the eastern boundary within the OAA (T18 to T33) at a distance of up to 35 km. Therefore, the HFoV occupied by the WTGs, and accordingly with the most visible lights, would only be 17 degrees, which is half the extent as shown on the wireline. The red, medium intensity 2000 cd lights on the nacelles of the perimeter WTGs would only be visible in poor visibility (<5 km) and would introduce new lighting in views which currently have almost no visible lighting sources as part of the baseline. The nacelle lights of a small number of the closest perimeter WTGs would be most visible above the sea horizon where high levels of darkness are currently experienced. The aviation warning lights are backdropped by the sky and therefore partially interrupt the night sky, however, due to the long distance of the viewpoint the lights are relatively low to the horizon and do not extend high into the sky, therefore not interrupting the sky above the viewpoint. The aviation warning lights are not expected to result in an obtrusive light that impedes the wider expanse of the night sky, which can be experienced readily above the aviation warning lights, nor result in brightening of the night sky (skyglow) that might be of detriment to the overall experience of the dark skies in this view. The magnitude of change on the night-time view as a result of the 2000cd aviation warning lights is assessed as Low, due to the long intervening distance and limited number of perceivable lights. The red, medium intensity 200 cd lights on the nacelles of all 125 WTGs would be visible in clear visibility (>5 km), having similar effects as described above (for 2000 cd) but at notably reduced intensity. It is considered therefore that the 200 cd lights whilst still perceptible would not form as noticeable an addition to the existing baseline as the 2000 cd lights. The magnitude of change is assessed as Low-negligible. The marine navigational lights on the closest row of WTGs would barely be perceptible at this distance with the remainder obscured by the curvature of the earth.

DESCRIPTION AND ASSESSMENT		
	Medium intensity 2000 cd CAP393 lights	**200 cd red CAP437 & SAR lights**
Significance of Effects:	Moderate and not significant.	Minor and not significant.
Future Cumulative context:	The Pentland Floating Offshore Wind Farm lights would be barely perceptible at 50 km distance. The magnitude of change of the offshore Project, in addition to the potential future cumulative context, is considered to remain Low to low-negligible.	
Cumulative Effects	Moderate and not significant.	Minor and not significant.
Nature of Effects:	Long term (reversible), cumulative, direct and adverse	Long term (reversible), cumulative, direct and neutral

18.6.4.1.1 Summary of night-time viewpoint assessment

Table 18-11 Night-time Viewpoint Operational Assessment Summary

VP REF	VIEWPOINT LOCATION	SENSITIVITY	MAGNITUDE OF CHANGE	LEVEL OF EFFECT*
Sutherland Viewpoints				
N1	Faraid Head	Medium-high	Medium-low to Low	**Moderate (significant)** (2000cd perimeter lights) to Moderate / minor (not significant)
N6	Strathy Point	Medium-high	Medium-low to Low	**Moderate (significant)** (2000cd perimeter lights) (only when the light on Strathy Lighthouse is switched off) to Moderate / minor (not significant)
Caithness Viewpoints				
N18	A836 Between Thurso and Castletown	Medium	Low-negligible	Minor-negligible (not significant)

VP REF	VIEWPOINT LOCATION	SENSITIVITY	MAGNITUDE OF CHANGE	LEVEL OF EFFECT*
Orkney Viewpoints				
N21	Rackwick Bay - at Rackwich Bothy bench	High	Low to Low-negligible	Moderate to minor (not significant)
N25	Yesnaby - Brough of Bigging	High	Low to Low-negligible	Moderate to minor (not significant)

*Significant effects are highlighted in **bold.**

18.6.5 Night-time visual effects during operation

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.

18.6.5.1 Settlements

18.6.5.1.1 Sutherland

Along the coast of **Sutherland,** the most notable visibility of the offshore Project would mainly be from small coastal settlements with limited street lighting or sources of external lighting. In these areas views out across the darker surrounding landscape are possible and the proposed aviation warning lights would be seen across the skyline, similar to that illustrated at Viewpoint N1. The primary area of effects would be to the periphery of settlements where WTG lighting may be seen from houses and gardens. The lighting would be seen in the context of other occasional lighting, from some settlements, within a landscape associated with isolated dwellings, farms or coastal settlements, similar to that illustrated at Viewpoint N6. People in their home within the coastal settlements of Sutherland are considered to be of High sensitivity, even at night-time. Long-term effects would range from Medium-low to Low magnitude which would result in **Moderate** and **significant** effects from Durness, Midfield to Midtown, Skullomie and Coldbackie, Bettyhill, Kirtomy, Armadale, Lednagullin, Portskerra and Melvich, primarily as a result of the 2000 cd perimeter lights during periods of poor visibility (<5 km). According to meteorological records, poor visibility is likely to occur for 6% of the time. The nature of these effects would be direct, cumulative, long-term (reversible) and adverse. More typically, the effects would be not significant from the above settlements during periods of good visibility (>5 km) when the light intensity would be at 200 cd. According to meteorological records, good visibility is likely to occur for 94% of the time. The marine navigational lights would barely be perceptible at these distances from the coastal settlements. The remaining Sutherland settlements would not be significantly affected by the offshore Project.

18.6.5.1.2 Caithness

In relation to the coastal area of Caithness, the offshore Project is over 30 km distance from any of the settlements. The aviation warning lights would be seen at a distance where they would constitute only a limited change to the baseline environment and would not be particularly notable due to the presence of other lighting within settlements and the wider landscape, similar to that illustrated at viewpoint N18. People in their home within the coastal settlements of Caithness are considered to be of High sensitivity, even at night-time. Long-term effects would range from Low to Low-negligible magnitude which would result in Moderate / minor to Minor and not significant effects. The marine navigational lights would barely be perceptible at these distances from the coastal settlements. The nature of these effects would be direct, cumulative, long-term (reversible) and adverse to neutral.

18.6.5.1.3 Hoy and the West Mainland of Orkney

Similarly, settlements of Hoy and the West Mainland of Orkney are over 30 km distance, and the aviation warning lights would be seen at a distance where they would constitute only a limited change to the baseline environment and would not be particularly notable, similar to that illustrated at viewpoints N21 and 28 (however, these viewpoints are not at settlements). Long-term effects would range from Low to Low-negligible magnitude which would result in Moderate to Minor and not significant effects. The marine navigational lights would barely be perceptible at these distances from the coastal settlements. The nature of these effects would be direct, cumulative, long-term (reversible) and adverse to neutral.

18.6.5.2 Transport routes

The study area encompasses a large proportion of a landscape which has no street lighting, particularly along the north coast of Sutherland and the coast of Hoy and West Mainland of Orkney, with more lighting in Caithness. These areas are generally dark requiring drivers to focus on the road ahead of them with visibility beyond the beam of headlights reduced due to the contrast between the bright light emanating from the vehicle and the dark landscape beyond.

The key route within the study area which is likely to experience some visual effects is the A838 and A836, however these overlap with the North Coast 500 Route and Sustrans National Cycle Route 1 and is assessed further below. Other routes have very limited potential visibility of the aviation warning lights and are located at a distance where the magnitude is negligible and not significant level of effects.

18.6.5.3 Ferry routes

The sensitivity of people on the Scrabster – Stromness ferry at night-time is assessed as Medium-low due to the medium-low value and low susceptibility to change. There are likely to be a smaller number of people standing on the upper deck at night-time. A review of the ferry timetable highlights that the greatest night-time visual effects would only be between the months of January to March due to less daylight hours. Between April and September, there would be very limited effects due to the long day light hours when the ferry will be travelling. The ferry does not run October to December.

The route comes closest to the offshore Project at 24.4 km distance from its south-east corner, approximately 8 km from the west coast of Hoy. When approaching the Hoy Sound and passing the Old Man of Hoy at 1.5 km distance, the ferry would be 26.4 km distance from the western side of the offshore Project. It should be also considered that the HFoV occupied by the closest visible WTGs up to 35 km is 28 degrees. Around Scrabster and the nearby coastline, there are existing lighting sources provided by Dounreay Power Station and Scrabster Harbour and its related marine traffic. In addition, these views alongside Caithness coast are more than 30 km from the offshore Project. The most notable views of the aviation warning lights would be as the route passes the western coast of Hoy and before it enters the Hoy Sound at distances between 24.4 – 30 km distance. Along this section of the route, views of the 2000cd perimeter aviation warning lights to the west across the sea would be seen across the skyline. The aviation warning lights would be backdropped by the sky and therefore partially interrupt the night sky, however, due to the long distance of the route the lights are relatively low to the horizon and do not extend high into the sky, therefore not interrupting the sky above the route. The aviation warning lights are not expected to result in an obtrusive light that impedes the wider expanse of the night sky, which can be experienced readily above the aviation warning lights, nor result in brightening of the night sky (skyglow) that might be of detriment to the overall experience of the dark skies in the views from part this route.

Long-term effects would range from Medium-low to Low magnitude which would result in Moderate and significant effects from this section of the route to the west of Hoy, primarily as a result of the 2000 cd perimeter lights during periods of poor visibility (<5 km). According to meteorological records, poor visibility is likely to occur for 6% of the time, and largely for three months of the year. The nature of these effects would be direct, cumulative, long-term (reversible) and adverse. More typically, the effects would be not significant during periods of good visibility (>5 km) when the light intensity would be at 200 cd. According to meteorological records, good visibility is likely to occur for 94% of the time. The marine navigational lights would barely be perceptible from this route. The remainder of the ferry route would not be significantly affected by the offshore Project.

18.6.5.4 Recreational routes

18.6.5.4.1 NC 500 Route (which overlaps with the Sustrans National Cycle Route 1, the A838 and A836):

The sensitivity of the route at night is assessed as Medium for tourists and cyclists (Low for other road users), reflecting a medium value and the receptors experiencing the view having medium susceptibility to change. There is no formal recognition of the views having value at night-time along this route and it is not specifically promoted to encourage visitors with the express intention of viewing the night sky. The route, however, passes through the Kyle of Tongue NSA and some SLAs, none of the SLQs identify any special night-time or dark sky qualities. The route also passes through smaller settlements which have street lighting and along scattered houses along the route. In Caithness, there are existing lighting sources provided by Dounreay Power Station and Scrabster Harbour and its related marine traffic. In addition, these views alongside Caithness coast are more than 30 km from the offshore Project. The experience of driving / cycling along this route would vary from being a lit, partially lit or dark locations. Along this northern coastline along this route, views of the aviation warning lights would vary with distance and other light sources in the area with the greatest visibility of the 2000 cd perimeter aviation warning lights visible across the skyline. The aviation warning lights would be backdropped by the sky and therefore partially interrupt the night sky, however, due to the long distance of the route the lights are relatively low to the horizon and do not extend high into the sky, therefore not interrupting the sky above the route. The aviation warning lights are not expected to result in an obtrusive light that impedes the wider expanse of the night sky, which can be experienced readily above the aviation warning lights, nor result in brightening of the night sky (skyglow) that might be of detriment to the overall

experience of the dark skies in these views from this route, particularly in areas where there are limited light sources. Long-term effects would range from Medium-low to Low magnitude which would result in Moderate to Negligible and not significant effects, primarily as a result of the 2000cd perimeter lights during periods of poor visibility (<5 km). According to meteorological records, is likely to occur for 6% of the time. The nature of these effects would be direct, cumulative, long-term (reversible) and adverse. More typically, the effects would be Minor to Negligible and not significant during periods of good visibility (>5 km) when the light intensity would be at 200cd. According to meteorological records, is likely to occur for 94% of the time. The marine navigational lights would barely be perceptible at these distances from this route.

Old Man of Hoy (H2) Core Path: The sensitivity of the route at night is assessed as High for a very small number of walkers and campers, reflecting a medium-high value and the receptors experiencing the view having high susceptibility to change. There is no formal recognition of the views having value at night-time along this route and it is not specifically promoted to encourage visitors with the express intention of viewing the night sky. The route, however, is located within the Hoy and West Mainland NSA, none of the SLQs identify any special night-time or dark sky qualities. The views from the route would largely be a dark landscape with the occasional distant ferries and very distant views of lights on the Caithness / Sutherland coast. Views of the aviation warning lights would be visible from the southern slopes of Moor Fea until it reaches in front of the Old Man of Hoy. Along this section of the route, views of the 2000 cd perimeter aviation warning lights would be most visible across the skyline at 28 km distance. The aviation warning lights would be backdropped by the sky and therefore partially interrupt the night sky, however, due to the long distance of the route the lights are relatively low to the horizon and do not extend high into the sky, therefore not interrupting the sky above the route. The aviation warning lights are not expected to result in an obtrusive light that impedes the wider expanse of the night sky, which can be experienced readily above the aviation warning lights, nor result in brightening of the night sky (skyglow) that might be of detriment to the overall experience of the dark skies in these views from this route, particularly in areas where there are limited light sources. Long-term effects would be Medium-low magnitude which would result in Moderate and significant effects, primarily as a result of the 2000cd perimeter lights during periods of poor visibility (<5 km). According to meteorological records, is likely to occur for 6% of the time. The nature of these effects would be direct, cumulative, long-term (reversible) and adverse. More typically, the effects would be Moderate / minor to Minor and not significant during periods of good visibility (>5 km) when the light intensity would be at 200c d. According to meteorological records, is likely to occur for 94% of the time. The marine navigational lights would have a very limited visual effect from this elevated route due to the long intervening distance.

Rackwick Beach (H3) Core Path: Assessed as part of Viewpoint N21 in Table 18-9 above.

Other recreational routes have limited potential visibility of the aviation warning and marine navigational lights and are located at a distance where the magnitude is likely to be negligible and not significant level of effects.

18.6.5.5 Visitor destinations

The only landscapes likely to experience regular use during the hours of darkness are those promoted for specific activities such as designated Dark Sky Parks or dark sky discovery sites used for stargazing. There are no such sites within the study area. A number of tourist locations are likely to be closed to the public during the hours of darkness.

There are a number of visitor destinations such as Faraid Head, Achininiver Beach, Torrisdale Bay. Strathy Point, Melvich Beach and Armadale Bay in Sutherland, and Rackwick Beach and the Old Man of Hoy on Hoy where the

aviation warning lights would be seen across the skyline, similar to that illustrated at Viewpoints N1, N6 and N21. The sensitivity of people at these locations would range from Medium-high to High. There are likely to be less people in these locations during periods of dusk and dawn and at night. Views of the 2000 cd perimeter aviation warning lights would be most visible from the above destinations across the skyline. The aviation warning lights would be backdropped by the sky and therefore partially interrupt the night sky, however, due to the long distance of the destinations the lights are relatively low to the horizon and do not extend high into the sky, therefore not interrupting the sky above the route. The aviation warning lights are not expected to result in an obtrusive light that impedes the wider expanse of the night sky, which can be experienced readily above the aviation warning lights, nor result in brightening of the night sky (skyglow) that might be of detriment to the overall experience of the dark skies in these views from these destinations.

Long-term effects would range from Medium-low to Low magnitude which would result in Moderate and significant effects from the above destinations, primarily as a result of the 2000 cd perimeter lights during periods of poor visibility (<5 km). According to meteorological records, is likely to occur for 6% of the time. The nature of these effects would be direct, cumulative, long-term (reversible) and adverse. More typically, the effects would be not significant during periods of good visibility (>5 km) when the light intensity would be at 200 cd. According to meteorological records, is likely to occur for 94% of the time. The marine navigational lights would barely be perceptible at these distances from the destinations.

The remaining visitor destinations would not be significantly affected by the offshore Project.

With regards to hill summits such as Ben Hope, Ben Loyal and Beinn Ratha in Sutherland, it is considered less likely that walkers would attempt to undertake mountain walks to coincide with twilight hours, more likely are late walkers who would be completing their walk just before, or at, twilight. Theoretically walkers coming down from these summits during the twilight (and wearing head torches) would not see the lights from the paths due to intervening landform. There may also be a very small number of walkers camping at the summits. The magnitude of change from these summits would be Low-negligible to Negligible and not significant effects.

18.6.5.6 Cumulative night-time visual effects

There would be no significant cumulative night-time visual effects with any of the lit operational, under construction or consented wind farms which is due to the long intervening distance between them and the offshore Project.

There would, however, be cumulative night-time effects with the application Pentland Floating Offshore Wind Farm, which would have aviation warning lights fitted on all seven of its WTGs. The lights on the Pentland Floating Offshore Wind Farm would intensify the baseline lighting closer to the Caithness coast due to its distance of 8 km from the coast. It would be largely screened in views from Sutherland and barely perceptible from Orkney. In views from Strathy Point (see Viewpoint N6 in Table 18-7 above), it would appear in views to the north-east, and the offshore Project in views to the north, with approximately 45-degrees angle of open sea in between both developments. The combined cumulative effects would be significant as a result of both developments. The additional cumulative effect of the offshore Project would also remain significant, particularly in relation to the 2000 cd perimeter aviation warning lights of the offshore Project.

18.7 Assessment of night-time effects on coastal character and designated landscapes

An assessment of the night-time visual effects undertaken in section 18.6 has informed the following assessment of the night-time effects of the aviation lighting on coastal character. The viewpoint assessment found that the aviation warning lights results in not significant effects on visual receptors at night from Caithness and West Mainland of Orkney; with significant (moderate) effects concentrated to the coastline around parts of Sutherland and west coast of Hoy. An assessment of effects from aviation warning lights on coastal character rests to a large extent on a perceptual appreciation of the lighting effects that someone might experience in different levels of darkness at night in the context of the features that define coastal character (such as the skyline and coastal landforms).

The SLVIA study area includes a number of rural coastal areas, particularly along Sutherland and West Orkney that are both intrinsically darker at night, afford opportunity to perceive coastal character at night and see the aviation lights. In particular, these areas afford potential to experience the sea skyline and its relationship with foreground landforms, including distinctive rocky foreshores, cliffs and inshore islands, contributing to character, where effects on perceived character may occur as a component of visual effects. These areas consist of parts of the coastlines within the following coastal character types and designated landscapes assessed further below:

- Type 1: Remote High Cliffs – Sutherland (includes Oldshoremore, Cape Wrath and Durness SLA, Eriboll East and Whiten Head SLA and Farr Bay, Strathy and Portskerra SLA);
- Type 7: Kyles and Sea Lochs – Sutherland (Kyle of Tongue) (includes Kyle of Tongue NSA); and
- RCCA 37 Rora Head and St John's Head – Hoy (Orkney) (includes Hoy and West of Mainland NSA).

18.7.1 Type 1: Remote high cliffs – Sutherland

This coastal character type overlaps with three SLAs in Sutherland including Oldshoremore, Cape Wrath and Durness SLA, Eriboll East and Whiten Head SLA and Farr Bay, Strathy and Portskerra SLA which are included as part of this assessment. Apart from the small settlements of Durness, Armadale, Lednagullin, Kirtomy, Portskerra and Melvich and isolated farmsteads and properties, there is little illumination in this character area. The sensitivity of the coastal character type associated with the lighting of the offshore Project at night is considered to be Medium, reflecting a Medium-high value and a medium susceptibility to change. Although the limited illumination of the coastal character type and general lack of development, there are popular beaches or recognised points along the high cliffs where small numbers of people may visit at night and much of the area is designated by the SLAs, however, it is not recognised for any defined dark skies qualities. The key characteristic that is susceptible to change is the perceived relationship of the sea skyline at night with the dark landform outline of the high cliffs from the bays and beaches, which provide a limited sense of enclosure. The open sea skyline, however, appears simple across the bays and beaches that is framed by these cliffs, which moderates the susceptibility of the perceived character at night to changes associated with distant lighting of the offshore Project. Views from the elevated cliffs are however open and exposed to the sea.

The offshore Project is located a minimum distance of 23 km from the coastal character type. The dark landform outline of the cliffs from the bays and beaches may be perceived during civil twilight (dusk), however these characteristics will be appreciated less after the end of civil twilight, when it is technically 'dark' and aviation warning lights are switched on. The aviation warning lights associated within the offshore Project would be located at long

distance on the sea horizon and will not interrupt the perception of the dark landform outline of the high cliffs. Views from the high cliffs would be open towards the sea horizon with no dark landform outlines. The aviation warning lights on the sea horizon to the north would be viewed with separation from the landform, offshore, on or close to the horizon in the backdrop to the simple, large-scale seascape, and bays and beaches. The aviation warning lights would form a distinct new array of lights to the north representing a new form of lighting of the undeveloped sea horizon. As a result, the magnitude of change on the perceived character of the coastal character at night (in relation to the bays and beaches, and not the elevated open cliffs), resulting from the 2000 cd aviation warning lights of the perimeter WTGs is assessed as Medium-low, and when combined with the Medium sensitivity of the receptor, results in a Moderate and significant effect. According to meteorological records, is likely to occur for 6% of the time during periods of poor visibility (<5 km). The nature of these effects would be direct, cumulative, long-term (reversible) and adverse. More typically, the effects would be Minor and not significant during periods of good visibility (>5 km) when the light intensity would be at 200 cd. According to meteorological records, is likely to occur for 94% of the time.

The aviation warning lights may influence the continuity between the dark sea below and the dark skies above, however they are low to the horizon and do not extend into, nor impede, the view of sky at night. The aviation warning lights are not expected to result in obtrusive light that impedes the wider expanse of night sky, which can be experienced readily above the viewer, nor result in brightening of the night sky (skyglow) or glare on to the sea surface and would therefore not be of detriment to the overall experience of the night skies experienced from the high cliffs including the Old Man of Hoy.

18.7.2 Type 7: Kyles and sea lochs – Sutherland (Kyle of Tongue)

The Kyle of Tongue within this coastal character type overlaps with the Kyle of Tongue NSA which is included as part of this assessment. Apart from the small settlements of Tongue, Midtown and Talmine and isolated farmsteads and properties, there is little illumination in this character area. The sensitivity of the coastal character type associated with the lighting of the offshore Project at night is considered to be Medium-high, reflecting a High value and a medium susceptibility to change. Although the limited illumination of the coastal character type and general lack of development, the Kyle itself is a key feature with some popular beaches including Torrisdale Bay where small numbers of people may visit at night and much of the area is designated by the NSA. Dark skies are not identified as a special quality of this character type or NSA and there are no dark skies planning policy protection for this area, a reflection of the value that society attaches to coast at night. The key characteristic that is susceptible to change is the perceived relationship of the sea skyline at night with the dark landform outline of the steep high hills from the kyle and beaches, which provide a sense of enclosure / containment. The open sea skyline, however, appears simple across the kyle and beaches that is framed by these steep high hills, which moderates the susceptibility of the perceived character at night to changes associated with distant lighting of the offshore Project.

The offshore Project is located a minimum distance of 26 km from the coastal character type. The dark landform outline of the steep high hills from the kyle and beaches may be perceived during civil twilight (dusk), however these characteristics will be appreciated less after the end of civil twilight, when it is technically 'dark' and aviation warning lights are switched on. The aviation warning lights associated within the offshore Project would be located at long distance on the sea horizon and will not interrupt the perception of the dark landform outline of the steep high hills. Views from these hills would be open towards the sea horizon with no dark landform outlines and would have limited effect on perceptual qualities of the coastal character type. Views of the aviation warning lights from within the kyle itself would be restricted due to intervening landform associated with the headlands, Rabbit Islands and Eilean nan

Ron. The aviation warning lights on the sea horizon to the north would be viewed with separation from the landform, offshore, on or close to the horizon in the backdrop to the simple, large-scale seascape, and beaches. The aviation warning lights would form a distinct new array of lights to the north representing a new form of lighting of the undeveloped sea horizon. As a result, the magnitude of change on the perceived character of the coastal character at night (in relation to the beaches, and not the interior kyle or steep high hills), resulting from the 2000 cd aviation warning lights of the perimeter WTGs is assessed as Medium-low, and when combined with the Medium-high sensitivity of the receptor, results in a Moderate and significant effect. According to meteorological records, is likely to occur for 6% of the time during periods of poor visibility (<5 km). The nature of these effects would be direct, cumulative, long-term (reversible) and adverse. More typically, the effects would be Minor and not significant during periods of good visibility (>5 km) when the light intensity would be at 200 cd. According to meteorological records, is likely to occur for 94% of the time.

18.7.3 RCCA 37 Rora Head and St John's Head – Hoy (Orkney)

The Rora Head and St John's Head coastal character type on Hoy overlaps with the Hoy and West Mainland NSA which is included as part of this assessment. There is little illumination in this character area, however, there is some lighting at ships at sea. The sensitivity of the coastal character type associated with the lighting of the offshore Project at night is considered to be High, reflecting a High value and a medium-High susceptibility to change. Dark skies are not identified as a special quality of this character type or NSA and there are no dark skies planning policy protection for this area, a reflection of reflection of the value that society attaches to coast at night. The main characteristic that is susceptible to change at night is the perception of the "*The high cliffs of western Hoy offer expansive views across the Atlantic to the open horizon, and the main focus of views along the coast is the Old Man of Hoy*." The landform of the high cliffs including the Old Man of Hoy may be perceived at night in the context of the wider the sea horizon.

The offshore Project is located a minimum distance of 28 km from the coastal character type. The visible aviation lighting would be seen as distant point sources of red light, at slightly varying heights, seen close to the sea horizon which would limit intrusion into views of stars in the night sky overhead. The aviation warning lights would form a distinct new array of lights to the west representing a new form of lighting of the undeveloped sea horizon. The aviation warning lights are located out to sea, contrasting with the dark seascape, yet being located in an area which is visually separated from the coast and therefore avoids effects on the perception of the high cliffs, along the coast. As a result, the magnitude of change on the perceived character of the coastal character at night, resulting from the 2000 cd aviation warning lights of the perimeter WTGs is assessed as Medium-low, and when combined with the High sensitivity of the receptor, results in a Moderate and significant effect. According to meteorological records, is likely to occur for 6% of the time during periods of poor visibility (<5 km). The nature of these effects would be direct, cumulative, long-term (reversible) and adverse. More typically, the effects would be Minor and not significant during periods of good visibility (>5 km) when the light intensity would be at 200 cd. According to meteorological records, is likely to occur for 94% of the time.

The aviation warning lights may influence the continuity between the dark sea below and the dark skies above, however they are low to the horizon and do not extend into, nor impede, the view of sky at night. The aviation warning lights are not expected to result in obtrusive light that impedes the wider expanse of night sky, which can be experienced readily above the viewer, nor result in brightening of the night sky (skyglow) or glare on to the sea surface and would therefore not be of detriment to the overall experience of the night skies experienced from the high cliffs including the Old Man of Hoy.

18.8 Conclusions

The night-time effects on visual receptors arising as a result of the aviation and marine navigational lighting associated with the offshore Project have been assessed in respect of the worst-case scenario, subject to CAA approval.

Five representative viewpoints have been assessed in detail to demonstrate the potential effects of the aviation warning lights on visual receptors. Significant (Moderate) effects would arise in respect of Viewpoint N1: Faraid Head and N6: Strathy Point in Sutherland, albeit only in respect of the 2000 cd perimeter lights which would only be experienced very infrequently (6% of the time during periods of poor visibility (<5 km)) and not the 200 cd lighting that would be experienced for the majority of the time (94% of the time during periods of good visibility (>5 km)). Viewpoint N6 would also only experience significant effects when the Strathy Lighthouse is switched off. None of the night-time viewpoints in Caithness or Orkney would be significant.

A number of factors are considered when assessing the significance of night-time visual effects:

- The low likelihood of people being present at the viewpoints at night;
- The transient nature of views when moving through the landscape;
- The likelihood of people having some form of personal light sources with them for their own safety, which will create some element of baseline light; and
- The short duration that such effects are likely to be experienced for.

The visual receptors that would experience significant (Moderate) visual night-time effects (and cumulative effects) include the Sutherland settlements of Durness, Midfield to Midtown, Skullomie and Coldbackie, Bettyhill, Kirtomy, Armadale, Lednagullin, Portskerra and Melvich, the Scrabster to Stromness ferry route (for three months of the year), the Old Man of Hoy Core Path, and a number of visitor destinations such as Faraid Head, Achininiver Beach, Torrisdale Bay. Strathy Point, Melvich Beach and Armadale Bay in Sutherland, and Rackwick Beach in Orkney. There would also be significant combined cumulative effects as a result of the offshore Project and the Pentland Floating Offshore Wind Farm from Strathy Point.

There would also be significant (Moderate) night-time effects on the perceived character that may occur as a component of visual effects from the following coastal character types and designated landscapes:

- Type 1: Remote High Cliffs – Sutherland (includes Oldshoremore, Cape Wrath and Durness SLA, Eriboll East and Whiten Head SLA and Farr Bay, Strathy and Portskerra SLA);
- Type 7: Kyles and Sea Lochs – Sutherland (Kyle of Tongue) (includes Kyle of Tongue NSA); and
- RCCA 37 Rora Head and St John's Head – Hoy (Orkney) (includes Hoy and West of Mainland NSA).

All the above significant effects would be as a result of the 2000 cd perimeter lights during periods of poor visibility (<5 km). According to meteorological records, this is likely to occur for 6% of the time. More typically, the effects would be not significant during periods of good visibility (>5 km) when the light intensity would be at 200 cd. According to meteorological records, this is likely to occur for 94% of the time.

None of the remaining visual receptors would be significantly affected by the aviation warning lights of the offshore Project.

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.