Appendix 6.2: ZTV Mapping and Visualisation Methodology

Loch Liath Wind Farm Ltd

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Loch Liath Wind Farm Ltd

Loch Liath Wind Farm

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Appendix 6.2

ZTV Mapping and Visualisation Methodology

Introduction

A6.2.1 This appendix sets out the approach to the production of figures and visualisations which accompany the Loch Liath Wind Farm Landscape and Visual Impact Assessment (LVIA) (which includes the cumulative assessment) set out in **Chapter 6: Landscape and Visual Amenity**, Volume I of the Environmental Impact Assessment Report (EIA Report). Figures referred to in this appendix are located in **Volume 2** of the EIA Report. Zone of Theoretical Visibility (ZTV) figures referred to in this appendix are contained in **Volume 2: Figures**, whilst visualisations are contained in **Volume 3a-b: NatureScot LVIA Visualisations** and **Volume 4a-b: THC LVIA Visualisations.**

A6.2.2 The methodology for the production of visualisations was based on current good practice guidance[1] from NatureScot (formerly known as Scottish Natural Heritage (SNH)[2]) and the Landscape Institute[3,4,5], and additional requirements set out by the Highland Council[6]. Further information about the approach is provided below.

Paper Maps Used

- Ordnance Survey (OS) Maps:
  - Landranger 1:50,000 Scale;
  - Explorer 1:25,000 Scale;
- Online map search engines:
  - Bing, mapping website. (Online - Available at: www.bing.com/maps); and
  - Google, mapping website. (Online - Available at: www.maps.google.com).

Data Used for Digital Terrain Modelling (DTM)

- OS Terrain® 5 mid-resolution height data (DTM) (5m grid spacing, 2.5 metres RMSE);
- OS 1:25,000 raster data (to provide detailed maps for viewpoint locations);
- OS 1:50,000 raster data (to show surface details such as roads, forest and settlement detail equivalent to the 1:50,000 scale Landranger maps); and
- OS 1:250,000 raster data (to provide a more general location map).

Zone of Theoretical Visibility (ZTV) Mapping

A6.2.3 Evaluation of the theoretical extent to which the wind farm would be visible across the Study Area was undertaken by establishing a ZTV. This used ESRI's ArcMap 10.5.1 software, which is designed to calculate the theoretical visibility of the Proposed Development within its surroundings. This program calculates areas from which the turbines are potentially visible. The Spatial Analyst/Viewshed tool does not use mathematically approximate methods. The calculation is based on a 'bare ground' computer generated terrain model, which does not take account of potential screening by buildings or vegetation. The software uses raster height data, but while it is displayed as continuous data (with each grid square referred to as a 'cell'), it assumes a single height value from the centre of that cell for the whole cell. In this case OS Terrain® 5 data was used which calculates the cell value as the mean of the heights across each 5x5m pixel.

A6.2.4 The DTM used for the LVIA analysis is OS Terrain® 5 height data, obtained from OS in 2022. The root-mean-square error (RMSE) of this data is 2.5m. The DTM data is represented by 5x5m grids, which means that the software calculates the number of turbines visible from the centre point of each 5x5m grid/square area. This data was used to calculate visibility within the 45km buffer area of the Site. Visibility beyond the 45km buffer was based on the OS Terrain™ 50 height data (25m contours).

A6.2.5 The DTM data was not altered (i.e. by the addition of local surface screening features) for the production of the ZTV. No significant discrepancies were identified between the used DTM and the actual topography around the Study Area. The effect of earth curvature and light refraction was included in the ZTV analysis and a viewer height of 2m above ground level was used. As the ZTV was based on a 'bare ground' model, it is considered to over emphasise the extent of visibility of the Development and therefore represents a 'maximum potential visibility' scenario.

A6.2.6 The ZTV was calculated to show the number of turbines visible to blade tip height (180-200m) and hub height (102.5-122.5m). The ZTV for the blade tip height is shown on **Figure 6.2a** and **Figure 6.2b**. The hub height ZTV is shown in **Figure 6.3a** and **Figure 6.3b**. An additional ZTV, illustrating the comparative visibility of turbine blade tips with turbine hubs and blade tips (effectively highlighting where only blades will be seen), is shown on **Figure 6.4**. Subsequent figures which include the ZTV make use of the turbine blade tip height ZTV.

A6.2.7 To make cumulative ZTVs (CZTVs) which illustrate the cumulative visibility of the Proposed Development in conjunction with other wind farms, the ZTV to tip height of each wind farm was generated, based on the tip height of each turbine to an applicable maximum radius in accordance with the current NatureScot guidance (SNH, 2017). Each of these was then combined with the blade tip height ZTV for the Proposed Development, run to a 45km radius. The cumulative CZTVs were set up to show the number of wind farms visible, rather than the number of turbines. They are shown on **Figure 6.8** to **Figure 6.13**. The CZTVs are colour coded to distinguish between areas where the Proposed Development is predicted to be visible, either on its own, or in conjunction with other wind farms, and areas where other wind farms would be visible, but the Proposed Development would not be.

Aviation Lighting ZTVs

A6.2.8 **Appendix 6.5: Aviation Lighting Impact Assessment** considers the potential landscape and visual effects arising from the introduction of visible aviation lighting. It is supported by ZTVs illustrating the predicted extents of theoretical visibility of lights mounted on both the nacelles of specific turbines. The Civil Aviation Authority (CAA) approved aviation lighting scheme for the Proposed Development is detailed in **Appendix 14.2: Wind Farm Aviation Lighting and Mitigation Report**. It consists of medium intensity nacelle lights (2,000cd) positioned on six of the proposed turbines. It was used to inform the preparation of the aviation lighting ZTVs.

A6.2.9 ZTVs to illustrate the extent of theoretical visibility of all turbine hubs are shown on **Figure 6.3a** and **Figure 6.3b.** These illustrate the extent of predicted theoretical visibility to 45km and 20km respectively. These ZTVs assume visibility of all turbine hubs, rather than only the six of the proposed turbines which would have visible lights installed.

A6.2.10 To supplement the hub height ZTVs, directional lighting intensity ZTV figures are presented as **Figure A6.5.1** and **Figure A6.5.2** and illustrate the maximum and minimum predicted luminous intensity (candela (cd)) of the nacelle mounted aviation lights relative to viewing angle/elevation, and to a radius of 45km and 20km respectively. The DTM data and methodology for the calculation of the ZTV were identical to the ZTV (hub height) as defined above, except that vertical limits were set for the output. The maximum

[1] SNH (2017), Visual Representation of Wind Farms, Version 2.2. [Online] Available at: https://www.nature.scot/visual-representation-wind-farms-guidance (Accessed 25/04/2024).
[2] Scottish Natural Heritage (SNH) rebranded in August 2020 as NatureScot. Where relevant reference is still made to SNH within this chapter in respect of guidance which remains valid and is yet to be republished.
[3] Landscape Institute (2019). Advice Note 01/11 Photography and photomontage in landscape and visual impact assessment. [Online] Available at: https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/migrated-legacy/LIPhotographyAdviceNote01-11.pdf (Accessed 25/04/2024).
[4] Landscape Institute and the Institute of Environmental Management and Assessment (2013). Guidelines for Landscape and Visual Impact Assessment Third Edition (GLVIA3).
[5] Landscape Institute (2019). Technical Guidance Note 06/19 Visual Representation of Development Proposals. [Online] Available at: https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2019/09/LI_TGN-06-19_Visual_Representation.pdf (Accessed 25/04/2024).
[6] The Highland Council (THC) (2016). Visualisation Standards for Wind Energy Developments. [Online] Available at: http://www.highland.gov.uk/download/downloads/id/12880/visualisation_standards_for_wind_energy_developments.pdf (Accessed 25/04/2024).

and minimum predicted luminous intensity values (candela/cd) are based on the CEL-MI-ACWGAM light[7], which meets the minimum requirements of ICAO/CAP393 medium-intensity nacelle mounted aviation light - including ICAO Minimum 2,000cd average intensity required between 0˚ (horizontal) and +3˚. The specific maximum and minimum luminous intensity values are detailed in **Table A6.2.1** below. The ZTV was run six times with different upper and lower angle elevation limits (where 0° represents the horizontal plane), to represent the minimum average intensities required at different elevation angles.

Table A6.2.1: Maximum and minimum luminous intensity relative to viewing angle - CEL-MI-ACWGAM light

Vertical angle of lighting from nacelle	Maximum luminous intensity (cd)	Minimum luminous intensity	Maximum luminous intensity at 10% (cd)	10% Minimum luminous intensity at 10% (cd)
Above 2°	1568cd	632cd	156cd	63cd
Between 1° to 2°	2306cd	1630cd	230cd	163cd
Between 0° to 1°	2341cd	2067cd	234cd	206cd
Between -1° to 0°	1965cd	850cd	196cd	85cd
Between -2° to -1°	832cd	356cd	83cd	35cd
Between -3 to -2°	344cd	188cd	34cd	18cd
Below -3°	≤188cd	n/a	≤18cd	n/a

A6.2.11 As the difference in the vertical height from highest proposed turbine (550m AOD) to the lowest proposed turbine (497m AOD) is over 50m and taking account of the varying height of the proposed turbines (180-200m), there is some variability in the predicted luminous intensity of each turbine light. There is overlap between each of the six layers which represent the visibility of each of the six lit turbines. **Figure A6.5.1** and **Figure A6.5.2** show the layer with the greater intensity on top, so as to represent the worst case/maximum effect scenario.

Preparation of Visualisations

Daytime Visualisations

Viewpoint Photography

A6.2.12 The methodology for photography is in accordance with guidance from NatureScot[8], the Landscape Institute[9] and the Council[10]. The focal lengths used are in accordance with recommendations contained in guidance and are stated on the figures. Photography for the 20 assessment viewpoints was taken between October 2019 and February 2023 using Canon EOS 6D, Sony ILCE-7RM3 and Nikon D750 full frame digital SLR cameras, each with a fixed 50mm focal length lens.

A6.2.13 A tripod with vertical and horizontal spirit levels was used to provide stability and to ensure a level set of adjoining images. A panoramic head was used to ensure the camera rotated about the no-parallax point of the lens to eliminate parallax errors between the successive images and enable accurate stitching of the images. The camera was moved through increments of 24˚ (degree) and rotated through a full 360˚ at each viewpoint. Fifteen photographs were taken for each 360˚ view.

A6.2.14 The location of each viewpoint was recorded (GPS grid reference, location map and photograph of the tripod) in accordance with NatureScot and Landscape Institute guidance[11].

A6.2.15 Weather conditions and visibility were considered an important aspect of the field visits for the photography. Where possible, visits were planned around clear days with good visibility. Viewpoint locations were visited at times of day to ensure, as far as possible, that the sun lit the scene from behind, or to one side of the photographer. Adjustments to lighting of the turbines were made in the rendering software to make the turbines appear realistic in the view under the particular lighting and atmospheric conditions present at the time the photography was taken.

Photograph Stitching, Wireframes and Photomontages

A6.2.16 Photographic stitching software PTGui© 12.20 was used to stitch together the adjoining frames to create panoramic baseline photography. A selection of identical control points was created within each of the adjoining frames to increase the level of accuracy when stitching the 360° panoramic photography.

A6.2.17 The software package ReSoft© WindFarm version 4.2.5.3 was used to view the wind farm from selected viewpoints in wireframe format. OS Terrain 5 and OS Terrain 50 data were used to create a Digital Terrain Model (DTM) which provided a detailed and reliable representation of the topography for the wireframe view. Turbine locations, type and size, and viewpoint location coordinates were entered. Photomontages were constructed to show the candidate turbine with the specified tip height, hub height and rotor diameter. Viewer height was set to 1.5m above ground level. On limited occasions this viewer height was increased by a small increment to achieve a closer match between the terrain data and photographic landform content. The pre-prepared panoramic baseline daytime photographic images were imported into ReSoft© WindFarm software. From each viewpoint the wireline views of the landform model with the proposed turbines were carefully adjusted to obtain a match. Fixed features on the ground, such as buildings and roads, were identified in the model and used as markers to help with the alignment process where necessary.

A6.2.18 Wind farm layouts included within the cumulative assessment were added to the ReSoft© WindFarm model.

A6.2.19 The presentation of fully rendered photomontages involved additional stages, as follows.

A6.2.20 ReSoft© WindFarm software was used to render the turbines. Each view was rendered taking account of the sunlight and the position of the sun in the sky at the time the photograph was taken. Blade angle and orientation adjustments were also made to represent a realistic situation.

A6.2.21 The next stage required the rendered turbines to be blended into the baseline photographic view. This was carried out using Adobe Photoshop© software and allowed, where relevant, for turbines or parts of turbines to be removed where they were located behind foreground elements that appeared in the original photograph. The software package 43D Topos© was used for adding the access tracks and proposed met mast, where visible, to viewpoints within 10km of the development. These elements were informed by infrastructure data either imported as a GIS shapefile or modelled in 3D to their specified dimensions and positioned within a DTM created from the same OS Terrain 5 and OS Terrain 50 data used for the turbine alignment and renders. Cameras were set up within the 3D software to replicate the coordinate positions, view direction and field of view of the baseline photography and the model views were aligned.

A6.2.22 Views were then rendered and the exported Topos images combined with the baseline photography, using Adobe Photoshop© software, to create the photomontage images.

A6.2.23 Finally, and where applicable, the images were converted from Cylindrical Projection to Planar Projection using PTGui© software.

Single Frame Images

A6.2.24 Single frame landscape photographs orientated towards the centre of the turbine layout were taken at the same time as photography for the panoramas in accordance with THC guidance[10].

A6.2.25 Single frame Photomontages were set up in ReSoft© WindFarm following the same process as the panoramic images.

A6.2.26 These photomontages were set up using the 50mm lens photography and additional images were provided to 75mm lens equivalent, cropped from the 50mm image using PTGui© 12.20 software.

A6.2.27 Information regarding the correct viewing distance (binocular) and caveats are located on the figure.

[7] https://www.aircraftwarninglights.co.uk/datasheets/CEL-MI-ACWGAM%20-%20datasheet%20rev10.pdf (Accessed 25/04/2023).
[8] Scottish Natural Heritage (2017). Visual Representation of Wind Farms, Version 2.2. [Online] Available at: https://www.nature.scot/visual-representation-wind-farms-guidance (Accessed 25/04/2024).
[9] Landscape Institute (2019). Advice Note 01/11 Photography and photomontage in landscape and visual impact assessment. [Online] Available at: https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/migrated-legacy/LIPhotographyAdviceNote01-11.pdf (Accessed 25/04/2024).
[10] The Highland Council (2016). Visualisation Standards for Wind Energy Developments. [Online] Available at: http://www.highland.gov.uk/download/downloads/id/12880/visualisation_standards_for_wind_energy_developments.pdf (Accessed 25/04/2024).
[11] Landscape Institute. (2011). Practice Advice Note, Photography and photomontage in landscape and visual impact assessment. Advice Note 01/11.

Dusk/Night-time Visualisations

A6.2.28 To date, consultants including LUC have generally prepared photomontage visualisations to consistently represent aviation lights illuminated at their minimum required luminous intensity (2,000cd). In addition, they are also shown when dimmed to 10% of their maximum (i.e. minimum 200cd) in times of clear meteorological conditions, where visibility exceeds 5km at the point of measurement (i.e. sensors on the turbine hubs). This approach has been accepted by NatureScot and other stakeholders. However, it does **not** take account for the mitigation which exists to reduce the perceptibility of aviation lights using the latest technological advances in lighting design, particularly the influence of directional luminous intensity relative to viewing angle/elevation.

A6.2.29 The specific luminous intensity (candela - cd) of medium intensity aviation obstruction lights, which meet the minimum regulatory requirements, result in light being emitted more strongly at a horizontal angle. It reduces at elevation angles above and below the horizontal. This is referred to as **angle intensity reduction** and is mitigation that is inbuilt into this specific type of light.

A6.2.30 Variation in the elevation angle between the light and the viewpoint (observer/receptor) can result in a considerable increase or decrease in the luminous intensity experienced at each representative viewpoint location. Predicted values are presented in the form of lighting intensity Zone of Theoretical Visibility (ZTV) mapping (as detailed above in relation to **Figure A6.5.1** and **Figure A6.5.2**), which illustrate the potential variability in lighting intensity. This is referred to as luminous intensity and is expressed as values in cd, in relation to vertical viewing angle across the study area.

A6.2.31 Until recently this information has not been interpreted and translated for presentation within illustrative photomontage images for specific assessment viewpoints. The predicted values can however be applied to a modelled light source and illustrated in photomontage visualisations.

A6.2.32 For the aviation lighting photomontage visualisations presented in this EIA Report, LUC and the Applicant agreed that visualisations utilising the luminous intensity data presented in **Appendix 14.2: WPAC Aviation Lighting and Mitigation Report - Version 2.1** would also be produced. These visualisations take account of the elevation angle between each individual turbine nacelle/hub light and assessment viewpoint, at a viewing height of 1.5m, and seek to illustrate the actual luminous intensity of each individual turbine light predicted to be perceptible from each representative assessment viewpoint.

A6.2.33 The cd values modelled in these night-time visualisations are based on the individual values as set out in **Appendix 14.2** (Appendix A: Lighting Results Tables). This table show the maximum predicted luminous intensity of each turbine light from each representative viewpoint, taking account of viewing angle. Further visualisations illustrate the nacelle lights at both their maximum intensity (the ‘Maximum candela’ visualisations) and when dimmed to 10% (the ‘10% of maximum candela’ visualisations).

A6.2.34 As such, four visualisations were prepared for each illustrated viewpoint. The first two show specific luminous intensities at full brightness and dimmed to 10%, both with angle intensity mitigation. Two further visualisations show the minimum required luminous intensities at full brightness (2,000cd) and when dimmed to 10% (i.e. 200cd). Each of the visualisations is referred to in the assessment presented in **Appendix 6.5: Aviation Lighting Impact Assessment**.

A6.2.35 Dusk/night-time visualisations were prepared from the following viewpoints:

- Viewpoint 1: Affric Kintail Way near Braefield (**Figure 6.14**, **Volume 3a: NatureScot LVIA Visualisations**);
- Viewpoint 10: Creag Dhubh (**Figure 6.23**, **Volume 3a: NatureScot LVIA Visualisations**);
- Viewpoint 18: Toll Creagach (**Figure 6.31**, **Volume 3b: NatureScot LVIA Visualisations**).

A6.2.36 Baseline photographs from the three night-time assessment viewpoints were taken between December 2021 and March 2022, using the same camera equipment and similar procedure as the daytime views. 360˚ ranges of photography were taken at regular intervals starting shortly before sunset or sunrise (depending on the viewpoint) with subsequent ranges taken as natural light faded and existing manmade light sources became visible or before natural light increased at dawn.

A6.2.37 In accordance with good practice guidance, baseline photography is carried out in appropriate conditions close to dusk or dawn (dependent on viewing direction, and/or in response to specific requests of consultees). NatureScot guidance states ‘*The visualisation should use photographs taken in low light conditions, preferably when other artificial lighting (such as street lights and lights on buildings) are on, to show how the wind farm lighting will look compared to the existing baseline at night*’… ‘*We have found that approximately 30 minutes after sunset provides a reasonable balance between visibility of the landform and the apparent brightness of artificial lights, as both should be visible in the image*.’ (paragraphs 174 – 177, pages 35 and 36). The baseline photography selected for visualisations was captured at approximately 30 minutes after sunset on the date the photography was taken in accordance with the latest guidance from NatureScot[12,13].

A6.2.38 Baseline photography, including the presence of existing sources of artificial lights where applicable, was taken in clear atmospheric conditions. Photography was captured using a full frame sensor digital single lens reflex (SLR) camera with a fixed 50mm focal length lens from all viewpoint locations.

A6.2.39 A tripod with vertical and horizontal spirit levels was used to provide stability and to ensure a level set of adjoining images is captured. The camera was orientated to take photographs in landscape format. A panoramic head was used to ensure the camera is rotated about the no-parallax point of the lens in order to eliminate parallax errors[14] between the successive images and enable accurate stitching of the images. The camera was rotated through increments of 24˚ and through a full 360˚ at each viewpoint. Fifteen photographs were taken for each 360˚ view.

A6.2.40 Exposure settings were carefully optimised at each viewpoint with shutter speed, aperture and ISO levels balanced to ensure the photography provided an accurate representation of the conditions at the time.

A6.2.41 Photographic stitching software PTGui© 12.20 was used to stitch together a small number of the adjoining frames to create panoramic baseline photography. A selection of control points were positioned over each of the adjoining frames to increase the level of accuracy when stitching the panoramic photography.

A6.2.42 A 3D scene file was created for each viewpoint location in Autodesk3DS Max© Vray© modelling and rendering software. A virtual ‘camera’ was created within each scene to match the coordinate locations of the baseline photography and set to a default viewer height of 1.5m above ground level (OS Terrain® 5 height data). The virtual camera in the 3D scene was set to match the perspective attributes (horizontal field of view and projection) of the physical camera used for the baseline photography.

A6.2.43 The proposed turbine layout was created within Autodesk3DS Max© software with the candidate turbines of specified tip height, hub height and rotor diameter positioned to their x and y coordinate points and with their z (base) height informed by Ordnance Survey (OS) Terrain® 5 height data.

A6.2.44 The turbines were orientated with the nacelle/hub facing the camera within the 3D scene (and not obscured by turbine blades). This ensured that the images show the maximum visibility of the lighting proposed to be installed on the nacelle, with blade angle and orientation adjustments made to represent a realistic situation.

A6.2.45 Simple ‘sphere’ shaped lights within the Autodesk3DS Max© software were matched to the luminous intensity of the light source (in /cd). The aviation lights were positioned on each proposed turbine nacelle and set to the minimum required luminous intensity (2,000cd) and when dimmed to 10% of their maximum (200cd). The lights were coloured red to match the specification of those proposed. Note that in practice the lights will be a complex composite of bulbs, not a single source. The modelling is therefore indicative.

A6.2.46 Additional lighting settings were then applied to supplementary 3D scene files. The cd values modelled in the visualisations only take account of the influence of elevation angle between the individual nacelle mounted obstruction light and the individual viewpoint. The dimensions of the nacelle light modelled reflect the specification (CEL-MI-ACWGAM [15]) noted in paragraph 16 of **Appendix 14.2**.

A6.2.47 The luminous intensity value (in cd) for each medium intensity aviation light (as applicable to each individual dusk/night-time viewpoint) was modelled individually. The values were taken from the results presented in the WPAC Aviation Lighting and Mitigation Report - Version 2.1 (**Appendix 14.2** (Appendix A: Lighting Results Tables) and take account of the elevation angle between the light and viewpoint provided (results provided to every 0.1° from the horizontal plane). Values for both the full illumination (meeting the maximum luminous intensity in the horizontal plane and slightly above) and dimmed to 10% scenarios were modelled.

[12] NatureScot (September 2020) General pre-application and scoping advice for onshore wind farms (superseded).
[13] Scottish Natural Heritage (2017). Visual Representation of Wind Farms, Version 2.2. [Online] Available at: https://www.nature.scot/visual-representation-wind-farms-guidance (Accessed 25/04/2024).
[14] Parallax is the difference in the position of objects when viewed along two different lines of sight. In the case of a camera this would occur if the rotation point of the lens was not constant and would result in stitching errors in the panorama.

[15] Contarnex Europe Ltd. (CEL) - CEL-MI-ACWGAM Medium Intensity Red 2,000cd Light.
230VAC - LED Aircraft Warning Light [Online] Technical specification available at: https://www.aircraftwarninglights.co.uk/datasheets/CEL-MI-ACWGAM%20-%20datasheet%20rev10.pdf

A6.2.48 The panoramic baseline dusk photography for each viewpoint was imported into each viewpoint virtual 3D scene and the exposure settings applied (ISO, Shutter Speed and f/Stop) to enable the software to match the physical camera setup. Background lighting levels were simulated by the software, informed by the time/date/year/geographical location of the baseline photograph, using High Dynamic Range spherical imagery at the correct phase of the day. This means the lighting conditions within which the baseline photography was captured can be simulated within the virtual 3D scene.

A6.2.49 Settings within Vray© rendering software were optimised (minimum sub-divisions were increased and the overall 'noise' threshold decreased) to ensure the rendered outputs maintain a high level of accuracy in terms of pixel resolution. This is especially important when the software is computing lower levels of light source and rendering lighting objects at distance.

A6.2.50 The 3D renders of turbines and lighting scenarios were then combined with the baseline photograph using Adobe Photoshop©. Adobe Photoshop© software was used to combine the images and remove turbines or sections of turbines which were located behind foreground elements in the original photograph.

A6.2.51 As with the daytime images, the exported renders were then combined with the baseline photographic view using Adobe Photoshop© software and converted from Cylindrical Projection to Planar Projection using PTGui© software.

A6.2.52 Finally, Adobe InDesign© software was used to present the 53.5˚ photomontages. The dimensions for each image (printed height and field of view) are in accordance with the requirements set out in the guidance, and consistent with similar photomontages presented to illustrate daytime effects. Photography information and viewing instructions are provided on each page.

A6.2.53 The photomontages do not seek to replicate the additional variable influence which distance (between the light and the viewpoint/observer) or atmospheric attenuation[16] by moisture (cloud/rain/fog) or by dust or other particulates[17] can have on the observed brightness[18] of the lights. However, it is understood that the additional influence of these factors could lead to a further decrease in the brightness as it is perceived.

A6.2.54 As required by the EIA Regulations, it is considered that the photomontages prepared and presented in this EIA-R illustrate a likely 'maximum case effect' in clear conditions for each representative viewpoint, providing an indicative tool, which is referred to when visiting the viewpoint in the field. As with any visualisation, limitations are recognised, including issues relating to print quality and paper surface if printed, or size, screen brightness and output resolution if viewed on screen. Judgements on levels of effect were informed by research, reference to the WPAC report (**Appendix 14.2**) and lighting intensity ZTVs (**Figure A6.5.1** and **Figure A6.5.2**), observations made in the field work for this project and experience from other projects and background fieldwork.

Presentation of Photomontages

A6.2.55 The printed figures for the viewpoints produced in accordance with NatureScot and THC requirements were collated in two separate A3 volumes (**Volume 3a-b: NatureScot LVIA Visualisations** and **Volume 4a-b: THC LVIA Visualisations**) to allow them to be used independently.

NatureScot Compliant Visualisations

A6.2.56 Adobe InDesign© software was used to present the figures. The dimensions for each image (printed height and field of view) are in accordance with NatureScot requirements. Photography information and viewing instructions are provided on each page where relevant.

A6.2.57 The elongated A3/A1 width format pages presented for each viewpoint are set out as follows:

- The first page contains an OS 1:50,000 scale map on the left side showing the viewpoint location, direction of the 90˚ baseline photography, wireline views and 53.5˚ photomontage view. Wind turbine locations for the Proposed Development and other existing or proposed wind farms are also shown. A ZTV map using OS 1:25,000 scale raster data is also shown on the right side of the same page;
- The following page contains 90˚ baseline photography and wireline to illustrate the wider landscape and visual context. These are shown in cylindrical projection and presented on an A1 width page. Additional pages in the same format are provided where relevant to illustrate wider cumulative visibility up to 360˚;
- The subsequent two pages contain a 53.5˚ wireline and photomontage. These images are both shown in planar projection and presented on an A1 width page.

THC Compliant Visualisations

A6.2.58 Adobe InDesign software was used to present these figures. The dimensions for each image (printed height and field of view) are in accordance with THC requirements. Photography information and viewing instructions are provided on each page where relevant.

A6.2.59 The A3 format pages for each viewpoint, as agreed with THC, are set out as follows:

- The first page contains an enlarged OS 1:25,000 scale map showing, in detail, the viewpoint location and direction of view, and a written description of the viewpoint location;
- The following two pages contain 65.5˚panoramic images for landscape assessment. The panoramic photomontage is followed by the panoramic wireline and baseline photograph. These images are all shown in planar projection;
- 65.5˚cumulative wirelines were produced to show multiple wind farms considered in the CLVIA. A 65.5˚ cumulative wireline (planar projection) image follows on from the figures listed above. The colours assigned to cumulative wind farms follow THC requirements regarding their status; and
- The subsequent three pages contain the single frame images for visual impact assessment. The 50mm focal length photomontage precedes the 75mm focal length photomontage and 75mm focal length monochrome images.

[16] The decreasing brightness of light as it passes through the atmosphere and is scattered or absorbed by processes in the atmosphere.
[17] Microscopic solid or liquid particles suspended in the atmosphere, which may be natural, such as dust or pollen, or man-made pollutants, such as smoke of vehicle emissions. Sea salt is also prevalent in maritime environments, and liquid water in the form of water droplets suspended in the air as cloud or fog is common.
[18] The measure of luminous intensity of light that passes through a unit area of surface at a particular distance. The observability of light depends on the illuminance of a light and determines how bright a light appears.