TECHNICAL APPENDIX 7.1: TECHNICAL METHODOLOGIES FOR VISUAL REPRESENTATION

1. Technical Appendix 7.1: Technical Methodologies for Visual Representation

1.1 Introduction

1.1.1 The following is a detailed methodology for production of technical outputs contributing to the LVIA.

1.1.2 The Landscape and Visual Impact Assessment (LVIA) of the Proposed Development is informed by several technical models and drawings. The methods for producing these are described below.

1.1.3 It should be remembered that,

"visualisations, whether they are hand drawn sketches, photographs or photomontages, can never exactly match what is experienced in reality. They should, however, provide a representation of the proposal that is accurate enough for the potential impacts to be fully understood" (SNH, 2017g: para 96, p22) and that *"visualisations in themselves can never provide the full picture in term of potential impacts; they only inform the appraisal process by which judgements are made"* (SNH, 2017g; para 98, p22).

1.1.4 Viewpoint (VP) photography has been undertaken by ASH design + assessment Ltd (ASH), and Creative Sides Photography. All editing and modelling has been completed by ASH.

Turbine Specifications

1.1.5 The turbines considered in the assessment of the Proposed Development were modelled in accordance with the dimensions stated in Chapter 3: Description of Development as follows:

- Hub Height: 82 m
- Rotor Diameter: 136 m
- Overall Tip Height: 150 m.

1.1.6 Although the specified turbine height for the application has a tip height of 149.9m, a 150m turbine has been used for all visualisations as a worst case.

1.1.7 The location of each turbine included in visualisations is detailed in Table 1.1.1.

Table 1.1.1: Proposed Development – Turbine Locations

Turbine Number	Ordnance Survey (OS) Grid Coordinates	Base Elevation (m AOD)	Turbine Number	Ordnance Survey (OS) Grid Coordinates	Base Elevation (m AOD)
1	245164 911083	331	11	246722 909421	322
2	244595 910950	338	12	246915 908855	294
3	245618 910922	320	13	246390 909004	315
4	245980 910740	335	14	245810 909163	309
5	244768 910506	288	15	246334 908448	263
6	246023 910241	361	16	245756 908237	248
7	245495 910095	327	17	246564 907472	256
8	244872 910018	287	18	247025 907297	290

Turbine Number	Ordnance Survey (OS) Grid Coordinates	Base Elevation (m AOD)	Turbine Number	Ordnance Survey (OS) Grid Coordinates	Base Elevation (m AOD)
9	245597 909695	379	19	246838 906821	266
10	246198 909516	387	20	247468 906810	313

Current Guidance

1.1.8 The main guidance documents which have informed the technical methodologies used to undertake this LVIA and prepare the supporting drawings and visualisations are as follows:

- Scottish Natural Heritage (SNH), (2017), Visual Representation of Wind Farms (Version 2.2) (SNH, 2017g) (the NatureScot[1], 2017 Guidance).
- The Highland Council (THC), (2016), Visualisation Standards for Wind Energy Developments (THC, 2016) (the THC, 2016 Guidance).

1.1.9 The Landscape Institute also provides technical guidance on visualisation production (below). While the guidance prepared by NatureScot and THC are the most relevant for the Proposed Development, this document is also a useful reference guide:

- The Landscape Institute, (2019), TGN 06/19 Visual Representation of Development Proposals.

1.1.10 Two sets of photomontages and wirelines have been prepared to support the LVIA:

- One set to accord with the NatureScot, 2017 Guidance, included as Volume 3A of the EIA Report; and
- One set to accord with the THC, 2016 Guidance, included as Volume 3B of the EIA Report.

1.1.11 Location plans for both sets of photomontages and wirelines are also provided. These plans also illustrate the field of view for each set of photomontages. It should be noted that the illustrated field of view fans for the THC 2016 Guidance, single frame images are representative of the field of view of these images but do not take account of permissible offsets in the angle of view.

1.2 Zone of Theoretical Visibility (ZTV) Production

1.2.1 Zone of Theoretical Visibility (ZTV) diagrams have been prepared using Esri ArcGIS, Version 10.7 (ArcGIS) and an Ordnance Survey (OS) Terrain 5 digital terrain model (DTM) to illustrate the potential visibility of the wind farm. The ZTVs have been prepared based on a viewer height of 2m above ground level in line with the NatureScot, 2017 Guidance, with earth curvature and light refraction set to 0.075.

1.2.2 Terrain 5 is a grid of heightened points with regular five metre post spacing. The software uses this information to create a virtual, three-dimensional, bare ground model which is representative of the earth's surface. It does not take into account elements above the

[1] In 2020, Scottish Natural Heritage (SNH) rebranded as NatureScot. However when referencing guidance published by the organisation before this date, SNH has continued to be referred to as this was the name under which the guidance was published at that time.

ground such as buildings or trees. Therefore, while the ZTV indicates areas of potential visibility of the Proposed Development, in reality, not all locations within the ZTV would necessarily afford a view of it. Nevertheless, the ZTV is a valuable tool in both landscape character and visual impact appraisal.

1.2.3 While Terrain 5 is a product which is updated by OS on a quarterly basis, the terrain model was created using data available in 2018 and supplied to ASH by SSE. The terrain model has not been updated since that time. This prevents excessive reworking of models and allows for continuity during the appraisal process.

1.2.4 ZTV diagrams produced as part of the cumulative landscape and visual assessment (CLVIA) have also been prepared using ArcGIS and the same OS Terrain 5 data. All cumulative ZTVs have been run across the full page area.

1.3 Photography

1.3.1 Photographs have been taken using a full frame sensor (equivalent to a 35mm film frame), digital single lens reflex (DSLR) cameras. Cameras used include:

- Canon EOS 5D Mark II with Canon EF 50mm f/1.4 USM lens; and
- Sony ILCE-7RM3 with Sony 50mm f/1.2 Sony DT50mm lens.

1.3.2 The details of the camera and lens used for each VP are included on the relevant photograph or photomontage.

1.3.3 Lenses were fitted with a Polarising filter and/or Neutral Grad filter where appropriate to maximise the quality of light balance and photography at source and minimise the need for computer enhancement.

1.3.4 The VP photographs were taken in landscape format by a camera attached to a tripod and rotating panoramic head unit (set to 20° intervals) with a levelling base in order to maintain a stable platform for photography work, and to ensure an even overlap for successive panorama images. Photography was taken at a height of 1.5m above ground level.

1.3.5 On arrival at each VP location, a global positioning system (GPS) navigation device was switched on and allowed to acquire satellite positions. This device will identify its location, to the nearest metre, using a 12 figure OS grid reference, e.g. 252294 925050 or NC 52294 25050. In order to increase the accuracy of readings, the grid reference was not recorded until all other work at the VP was completed and the GPS device had been switched on for several minutes. This passage of time allows the GPS device to increase the accuracy of readings through repeated, automated measurements. All GPS readings taken were to a maximum of ±5 m accuracy.

1.3.6 While at a VP, the landscape architect or photographer recorded the grid reference, ground level and camera viewing height along with a brief description of the nature of view, weather conditions and visibility. The camera embeds details of the date, time, camera make and model, the lens focal length, shutter speed, f-number and ISO speed rating as metadata in each photograph file. A photograph of the tripod position was also taken.

1.3.7 Baseline photographs were then downloaded and combined to create 360° baseline panoramic images in cylindrical projection using PTGui software. Where applicable these were converted to planar projection using Hugin – Panorama Stitcher software (Hugin).

All single frame images conform to the fields of view characteristic of the lenses they represent (50mm or 75mm).

1.3.8 As detailed in Table 1.3.1 below, some adjustments were made using Adobe Photoshop CC 2019 (Photoshop) to the baseline photographs. For example, to alter the brightness and/or contrast; to enhance the depiction of the existing turbines when they were not clear in the original photograph; and/or to remove and re-montage back in operational cumulative turbines to face the VP in line with best practice guidance.

Table 1.3.1: Viewpoint Photography

VP	OS Grid Coordinates	Date and Time	Weather Conditions	Notes
VP1	NC 52294 25050	01/04/21 at 10:21	Clear and bright with snow on the hill-tops.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP2	NC 57475 13940	21/04/21 at 09:40	Clear and bright.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP3	NC 59173 08273	02/10/20 at 13.12	Sun-shine with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP4	NC 74824 06805	06/08/20 at 15:19	Clear and bright.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP5	NC 42655 33931	21/04/21 at 16:56	Bright sun-shine with distant high-level haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP6	NC 47028 02032	02/10/20 at 13:56	Sun-shine with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP7	NC 60226 04804	23/09/20 at 10:13	Sun-shine with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP8	NC 57326 09947	14/10/20 at 09:50	Sun-shine with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP9	NC 55793 12701	23/09/20 at 13:12	Sun-shine with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP10	231833, 920148	02/10/20 at 17:37	Bright sun-shine with distant high-level haze.	Minor enhancement to brightness and contrast and

VP	OS Grid Coordinates	Date and Time	Weather Conditions	Notes
				existing wind turbines visible, removed and re-montaged.
VP11	NC 44489 06224	23/09/20 at 11:50	Sun-shine with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged. This photo was pitched by 3° to ensure visibility of turbines.
VP12	NC 40664 12269	12/09/20 at 14:33	Sun-shine with clear views and high-level cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP13	NC 58527 29902	22/04/21 at 07:44	Bright sun-shine with high-level haze and some cloud inversion.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP14	NC 52823 15428	20/08/20 at 12:08	Sun-shine with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP15	NC 65267 85756	21/04/21 at 10:44	Clear and bright.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP16	NC 47391 00319	12/09/20 at 13:15	Sun-shine with broken cloud	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP17	NC 58238 01712	23/09/20 at 10:46	Sun-shine with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP18	NH 48364 83325	24/09/20 at 13:07	Cloudy but with clear visibility.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP19	NH 28181 87872	27/09/20 at 14:09	Sun-shine with distant high-level haze.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP20	NC 16208 11909	14/08/20 at 17:01	Sun-shine with broken cloud.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.
VP21	NC 33603 16417	24/04/21 at 17:33	Clear and bright.	Minor enhancement to brightness and contrast and existing wind turbines visible, removed and re-montaged.

1.4 Wireline Preparation

1.4.1 Wirelines of the Proposed Development turbines and cumulative development turbines as required, were created for all viewpoints using ReSoft WindFarm software (ReSoft) using the specified turbine model (see paragraph 1.1.5) and Terrain 5 DTM (see section 1.1.10). Where appropriate, wirelines were converted to planar projection using Hugin. The turbines in the wirelines are shown to face the viewer with the turbine tip pointing directly vertical.

1.4.2 To help understand the relationship of the Proposed Development to the existing nearby cluster of Achany and Rosehall Wind Farms, turbines for these developments are shown on all 53.5° NatureScot, 2017 Guidance and 65.5° THC, 2016 Guidance compliant wirelines of the Proposed Development where visible, in a dark grey colour.

1.4.3 The DTM shown in the wirelines is drawn as a mesh seen in perspective. In some instances, this can result in more distant parts of the view merging into a solid colour as the grid lines get closer together. To counteract this, an adaptive grid is used. The adaptive grid doubles the grid spacing every 2km from the viewpoint. This ensures a simple, readable image is maintained. However, because of the limitations of the project size in Resoft, the terrain model cannot extend to infinity and is restricted to around 40km from the viewpoint. For this reason, the full backdrop and horizon line visible in photographs is not always represented in the wireline view. Wirelines should therefore always be viewed in combination with baseline photographs and photomontages.

1.4.4 Similar to the limitations of the ZTV, these visualisations provide an indication of the Proposed Development's potential appearance but do not take account of screening elements such as buildings, trees or minor variations in topography.

1.5 Photomontage Preparation & Rendering

1.5.1 Photomontage visualisations were created using the wirelines and baseline panoramic photograph images described above. Turbines were rendered in Resoft and exported to Photoshop, using the wireline to position these accurately into the photograph. Tracks and other structures including the on-site substation and LiDAR positions were added where these would be visible using 3d georeferenced models and 43d Topos R2 which accurately places these features in the view. Final touch-up rendering to create a realistic image was applied in photoshop.

1.5.2 As with the wirelines, the turbines in the photomontages are shown to face the viewer directly. However, the turbine blades, are shown at random rotations to provide a greater sense of realism. However, where this would result in a blade not being visible due to foreground screening, the rotation of the affected turbine has been adjusted accordingly to ensure visibility.

Monochrome images

1.5.3 Monochrome images have been produced to comply with the THC, 2016 Guidance for all VPs where other existing or proposed wind farms are visible within the 75mm single frame image. Monochome images have been created by converting the single frame colour image in Photoshop before adding the rendered turbines from ReSoft Windfarm as described above.

1.6 Viewing Instructions

1.6.1 The graphic material used in this assessment is for illustrative purposes only and should not be considered completely representative of what the human eye will see. While visualisations can give a reasonable impression of the scale and distance to the Proposed Development, they cannot show exactly what they will look like in reality. This is due to various factors, including the resolution of the image; and the static nature of visualisations which cannot convey movement of the turbine blades and changing light/shadows, weather and seasonality etc. As such, visualisations are best viewed at the viewpoint location to appreciate the wider context.

1.6.2 All visualisations, whether prepared in accordance with NatureScot or THC guidance should be printed at the specified size and viewed flat at a comfortable arm's length. The graphic below has been extracted from the THC, 2016 Guidance to illustrate how single frame images prepared in accordance with the THC guidance should be viewed.

The image should be viewed at a comfortable arm's length (approximately 500mm) and viewed normally with both eyes. The page should obscure any foreground not visible within the photomontage itself. This enables the photomontage to be directly compared within the wider context of the real landscape.

Plate 1.6.1: Viewing Instructions for Single Frame Visualisations, Extracted from the THC, 2016 Guidance

1.6.3 If visualisations are viewed on a computer screen, rather than printed at the specified size, they should be enlarged to the full screen height to give a realistic impression. Use of devices with smaller screens, such as tablets, should be avoided for viewing visualisations.

1.6.4 It should be noted that, that the THC, 2016 Guidance 75mm focal length photomontage and the NatureScot, 2017 Guidance 53.5° field of view images, when printed at the correct size, illustrate an image greater than actual size if held at a comfortable arms length. This is intended to counteract the effects of a loss of relative perspective when viewing a flat image. It is important to note that these visualisations are provided for illustrative purposes to support the LVIA and are presented in a format to conform with

the NatureScot, 2017 and THC, 2016 Guidance. Whilst they provide a helpful tool for assessment purposes, the judgements of landscape and visual effects reported in the LVIA are not reached wholly on the basis of these images, but through the landscape architect's professional experience and understanding of how the Proposed Development would appear in the field.