Appendix 4.1: LVIA and Visualisation Methodology

EDF Energy Renewables Ltd

Dunside Wind Farm EIA Report

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Chapter 1
LVIA Methodology

Introduction

4.1.1 Chapter 1 of this appendix sets out the detailed methodology used for the Landscape and Visual Impact Assessment (LVIA) including the cumulative assessment contained in **Chapter 4: Landscape and Visual Impact Assessment**, Volume 2 of the Environmental Impact Assessment (EIA) Report. The methodology for the Residential Visual Amenity Assessment (RVAA) is set out in **Appendix 4.2**: **Residential Visual Amenity Assessment.**

4.1.2 The methodology for the production of accompanying visualisations was based on current good practice guidance produced by NatureScot[1] (previously Scottish Natural Heritage). Detailed information about the approach to viewpoint photography, Zone of Theoretical Visibility (ZTV) and visualisation production is provided in **Chapter 2** of this Appendix.

4.1.3 Landscape and visual assessments are separate, although linked, processes. LVIA therefore considers the likely effects of the Proposed Development on:

- Landscape as a resource in its own right (caused by changes to the constituent elements of the landscape, its specific aesthetic or perceptual qualities and the character of the landscape); and
- Views and visual amenity as experienced by people (caused by changes in the appearance of the landscape).

4.1.4 LVIA deals with landscape and visual effects separately, followed by an assessment of cumulative landscape and visual effects where relevant.

Guidance

4.1.5 This methodology was developed by Chartered Landscape Architects (Chartered Members of the Landscape Institute (CMLI)) at LUC, who have extensive experience in the assessment of landscape and visual effects arising from wind energy developments.

4.1.6 The methodology was developed primarily in accordance with the principles contained within the Guidelines for Landscape and Visual Impact Assessment, 3rd Edition Guidelines for Landscape and Visual Impact Assessment (GLVIA3)[2]. NatureScot cumulative guidance[3] also informs the approach to the assessment of cumulative landscape and visual effects in relation to onshore wind energy development.

Scope of Assessment

4.1.7 LVIA considers direct physical changes to the landscape as well as direct and indirect changes in landscape character. It also considers changes to areas designated for their scenic or landscape qualities, and the visual impacts of the Proposed Development as perceived by people.

4.1.8 All potentially significant landscape and visual effects (including cumulative effects) are examined, including those relating to construction and operation.

4.1.9 Where it is judged that significant effects are unlikely to occur, the assessment of likely effects on some receptors may be *'scoped out'*. For an EIA development this is usually agreed at Scoping stage.

[1] Scottish Natural Heritage (2017). Visual Representation of Wind Farms Guidance, Version 2.2.
[2] The Landscape Institute and Institute of Environmental Management and Assessment (2013). Guidelines for Landscape and Visual Impact Assessment, 3rd Edition. Routledge.
[3] NatureScot (2021). Guidance - Assessing the cumulative landscape and visual impact of onshore wind energy developments.

4.1.10 An assessment of the effects during the decommissioning phase is not undertaken in the EIA Report as the baseline against which to assess the likely significant effects arising from decommissioning is not yet known.

Assessment Methodology

Study Area

4.1.11 The study area for a LVIA is determined by the nature and scale of the Proposed Development and the nature of the study area. Complex topography or extensive tree cover leading to visually enclosed areas may limit the extent of likely significant effects. The study area for the assessment was defined as 45 kilometres (km) from the outermost turbines that form part of the Proposed Development, in all directions. This is recommended in current guidance for turbines above 150 metres (m) to blade tip[1], and was agreed with the following statutory consultees: NatureScot and East Lothian Council (ELC)[4].

Methodological Overview

4.1.12 The key steps in the methodology for assessing landscape and visual effects are as follows:

- The landscape of the study area is analysed, and landscape receptors identified, informed by desk and field-survey;
- The area over which the Proposed Development will potentially be visible is established through the creation of an initial ZTV plan[5];
- The visual baseline is recorded in terms of the different receptors (groups of people) who may experience views of the Proposed Development (informed by the initial ZTV) and the nature of their existing views and visual amenity;
- Potential assessment viewpoints are selected, as advocated by GLVIA3 to represent a range of different receptors and views, in consultation with statutory consultees;
  - *"**Representative viewpoints**, selected to represent the experience of different types of visual receptor, where larger numbers of viewpoints cannot all be included individually and where the significant effects are unlikely to differ – for example, certain points may be chosen to represent the views of users of particular public footpaths and bridleways;*
  - ***Specific viewpoints**, chosen because they are key and sometimes promoted viewpoints within the landscape, including for example specific local visitor attractions, viewpoints in areas of particularly noteworthy visual and/or recreational amenity such as landscapes with statutory landscape designations, or viewpoints with particular cultural landscape associations; and*
  - ***Illustrative viewpoints**, chosen specifically to demonstrate a particular effect or specific issues, which might, for example, be the restricted visibility at certain locations"* (GLVIA3, Para 6.19, Page 109).
- Likely significant effects on both the landscape as a resource and visual receptors are identified; and
- The level (and significance) of landscape and visual effects are judged with reference to the **nature of the receptor** (commonly referred to as the sensitivity of the receptor), which considers both susceptibility and value, and the **nature of the effect** (commonly referred to as the magnitude of effect), which considers a combination of judgements including size/scale, geographical extent, duration and reversibility.

Direction of Effects

4.1.13 As required by the EIA Regulations[6] and GLVIA3, the assessment must identify the direction of effect as either being beneficial, adverse (also referred to as positive or negative) or neutral.

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[4] No response received from Scottish Borders Council as of 26 May 2023
[5] A bare ground ZTV indicates areas from where a development is theoretically visible, but does not account for screening from vegetation and/or buildings.
[6] Scottish Government (2017). The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.

4.1.14 The direction of landscape and visual effects is determined in relation to the degree to which the proposal fits with the existing landscape character or views, and the contribution to the landscape or views that the Proposed Development makes, even if it is in contrast to the existing character of the landscape or views.

4.1.15 With regard to wind energy development, whilst there is a broad spectrum of response from the strongly positive to the strongly negative, an assessment is required to take an objective approach. Therefore, to cover the 'worst case' situation, likely landscape and visual effects, including cumulative effects, relating to commercial scale wind farms are generally assumed to be adverse (negative).

Method for Assessing Landscape Effects

4.1.16 As outlined in GLVIA3: *"An assessment of landscape effects deals with the effects of change and development on landscape as a resource"* (GLVIA3, Para 5.1, Page 70). Changes may affect the elements that make up the landscape, the aesthetic and perceptual aspects of the landscape and its distinctive character.

4.1.17 An assessment of landscape effects requires consideration of the nature of landscape receptors (sensitivity of receptor) and the nature of the effect on those receptors (magnitude of effect). GLVIA3 states that the nature of landscape receptors, commonly referred to as their sensitivity, should be assessed in terms of the susceptibility of the receptor to the type of change proposed, and the value attached to the receptor. The nature of the effect on each landscape receptor, commonly referred to as its magnitude, should be assessed in terms of scale of effect, geographical extent, duration and reversibility.

4.1.18 The judgements of sensitivity and magnitude are then combined to reach an overall determination of the level of effect, and its significance (GLVIA3, Figure 5.1 Page 71). The following sections set out the methodology used to evaluate sensitivity and magnitude.

Significance of Landscape Effects

4.1.19 As outlined in GLVIA3: *"An assessment of landscape effects deals with the effects of change and development on landscape as a resource."* (GLVIA3, Para 5.1, Page 70). The introduction of a development could affect the elements which make up the landscape, the aesthetic or perceptual aspects of the landscape or its distinctive character.

4.1.20 Landscape receptors are the constituent elements of the landscape, its specific aesthetic or perceptual qualities and the character of the landscape in different areas (GLVIA3, Para. 3.21, Page 36).

Sensitivity of Landscape Receptors

4.1.21 The sensitivity of a landscape receptor to change is defined as **high**, **medium** or **low** and is based on weighing up professional judgements regarding susceptibility and value, as set out below.

Table A4.1.1: Sensitivity of Landscape Receptors

	Higher		Lower
Susceptibility	Attributes that make up the character of the landscape offer very limited opportunities for the accommodation of change without key characteristics being fundamentally altered by wind energy development, leading to a different landscape character.	↔	Attributes that make up the character of the landscape are resilient to being changed by wind energy development.
Value	Landscape with high scenic quality, high conservation interest, recreational value, important cultural associations or a high degree of rarity. Areas or features designated at a national level e.g. National Parks or National	↔	Landscape of poor condition and intactness, limited aesthetic qualities, or of character that is widespread. Areas or features that are not formally designated.

	Higher		Lower
	Scenic Areas or key features of these with national policy level protection.		

Susceptibility of Landscape Receptors

4.1.22 Susceptibility is defined by GLVIA3 as "*the ability of the landscape receptor (whether it be the overall character or quality/condition of a particular type or area, or an individual element and/or feature, or a particular aesthetic and perceptual aspect) to accommodate the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of landscape planning policies and strategies*" (GLVIA3 paragraph 5.40).

4.1.23 A series of criteria are used to evaluate the susceptibility of Landscape Character Types (LCTs) or Landscape Character Areas (LCAs) to wind energy development as set out in the table below. These are drawn from a range of published sources relating to wind farm development, including NatureScot's Siting and Designing Windfarms in the Landscape[7] and GLVIA3.

Table A4.1.1: Susceptibility of Landscape Receptors

	Aspects indicating reduced susceptibility to wind energy development		Aspects indicating greater susceptibility to wind energy development
Landscape scale	Large scale	↔	Small scale
Landscape value	Absence of strong topographical variety; featureless, convex or flat	↔	Presence of strong topographical variety or distinctive landform features
Landscape pattern and complexity	Simple, regular or uniform	↔	Complex, rugged and irregular
Settlement and man-made influence	Presence of extensive settlement and/or contemporary structures e.g. utility, infrastructure or industrial elements	↔	Absence of modern development; presence of small scale, historic or vernacular settlement
Skylines	Non-prominent/ screened skylines; presence of existing modern man-made features	↔	Distinctive, undeveloped skylines; skylines that are highly visible over large areas; skylines with important historic landmarks
Inter-visibility with adjacent landscape	Little inter-visibility with adjacent sensitive landscape or viewpoints	↔	Strong inter-visibility with sensitive landscape; forms an important part of view from sensitive viewpoints
Perceptual aspects	Close to visible or audible signs of human activity and development; weak sense of place or local distinctiveness	↔	Remote from visible or audible signs of human activity and development; strong sense of place or local distinctiveness

4.1.24 Published landscape capacity or sensitivity studies (where they exist) are reviewed to inform the evaluation of susceptibility, in addition to fieldwork undertaken across the study area. This review includes an evaluation as to the relevance of the publication to the assessment being undertaken (e.g. consideration of the purpose and scope of the published studies and whether they have become out of date).

[7] Scottish Natural Heritage (2017). Siting and Designing Windfarms in the Landscape, Version 3a.

4.1.25 Landscape susceptibility is described as being **high**, **medium** or **low**.

Value of Landscape Receptors

4.1.26 The European Landscape Convention advocates that all landscape is of value, whether it is the subject of defined landscape designation or not: *"The landscape is important as a component of the environment and of people's surroundings in both town and country and whether it is ordinary landscape or outstanding landscape"* (Explanatory Report to the European Landscape Convention, Page 6). The value of a landscape receptor is recognised as being a key contributing factor to the sensitivity of landscape receptors.

4.1.27 The value of landscape receptors is determined with reference to:

- Review of relevant designations and the level of policy importance that they signify (such as landscape designated at international, national or local level); and/or
- Application of criteria that indicate value (such as scenic quality, rarity, recreational value, representativeness, conservation interests, perceptual aspects and artistic associations) as described in GLVIA3, paragraphs 5.44 - 5.47.

4.1.28 Internationally and nationally designated landscapes would generally indicate landscape of higher value whereas those without formal designation (such as a widespread or common landscape type without high scenic quality) are likely to be of lower value, bearing in mind that all landscape is valued at some level. There is however variation across both designated and undesignated areas, and so judgements regarding value are also informed by fieldwork.

4.1.29 Landscape value is described as being **high**, **medium** or **low**.

Combining Landscape Susceptibility and Value Judgements

4.1.30 There may be a complex relationship between the value attached to a landscape and the susceptibility of the landscape to a specific change. Therefore, the rationale for judgements on the sensitivity of landscape receptors needs to be clearly set out for each receptor. It should be noted that whilst landscape designations at an international or national level are likely to be accorded the highest value, it does not necessarily follow that such areas all have a high susceptibility to all types of change. Conversely, landscape which is undesignated may also have high value and susceptibility to change (GLVIA3, Page 90).

Magnitude of Landscape Effect

4.1.31 The overall judgement of magnitude of landscape effect is based on combining professional judgements on scale, geographical extent, duration and reversibility. Further information on the criteria is provided below.

Scale of Effect

4.1.32 For landscape elements/features this depends on the extent of existing landscape elements that would be lost or changed, the proportion of the total extent that this represents, and the contribution of that element to the character of the landscape.

4.1.33 In terms of landscape character, this reflects the degree to which the character of the landscape would change as a result of removal or addition of landscape components, and how the changes would affect key characteristics.

4.1.34 The scale of the effect is described as being **large**, **medium**, **small**, or **barely perceptible**.

Geographical Extent of Effect

4.1.35 The geographical extent over which the landscape effect would arise is described as being **large** (scale of the LCT, or widespread, affecting several landscape types or character areas), **medium** (more immediate surroundings) or **small** (site level). Geographical extent is always referenced to actual areas over which an effect would occur.

Duration of Effect

4.1.36 GLVIA3 states that *"Duration can usually be simply judged on a scale such as short term, medium term or long term"* (GLVIA3, Page 91). Frequency, and whether an effect is intermittent or continuous is also a consideration. For the purposes of this assessment, duration is determined in relation to the phases of the Proposed Development, as follows:

- **Short-term** effects are those that occur during construction, and may extend into the early part of the operational phase, e.g. construction activities, generally lasting 0 - 5 years;
- **Medium-term** effects are those that occur during part of the operational phase, generally lasting 5 - 10 years; and
- **Long-term** effects are those which occur throughout the operational phase (in this instance 35 years), e.g. presence of turbines, or are permanent effects which continue after the operational phase, generally lasting over 10 years.

Reversibility of Effect

4.1.37 In accordance with the principles contained within GLVIA3, reversibility is reported as **reversible**, **partially reversible** or **irreversible** (i.e. permanent), and is related to whether the change can be reversed at the end of the phase of development under consideration (i.e. at the end of construction or at the end of the operational lifespan of the development).

Combining Magnitude of Change Judgements

4.1.38 Judgements on the magnitude of landscape effect (nature of landscape effect) are recorded as **high**, **medium** or **low** and are guided by the table below.

Table A4.1.1: Magnitude of Landscape Effect

	Higher		Lower
Scale	Extensive loss of landscape features and/or elements, and/or change in, or loss of key landscape characteristics, and/or creation of new key landscape characteristics	←→	Limited loss of landscape features and/or elements, and/or change in or loss of some secondary landscape characteristics
Geographical Extent	Change in landscape features and/or character extending considerably beyond the immediate site and potentially affecting multiple LCTs/areas	←→	Change in landscape features and/or character extending contained within or local to the immediate site and affecting only a small part of the LCT/area
Duration	Changes experienced for a period of around 10 years or more Continuous or frequent	←→	Changes experienced for a shorter period of up to 5 years Intermittent or occasional
Reversibility	Change to features, elements or character which cannot be undone or are only partly reversible after a long period	←→	A temporary landscape change which is largely reversible following the completion of construction, or decommissioning of the development

Judging Levels of Landscape Effect and Significance

4.1.39 The final step in the assessment process requires the judgements of sensitivity and magnitude of effect to be combined to make an informed professional assessment on the significance of each landscape effect (GLVIA3, Figure 5.1, Page 71).

4.1.40 A numerical or formal weighting system is not applied, therefore enabling consideration of the relative importance of each aspect to feed into the overall decision. Levels of effect are identified as **Negligible**, **Minor**, **Moderate** or **Major** where **Moderate** and **Major** effects are considered **significant** in the context of the EIA Regulations.

4.1.41 This determination requires the application of professional judgement and experience to take on board the many different variables which need to be considered, and which are given different weight according to site-specific and location-specific considerations in every instance. Judgements are made on a case-by-case basis, guided by the principles set out in **Diagram 1** below. A rigid matrix-type approach, which does not allow for the application of professional judgement and experience, and where the level of effect is defined simply based on the level of sensitivity (nature of receptor) combined with the magnitude of change (nature of effect), is not used.

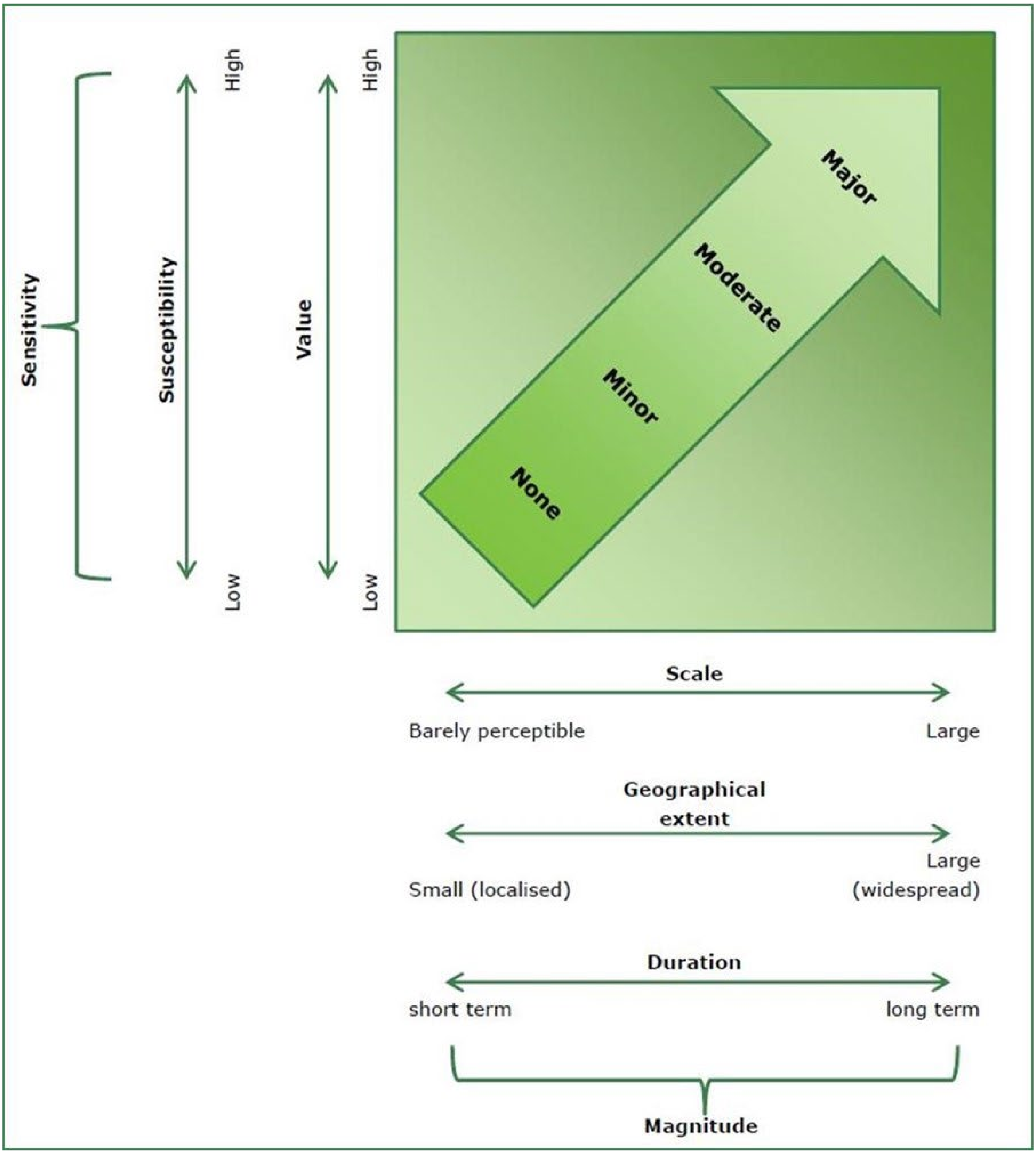

Diagram 1: Judging levels of effect – Landscape or Visual (including cumulative)

Method for Assessing Visual Effects

Significance of Visual Effects

4.1.42 As outlined in GLVIA3: "*An assessment of visual effects deals with the effects of change and development on views available to people and their visual amenity*" (GLVIA3, Para 6.1, Page 98). Changes in views may be experienced by people at different locations within the study area including from static locations (normally assessed using representative viewpoints) and whilst moving through the landscape (normally referred to as sequential views, e.g. from roads and walking routes).

4.1.43 Visual receptors are individuals or groups of people who may be affected by changes in views and visual amenity. They are usually grouped by their occupation or activity (e.g. residents, motorists, recreational users) and the extent to which their attention is focused on the view (GLVIA3, Paras. 6.31 – 6.32, Page 113).

4.1.44 GLVIA3 states that the sensitivity of visual receptors should be assessed in terms of the susceptibility of the receptor to change in views and/or visual amenity and the value attached to particular views. The magnitude of effect should be assessed in terms of the scale, geographical extent, duration and reversibility of the effect.

4.1.45 The judgements of sensitivity and magnitude are then combined to reach an overall determination of the level of effect, and its significance (GLVIA3, Figure 6.1 Page 99). The following sections set out the methodology used to evaluate sensitivity and magnitude.

Sensitivity of Visual Receptor

4.1.46 The sensitivity of a visual receptor to change is defined as **high**, **medium** or **low** and is based on weighing up professional judgements regarding susceptibility and value, and each of their component considerations, as set out below.

Table A4.1.4: Sensitivity of Visual Receptors

Higher		Lower
Viewers whose attention or interest is focused on their surroundings, including communities/ individual residential receptors/ people engaged in outdoor recreation/ visitors to heritage assets or other attractions where views of surrounding area an important contributor.	↔	People whose attention is not on their surroundings (and where setting is not important to the quality of working life) such as commuters/ people engaged in outdoor sports/ people at their place of work.
Views may be recorded in management plans, guide books, and/or which are likely to be experienced by large numbers of people.	↔	Views which are not documented or protected.

Susceptibility of Visual Receptor

4.1.47 The susceptibility of visual receptors to changes in views/visual amenity is a function of the occupation or activity of people experiencing the view and the extent to which their attention is focused on views (GLVIA 3, para 6.32). This is recorded as **high**, **medium** or **low** informed by the table below.

Table A4.1.5: Susceptibility of Visual Receptors

Susceptibility	Receptor Group
High	Viewers whose attention or interest is focussed on their surroundings, including: ▪ Communities where views contribute to the landscape setting enjoyed by residents; ▪ People engaged in outdoor recreation (for example users of rights of way whose interest is likely to be focused on the landscape); ▪ Visitors to heritage assets or other attractions where views of surrounding are an important contributor to experience; and ▪ People travelling on scenic routes and tourist routes, where attention is focused on the surrounding landscape.
Medium	People travelling on local road routes, where attention may be focused on the surrounding landscape, but is transitory; people at their place of work whose attention is focused on the surroundings and where setting is important to the quality of working life.

Susceptibility	Receptor Group
Low	People travelling more rapidly on major road, rail or transport routes (not recognised as scenic routes); people engaged in outdoor sport or recreation which does not involve or depend upon appreciation of views of the landscape; people at their place of work whose attention is not on their surroundings (and where setting is not important to the quality of working life).

Value of View or Visual Amenity

4.1.48 GLVIA3 also requires evaluation of the value attached to the view or visual amenity and relates this to planning designations and cultural associations (GLVIA3, Para. 6.37, Page 114).

4.1.49 Recognition of the value of a view is determined with reference to:

- Planning designations specific to views;
- Whether it is recorded as important in relation to designated landscapes (such as views specifically mentioned in the special qualities of a National Scenic Area);
- Whether it is recorded as important in relation to heritage assets (such as designed views recorded in citations of Gardens and Designed Landscapes (GDL) or views recorded as of importance in Conservation Area Appraisals); and
- The value attached to views by visitors, for example through appearances in guidebooks or on tourist maps, provision of facilities for their enjoyment and references to them in literature and art.

4.1.50 A designated viewpoint or scenic route advertised on maps and in tourist information, or which is a significant destination in its own right, such as a notable summit, is likely to indicate a view of higher value. High value views may also be recognised in relation to the special qualities of a designated landscape or heritage asset, or it may be a view familiar from photographs or paintings.

4.1.51 Views experienced from viewpoints or routes not recognised formally or advertised in tourist information, or which are not provided with interpretation or, in some cases, formal access are likely to be of lower value.

4.1.52 Judgements on the value of views or visual amenity are recorded as **high**, **medium** or **low**.

Combining Landscape Susceptibility and Value Judgements

4.1.53 An overall judgement of visual sensitivity is derived by combining the separate judgements on visual susceptibility and the value of views experienced from the visual receptor. The sensitivity of visual receptors may involve a complex relationship between a visual receptor's (e.g. person's) susceptibility to change and the value attached to a view. Therefore, the rationale for judgements of sensitivity is clearly set out for each receptor in relation to both its susceptibility (to the type of change proposed) and its value.

Magnitude of Visual Effect

4.1.54 The overall judgement of magnitude of visual effect (nature of visual effect) is based on weighing up professional judgements on scale, geographical extent, duration and reversibility. Further information on the criteria is provided below.

Scale

4.1.55 The scale of a visual change depends on:

- The scale of the change in the view with respect to the loss or addition of features in the view and changes in its composition, including the proportion of the view occupied by the Proposed Development;
- The degree of contrast or integration of any new features or changes in the landscape with the existing or remaining landscape elements and characteristics in terms of form, scale and mass, line, height, colour and texture; and
- The nature of the view of the Proposed Development, in terms of the relative amount of time over which it will be experienced and whether views will be full, partial or glimpses.

4.1.56 All changes are assumed to be during winter, representing a 'worst case' scenario with minimal screening by vegetation and deciduous trees. Note that wireframes and ZTVs prepared to illustrate potential visual effects are calculated on the basis of bare ground and therefore demonstrate the maximum extent of visibility possible, in the absence of buildings or vegetation. Where forestry is present, consideration is given to felling regimes if levels of screening by forestry are likely to change notably during the lifetime of the Proposed Development.

4.1.57 In this assessment scale of visual change is described as being **large**, **medium**, **small** or **barely perceptible**.

Geographical Extent

4.1.58 The geographical extent of a visual change records the extent of the area over which the changes will be visible e.g. whether this is a unique viewpoint from where the proposed wind farm can be glimpsed, or whether it represents a large area from which similar views are gained. Geographical extent is described as being **large**, **medium** or **small**, with reference to the actual areas where views are likely to be affected.

Duration of Effect

4.1.59 The duration of visual effects is reported as **short-term**, **medium-term** or **long-term**, as defined for the duration of landscape effects (see paragraph 1.36). Frequency, and whether an effect is intermittent or continuous is also a consideration.

Reversibility

4.1.60 Reversibility is reported as **irreversible** (i.e. permanent), **partially reversible** or **reversible**, and is related to whether the visual change can be reversed at the end of the phase of development under consideration (i.e. at the end of construction or at the end of the operational lifespan of the development). Operational visual effects are generally considered to be partially reversible as the decommissioning phase will remove turbines and most infrastructure at the end of the operational phase.

Combining Magnitude of Visual Change Judgements

4.1.61 Judgements on the magnitude of visual effect are recorded as **high**, **medium** or **low** guided by the table below.

Table A4.1.6: Magnitude of Visual Effects

	Higher		Lower
Scale	A large visual change resulting from the Proposed Development is the most notable aspect of the view, perhaps as a result of the development being in close proximity, or because a substantial part of the view is affected, or because the development introduces a new focal point and/or provides contrast with the existing view and/or changes the scenic qualities of the view.	↔	A small or some visual change resulting from the Proposed Development as a minor or generally unnoticed aspect of the view, perhaps as a result of the development being in the distance, or because only a small part of the view is affected, and/or because the Proposed Development does not introduce a new focal point or is in contrast with the existing view and/ does not change the scenic qualities of the view.
Geographical Extent	The assessment location is clearly representative of similar visual effects over an extensive geographic area.	↔	The assessment location clearly represents a small geographic area.
Duration	Visual change experienced over around 10 years or more. Continuous or frequent	↔	Visual change experienced over a short period of up to 5 years. Intermittent or infrequent
Reversibility	A permanent visual change which is not reversible or only partially reversible	↔	A temporary visual change which is largely reversible following the

	Higher		Lower
	following decommissioning of the Proposed Development.		completion of construction, or decommissioning, of the Proposed Development.

Direction of Visual Effects

4.1.62 The direction of visual effects (**beneficial**, **adverse** or **neutral**) is determined in relation to the degree to which the Proposed Development fits with the existing view and the contribution to the view that the Proposed Development makes, even if it is in contrast to the existing character of the view.

4.1.63 With regard to wind energy development there is a broad spectrum of response from the strongly positive to the strongly negative. However, to cover the 'worst case' situation, potential visual effects relating to commercial scale wind energy developments are generally assumed to be adverse.

Judging the Level of Visual Effect and Significance

4.1.64 As for landscape effects, the final step in the assessment requires the judgements of sensitivity of visual receptor and magnitude of visual effect to be combined to make an informed professional assessment on the significance of each visual effect.

4.1.65 A numerical or formal weighting system is not applied, therefore enabling consideration of the relative importance of each aspect to feed into the overall decision. Levels of effect are identified as **Negligible**, **Minor**, **Moderate** or **Major** where **Moderate** and **Major** effects are considered **significant** in the context of the EIA Regulations.

4.1.66 This determination requires the application of professional judgement and experience to take on board the many different variables which need to be considered, and which are given different weight according to site-specific and location-specific considerations in every instance. Judgements are made on a case-by-case basis, guided by the principles set out in **Diagram 1** above. A rigid matrix-type approach, which does not allow for the application of professional judgement and experience, and where the level of effect is defined simply based on the level of sensitivity (nature of receptor) combined with the magnitude of change (nature of effect), is not used.

Assessment of Cumulative Effects

4.1.67 The purpose of cumulative assessment is to *"describe, visually represent and assess the ways in which a proposed wind farm would have additional impacts when considered with other consented or proposed wind farms"*[8].

4.1.68 The cumulative assessment therefore focuses on the additional cumulative change which may result from the introduction of the Proposed Development (i.e. in addition to other development which may or may not be present).

4.1.69 Cumulative assessment for wind farm proposals focuses on potential interactions with other existing and proposed wind farms. It may also consider the potential interactions between different types of development (e.g. transmission infrastructure, other energy generation stations or other built development) if these are likely to result in significant cumulative landscape and visual impacts.

4.1.70 GLVIA3 also makes reference to 'combined cumulative effects', i.e. an assessment which considers the effects if all current, past and future proposals are deemed present, including the Proposed Development. GLVIA3 (paragraph 7.13) acknowledges that "*assessing combined effects involving a range of different proposals at different stages in the planning process can be very complex*". Therefore, this type of cumulative effect is only described where it is considered likely to be a relevant consideration in the determination of the Proposed Development.

Baseline Scenarios

4.1.71 The baseline for the LVIA is the current landscape at the time of writing the assessment. This is referred to as the 'primary assessment'. In the case of the present LVIA, the Proposed Development is being introduced into an area where wind

[8] NatureScot (2021). Guidance - Assessing the cumulative landscape and visual impact of onshore wind energy developments.

farms and wind turbines are already a feature of the baseline. Wind farms that are under construction are also considered within the primary assessment. As such, many effects considered within the primary assessment are cumulative effects, or include a cumulative component. Where this is the case, the cumulative elements are described within the assessment.

4.1.72 In order to consider potential future cumulative effects, it is also necessary to assess the effects of the addition of the Proposed Development into a speculative future landscape baseline. This includes wind farm proposals that are consented but not yet built, and/or undetermined planning applications. Two future baseline scenarios are defined, based on the level of certainty associated with the proposals. These scenarios are defined below.

- Scenario 1 includes, in addition to the primary assessment, wind farms that are more likely to be built as they have received planning consent.
- Scenario 2 includes, in addition to the primary assessment and scenario 1, wind farms that are less likely to be built as they are undetermined planning applications.

4.1.73 Wind farms at Scoping stage have less certainty attached, and limited information may be available about these proposals. They are not generally included in scenario 2 unless there is a high likelihood of significant cumulative effects, or at the specific request of statutory consultees.

4.1.74 A cut-off date of 21 February 2023 was applied for the inclusion of developments within the cumulative assessment.

Types of Cumulative Effects

4.1.75 The NatureScot cumulative guidance states that *"Cumulative landscape impacts can change either the physical fabric or character of the landscape, or any special values attached to it. For example:*

- *Cumulative impacts on the physical fabric of the landscape arise when two or more developments affect landscape components such as woodland, dykes, rural roads or hedgerows. Although this may not significantly affect the landscape character, the cumulative effect on these components may be significant – for example, where the last remnants of former shelterbelts are completely removed by two or more developments.*
- *Cumulative impacts on landscape character arise when two or more developments introduce new features into the landscape. In this way, they can change the landscape character to such an extent that they create a different landscape character type*."

4.1.76 Three types of cumulative effects on visual amenity are considered in the assessment: combined, successive and sequential:

- Combined effects occur where a static viewer is able to view two or more wind farms from a viewpoint within the viewers' same arc of vision (assumed to be about 90 degrees for the purpose of the assessment);
- Successive effects occur where a static viewer is able to view two or more wind farms from a viewpoint, but needs to turn to see them; and
- Sequential effects occur when a viewer is moving through the landscape from one area to another, for instance when a person is travelling along a road or footpath, and is able to see two or more wind farms at the same, or at different times as they pass along the route. Frequently sequential effects occur where wind farms appear regularly, with short time lapses between points of visibility. Occasionally sequential effects occur where long periods of time lapse between views of wind farms, depending on speed of travel and distance between viewpoints.

Assessment of Cumulative Effects

4.1.77 For each of the three baseline scenarios (primary assessment, scenario one, and scenario two) a separate assessment of effects is made. The approach does not assess the 'difference' between scenarios, but treats each as a separate potential situation. It is important to note that in practice only one situation will arise at any one time, so effects as set out should be interpreted as an either/or situation, and should not be double counted.

4.1.78 Cumulative effects are assessed in accordance with the methodology presented in the preceding sections, and guided by the principles set out in **Diagram 1**. Where the potential for cumulative effects needs to be determined, the following additional factors are considered as part of the scale of effect:

- The pattern and arrangement of wind farms in the landscape or view, e.g. developments seen in one direction or part of the view (combined views), or seen in different directions (successive views in which the viewer must turn) or developments seen sequentially along a route;
- The relationship between the scale of the wind farms, including turbine size and number, and if wind farms appear balanced in views in terms of their composition, or at odds with one another;
- The position of the wind farms in the landscape, e.g. in similar landscape or topographical context;
- The position of the wind farms in the view, e.g. on the skyline or against the backdrop of land; or how the Proposed Development will be seen in association with another development (separate, together, behind etc.); and
- The distances between wind farms, and their distances from the viewer.

4.1.79 More significant cumulative landscape effects are likely where:

- The Proposed Development extends or intensifies a landscape effect;
- The Proposed Development 'fills' an area such that it alters the landscape resource; and / or
- The interaction between the Proposed Development and other wind farms means that the total effect on the landscape is greater than the sum of its parts.

4.1.80 GLVIA 3 states *"The most significant cumulative landscape effects are likely to be those that would give rise to changes in the landscape character of the study area of such an extent as to have major effects on its key characteristics and even, in some cases, to transform it into a different landscape type. This may be the case where the project being considered itself tips the balance through its additional effects. The emphasis must always remain on the main project being assessed and how or whether it adds to or combines with the others being considered to create a significant cumulative effect*" (GLVIA 3, Para 7.28).

4.1.81 More significant cumulative visual effects are likely where:

- The Proposed Development extends or intensifies a visual effect;
- The Proposed Development 'fills' an area such that it alters the view/ visual amenity;
- The interaction between the Proposed Development and other developments means that the total visual effect is greater than the sum of its parts; and/or
- The Proposed Development will lengthen the time over which effects are experienced (sequential effects).

Chapter 2
ZTV Mapping and Visualisation Methodology

Introduction

4.2.1 This chapter sets out the approach to the production of the ZTVs and visualisations which accompany the LVIA and cumulative assessment contained in **Chapter 4: Landscape and Visual Impact Assessment**, Volume 2 of the EIA Report. Figures referred to in this appendix are located in Volume 3a of the EIA Report.

4.2.2 The methodology used for the production of visualisations was based on current good practice guidance produced by NatureScot[9] and the Landscape Institute[10]. Further information about the approach is provided below.

Data Sources:

- 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);
  - 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) (5 m grid spacing, 2.5 m root-mean-square error (RMSE));
  - OS Terrain® 50 mid-resolution height data (DTM) (50 m grid spacing, 4 m 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

4.2.3 Evaluation of the theoretical extent to which the Proposed Development would be visible was informed by establishing a ZTV, using specific computer software designed to calculate the theoretical visibility of the proposed turbines within its surroundings. ESRI's ArcMap 10.8.1 software was used to generate the ZTV. The software calculates areas from which the turbine hubs and maximum blade tip height are potentially visible. This is performed on a 'bare ground' computer generated terrain model, which does not take account of potential screening by buildings or vegetation. It should be noted that the software uses raster[11] height data, but while it is displayed as continuous data (with each grid square referred to as a 'cell'), it assumes an average height value for each cell. Therefore, any height variations across cells are not recognised.

4.2.4 The DTM used for the LVIA analysis is OS Terrain® 50 height data, obtained from the OS in 2023. The root-mean-square error (RMSE) of this data is stated as being up to 4 m. The DTM data is represented by 50x50 m grids, which means that the

[9] Scottish Natural Heritage (2017). Visual Representation of Wind Farms, Version 2.2.
[10] Landscape Institute (2019) Technical Guidance Note 06/19 Visual Representation of Development Proposals.
[11] Raster data is a matrix of cells (or pixels) which contain a value representing information.

software calculates the number of turbines visible from the centre point of each 50x50 m grid/square area. This data was used to calculate visibility within the 45 km study area.

4.2.5 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 between the used DTM and the actual topography around the study area were identified. The effect of earth curvature and light refraction was included in the ZTV analysis and a viewer height of 2 m above ground level was used. As it uses a 'bare ground' model, it is considered to over-emphasise the extent of visibility of the Proposed Development and therefore represents a 'maximum potential visibility' scenario. The ZTV is used as a starting point in the assessment to provide an indication of theoretical visibility. This information is verified in the field so that the assessment conclusions represent the actual visibility of the proposals reasonably accurately.

4.2.6 The ZTV was calculated to show the potential number of turbines visible to maximum blade tip height (220 m) and maximum hub height (130 m). The ZTV, calculated to blade tip height, is shown on **Figure 4.1.2 (a and b)** and the hub height ZTV is shown on **Figure 4.1.3 (a and b)**. Subsequent figures which include the ZTV make use of the ZTV which was run to maximum blade tip height.

4.2.7 To construct cumulative ZTVs, which illustrate the 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 guidance (SNH, 2017). It was then combined with the Proposed Development ZTV (20 km radius). The cumulative ZTVs 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.

Aviation Lighting ZTVs

4.2.8 Appendix 4.3: Aviation Lighting Assessment considers the potential landscape and visual effects arising from the introduction of visible aviation lighting. It is supported by a ZTV illustrating the predicted extents of theoretical visibility of lights mounted on the nacelles of specific turbines (**Figure A4.3.1**). The ZTV in **Figure A4.3.1** has been run to a maximum hub height of 139 m to account for a candidate turbine with a taller hub (see **Chapter 4** of the EIA Report for further details). The Civil Aviation Authority (CAA) approved aviation lighting scheme for the Proposed Development is detailed in **Appendix 11.1: Wind Farm Aviation Lighting and Mitigation Report**. It consists of medium intensity nacelle lights (2,000 candela - cd) positioned on seven of the proposed turbines. It was used to inform the preparation of the aviation lighting ZTVs.

4.2.9 To supplement the hub height ZTV shown in **Figure A4.3.1**, directional lighting intensity ZTV figures are presented as **Figure A4.3.2** and **Figure A4.3.3** and illustrate the maximum and minimum predicted luminous intensity (cd) of the nacelle mounted aviation lights relative to viewing angle/elevation, and to a radius of 45 km and 20 km 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 and minimum predicted luminous intensity values are based on the CEL-MI-ACWGAM light[12], which meets the minimum requirements of ICAO/CAP393 medium-intensity nacelle mounted aviation light - including ICAO Minimum 2,000 cd average intensity required between 0˚ (horizontal) and +3˚. The specific maximum and minimum luminous intensity values are detailed in **Table 2.1** below. The ZTV was run seven 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.

[12] https://www.aircraftwarninglights.co.uk/datasheets/CEL-MI-ACWGAM%20-%20datasheet%20rev10.pdf (Accessed XXX).

Table A4.2.1: 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

4.2.10 As there is a difference in the vertical height from highest proposed turbine to the lowest proposed turbine, there is some variability in the predicted luminous intensity of each turbine light. There is overlap between each of the layers which represent the visibility of each of the lit turbines. **Figure A4.3.2** and **Figure A4.3.3** show the layer with the greater intensity on top, so as to represent the maximum case scenario.

Preparation of Visualisations

Daytime Visualisations

Viewpoint Photography

4.2.11 Photography is taken in accordance with guidance from NatureScot[13] and the Landscape Institute[14]. The focal lengths used are in accordance with recommendations contained in guidance and are stated on the figures. Photography was undertaken between July 2022 and April 2023. A Nikon D750 and a D700 full frame sensor digital single lens reflex (SLR) camera, with a fixed 50 mm focal length lens, was used to undertake photography from all viewpoint locations.

4.2.12 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 in order to eliminate parallax errors[15] between the successive images and enable accurate stitching of the images. The camera was rotated through a full 360˚ at each viewpoint.

4.2.13 The location of each viewpoint and information about the conditions was recorded in the field in accordance with NatureScot (SNH, 2017) and LI guidance (LI, 2019).

4.2.14 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. South facing viewpoints can present problems particularly in winter when the sun is low in the sky. Photography opportunities facing into the sun were avoided where possible to prevent the wind turbines appearing as silhouettes. Adjustments to lighting of the turbines were made

[13] Scottish Natural Heritage (2017). Visual Representation of Wind Farms, Version 2.2.
[14] Landscape Institute (2019). Advice Note 01/11 Photography and photomontage in landscape and visual impact assessment.
[15] 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.

in the rendering software to help ensure the turbines appear realistic in the view under the particular lighting and atmospheric conditions present at that time the photography was taken.

Photographic Stitching, Wirelines and Photomontages

4.2.15 Wirelines are computer generated line drawings which show outlines of the proposed turbines and the bare earth topography. Photomontages are computer generated images of the Proposed Development modelled into the actual baseline photography. Wirelines and photomontages are assessment tools and are not a substitute for site visits. They do not convey turbine movement and are representative of views but cannot represent visibility at all locations.

4.2.16 Photographic stitching software PTGui© 12.18 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.

4.2.17 The software package ReSoft© WindFarm version 5.0.1.3 was used to create a DTM from OS Terrain® 5 height data. The DTM includes the Site, viewpoint locations and all landform visible within the baseline photography. Turbine and viewpoint location coordinates were entered. Photomontages were prepared to show the candidate turbine with the specified tip and hub height. A default viewer height of 1.5 m above ground level was set in the ReSoft© software, however 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[16].

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

4.2.19 The 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 located in the model and used as markers to help with the alignment process where necessary. 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.

4.2.20 The exported renders were imported into Adobe Photoshop© where they were aligned and combined with the baseline photography. Turbines or sections of turbines which were located behind foreground elements in the photograph were removed to create the photomontage. Where visible, infrastructure associated with the Proposed Development was modelled into photomontages, for viewpoints within 5 km.

4.2.21 Finally, where applicable, the images were converted from Cylindrical Projection to Planar Projection using PTGui© 12.18 software.

Dusk/Night-time Visualisations

4.2.22 To date, consultants including LUC have generally prepared photomontage visualisations to consistently represent aviation lights illuminated at their minimum required luminous intensity (2,000 cd). In addition, they are also shown when dimmed to 10% of their maximum (i.e. minimum 200 cd) in times of clear meteorological conditions, where visibility exceeds 5 km 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 of 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.

4.2.23 The specific luminous intensity 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.

4.2.24 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 ZTV mapping (as detailed above in relation to **Figure A4.3.1** and **Figure A4.3.2**),

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[16] An altered height above ground level was used for hill summits where local topography did not match the wireframes due to data resolution.

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.

4.2.25 Two visualisations were prepared for each illustrated viewpoint. These show the minimum required luminous intensities at full brightness (2,000cd) and when dimmed to 10% (i.e. 200 cd). Each of the visualisations is referred to in the assessment presented in **Appendix 4.3**.

4.2.26 Dusk/night-time visualisations were prepared from the following viewpoints:

- Viewpoint 3: Minor road near Wanside Rig Junction (**Figures 4.2.3g and h** in Volume 3b of the EIA Report);
- Viewpoint 7: B6456 Westruther (**Figures 4.2.7e and f** in Volume 3b of the EIA Report); and
- Viewpoint 12: Minor Road near Hen Law (**Figures 4.2.12f and g** in Volume 3b of the EIA Report).

4.2.27 Baseline photographs from the three night-time assessment viewpoints were taken between April and May 2023, 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, with subsequent ranges taken as natural light faded and existing manmade light sources became visible.

4.2.28 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.

4.2.29 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 50 mm focal length lens from all viewpoint locations.

4.2.30 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 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.

4.2.31 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.

4.2.32 Photographic stitching software PTGui© 12.18 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.

4.2.33 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 1.5 m 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.

4.2.34 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 OS Terrain® 5 height data.

4.2.35 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.

4.2.36 Simple 'sphere' shaped lights within the Autodesk3DS Max© software were matched to the luminous intensity of the light source. The aviation lights were positioned on each proposed turbine nacelle and set to the minimum required luminous intensity (2,000 cd) and when dimmed to 10% of their maximum (200 cd). 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.

4.2.37 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.

4.2.38 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.

4.2.39 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.

4.2.40 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.

4.2.41 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.

4.2.42 The photomontages do not seek to replicate the additional variable influence which distance (between the light and the viewpoint/observer) or atmospheric attenuation[17] by moisture (cloud/rain/fog) or by dust or other particulates[18] can have on the observed brightness[19] 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.

4.2.43 As required by the EIA Regulations, it is considered that the photomontages prepared and presented in this EIA Report 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 11.1**) and lighting intensity ZTVs (**Figure A4.3.1** and **Figure A4.3.2**), observations made in the field work for this project and experience from other projects.

Presentation of Photomontages

4.2.44 The printed figures for the viewpoints were produced in accordance with NatureScot requirements and are presented in Volume 3b of the EIA Report.

4.2.45 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.

[17] The decreasing brightness of light as it passes through the atmosphere and is scattered or absorbed by processes in the atmosphere.
[18] 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.
[19] 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.

4.2.46 The elongated A3/A1 width format pages for each viewpoint are set out as follows. This follows NatureScot visualisation standards:

- The first A3 page contains an OS 1:50,000 scale map showing the viewpoint location, direction of the 90˚ baseline photography, wireline views and 53.5˚ photomontage view, in addition to a cumulative base map. Wind turbine locations for the Proposed Development are also shown when visible in the map view;
- 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˚; and
- 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.