Appendix 6.1: LVIA and Visualisation Methodology

Car Duibh Wind Farm Limited

An Càrr Dubh Wind Farm

LVIA - Appendix 6.1 LVIA Methodology

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Appendix 6.1

LVIA and Visualisation Methodology

Introduction

A6.1.1 This appendix sets out the detailed methodology used in Chapter 6: Landscape and Visual Amenity. The methodology for the production of accompanying visualisations was based on current good practice guidance as set out by Scottish Natural Heritage (SNH)[1], now renamed as NatureScot.

A6.1.2 Landscape and visual assessments are separate, although linked, processes. LVIA therefore considers the potential effects of a 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).

A6.1.3 LVIA deals with landscape and visual effects separately, followed by an assessment of cumulative landscape and visual effects where relevant.

Guidance

A6.1.4 This methodology has been 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.

A6.1.5 The methodology has been developed primarily in accordance with the principles contained within the Guidelines for Landscape and Visual Impact Assessment, 3rd Edition (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

A6.1.6 An LVIA considers physical changes to the landscape as well as changes in landscape character. It also considers changes to areas designated for their scenic or landscape qualities, and the visual impacts of a proposed development as perceived by people.

A6.1.7 All potentially significant landscape and visual effects (including cumulative effects) were examined, including those relating to construction and operation.

A6.1.8 Where it is judged that significant effects are unlikely to occur, the assessment of potential effects on some receptors may be 'scoped out'. This is usually agreed at scoping stage in the case of development that requires an Environmental Impact Assessment (EIA).

Assessment Methodology

Study Area

A6.1.9 The study area for an LVIA is determined by the nature and scale of the development proposed and the nature of the study area (e.g. complex topography or extensive tree cover leading to visually enclosed areas may limit the extent of likely significant effects).

[1] SNH (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
[3] NatureScot (2021) Guidance: Assessing the Cumulative Impact of Onshore Wind Energy Developments

Methodological Overview

A6.1.10 The key steps in the methodology for assessing landscape and visual effects are as follows:

- the existing (baseline) landscape of the study area is analysed and landscape receptors identified, informed by desk and field survey. The baseline for the primary assessment is taken as including all existing development. Development that is consented but not yet built, as well as potential future development, is considered in the cumulative assessment;
- the area over which the development will potentially be visible is established through the creation of an initial Zone of Theoretical Visibility (ZTV) plan[4];
- the visual baseline is recorded in terms of the different receptors (groups of people) who may experience views of the development (informed by the initial ZTV) and the nature of their existing views and visual amenity. Again, the baseline for the primary assessment is taken as including all existing development, with potential future development being considered in the cumulative assessment;
- 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;*
  - ***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

A6.1.11 As required by the EIA Regulations[5], the assessment must identify the direction of effect as either being beneficial (positive), adverse (negative) or neutral.

A6.1.12 The direction of landscape, visual and cumulative effects (**beneficial, adverse** or **neutral**) 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.

A6.1.13 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 'maximum case effect' situation, potential landscape and visual effects relating to commercial scale wind farm developments are generally assumed to be adverse (negative).

[4] ZTV indicate areas from where a development is theoretically visible, but they cannot show what it would look like, nor indicate the nature or magnitude of landscape or visual impacts
[5] The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations (2017) (as amended)

Method for Assessing Landscape Effects

A6.1.14 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.

A6.1.15 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 size and scale of effect, geographical extent, duration and reversibility.

A6.1.16 These aspects were considered together, to form a judgement regarding the overall significance of landscape effects (GLVIA3, Figure 5.1 Page 71). The following sections set out the methodology used to evaluate sensitivity and magnitude.

Sensitivity of Landscape Receptors

A6.1.17 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.

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	Landscapes 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 Scenic Areas or key features of these with national policy level protection.	⟷	Landscape of poor condition and which is not intact, or has limited aesthetic qualities, or is of a character that is widespread. Areas or features that are not formally designated.

Susceptibility of Landscape Receptors

A6.1.18 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).

A6.1.19 A series of criteria were 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 criteria or aspects are drawn from a range of published sources relating to wind farm development, including Siting and Designing Windfarms in the Landscape (Version 3a, SNH, 2017) and GLVIA3.

Aspects Influencing Susceptibility of Landscape Receptors to Wind Turbines			
Characteristic/ attribute	Aspects indicating reduced susceptibility to wind energy development	⟷	Aspects indicating greater susceptibility to wind energy development
Scale	Large scale	⟷	Small scale
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 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 or exert a large influence on landscape character Skylines with important historic landmarks
Inter-visibility with adjacent landscapes	Little inter-visibility with adjacent sensitive landscapes or viewpoints	⟷	Strong inter-visibility with sensitive landscapes Forms an important part of a view from sensitive viewpoints
Perceptual aspects	Close to visible or audible signs of human activity and development	⟷	Remote from visible or audible signs of human activity and development

A6.1.20 Published landscape capacity or sensitivity studies (where they exist) may be reviewed to inform the evaluation of susceptibility, in addition to fieldwork undertaken across the study area which is required to inform a more detailed understanding. 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 – which are typically more strategic in scale - and whether they have become out of date). Such studies may also include strategic guidance on development within certain areas. Cognisance is taken of this.

A6.1.21 Landscape susceptibility is described as being **high, medium or low.**

Value of Landscape Receptors

A6.1.22 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.'*[6] The value of a landscape receptor is recognised as being a key contributing factor to the sensitivity of landscape receptors.

A6.1.23 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 landscapes 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.

[6] Council of Europe, (2000). The European Landscape Convention – Council of Europe Treaty Series No. 176.

A6.1.24 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 landscapes are valued at some level. There is however variation across both designated and undesignated areas, and so judgements regarding value are also informed by fieldwork.

A6.1.25 Landscape value is described as being **high, medium** or **low.**

Magnitude of Landscape Effect

A6.1.26 The overall judgement of magnitude of landscape effect is based on combining professional judgements on size and scale, geographical extent, duration and reversibility. Further information on the criteria is provided below.

Size and Scale of Effect

A6.1.27 For landscape elements/features this depends on the extent of existing landscape elements that would be lost or changed, the extent that this represents, and the contribution of that element to the character of the landscape.

A6.1.28 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.

A6.1.29 The size and scale of the effect is described as being large, medium, small, or barely perceptible.

Geographical Extent of Effect

A6.1.30 The geographical extent over which the landscape effect would arise is described as being **large** (scale of the landscape character type, or widespread, affecting several landscape types or character areas), **medium** (more immediate surroundings) or **small** (site level). Where the effect will be localised, then place names or landscape features may be used to help inform the reader as to the extent of the effect.

Duration of Effect

A6.1.31 GLVIA3 states that *'Duration can usually be simply judged on a scale such as short term, medium term or long term.'* For the purposes of the assessment, duration is often 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.

Duration is also a relevant consideration for effects which are intermittent (for example lighting).

Reversibility of Effect

A6.1.32 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).

A6.1.33 Judgements on the magnitude of landscape effect (nature of landscape effect) were recorded as high, medium or low and are guided by the table below.

Magnitude of Landscape Effect			
	Higher	⟷	Lower
Size/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 landscape character types/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 landscape character type/area
Duration	Changes experienced for a period of around 10 years or more Continuous	⟷	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.

Judging Levels of Landscape Effect and Significance

A6.1.34 The final step in the assessment 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).

A6.1.35 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 landscapes all have a high susceptibility to all types of change, and conversely, undesignated landscapes may also have high value and susceptibility to change (GLVIA3, Page 90).

A6.1.36 Levels of effect were identified as **negligible, minor, moderate** or **major.** Moderate and major effects were considered significant in the context of the EIA Regulations.

A6.1.37 Determination of the level of effect requires the application of professional judgement and experience to take on board the many different variables which need to be considered, and which were given different weight according to site-specific and location-specific considerations in every instance. Judgements were made on a case by case basis, guided by the principles set out in Diagram 1.

A6.1.38 A rigid matrix-type approach, where the level of landscape effect would be defined simply based on the level of sensitivity (nature of receptor) combined with the magnitude of change (nature of effect), is not used. This is given the need for consideration of the relative importance of each aspect to feed into the overall decision. An assessor takes on board professional judgement and experience to determine the weight given to each variable in each case. As such, the conclusion on the level of effect is not always the same.

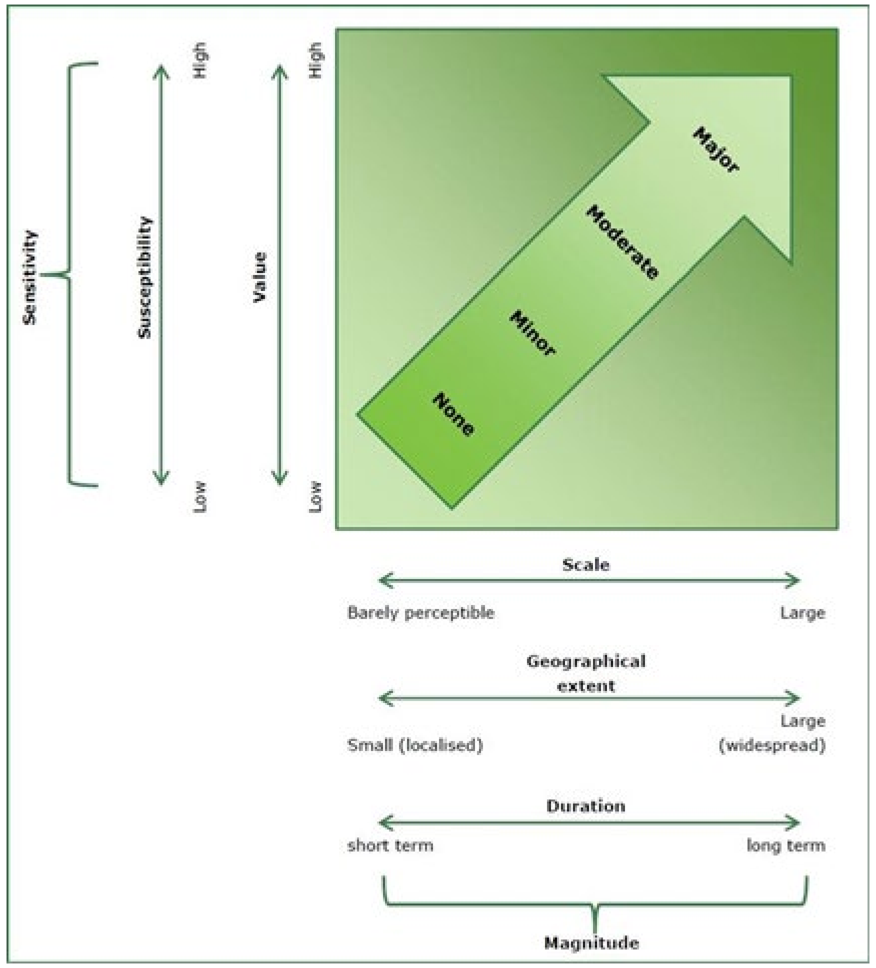

Diagram 1 - Judging levels of effect - Landscape or Visual (including cumulative)

Method for Assessing Visual Effects

Significance of Visual Effects

A6.1.39 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).

A6.1.40 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).

A6.1.41 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 size and scale, geographical extent, duration and reversibility of the effect.

A6.1.42 These aspects were considered together, to form a judgement regarding the overall significance of visual effect (GLVIA3, Figure 6.1 Page 99). The following sections set out the methodology used to evaluate sensitivity and magnitude.

Sensitivity of Visual Receptor

A6.1.43 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 in the table below.

Sensitivity of Visual Receptors			
	Higher	↔	Lower
Susceptibility	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.
Value	Views may be recorded in management plans, guide books, and/or which are popular and thus likely to be experienced by large numbers of people. Views may be associated with nationally designated landscapes; local authority designated landscapes; designed views recorded in citations for historic parks, gardens/scheduled monuments etc.	↔	Views which are not documented or protected. Views which are more incidental, and less likely to be associated with somewhere people travel to or stop, or which may be less popular and thus experienced by smaller numbers of people.

Susceptibility of Visual Receptor

A6.1.44 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.

Susceptibility of Visual Receptors		
High	Medium	Low
Viewers whose attention or interest is focussed on their surroundings, including: communities where views contribute to the landscape setting enjoyed by residents; visitors to heritage assets, other attractions and popular hill summits where views of surroundings are an important contributor to experience; and formal or promoted stopping places on scenic or tourist routes.	People engaged in outdoor recreation (including users of cycle routes, footpaths and public rights of way whose interest is likely to be partly focused on the landscape); People travelling in vehicles on scenic routes and tourist routes, where attention is focused on the surrounding landscape, but is transitory; and People at their place of work whose attention is focused on the surroundings and where setting is important to the quality of working life.	People travelling more rapidly on more major roads, 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; and 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 of Visual Amenity

A6.1.45 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).

A6.1.46 Recognition of the value of a view is determined with reference to:

- planning designations specific to views including views with recognised scenic value;
- whether it is recorded as important in relation to designated landscapes (such as views specifically mentioned in the special qualities of a National Park or 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.

A6.1.47 A designated viewpoint or scenic route advertised on maps and in tourist information, or which is a popular destination, such as a Munro 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.

A6.1.48 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, and to be less well frequented.

A6.1.49 Judgements on the value of views or visual amenity were recorded as **high, medium** or **low.**

Magnitude of Visual Effect

A6.1.50 The overall judgement of magnitude of visual effect (nature of visual effect) is based on weighing up professional judgements on size and scale, geographical extent, duration and reversibility. Further information on the criteria is provided below.

Size and Scale

A6.1.51 The size and 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 extent 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.

A6.1.52 All changes were assumed to be during winter, representing a 'maximum case effect' scenario with minimal screening by vegetation and deciduous trees. Note that wireframes and ZTVs prepared to illustrate potential visual effects were 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.

A6.1.53 In this assessment scale of visual change is described as being **large, medium, small** or **barely perceptible.**

Geographical Extent

A6.1.54 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.**

Duration

A6.1.55 The duration of visual effects is reported **as short-term, medium-term** or **long-term,** as defined for the duration of landscape effects (see above). It is also relevant to consider duration in terms of the period over which intermittent or occasional effects may operate (for example lighting), or the duration over which an effect may be experienced, for example when travelling along a road or path.

Reversibility

A6.1.56 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 were generally considered to be partially reversible due to the removal of turbines and most infrastructure at the end of the operational phase.

A6.1.57 Judgements on the magnitude of visual effect were recorded as **high, medium** or **low** guided by the table below.

Magnitude of Visual Effects			
	Higher	⟷	Lower
Size/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 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 Longer periods of time when travelling along a linear receptor	⟷	Visual change experienced over a short period of up to 5 years. Intermittent or occasional Shorter periods of time when travelling along a linear receptor
Reversibility	A permanent visual change which is not reversible or only partially reversible at the end of the operational life of the Proposed Development.	⟷	A temporary visual change which is largely reversible following the completion of construction and at the end of the operational life of the Proposed Development.

Direction of Visual Effects

A6.1.58 The direction of visual effects (**beneficial, adverse** or **neutral**) is determined in relation to the degree to which the proposal fits with the existing view and the contribution to the view that a proposed development makes, even if it is in contrast to the existing character of the view.

A6.1.59 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 'maximum case effect' 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

A6.1.60 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.

A6.1.61 The evaluations of the individual aspects set out above (susceptibility, value, size and scale, geographical extent, duration and reversibility) were considered together to provide an overall profile of each identified visual effect. An overview is then taken of the distribution of judgements for each aspect to make an informed professional assessment of the overall level of effect, drawing on good practice guidance provided in GLVIA3.

A6.1.62 The sensitivity of visual receptors may involve a complex relationship between a visual receptor's (e.g. people'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.

A6.1.63 Levels of visual effect were identified as **negligible, minor, moderate** or **major**. Moderate and major visual effects were considered **significant** in the context of the EIA Regulations.

A6.1.64 Determination of the level of effect requires the application of professional judgement and experience to take on board the many different variables which need to be considered, and which were given different weight according to site-specific and location-specific considerations in every instance. Judgements were made on a case by case basis, guided by the principles set out in Diagram 1.

A6.1.65 A rigid matrix-type approach, where the level of visual effect would be defined simply based on the level of sensitivity (nature of receptor) combined with the magnitude of change (nature of effect), is not used. This is given the need for consideration of the relative importance of each aspect to feed into the overall decision. An assessor takes on board professional judgement and experience to determine the weight given to each variable in each case. As such, the conclusion on the level of effect is not always the same.

Cumulative Landscape & Visual Impact Assessment (CLVIA)

A6.1.66 The aim of a Cumulative Landscape and Visual Impact Assessment (CLVIA) is to '*describe, visually represent and assess the ways in which a proposed wind farm would have additional impacts when considered together with other consented or proposed wind farms'* (NatureScot, 2021).

A6.1.67 The cumulative assessment therefore focuses on the **additional** cumulative change which may result from the introduction of a proposed development. The cumulative assessment also makes reference to **in-combination** (sometimes also referred to as total) cumulative effects, where these have the potential to be significant. A cumulative assessment 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 similar landscape and visual impacts.

A6.1.68 As with an LVIA, a CLVIA deals with cumulative landscape and visual effects separately.

Differences between the LVIA and CLVIA

A6.1.69 Although both LVIA and CLVIA look at the effects of a proposed development on the landscape and on views, there are differences in the baseline against which the assessments are carried out.

A6.1.70 For the LVIA (the **primary** assessment), the baseline includes existing wind farm developments which are present in the landscape at the time of undertaking the assessment, which may be either operational or under construction, as they form a part of the baseline situation. Their presence has the potential to influence the assessment of effects on landscape character and the assessment of effects on views. For the CLVIA the baseline is partially speculative and includes:

- **Scenario 1** – operational, under construction and wind farms which have been granted planning consent but are not yet constructed **(consented)**; and
- **Scenario 2** – Scenario 1, plus submitted valid wind farm applications which are currently awaiting determination by the relevant consenting authority, including those at appeal and in some instances those currently at scoping when specifically requested **(proposed).**

A6.1.71 The cumulative assessment considers the operational and under construction sites, as well as consented and proposed sites. It differs from the primary assessment in that it focuses specifically on the **additional** impact of the proposed development due to the way it associates and interacts with all other wind energy developments. It describes the detailed relationship between them, and also considers the in-combination effects that may arise.

A6.1.72 Where the magnitude of change that would occur as a result of the introduction of the proposed development in the primary LVIA is identified as either low or barely perceptible, potential cumulative effects were scoped out of the cumulative assessment, as it is considered that such an addition would not give rise to a significant cumulative effect.

Types of Cumulative Effects

A6.1.73 Assessing the Cumulative Impact of Onshore Wind Energy Developments[7] states that *'cumulative landscape impacts can change either the physical fabric or character of the landscape, or any special values attached to it'* (NatureScot, 2021).

A6.1.74 Three types of cumulative effects on visual amenity were 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. Frequent sequential effects occur where wind farms appear regularly, with short time lapses between points of visibility. Occasional sequential effects occur where long periods of time lapse between views of wind farms, depending on speed of travel and distance between viewpoints.

Assessing Cumulative Effects

Assessment Methodology for the CLVIA

A6.1.75 The CLVIA considers the potential effects of the addition of a proposed development, against a baseline landscape that includes wind farms that may or may not be present in the landscape in the future, i.e. wind farms that are consented but not yet built, and/or undetermined planning applications. The wind farms included in each scenario were assumed to be present in the landscape for the purposes of the CLVIA.

A6.1.76 The methodology for the CLVIA follows that of the LVIA, which considers the introduction of a proposed development to a baseline which includes existing (operational and under construction) wind farms. The size and scale of cumulative change focuses on:

- 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.

A6.1.77 Consideration is given to whether an effect may be intensified, reduced or remain similar, through consideration against different potential future baseline scenarios.

[7] https://www.nature.scot/doc/guidance-assessing-cumulative-landscape-and-visual-impact-onshore-wind-energy-developments

Significance of Cumulative Effects

A6.1.78 As for a LVIA, judging the significance of cumulative landscape and visual effects requires consideration of the sensitivity and the magnitude of effect on those receptors. The following sections set out the methodology applied for the assessment of cumulative effects for both landscape and visual receptors and explain the terms used.

Assessing Cumulative Landscape Effects

Sensitivity

A6.1.79 An assessment of cumulative landscape effects requires consideration of the sensitivity of the landscape receptors. This requires consideration of susceptibility and value, and is as recorded in the LVIA.

Magnitude of Cumulative Landscape Effects

A6.1.80 As for the methodology applied for the LVIA, the magnitude of cumulative landscape effect (nature of cumulative landscape effect) is based on combining professional judgements on size and scale, geographical extent, duration and reversibility. Judgements on the magnitude of cumulative landscape effect (nature of cumulative visual effect) were recorded as **high, medium** or **low.**

Size and Scale

A6.1.81 The size/scale of cumulative landscape change is the additional influence the proposed development has on the characteristics and character of the area assuming the other wind farm developments considered in the CLVIA baseline scenarios are already present in the landscape. This is influenced by:

- how the proposal fits with existing pattern of cumulative wind farm development, including the relationship to landscape character types and areas; and
- the siting and design of the proposed development in relation to other existing and proposed wind farm developments (including distance between wind farms, composition, size and scale).

Geographical Extent

A6.1.82 As for the LVIA, the geographical extent over which the cumulative landscape change will be experienced is described as being **large** (scale of the landscape character type, or widespread, affecting several landscape types or character areas), **medium** (immediate surroundings) or **small** (site level).

Duration and Reversibility

A6.1.83 For the purpose of the cumulative landscape assessment consideration of the judgements of the duration and reversibility of landscape effects were as recorded in the LVIA.

A6.1.84 Judgements on the magnitude of cumulative landscape effect were recorded as **high, medium** or **low.**

Levels of Cumulative Landscape Effect and Significance

A6.1.85 The final step in the assessment of cumulative landscape effects requires the judgements of sensitivity and magnitude of cumulative landscape effect to be combined to make an informed professional assessment on the significance of each cumulative landscape effect.

A6.1.86 As for the LVIA the levels of cumulative landscape effect were described as **negligible, minor, moderate** or **major** where moderate and major cumulative landscape effects were considered **significant** in the context of the EIA Regulations.

A6.1.87 More significant 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 farm developments means that the effect on the landscape is greater than the sum of its parts.

A6.1.88 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'* (para 7.28 GLVIA 3).

A6.1.89 This determination of cumulative landscape effects requires the application of professional judgement and experience to take on board the many different variables which need to be considered, and which were given different weight according to site-specific and location-specific considerations in every instance. Judgements were made on a case-by-case basis.

Assessing Cumulative Visual Effects

Sensitivity

A6.1.90 The assessment of the significance of cumulative visual effects requires consideration of the sensitivity of the visual receptors. This requires consideration of susceptibility and value, and is as recorded in the LVIA.

Magnitude of Cumulative Visual Effects

A6.1.91 As for cumulative landscape effects and the methodology for the LVIA, the magnitude of cumulative visual effect (nature of cumulative visual effect) is based on combining professional judgements on size and scale; geographical extent; duration and reversibility. Judgements on the magnitude of cumulative visual effect (nature of cumulative visual effect) were recorded as **high, medium, low** or **barely perceptible.**

Size and Scale

A6.1.92 The size/scale of cumulative change to views depends on the additional influence the proposed development has on views assuming the other wind farm developments are already present in the landscape. This is influenced by:

- Whether the proposed development introduces development into a new part of the view so that the extent of the developed part of the view increases;
- the relationship between the proposed development and other wind farm developments in terms of design, size and layout;
- the apparent visual relationship of cumulative wind farm developments to landscape character types and or landscape character areas; and / or
- in the case of magnitude of change to routes, the relative duration of views of wind farm developments from routes, and whether these will be intermittent or continuous.

A6.1.93 There has to be clear visibility of more than one wind farm development, of which one must be the proposed development, for there to be a cumulative effect (given this is an assessment of the effects of the proposed development and not a broader CLVIA of combined cumulative effects or capacity study). Where the proposed development is clearly visible and other wind farm developments are not, the effect is likely to be the same as recorded in the LVIA (i.e. the effect is not a cumulative effect).

Geographical Extent

A6.1.94 As for the LVIA, the geographical extent of cumulative visual changes 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 from large areas. Geographical extent is described as being **large, medium** or **small.**

Duration and Reversibility

A6.1.95 For the purpose of the cumulative visual assessment consideration of the judgements of the duration and reversibility of visual effects were as recorded in the LVIA.

Levels of Cumulative Visual Effect and Significance

A6.1.96 The final step in the assessment of cumulative visual effects requires the judgements of sensitivity and magnitude of cumulative visual effect to be combined to make an informed professional assessment on the significance of each cumulative visual effect.

A6.1.97 As for the LVIA the levels of cumulative visual effect were described as **negligible, minor, moderate** or **major** where moderate and major cumulative visual effects were considered **significant** in the context of the EIA Regulations.

A6.1.98 The evaluations of susceptibility, value, size and scale, geographical extent, duration and reversibility were considered together to provide an overall profile of each identified visual effect. An overview is taken of the distribution of judgements for each aspect to make an informed professional assessment of the overall level of each visual effect, drawing on guidance provided in GLVIA3. Levels of effect were identified as **negligible, minor, moderate** or **major** where moderate and major visual effects were considered significant in the context of the EIA Regulations.

A6.1.99 More significant 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 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).

A6.1.100 This determination of cumulative visual effects requires the application of professional judgement and experience to take on board the many different variables which need to be considered, and which were given different weight according to site-specific and location-specific considerations in every instance. Again, as for the assessment of landscape and visual effects, judgements were made on a case-by-case basis, guided by the same principles as set out in **Diagram 1** above.

Preparation of Visualisations

Daytime

Viewpoint Photography

A6.1.101 Photography for the 24 assessment viewpoints (the remaining two viewpoint assessments are wireframe only) was taken between May 2021 and July 2022 using a Nikon D600 and Sony ILCE-7RM3 full frame digital SLR camera, with a fixed 50mm focal length lens. The methodology for photography is in accordance with guidance provided by SNH[8].

A6.1.102 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 degrees and rotated through a full 360 degrees at each viewpoint. Fifteen photographs were taken for each 360 degree view.

A6.1.103 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[9].

A6.1.104 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.

Photograph Stitching, Wireframes and Photomontages

A6.1.105 Photography stitching software (PTGui©) was used to stitch together the adjoining images to form panoramic images in cylindrical projection.

A6.1.106 The software package ReSoft© WindFarm version 4.2 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 photos were imported into the ReSoft© WindFarm software and the wireframe views overlaid and aligned with the photographs.

A6.1.107 The presentation of fully rendered photomontages involved additional stages as follows.

A6.1.108 ReSoft© WindFarm software was used to render the turbines, taking account of the sunlight conditions 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.

A6.1.109 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 masked (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 other ancillary features. 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.

A6.1.110 The proposed infrastructure layout was modelled in Autodesk 3DS Max© software. The 3D model contains the main components of the proposed infrastructure (including track layout and access track, permanent and temporary hardstanding, borrow pits and temporary and permanent hardstanding) modelled accurately in terms of their size and position and to a level of detail which was considered appropriate for the distance of viewpoint locations from where they would be visible. 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 carefully aligned. The 3D model views were then rendered taking account of the sunlight conditions and the position of the sun in the sky at the date and time the photographs were taken. The 3DS Max exported images were then composited with the baseline photography using Adobe Photoshop© software to create the photomontage images.

A6.1.111 Views were rendered and exported images composited with the turbine renders and photographs to create the photomontages.

A6.1.112 ReSoft© WindFarm software was used for adding the proposed met mast using the specified dimension and position. An image showing the position of the met mast was exported as a guide and used in Adobe Photoshop© to composite the met mast into the photomontages produced for viewpoints within 10km of the Proposed Development.

A6.1.113 Finally, and where applicable, the images were converted from Cylindrical Projection to Planar Projection using PTGui© software.

Dusk/Night-time

A6.1.114 To date, consultants including LUC have generally prepared photomontage visualisations to consistently represent aviation lights illuminated at their minimum required luminous intensity (2000 candela) and when dimmed to 10% of their maximum intensity (i.e. minimum 200 candela) in times of clear meteorological conditions where visibility exceeds 5km at the point of measurement (sensors on the turbine hubs). This approach has been accepted by NatureScot and other stakeholders. This approach does not however 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.

A6.1.115 For the aviation lighting photomontage visualisations presented in this EIA Report, LUC and the applicant has agreed an alternative approach. In addition to providing visualisations showing the minimum required luminous intensity (2000 candela) and when dimmed to 10% of their maximum intensity (i.e. minimum 200 candela), supplementary visualisations utilising the luminous intensity data presented by WPAC Aviation Lighting and Mitigation Report - Version 3.1 (WPAC 067/22) were produced. These supplementary visualisations take account of the elevation angle between each individual turbine nacelle/hub light and assessment viewpoint (at a viewing height of 1.5m) to present visualisations which seek to illustrate the actual luminous intensity (candela) values of each individual turbine light predicted to be perceptible from each representative assessment viewpoint.

[8] SNH (2006) and Version 2.2 (2017) Visual Representation of Windfarms: Good Practice Guidance.

[9] Landscape Institute. (2011). Practice Advice Note, Photography and photomontage in landscape and visual impact assessment. Advice Note 01/11.

A6.1.116 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 type of light. The predicted values can be applied to a modelled light source and illustrated in photomontage visualisations. Predicted values were also presented in the form of lighting intensity Zone of Theoretical Visibility (ZTV) mapping, which illustrate the potential variability in lighting intensity (referred to as luminous intensity and expressed as values in candela) in relation to vertical viewing angle across the study area. However, this information has until recently not been interpreted and translated for presentation within illustrative photomontage images for specific assessment viewpoints.

A6.1.117 This approach to the production of the supplementary photomontage visualisations was followed for the preparation of each of the three dusk/night-time assessment viewpoints listed below and detailed in **Table A6.1.1.**

- Viewpoint 2: Dalavich Jetty (Figure 6.2.2)
- Viewpoint 4: Folly at Dun na Cuaiche (Figure 6.2.4)
- Viewpoint 29: Beinn Bhuidhe (Figure 6.2.29)

A6.1.118 As illustrated in **Table A6.1.1**, 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 values emitted to each representative viewpoint location.

Table A6.1.1: Predicted Luminous Intensity of Nacelle Mounted Aviation Lighting

Turbine Number	DUSK/NIGHT-TIME VISUALISATION VIEWPOINTS / PREDICTED LUMINOUS INTENSITY (Candela/cd) i.e. light emitted in the direction of the viewpoint					
	Green – lights obscured by terrain from viewpoint					
	Viewpoint 2		Viewpoint 4		Viewpoint 29	
	Full	**10%**	**Full**	**10%**	**Full**	**10%**
T1	291	29	291	29	2347	235
T2	217	22	273	27	2347	235
T3	122	12	273	27	2439	244
T7	194	19	448	45	2276	228
T10	119	12	902	90	2099	210
T11	112	11	1982	198	2347	235
T13	75	8	2379	238	2347	235

A6.1.119 Utilising the individual luminous intensity values for each individual turbine light detailed in **Table A6.1.1** above, comparative photomontage visualisations from each of the representative assessment viewpoints, illustrating the nacelle lights at both their maximum intensity and when dimmed to 10% intensity are presented. These visualisations are included in addition to those showing aviation lights illuminated at their minimum required luminous intensity (2000 candela) and when dimmed to 10% of their maximum intensity (i.e. minimum 200 candela) in times of clear meteorological conditions, where visibility exceeds 5km at the point of measurement.

A6.1.120 The luminous intensity values presented in **Table A6.1.1** and utilised in the production of the corresponding photomontage visualisations only take account of the influence of elevation angle between the individual nacelle mounted obstruction light and the individual viewpoint, and do not seek to replicate the additional influence of other factors which may further decrease the perceived brightness of the lights, for example reduced atmospheric clarity arising from fog/rain/haze etc..

Key Steps in the Methodology

- In accordance with good practice guidance, baseline photography was carried out in appropriate conditions close to dusk or dawn (dependent on viewing direction, and/or in response to specific requests of consultees). SNH's Visual Representation of Wind Farms 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, page 35 and 36).
- Baseline photography, including the presence of existing sources of artificial lights where applicable, was captured 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.
- 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[10] between the successive images and enable accurate stitching of the images. The camera was rotated through increments of 24˚ (degrees) and through a full 360˚ at each viewpoint. Fifteen photographs were taken for each 360˚ view.
- 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.
- 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 (Ordnance Survey (OS) Terrain® 50 height data)[11]. 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.
- 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® 50 height data.
- 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.
- Simple 'sphere' shaped lights within the Autodesk3DS Max© software were matched to the luminous intensity of any light source (in candela). The aviation lights were positioned on each proposed turbine nacelle and set to the minimum required luminous intensity (2000 candela) and when dimmed to 10% of their maximum intensity (200 candela). 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.
- Additional lighting settings were then applied to supplementary 3D scene files. The luminous intensity value (in candela) for each medium intensity aviation light[12] (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 3.1 (WPAC

[10] 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.
[11] Where required to illustrate more complex or variable terrain, OS Terrain® 5 height data can be used.

[12] Based on the technical specification of CEL Aviation Lighting – CEL ML 2-KR. Weblink: https://www.contarnex.com/led- obstruction-lighting/datasheets/Medium-Intensity/4-ICAO-MI-Type-B-C-2000cd-SAL/CEL-MI-2KR-230-A-medium-intensity-led-obstruction-warning-light.pdf

067/22) and take account of the elevation angle between the light and viewpoint provided (results provided to every 0.1° (degrees) 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.

- 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 (HDR) 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.
- Settings within Vray© were optimised (minimum sub-divisions were increased and the overall noise threshold decreased) to ensure the render 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.
- The 3D renders of turbines and lighting scenarios were then composited 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.
- Photomontage images were then converted from cylindrical projection to planar projection using PTGui© 12.20 panorama photo stitching software.
- 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.

A6.1.121 The photomontages do not seek to replicate the additional variable influence which distance (between the light and the viewpoint/observer) or atmospheric attenuation[13] from aerosols[14], can have on the observed illuminance[15] (brightness or brilliance) of the lights. However, it is understood that the additional influence of these factors would lead to a further decrease in the perceived brightness.

A6.1.122 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 and lighting intensity ZTVs, field work and experience.

Presentation of Photomontages

A6.1.123 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.

A6.1.124 The elongated A1 width format pages presented for each viewpoint are set out as follows:

- The first three pages contain 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˚;
- Subsequent pages contain a 53.5˚ wirelines and photomontages. These images are both shown in planar projection and presented on an A1 width page; and
- For 7 additional viewpoints it was agreed with NatureScot that wireline only visualisations would be prepared. For these viewpoints (Viewpoints 1, 8 and 27-31) up to 360˚ wirelines are presented to illustrate wider visibility of other projects.

[13] The decreasing brightness of light as it passes through the atmosphere and is scattered or absorbed by processes in the atmosphere.
[14] 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.
[15] The measure of luminous intensity of light that passes through a unit area of surface at a particular distance and measured in lumens per square metre (also known as lux). The observability of light depends on the illuminance of a light and determines how bright a light appears.