1 LVIA METHODOLOGY

1.1 ZTV Mapping

1.1.1 ZTV Introduction

The Zone of Theoretical Visibility (ZTV) represents the area over which a development can **theoretically** be seen, and is based on a Digital Terrain Model (DTM), overlaid on a map base. A DTM refers to the way in which a computer represents a piece of topography in three dimensions as a digital model. However, it is important to note that the ZTV indicates theoretical and not actual visibility, and that they do not convey the nature or magnitude of the visual effects. ZTV maps provide the following information:

- Indicates broad areas where visibility of a wind energy development is most likely to occur;
- How many wind turbines are likely to be visible (using different coloured bands for different numbers of turbines);
- How much of the wind energy development is likely to be visible
- The extent and pattern of theoretical visibility.

Production of ZTV maps is usually one of the first steps of the assessment of visual effects, helping to inform the selection of the Study Area in which likely significant effects will be considered in more detail and the identification of sensitive vantage points. *(Visual Representation of Wind Farms*, Scottish Natural Heritage, 2017).

1.1.2 Limitations of ZTV Mapping

The Scottish Natural Heritage guidelines (2017) referred to above acknowledge the following limitations inherent to the use of theoretical visibility mapping, which include:

- The ZTV shows theoretical visibility only - it cannot show how the proposed development will look, nor indicate the nature or magnitude of likely landscape or visual effects, or show the likely significance of effects.
- The ZTVs in this EIS present a 'bare ground' scenario, i.e. visibility of the proposed development in a landscape without screening structures or vegetation. This includes trees, hedgerows, buildings and small-scale landform or ground surface features. The ZTV also does not take into account the effects of weather and atmospheric conditions, and therefore can be said to represent a 'worst-case' scenario, that is where the wind farm could potentially be seen given no intervening obstructions and in favourable weather conditions.
- A ZTV is only as accurate as the data on which it is based. It is not easy to test the accuracy of a ZTV in the field, although some verification will occur during the assessment of viewpoints.
- In order to handle large areas of terrain, the DTM data is based on information that does not allow detail to be distinguished below a certain level. There are also differences in the way that the software package 'interpolates' between heights in the calculations made.

1.1.3 ZTV Methodology

Maps showing the Zone of Theoretical Visibility (ZTV) have been prepared for the proposed wind turbines, using the software package WindFarm Version 4.2.5.1 (Copyright 1997 – 2015, ReSoft Ltd.). WindFarm is a commercially available software tool that enables developers to analyse,

design and optimise wind energy developments. The applications of this system include the production of detailed ZTV or zone of visual influence maps.

The ZTV maps presented in the EIAR show visibility of the proposed wind farm using the half blade height of the wind turbines as points of reference. The maps also show the visibility of the proposed wind farm in addition to visibility of other existing and permitted wind farms in the area. The area covered by the ZTV maps has a radius of 20 kilometres from the outer-most proposed turbines. As this ZTV area includes a considerable proportion of sea, the ZTV maps show only the visibility on land.

ZTV maps assume a worst-case or 'bare ground' scenario, i.e. no land-cover. They represent visibility of the proposed wind farm in the absence of all natural and manmade features from the landscape, including vegetation, houses and other buildings. In reality, such features will restrict or limit visibility of the wind turbines, due to the screening effects of vegetation, for example forestry and road-side hedgerows and trees, and buildings, particularly within towns and villages.

Separate colour bands are used on each ZTV map to indicate the number of turbines which will potentially be visible to half blade i.e. only half a blade might be visible over the topography as opposed to seeing a full turbine. The legend on each map shows the number of visible turbines for each corresponding colour.

1.2 Viewpoint Photomontages

1.2.1 Viewpoint Identification

Viewpoints, the photo locations from which the photomontages are produced, were chosen using a variety of information. A preliminary list of viewpoints was identified following production of initial ZTV maps for the proposed development, in order to determine the areas from where there was theoretical visibility. Viewpoints were also chosen to represent various landscape character areas and landscape sensitivities. Viewpoints from various elevations, aspects, and roads, were also identified. Areas of scenic amenity were also identified. Some photomontages where the proposed development is theoretically visible but is not actually visible on the ground are included in the assessment because they represent a view which is considered important.

Viewpoints were chosen having regard to the SNH Guidance (2017) which advises that a range of views should be shown at a range of distances and aspects, as well as at varying elevations and showing both where the development will be completely visible as well as partially visible, and these are reflected in the choice of viewpoint locations. Views are taken from different landscape character areas in the vicinity of the site, and views were taken in close proximity to the site, where turbines are likely to be more visible, as well as more distant views. Consideration was also given to ensure that photomontages captured other wind farms in order to assess cumulative visual effects.

1.2.2 Photomontages

Photomontages are visualisations that superimpose an image of a proposed development upon a photograph or series of photographs. They are intended as graphical representations of how a proposed development will appear in the existing landscape and are used as a tool in the LVIA process. A series of photomontages has been prepared as part of this assessment and are presented in a separate Volume 2 Photomontage Booklet to be submitted to along with this EIAR.

1.2.3 Photomontages Limitations

Photographs, and therefore photomontages, are subject to a range of limitations, as stated in 'Visual Assessment of Wind Farms' (Scottish Natural Heritage, 2014):

- *Visualisations provide a tool for assessment that can be compared with an actual view in the field; they should never be considered as a substitute to visiting a viewpoint in the field.*
- *Neither photographs nor visualisations can replicate a view as seen in reality by the human eye.*
- *Visualisations are only as accurate as the data used to construct them.*
- *Visualisations can only represent the view from a single location at a particular time and in particular weather conditions.*
- *Static visualisations cannot convey the effect of turbine blade movement.*

Although the scale, siting and geometry of photomontages are based on technical data, the other qualities of the image are open to judgments. The Guidance also notes that interpretation of visualisations also needs to take into account additional information including variable lighting, movement of turbine blades, seasonal differences and the movement of the viewer through the landscape. However, accepting these limitations, the SNH guidelines state that photomontages are useful tools in the Visual Impact Assessment of wind turbines.

When viewing the photomontages, it should be noted that the photographs for photomontages reflect the weather conditions of the particular day. The photographs also depict atmospheric or weather conditions.

1.2.4 Photomontage Presentations

The viewpoints presented in the accompanying Photomontage Booklet show several views from each viewpoint location. These include an existing view (without any of the proposed turbines), a proposed view (with the proposed turbines) and a cumulative view (with all proposed, permitted and existing turbines). The angle of view presented in each image is detailed below and is stated on each photomontage. Technical data relating to each photomontage, such as camera and tripod model, height, date and time, is also included in the Photomontage Booklet. Five types of photomontage images have been prepared and presented for each viewpoint, as detailed below.

1. **Existing View –** Showing viewpoint location details, location maps and a 90-degree existing view image without any turbine from the proposed development. Existing turbines visible in the landscape may appear within the 90-degree photographic image, and the horizontal extent of the 53.5-degree image to be presented in subsequent images is also framed.

2. **Existing View and Wireframe –** Showing a 90-degree existing view image without any proposed turbine from the proposed development (as on Page 1) and a matching wireframe image of the same view which includes any existing turbines visible in the landscape. If turbines are already existing in the landscape, these are visible on the photograph and are rendered in the wireframe.

3. **Cumulative View –** Showing a 90-degree photomontage image with the proposed wind farm and all other existing and permitted wind farms shown. A matching wireframe image shows the turbines of all proposed, permitted and existing wind farms are individually coloured and labelled for ease of identification.

4. **Cumulative 53.5-degree Photomontage View –** Showing a photomontage image of only the proposed turbines and any existing turbines in a 53.5-degree horizontal field of view. Other wind farms already built and operational in the landscape are also be visible in this view.

5. **Cumulative 53.5-degree Wireframe View -** Showing a wireframe image of only the proposed turbines and any other existing or proposed turbines, in a 53.5-degree horizontal field of view. Other wind farms already built and operational in the landscape are added to the wireframe. The proposed turbines and any other existing wind farms are individually coloured and labelled for ease of identification.

1.3 Landscape and Visual Impact Assessment Methodology

1.3.1 Assessing Landscape Effects

The potential visual effects of the proposed development are informed by the nature of the proposal, desk study, site visit, along with tools such as ZTV and photomontages. The methodology uses qualitative methods in order to arrive at an assessment, which is based on the Landscape and Landscape Assessment (2000) Guidelines as well as the GLVIA (2013), and the DoEHLG (2006) Guidelines were also taken into account. Landscape and Visual Impact Assessment, though related, can be described separately. Descriptions below are based on the GLVIA (2013).

Landscape effects can be described as changes which affect the landscape as a resource. This includes how the proposal will affect the elements that make up the landscape, the aesthetic and perceptual aspects, and its landscape character. Landscape effects also relate to changes in the structure of the landscape. Under the GLVIA (2013), the assessment of likely significant effects on landscape receptors includes a judgement on both the sensitivity of the receptor as well as magnitude of the change.

1.3.1.1 Assessing Landscape Sensitivity

Landscape Sensitivity, which is described in the GLVIA (2013) as a combination of the landscape's susceptibility to change as well as the value attached to the landscape

Susceptibility to change can be described as the ability of the landscape receptor (either the overall character or quality of the landscape, or a particular landscape feature), to accommodate the proposed development without undue consequences for the maintenance of the baseline (existing) landscape situation, and/or the achievements of landscape planning policies and strategies. Landscape value is a combination of values which are assessed in the landscape baseline, combining any formal landscape designations.

For the purposes of this LVIA and the assessment of landscape sensitivity, the landscape sensitivity ratings were taken from the County Galway Wind Energy Strategy, forming part of the Galway County Development Plan 2015-2021, which provides a "landscape sensitivity to wind farm development" for each landscape character area. The LCA landscape sensitivity is classified as either:

- Low
- Moderate
- High
- Very High

1.3.1.2 Assessing Magnitude of Change

The magnitude of change resulting from the landscape effects arising in each landscape character area is a combination of the visual presence - size and scale - of the change, the extent of the area to be affected, and the duration and reversibility of the effect. The magnitude of change for each landscape character area was assessed using the definitions outlined in Table 1 below.

Table 1 Magnitude of Landscape Effects

Magnitude of Change	Description
Substantial	Where a landscape will experience the loss of key landscape features or the introduction of uncharacteristic additions over a large area. The changes to the landscape are prominent and large in scale. The level of change has an effect on the overall landscape character. The effects are likely long term and may be irreversible.
Moderate	A more limited loss of or change to landscape features over a medium extent which will result in some change to landscape features and aesthetics. Could include the addition of some new uncharacteristic features or elements that would lead to the potential for change in landscape character in a localised area or part of a landscape character area. Would include moderate effects on the overall landscape character that do not affect key characteristics. The effects could be long to medium term and/or partially reversible.
Slight	The loss of or change to landscape features of limited extent, or changes to landscape character in smaller areas. Changes would not affect key characteristics. The addition of any new features or elements to the landscape would only result in low-level changes to the overall aesthetics of the landscapes. Changes to the landscape are more evident at a local level and not over a wide geographical area. The effects could potentially be medium to short term and/or reversible.
Negligible	A change affecting smaller areas of landscape character including the loss of some landscape elements or the addition of features or elements which are either of low value or hardly noticeable. The effects could be short term and/or reversible.

1.3.1.3 Landscape Effects Assessment Matrix

The significance of landscape effect was calculated by combining the magnitude and sensitivity classifications, using the assessment matrix in Table 2 below, where landscape sensitivity is shown the Y-axis on the left of the matrix, and magnitude of change is shown on the X-axis on the top of the table.

Table 2 Landscape effects significance assessment matrix

	Substantial	Moderate	Slight	Negligible
Very High	Major	Major/Moderate	Moderate	Moderate/Minor
High	Major/Moderate	Moderate	Moderate/Minor	Minor
Moderate	Moderate	Moderate/Minor	Minor	Minor/Negligible
Low	Moderate/Minor	Minor	Minor/Negligible	Negligible

The determination of significance uses a seven-point scale, ranging from Major to Negligible. This seven-point scale is translated to the EPA impact assessment classifications of significance, as outlined in Table 3 below.

Table 3 EPA Impact Assessment Significance Classification for Landscape Effects

Significance Matrix Classification	EPA Significance Classification	EPA (2017) Definition of Significance
Major	Profound	An effect which obliterates sensitive characteristics
Major/Moderate	Very significant	An effect, which by its character, magnitude, duration or intensity alters most of a sensitive aspect of the environment
Moderate	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Moderate/Minor	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends
Minor	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Minor/Negligible	Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Negligible	Imperceptible	An effect capable of measurement but without significant consequences

1.3.2 Assessing Visual Effects

Visual effects relate to changes in views and visual amenity of the surroundings of individuals or groups of people. These may result from changes in content and character of views as a result in changes to the landscape. The assessment of visual effects is based on views shown in photomontages and also on the potential visibility indicated by the ZTV maps, as well as actual visibility on the ground.

It should be noted that in assessing visual effects, there are different types of visual effects:

Visual obstruction:	This occurs when there is an impact on a view which blocks the view
Visual intrusion:	This occurs when there is an impact on a view but which does not block the view.

Due to the nature of the development and the appearance of wind turbines, visual intrusion occurs more frequently than obstruction.

The likely significant effects of the proposed development in terms of visual and landscape effects are informed by the ZTV and photomontages. Visual effects relate to changes in views and visual amenity of the surroundings of individuals or groups of people. These may result from changes in content and character of views as a result of changes to the landscape. The significance of the effect on visual receptors is a combination of the sensitivity of the receptor as well as the magnitude of the change.

1.3.2.1 Assessing Sensitivity and Magnitude

Visual Receptor Sensitivity depends on the occupation or activity of the people, as well the extent to which the attention is focused on views and visual amenity, according to the GLVIA

Guidelines (2013). Visual receptor sensitivity is assessed as either being High, Medium or Low, based on the definition of descriptions and examples set out in Table 4 below.

Table 4. Assessing Visual Receptor Sensitivity

Sensitivity of Visual Receptor(s)	Description and example criteria
High	These include viewers at designated views or landscapes; Viewers such as residents which are focussed to a large extent on the development due to location in close proximity; viewers at well-known heritage or popular tourist or recreational areas, viewers along scenic or tourist routes
Medium	These include viewers who may have some susceptibility to a change in view, such as those from views which are not designated but may have local recreational uses or those travelling along routes or at views that are considered moderately scenic.
Low	These include viewers engaged in activities where the focus is not on the landscape or view. These including those travelling along a busy route, viewers at work or engaged in sport not related to views or experience of the landscape.

1.3.2.2 Assessing Magnitude Visual Effect

The magnitude of the visual effect resulting at each viewpoint is a combination of size and scale of the change, the extent of the area to be affected, and the duration and reversibility of the effect, determined by reviewing the photomontage and wireframe images, ZTV mapping and site visits to each viewpoint. The magnitude of visual effect is determined in accordance with the definitions and descrptions included in Table 5 below.

Table 5 Magnitude of Visual Effects

Magnitude of Change	Description
Substantial	Substantial change, where the proposals would result in large-scale, prominent or very prominent change, leading to substantial obstruction of existing view or complete change in character and composition of the baseline though removal of key elements or addition of uncharacteristic elements which may or may not be visually discordant. This includes viewpoints where the proposed development is fully or almost fully visible over a wide extent, at close proximity to the viewer. This change could be long term or of a long duration.
Moderate	The change in the view may involve partial obstruction of existing view or partial change in character and composition of the baseline through the introduction of new elements or removal of existing elements. Likely to occur at locations where the development is partially visible over a moderate or medium extent, and which are not in close proximity to the development. Change may be readily noticeable but not substantially different in scale and character from the surroundings and wider setting.
Slight	The proposals would be partially visible or visible at sufficient distance to be perceptible and result in a low level of change in the view and its composition and a low degree of contrast. The character of the view may be altered, but will remain similar to

Magnitude of Change	Description
	the baseline existing situation. This change could be short term or of a short duration.
Negligible	Any change would only be barely distinguishable from the status quo "do-nothing scenario" in the surroundings. The composition and character of the view would be substantially unaltered, approximating to little or no change.

1.3.2.3 Visual Effects Assessment Matrix

The significance of visual effects was calculated by combining the magnitude and sensitivity classifications, using the assessment matrix in Table 6 below, where the sensitivity of the visual receptors is shown the Y-axis on the left of the matrix, and magnitude of change is shown on the X-axis on the top of the table.

Table 6 Visual effects significance assessment matrix

	Substantial	Moderate	Slight	Negligible
High	Major	Major/Moderate	Moderate/Minor	Minor
Medium	Major/Moderate	Moderate	Minor	Minor/Negligible
Low	Moderate	Moderate/Minor	Minor/Negligible	Negligible

The determination of significance uses a seven-point scale, ranging from Major to Negligible. This seven-point scale is translated to the EPA impact assessment classifications of significance, as outlined in Table 7 below.

Table 7 EPA Impact Assessment Significance Classification for Visual Effects

Significance Matrix Classification	EPA Significance Classification	EPA (2017) Definition of Significance
Major	Profound	An effect which obliterates sensitive characteristics
Major/Moderate	Very significant	An effect, which by its character, magnitude, duration or intensity alters most of a sensitive aspect of the environment
Moderate	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Moderate/Minor	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends
Minor	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Minor/Negligible	Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Negligible	Imperceptible	An effect capable of measurement but without significant consequences

1.3.3 Assessing Cumulative Landscape and Visual Effects

Cumulative effects can be described as additional changes caused by a proposed development in conjunction with other similar developments, or as the combined effect of a set of developments, taken together (SNH, 2012). The DoEHLG Guidelines (2006) define Cumulative Effects in terms of wind farms as the perceived effect on the landscape of two or more wind energy developments visible from any one place.

In the case of proposed wind farm developments, the most likely significant cumulative effects are the cumulative visual effects with other wind farms. For completeness, other developments in the vicinity are often also considered.

The Cumulative Landscape and visual effects are assessed following the same principles as the Landscape and Visual Assessment, as described above.

For this assessment, the SNH (2012) definition of Cumulative effects as *additional changes caused by a proposed development in conjunction with other similar developments,* is used, however this assessment also considers other types of developments. The definition in the DoEHLG Guidelines (2006) defines Cumulative Impacts in terms of wind farms, as the perceived effect on the landscape of two or more wind energy developments visible from any one place, and this is also relevant to when relating to other wind energy projects.

Study area
Cumulative Visual Effects are assessed using the same study area as for the main landscape and visual impact assessment, which is 20 kilometres from the proposed development site boundary.

Baseline
The baseline is the same as for the landscape and visual assessment, which is described in EIAR LVIA chapter.

Sensitivity
Sensitivity criteria for both landscape and visual receptors is the same as those outlined above.

Magnitude
The magnitude of the effect is assessed in the same way, based on the tables above, but the emphasis is on the *additional changes caused by a proposed development* as noted above, and includes the size and scale of the change, the extent of the area to be affected, and the duration and reversibility of the effect.

The GLVIA (2013) and SNH (2012) guidance also notes that in terms of identifying cumulative visual effects, an important element is the way in which they are experienced, and that they can be both experienced in combination, where two or more developments are visible from one viewpoint, as well as sequentially, where a viewer moves to another viewpoint and sees the same or different developments. The photomontage viewpoints in the LVIA are important in terms of illustrating the cumulative assessment of visual effects, as they illustrate combined visibility, and analysis of the photomontages and route screening allows sequential visibility to be assessed.