Landscape Institute Technical Guidance Note

Visual Representation of Development Proposals

Technical Guidance Note 06/19

17 September 2019

This Technical Guidance Note is under review (January 2024)

This guidance aims to help landscape professionals, planning officers and other stakeholders to select types of visualisations which are appropriate to the circumstances in which they will be used. It provides guidance as to appropriate techniques to capture site photography and produce appropriate visualisations.

Contents

1 Introduction

1.1 Purpose of this Guidance

1.1.1 This document aims to help landscape professionals, planning officers and other stakeholders in the selection, production and presentation of types of visualisation appropriate to the circumstances in which they will be used. In doing so, it follows and amplifies the broad principles set out in The Guidelines for Landscape and Visual Impact Assessment 3rd edition (GLVIA3). Consistent with the Environmental Impact Assessment Regulations (EIA Regs), GLVIA3 advocates proportionate and reasonable approaches to the scope of assessments.

1.1.2 In all instances, the principles of clear, open and transparent communication and fitness for purpose should apply. Visualisations produced in accordance with this guidance should assist in informed decision-making.

1.2 Why Visualisations are Required

1.2.1 The world we live in constantly changes and this affects our visual experience. New development is one of the causes of this change. When people are asked to consider the merits of new development proposals or major changes in the landscape, the information available normally includes images illustrating the likely appearance of the proposals. Developers will often illustrate their proposals in brochures using drawings, photographs and artists impressions. Many other kinds of images are used in the formal planning process.

1.2.2 This guidance focuses on the production of **technical visualisations**, described as Visualisation Types, which are intended to form part of a professional Landscape and Visual Impact assessment (LVIA), Townscape and Visual Impact Assessment (TVIA) or Landscape and Visual Appraisal (LVA) that typically accompany planning applications. It is critical that these visualisations are accurate, objective and unbiased. They should allow competent authorities to understand the likely effects of the proposals on the character of an area and on views from specific points.

1.2.3 In contrast, **illustrative visualisations** may be intended for marketing or to support planning applications by conveying the essence of what a proposal would look like in context. These do not have to be based on specific viewpoints and could, for example, include a colour perspective illustration or an artists impression based on a bird's eye view.

1.2.4 Similarly, context photographs and sketches may be effective ways to communicate to stakeholders, in advance of, or association with, more sophisticated Visualisation Types. Generally speaking, they will not be used to explain design proposals *within the planning process*. They may indicate the appearance or context of a landscape or site, show specific points of detail, or be used for internal design iteration. Such illustrations, sketches and photographs are not, therefore, the subject of this guidance.

1.2.5 Technical visualisations can take a variety of generally 'static' forms, including: annotated photographs, wirelines, photomontages and 3D simulations. Plans and sections are potentially effective ways to communicate to stakeholders, in association with visualisations.

1.2.6 Augmented Reality (AR) and Virtual Reality (VR) are 'dynamic' visualisation techniques which are considered separately in this guidance.

1.2.7 Photographs show the baseline conditions; visualisations show the proposed situation; and both combine to simulate the change, for example as photomontages. Visualisations help to show how a proposed development could give rise to change in the character of a place, or affect the quality and nature of views, for example through introduction of new built elements or structures, changes in ground level, and loss of trees, vegetation or landscape features. Visualisations may also be used to illustrate other forms of landscape change, such as changes arising from landscape management or from influences such as climate change.

1.2.8 Depending upon the nature / type of the development or change, visualisations may need to show the development: during construction (if the construction period is of long duration and a notable element of the proposal's visual impact); at specific points in time during operation to illustrate the effectiveness of landscape mitigation; or possibly at decommissioning and restoration (e.g. as with a quarry or landfill site).

1.2.9 Visualisations should provide the viewer with a fair representation of what would be likely to be seen if the proposed development is implemented and should portray the proposal in scale with its surroundings. In the context of landscape / townscape and visual impact assessment, it is crucial that visualisations are objective and sufficiently accurate for the task in hand. In short, visualisation should be fit for purpose.

1.2.10 Visualisations may be used to illustrate other forms of landscape change, such as changes arising from landscape management or from influences such as climate change.

1.2.11 Some types of visualisation are more readily or quickly produced, but all visualisations share a role as a form of graphic communication, intended to represent the anticipated change in the visual environment, to illustrate key components of the proposed change or to give an indication of how much would or would not be visible from a given location.

1.2.12 As a general principle, any visualisation should reasonably represent the proposal in such a way that people can understand the likely landscape and visual change. The degree of detail shown will typically be relative to the design and / or planning stage that has been reached. Visualisations should assist interested parties in understanding the nature of a proposed development within its context, and its likely effects. Their use as part of an iterative process of assessment and design can help inform sensitive siting, design and primary mitigation, all of which are important considerations in the planning process. Showing the development within its context should help to secure better design at an early stage.

1.2.13 Two-dimensional visualisations, however detailed and sophisticated, can never fully substitute what people would see in reality. They should, therefore, be considered an approximation of the three-dimensional visual experiences that an observer might receive in the field.

1.2.14 Note that this guidance cannot provide a complete manual of techniques. Landscape professionals may need to draw upon the expertise of visualisation specialists, particularly for the most sophisticated forms of photography and visualisation.

1.3 A Proportionate Approach

1.3.1 To maintain a proportionate approach, different types of visualisation may be required, depending on:

- the type and scale of project;
- the aim (Purpose) and likely audience (Users) of the visualisation in the decision-making process; and
- the Sensitivity of the receptors and Magnitude of potential landscape and visual change.

1.3.2 The time, effort, technical expertise and cost involved in producing visualisations should be proportionate to these factors.

1.3.3 Other considerations which influence the scope of required visualisations, which should be reasonable and proportionate in relation to Purpose, are:

- The number of viewpoints to be illustrated photographically, and how many of these require visualisations;
- The Visualisation Type (1-4 in the following guidance); and
- The level of detail illustrated within the visualisation, for example as described in the London View Management Framework (see Appendix 6.4)

1.3.4 This guidance represents current best practice, provides a starting point to identify what types of visualisation may be appropriate and sets out approaches to potential visualisation techniques.

1.4 Relationship to previous LI Guidance

1.4.1 This guidance note replaces Landscape Institute (LI) Advice Note 01/11 (Photography and Photomontage for LVIA) and LI Technical Guidance Note 02/17 (Visual Representation of Development Proposals).

1.4.2 Advice Note (AN) 01/11 has been replaced in order to:-

- reflect other sources of guidance and additional research on the topic (see Section 5 - Further Reading);
- accord with the principles of GLVIA3 (2013) - (especially GLVIA3 paras 8.15-8.34);
- encourage best practice in the presentation of visualisations accompanying LVIAs, LVAs and planning applications; and
- ensure that visualisation techniques are properly explained and easily understood by all Users.

1.4.3 TGN 02/17 has been integrated in this guidance in order to provide a single source of guidance from the LI in respect of visualisations. LI AN 01/11 and TGN 02/17 are now withdrawn.

1.4.4 Further information on related landscape and visual assessment, and visualisation advice, may be found on the LI website: https://www.landscapeinstitute.org

1.4.5 These include:

- Glossary and Abbreviations;
- Earth Curvature;
- Camera Auto Settings and Limitations of Zoom Lenses; and
- Examples of Visualisation Types 1-4.

1.5 Visualisation Guidance by Others

1.5.1 This guidance applies to visual representation of all forms of development. The LI recommends its use to its members and to all parties using visualisations as part of the development process. The LI recognises that, for some types of development, targeted or authority-specific guidance may be appropriate.

1.5.2 The Highland Council (THC) Visualisation Standards for Wind Energy Developments 2016, the SNH Visual Representation of Wind Farms 2017 and the London View Management Framework 2012 (LVMF) are examples of 'authority-specific' guidance.

1.5.3 The LI supports Scottish Natural Heritage Guidance: Visual Representation of Wind Farms v2.2 February 2017 (SNH 2017). This Technical Guidance Note is broadly consistent with SNH 2017, particularly in respect of Type 4 Visualisation (see Sections 3 and 4).

1.5.4 The London View Management Framework provides useful guidance for large-scale urban development, and is particularly useful in identifying what it refers to as 'AVR Types' (0 - 3). See 'Further Reading' and Appendices 6.4 and 11.3.

1.5.5 When regulatory authorities specify their own photographic and photomontage requirements, the landscape professional should follow them unless there is a good reason not to do so. Failure to follow such guidance may risk requests for further information during the planning consultation process. Failure to satisfy stated validation requirements could lead to delays in validating planning applications. Seeking early engagement with the competent authority is recommended.

2 Guiding Principles

2.1 This guidance follows the broad principles set out in GLVIA3. Readers should note should note the comments in the Introduction (para 1.2.13) regarding the limitations of two-dimensional images.

2.2 Baseline photography should:

- be sufficiently up-to-date to reflect the current baseline situation;
- include the extent of the site and sufficient context;
- be presented at a size and relative position, on a corresponding sheet, to allow like-for-like comparison with the visualisation;
- be based on good quality imagery, secured in good, clear weather conditions wherever reasonably possible *(see Appendix 4 and GLVIA3 para 8.22)*;
- avoid foreground clutter; and
- in LVA / LVIA baseline photography, if relying on only existing views with no visualisations, clearly identify the extent of the application site in the view *(see Type 1 Visualisations)*.

2.3 Visualisations should:

- provide a fair representation of what would be likely to be seen if the proposed development is implemented;
- be based on replicable, transparent and structured processes *(Section 4)* and use a reasonable choice of agreed viewpoint locations, view directions, view angles and times of day *(Appendix 4)*;
- be reproduced at a suitable size and level of geometric accuracy relative to the baseline photographs *(Sections 3/4 and Appendices 7/8)*;
- be accompanied by appropriate information, including a Technical Methodology and required data within page title blocks *(Appendix 7.2 and 10)*; and
- where necessary, the photography and visualisation should be capable of being verified *(see Visualisation Type 4, Section 4 and Appendix 11)*.

2.4 The producers of visualisations should:

- refer to GLVIA3 paras 8.15-8.31
- use Visualisation Types 1-4, described further below, selected by reference to Purpose of use and anticipated Users, combined with the indicative overall Degree or Level of Effect (a product of Magnitude and Sensitivity) *(see Section 3)*;
- use techniques and media, with appropriate explanation, that represent the proposed scheme and its setting as accurately as reasonably practicable, proportionate to its potential effect;
- where reasonable within project timescales, include maximum effect scenario *(e.g. winter views - see GLVIA3 paras 6.28, 8.15)*; and
- use appropriate equipment and settings *(Sections 3/4 and Appendices 1-5)*.

3 Taking a Proportionate Approach

3.1 Understanding the Proportionate Approach

3.1.1 This section concerns how to determine which type of visualisation is proportionate to the task in hand. When identifying the need for some form of visual representation, landscape professionals, competent authorities and other stakeholders should use this guidance as the basis for reaching agreement on the appropriate Visualisation Type for the project in question. That does not preclude subsequent preparation of other visualisations, but working this way should help to ensure that public interests are secured in a way that is recognised as proportionate and fit for purpose by all those involved.

3.1.2 The factors which determine the appropriate Visualisation Type are:

- the intended Purpose of the visualisation;
- the anticipated Users;
- the stage in the planning application process;
- the Sensitivity of the context / host environment, having regard to the landscape and visual receptors [1]; and
- the likely overall Magnitude of effect of the development in terms of its 'size and scale', 'geographic extent' and 'duration and reversibility' [2].

3.1.3 Selecting the appropriate Visualisation Type requires a staged approach, described in more detail below in this section, and summarised as follows:

- identifying the Purpose and Users of the visualisation;
- identifying the type and nature of the proposed development and early indications of the likely overall Magnitude of effect it would generate;
- examining the context / host environment in which the development would be placed and assessing its overall Sensitivity;
- using the above to arrive at an indicative overall 'Degree or Level of Effect'; and
- selecting the most appropriate Visualisation Type based on the above criteria; and
- explaining the reason for its selection.

3.1.4 The process of selecting Visualisation Types can be considered in terms of a need for increasing levels of scrutiny of information or evidence required, with Purpose and Users considered alongside the likely overall effect of the proposed development on the host environment.

3.1.5 This guidance proposes four Visualisation Types (1-4), from least to most sophisticated, which are described in more detail in Section 4 and summarised in Tables 1 and 2 below.

[1] GLVIA3, paras 6.31- 6.37
[2] GLVIA3, paras 6.38- 6.41

3.2 Working with the Competent Authority

3.2.1 EIA development may be subject to Scoping, which can be used to help determine the appropriate scope and level of detail for the visual components of the LVIA. For non-EIA development, developers are encouraged to request pre-application ('pre-app') advice. If landscape / townscape and visual issues will be a key issue, submission of the proposed visualisation approach, suggested viewpoints and a Zone of Theoretical Visibility (ZTV), will assist in reaching agreement with the competent authority. Draft visualisations which are not fully worked up can be used for pre-app discussions or scoping requests. This should help reduce risk of requests for further information during the planning consultation period, and consequential further costs and delays.

3.2.2 The landscape professional is likely to need to determine an approach to visualisation before having completed (or possibly started) the LVA / LVIA itself. Therefore, a preliminary judgement on the likely overall 'Degree or Level of Effect' will be required. Whilst this should not prejudice the detailed process or outcome of the LVA / LVIA, the context and likely extent of the proposal will be known at an early stage and should be sufficient to inform the initial assessment.

3.2.3 It may be possible at this stage to anticipate a transition from one Purpose and set of Users to another during the course of the project and, therefore, to determine an approach appropriate to the spectrum of Users involved. A typical example is the transition from Planning Application to Planning Appeal.

3.2.4 Although this guidance is particularly aimed at visualisations prepared for use in the decision making process with competent authorities as the intended main Users, visualisations may also be used iteratively during the design process where the Users will be design / planning professionals and their clients.

3.3 Purpose and Users

Purpose

3.3.1 A principal consideration is the of the visualisation, i.e. the Purpose for which it will be used. For example, does it:

- provide basic contextual information in support of a planning application?
- purport to demonstrate the visual change that will be brought about if the development proceeds? or
- aim to prove or disprove if the development is visible, or demonstrate the effectiveness of a mitigation strategy?

3.3.2 Examples of the potential range of Purposes are:

- the illustration of a project prepared for the client as the project develops;
- the illustration of a development proposal prepared to accompany a planning application; and / or
- to illustrate the likely change in a view that may occur as a result of the development being introduced into that view; to inform an LVA or LVIA, e.g. as part of an EIA.

Users

3.3.3 In addition to being clear about the Purpose of the visualisation, it is important to understand and identify the likely Users. Are they:

- people potentially affected by the development who are being asked to give an early opinion as part of a consultation process?
- clients?
- other consultants communicating with the landscape professional?
- those formally commenting on the planning application?
- planning officers considering the merits of an application?
- participants at public inquiry (including members of the public, expert witnesses, legal advisers, Inspectors and Reporters)? and / or
- decision-makers (Councillors, Reporters / Inspectors, Ministers)?

3.4 Combining Purpose / User and Degree or Level of Effect

3.4.1 Having established the Purpose and Users of the visualisations, it is necessary to consider these in relation to the type of development proposed and the likely overall effect it would have on the host environment, having regard to landscape and visual receptors, in line with GLVIA3 principles.

3.4.2 An assessment of the Sensitivity of the context or host environment, together with a judgement of the likely Magnitude of landscape and visual change that may result as consequence of the development, will establish the indicative overall Degree or Level of Effect. This, considered with the Purpose and Users of the visualisation, will help determine which Visualisation Type would best suit the circumstances of the proposal and aid informed decision making.

3.4.3 Sensitivity and Magnitude, as determinants of Degree or Level of Effect, are extensively discussed in GLVIA3, as amended by GLVIA3 Statement of Clarification 1/13 (10-06-13)[3].

3.4.4 The broad principles of assessment are set out in GLVIA3 Figure 3.5. These principles apply to both landscape and visual effects and have clear contributory factors:

- susceptibility and value for Sensitivity;
- size / scale, extent, duration and reversibility for Magnitude.

3.4.5 When assessing Sensitivity and Magnitude and arriving at a judgement of indicative overall Degree or Level of Effect, consideration should be given to the landscape and visual effects of the project as a whole, rather than against individual viewpoints or receptors.

[3] statements of clarification 3 and 4 clarify and augment GLVIA3 paras 3.32-3.36, p.40-41.

3.5 Selecting the Appropriate Visualisation Type

3.5.1 Drawing these threads together, identifying the Visualisation Type, proportionate to the project under consideration, involves combining its Purpose / Users with the indicative overall Degree or Level of Effect of the proposed development. This, in turn, requires an understanding of:

- the landscape / townscape and visual context within which the development may be seen;
- the type of development proposed, its scale and size; and
- the likely overall landscape and visual effect of introducing the development into the existing environment.

3.5.2 The four Visualisation Types proposed in this guidance comprise the following (from least to most sophisticated, in terms of equipment, processing and presentation):

Type 1 annotated viewpoint photographs;
Type 2 3D wireline / model;
Type 3 photomontage / photowire;
Type 4 photomontage / photowire (survey / scale verifiable).

3.5.3 The most sophisticated Visualisation Types are appropriate when the Purpose / User requires the highest levels of accuracy, and the Sensitivity and Magnitude combine to generate the highest Degree or Level of indicative overall Effect.

3.5.4 The Visualisation Types are summarized in Table 2 and described in more detail in Section 4. Types 1-4 are typically all 'static' visualisations (i.e. capable of being printed).

3.5.5 'Dynamic' visualisations such as Augmented and Virtual Reality (AR / VR) are dealt with separately in Section 4.6.

3.5.6 Table 1 provides a broad indication as to appropriate Visualisation Types for different Purposes and Users. Note that Categories 'A' to 'D' illustrate four convenient levels along a scale, not four fixed interpretations.

Table 1: Relationships between Purpose, User and Visualisation Types

Category	Purpose and Users	Appropriate Visualisation Types
A	Evidence submitted to Public Inquiry, most planning applications accompanied by LVIA (as part of formal EIA), some non-EIA (LVA) development which is contrary to policy or likely to be contentious. Visualisations in public domain.	2 - 4
B	Planning applications for most non-EIA development accompanied by LVA, where there are concerns about landscape and visual effects and effective mitigation is required. Some LVIAs for EIA development. Visualisations in public domain.	1 - 4
C	Planning applications where the character and appearance of the development is a material consideration. LVIA / LVA is not required but supporting statements (such as Planning Statements and Design and Access Statements) describe how the proposal responds to landscape context and policies. Visualisations in public domain.	1 - 3
D	To inform the iterative process of assessment and design with client, and / or pre-application consultations with the competent authority. Visualisations mainly confidential.	1 - 2

3.5.7 The decision as to appropriate Visualisation Type should be based on a proportionate approach, taking account of its Purpose / Users and indicative overall Degree or Level of Effect (based on Sensitivity and Magnitude) of the proposed development. In all cases, professional judgement should be applied, and agreement reached with the competent authority wherever possible.

3.5.8 A combination of simpler and more sophisticated graphics may be appropriate to illustrate specific points. So, for example, 3D models, or annotated viewpoint photos (Types 1 and 2) at less important locations, may usefully support more sophisticated (Types 3 and 4) visualisations at key locations.

3.5.9 However, different interpretations of scale between visualisations should be avoided unless there is a specific reason to do so, which should be explained in the Visualisation Type Methodology, the subject of the next section.

3.5.10 When making a final choice it will be important to consider:

- The contextual Sensitivity and Magnitude of landscape and visual effects of the development overall (rather than that applying to a single location) and the application of a proportionate and consistent approach.
- Cost of the visualisation; several factors are relevant here. Firstly, it depends on what readily available technologies are available to the landscape professional. Secondly, it depends on the nature (type, size and scale) of the development and thirdly, on the degree of realism required. For example, wind farm visualisations are less expensive to prepare than for mixed use or other forms of development, because wind farms consist of a number of single objects of the same size and shape with the same surface finish. However, subject to the proportionality principle, cost considerations should not override the reasonable requirement for appropriate visualisations.
- Available technology – some techniques are dependent on particular technologies / software (e.g. digital photo / panoramic viewers) which not all of those preparing visualisations will have access to. Nor will competent authorities necessarily be able to view particular technologies.
- The nature of the development and how it may best be illustrated. For example, where a development is predominantly screened from view, a photowire image may be more helpful than a photomontage, as it can indicate the position of the development beyond any screening.

3.6 Introducing Visualisation Types 1-4

3.6.1 Table 2 below sets out the general aims of Visualisation Types 1-4, together with indications of appropriate locational accuracy, photographic equipment and presentational approaches.

3.6.2 Note that it is not possible to categorise every possible kind of visualisation into Types 1-4; some inevitably straddle categories. If a visualisation does not fit neatly into one of the four categories, that does not make it unacceptable, provided it is fit for purpose and not misleading, and is clearly explained in the Visualisation Type Methodology.

Table 2 Visualisation Types 1-4		Type 1	Type 2	Type 3	Type 4
		Annotated Viewpoint Photograph	3D Wireline / Model (non-photographic)	Photomontage / Photowire	Photomontage / Photowire Survey / Scale Verifiable
Aim of the Visualisation		To represent context and outline or extent of development and of key features	To represent 3D form of development / context	To represent appearance, context, form and extent of development	To represent scale, appearance, context, form, and extent of development
Photographic Equipment	Tripod	Recommended but discretionary	Not relevant	Recommended	Necessary
	Panoramic head	Not relevant	Not relevant	Recommended for panoramas	Necessary for panoramas
	Minimum Camera / Lens	Cropped frame or FFS + 50mm	Not relevant	Cropped frame or FFS + 50mm	Full Frame Sensor (FFS) + 50mm FL lens [1]
Locational Accuracy	Source of camera/viewpoint location data	GPS, OS Maps, geo-referenced aerial photography	Varies according to technology	Use good quality data: GPS, OS Maps, geo-referenced aerial photography, LiDAR	Use best available data: High resolution commercial data, LiDAR, GNSS, or measured / topographic surveys
	Survey-verified [2]	Not relevant	Not relevant	Not relevant	When appropriate
Data & Presentation	Verifiable (SNH) [3]	Not relevant	Not relevant	Not relevant	Required
	3D model	Not required	Required	Required	Required
	Image Enlargement [4]	Typically 100%	Not relevant	Typically 100%	100% - 150%
	Form of Visualisation	sketch / outline / arrows	massing / wireline / textured	wireline / massing / rendered / textured to agreed AVR level [5]	wireline / massing / rendered / textured to agreed AVR level [5]
	Viewpoint mapping	Dedicated viewpoint location plan	Dedicated viewpoint location plan	Dedicated viewpoint location plan	Dedicated viewpoint location plan, + individual inset maps recommended
	Reporting of methodology and data sources	Outline description of sources and methodology recommended	Outline description of sources and methodology recommended	Data, sources and methodology recommended	Verifiable data, sources and methodology required

Table 2 footnotes:

1 **FFS+50mm FL** - note exceptions to 50mm lens FL. See Section 4 and Appendices 01 and 06.

2 **Survey-verified** means the camera position and survey features being recorded by highly accurate survey processes. See Section 4 Locational Accuracy & Appendix 14.

3 **Verifiable (SNH)** has the same meaning as in SNH 2017 - the photographic process and image scaling is capable of being verified to agreed standards by reference to the original photograph with metadata. See Appendices 6 & 11.

4 **Image Enlargement** - see 3.8 below.

5 **AVR level** - see Appendix 6.4.

3.7 Visualisation Type Methodology

3.7.1 For any given project for which visual representation may be required, the proposed approach to visualisation should be set out in a brief description, explaining:

- the anticipated Purpose / Users;
- the indicative assessment of Sensitivity and Magnitude and resulting likely indicative overall Degree or Level of Effect; and
- other factors influencing the selection of the Visualisation Type.

3.7.2 This may be combined with a preliminary selection of proposed viewpoints and submitted to the competent authority and, ideally, agreed prior to submission of any planning application. See also GLVIA3 para 6.18.

Examples

3.7.3 The following are examples of using Tables 1 and 2 to arrive at an appropriate Visualisation Type 1-4. Letters A-D refer to the 'Category' column in Table 1 above.

(1) ***A single house****, submitted as a planning application in a prominent location within a designated landscape, might be regarded as:*

- *Purpose / User C, Planning Application;*
- *High-Medium Sensitivity, Small-Negligible Magnitude;*
- *likely Slight-Moderate Degree or Level of Effect.*

This would suggest ***Type 1*** *visualisations - perhaps an annotated photograph (40° at A3 width) indicating the extent (width / height, or outline) of the proposed development.*

(2) Pre-application discussions with developer over ***proposals to re-work a large clay waste tip*** *on the edge of a National Park, screened as requiring EIA. Accurate output from a 3D model is required to understand the nature and magnitude of visual impacts from key sensitive locations and determine the need for fully rendered photomontage to form part of a formal LVIA.*

- *Purpose / User D, pre-application discussions;*
- *High Sensitivity context, Large Magnitude;*
- *likely Substantial Degree or Level of Effect.*

This would suggest ***Type 2*** *(3D modelling) - outputs required for informed discussion, not determination of planning application.*

(3) ***A small quarry / extension****, submitted as a planning application, in a landscape considered of medium to high sensitivity to the proposed change, might be regarded as:*

- *Purpose / User B, accompanying an LVA;*
- *Medium Sensitivity, Medium Magnitude;*
- *likely Moderate Degree or Level of Effect.*

*This would suggest **Type 3** - photowires or photomontages (40° at A3 width or 90° at A1) indicating the appearance of the proposed development.*

*(4) **A large housing site**, submitted as a planning application with potential implications on a local designation (e.g. Conservation Area or Important Landscape Area) might be regarded as:*

- *Purpose / User B, accompanying an LVA;*
- *High-Medium Sensitivity context, Large-Medium Magnitude;*
- *likely Substantial Degree or Level of Effect.*

*This would suggest **Type 3** photowires or photomontages, or possibly **Type 4** (surveyed) if close-proximity sensitive views were required.*

*(5) **A large wind farm** in a locally-designated landscape area, the subject of a public inquiry, might be regarded as:*

- *Purpose / User A, part of an EIA;*
- *High-Medium Sensitivity, Large Magnitude;*
- *likely Substantial Degree or Level of Effect.*

*This would suggest **Type 4** visualisations, where surveyed locational accuracy is not necessary but image enlargement, to illustrate perceived scale, would be appropriate.*

*(6) Planning application for **a very large energy from waste plant** building with 90m twin stacks and plume emissions on an edge of town industrial estate, within potential visual range of important views from a Grade 2 Registered Historic Park (designated heritage asset):*

- *Purpose / User A / B (Planning / Public Inquiry);*
- *High Sensitivity, Large-Medium Magnitude;*
- *likely Substantial Degree or Level of Effect.*

*This would suggest **Type 4** visualisations, where surveyed locational accuracy may not be necessary but image enlargement, to illustrate perceived scale, would be appropriate.*

*(7) **A proposed new tower block** with potential implications on a designated landscape / townscape, subject to a planning application, might be regarded as:*

- *Purpose / User A / B (Planning / Public Inquiry);*
- *High Sensitivity, Large Magnitude;*
- *likely Substantial or Very Substantial Degree or Level of Effect.*

*This would suggest **Type 4** visualisations. In addition, if the precise visual relationship between the tower block and other buildings is of particular importance, surveyed locational accuracy may be appropriate.*

3.7.4 The preceding examples are just that - examples - and should not be regarded as templates. This approach can be used in preparing a Visualisation Type Methodology. It is not a sophisticated LVA / LVIA, but a review of basic criteria, known early in the project, to inform selection of appropriate Visualisation Types.

3.7.5 The selected Visualisation Type (1-4) should be clearly stated on all visualisation pages, such that recipients can understand the approach being taken.

3.8 Viewing Distance and Image Enlargement

3.8.1 Table 2 introduces the concept of 'image enlargement', which is carried forward into the detail of Visualisation Types 3-4 , described in the next section.

'Monocular' and 'Binocular' viewing

3.8.2 Printed photographic images have a theoretical viewing distance at which the scale of the view is reconstructed, although this assumes that cameras and humans have similar optical systems, which they do not. The essential difference is that cameras (for this purpose) are monocular, and humans are generally binocular. In addition, the fact that reality is viewed as a 3D space, whereas photographs are viewed as 2D projections, combine to alter perceptions of 'scale' and 'depth' between reality and photography. See Section 5 'Further Reading' for more information.

3.8.3 Whilst mathematical viewing distances have historically been quoted alongside visualisations, it is generally regarded that viewing distances of between 500mm – 550mm (approximately arm's length) are the most practical and widely used. All scale-representative views should, therefore, be accompanied by a note: "To be viewed at comfortable arm's length".

100% Reference Image

3.8.4 A 'mathematically correct' image is established for a 50mm FL approximately 39.6 Horizontal Field of View (HFoV) image, printed at a size of 390mm x 260mm on an A3 sheet, and held at 542mm[1] from the eye. This 'monocular view' represents a reference point of 100% in this guidance note, against which enlargements, such as 150%, can be described. For example, a 50% increase in image size can be described as a 150% enlargement.

3.8.5 Changes in the relative size of printed images are described in other documents as the 'Effective Focal Length' (EFL) at which an image is presented. 50mm EFL equates to 100% and 75mm EFL equates to 150%. For simplicity, this guidance describes the enlargement by percentage, related to the 100% reference image.

150% Enlargement Factor

3.8.6 Whilst presenting a 50mm FL image (39.6° HFoV) at A3 size is a straightforward use of the camera image, this approach has been found to be lacking in respect of expansive projects in open landscapes or seascapes, such as windfarms. This is because, for a 50mm FL image printed at A3 and held at comfortable arm's length, the scale of the viewed image is smaller than reality.

3.8.7 As a result of research in Scotland over the last decade (see Section 5 - Further Reading) there is a consensus that increasing the printed image size by 150% (as if a 75mm FL lens had been used) provides a better impression of scale for most viewers using two eyes (binocular vision). This is particularly appropriate for projects such as windfarms, whether viewed on a desktop or on site.

3.8.8 The approach of this guidance is, therefore, to recognise that, for larger-scale projects with more distant components such as windfarms, the approach taken in SNH 2017 (put simply, a 150% enlargement) is appropriate.

3.8.9 This brings with it some issues:

a) Paper size or constrained Field of View

Adding 50% to the image size increases the presentation size (digital or paper). Conversely, the site can only be represented

1 Note that 542mm simply establishes a mathematical reference point. Generally, there is no need to hold the image at such a specific distance.

if it can be accommodated within an A3 sheet (27°HFoV x 18.2° VFoV) or A1 sheet (53.5°HFoV x 18.2°VFoV). If it occupies a greater vertical or horizontal FoV, then alternatives must be considered.

This is accounted for in the SNH Guidance, in that exceptions to its standard can be discussed and agreed with SNH.

b) Appropriateness in all situations

Whilst the 150% enlargement overcomes the scale issues for the expansive projects for which it was designed, it may over-compensate for projects in more constrained environments, such as urban or small-scale enclosed landscapes. In these situations, less enlargement may be appropriate.

3.8.10 Research by the LI Working Group in the preparation of this guidance, carried out across several cities, suggests that, in mid- to smaller-scale landscapes / townscapes, an enlargement around half-way between 100% and 150% results in a binocular relationship between the presented image and reality.

3.8.11 In addition, there will be situations - for example very close urban contexts or developments of considerable height or width - where scaling at less than 150% may provide more flexibility to fit an image on the page.

3.8.12 In these instances, the landscape professional should present the logic, behind opting for a particular enlargement factor, to the competent authority.

3.8.13 Notwithstanding the above, SNH considers that consistent use of 150% enlargement is beneficial.

Other means of achieving enlarged images

3.8.14 An A3 (50mm FL, 39.6° HFoV) sheet, when printed at A2 size, is enlarged by 141%. This provides a basic way to create a printed page with improved image scaling, simply by printing an A3 figure, enlarged to fill an A2 sized sheet. This will, however, result in some loss of resolution compared to an image which is created to be placed in an A2 sheet at full resolution. It should not, therefore, be used in the more rigorous context of Visualisation Type 4.

3.8.15 A 35mm FL lens on a FFS camera will capture a HFoV of 54.4°, which is very close to the requirements of an SNH 2017 planar A1 panorama (53.5° HFoV). Whilst it will not satisfy SNH 2017 Guidance (which requires the 50mm / FFS combination) a 35mm FL image of sufficient resolution and clarity may, therefore, provide an A1-width planar panoramic image, without stitching and re-projecting of multiple 50mm images.

3.8.16 In either case, the practitioner should ensure that image quality is appropriate for the Purpose, and set out the approach in the Visualisation Type Methodology (3.7) and Technical Methodology (Appendix 10).

4 Description of Visualisation Types 1-4

4.1 Visualisation Types 1-4

4.1.1 The main characteristics of Visualisation Types 1-4 are introduced below. More detail on these 'static' visualisations is provided in the sections which follow, including a separate subsection on 'dynamic' visualisations, namely AR / VR.

Type 1 Annotated Viewpoint Photograph:

Reproduced at a size which aids clear understanding of the view and context, these simply show the extent of the site within the view, and annotate any key features within the view.

Type 1 is the most basic form of visual representation with a focus on the baseline information.

Type 2 3D Wireline / Model:

This covers a range of computer-generated visualisation, generally without a photographic context. Wirelines and other 3D models are particularly suited to graphically describing the development itself.

Type 2 visualisations use basic graphic information to assist in describing a proposed development and its context.

Type 3 Photomontage / Photowire:

This Type encompasses photomontages and photowires which will commonly be produced to accompany planning applications, LVAs and LVIAs. They provide a reasonable level of locational and photographic accuracy, but are not suitable for the most demanding and sensitive of contexts. Type 3 visualisations do not need to be accompanied by verification data, nor is a precise survey of features and camera locations required. Although minimum standards are set for image presentation, the visualisations do not need to be reproduced with scale representation.

Type 3 visualisations offer an appropriate level of detail and accuracy for a range of EIA and non-EIA projects.

Type 4 Photomontage / Photowire (survey / scale verifiable):

Type 4 photomontages and / or photowires require the use of equipment and processes which provide quantifiable verification data, such that they may be checked for accuracy (as per industry-standard 'AVRs' or 'Verified Views'). Precise survey of features and viewpoint / camera locations may be included where warranted. Type 4 visualisations are generally reproduced with scale representation.

Type 4 visualisations represent the highest level of accuracy and verifiability for use in the most demanding of situations. See also Appendix 11, Verified Photomontages.

4.1.2 In providing flexibility across Visualisation Types 3 and 4, there is inevitably some degree of overlap between them, for example in terms of image scaling or presentation size. Whilst Type 3 will be acceptable in many situations, only Type 4 methodology and equipment can provide the levels of verifiable accuracy which are appropriate to high Sensitivity contexts and Purposes.

4.2 Type 1: Annotated Viewpoint Photograph

4.2.1 Viewpoint photographs are often used in LVIAs and LVAs and may usefully be annotated to show the extent or position of the site and other features. 3D-modelling is not required - the annotations of site extent (horizontally) may be estimated by reference to site features such as field or plot boundaries.

4.2.2 Single images will be planar (i.e. as captured by the camera). Alternative lens types may be considered - see Appendix 1. Where single images can capture the site (e.g. 39.6° x 27°) and be presented at A3, they may be supported by two baseline panoramic images (maximum 60° HFoV) presented on an A3 sheet. This is purely to show the location of the full-size single image frame in its context and, as such, should be noted as being 'for context only'. Wide panoramas on an A3 sheet are too small to provide a representation of the proposed development.

4.2.3 Where panoramic images are required to capture the site, they may be presented as cylindrical panoramas of up to 90° HFoV at A1 width with an image size of 820mm x 250mm (see Appendix 8). This sizing equates to around 96% image 'enlargement'.

4.2.4 Locational accuracy is moderately important, and reasonably precise locations can be determined from GPS data, OS maps or aerial photography.

4.2.5 Refer also to the Technical Methodology, Appendix 10.

Table 3: Suitable photographic / print formats (Type 1):

Camera / lens	FFS + 50mm lens	Cropped frame + 28 or 35mm lens
Sheet size	A3	
Image size (mm)	390 x 260	
Presented Field of View (H x V)	39.6° x 27°	Either 35mm = slightly narrower than FFS+50mm, or crop 28mm image to match FFS+50mm
Sheet size	Cylindrical Panoramic image @ A1 width	
Presented Field of View (H x V)	90° x 27° (VFoV as appropriate)	
Image size (mm)	820 x 250 minimum (height as appropriate)	

Type 1 Summary

Type 1 visualisations are simple, annotated photographic illustrations which often accompany LVAs.

- Use a Full Frame Sensor camera with 50mm lens, or cropped-frame sensor camera with 35mm or 28mm fixed lens. See Appendix 1.
- Images will typically be presented with a single frame on an A3 sheet.

4.3 Type 2: 3D Wireline / Model

4.3.1 This Type covers the use of 'static' presentation of 3D models which are visual representations distinct from photographically-based photomontages.

4.3.2 The main examples are computer-generated 3D wirelines (also described as 'wireframes') and 'massing' models, potentially with computer-generated context, such as buildings, terrain or other surrounding features.

4.3.3 'Dynamic' visual representations, such as 'augmented reality' or 'virtual reality' (AR or VR), are dealt with separately in Section 4.6 below.

4.3.4 Images to be included in reports should be of sufficient size to communicate a sense of the scale of the development. An A3 Sheet, as with Types 1 and 3, would generally be appropriate. An image based on a 3D model to show proposed development layout (for example, an aerial view) need have no specific FoV or location reference, but should have a realistic sense of perspective.

4.3.5 Computer models generally do not convey landscape context unless they are extremely sophisticated. Most planning applications should be accompanied by photographs or photomontages, rather than solely relying on Type 2 visualisations to convey an impression of a development proposal.

4.4 Type 3: Photomontage / Photowire

4.4.1 Type 3 visualisations are photomontages or photowires (photographs with wireline overlays) where site photography forms the basis of the imagery, which is then overlaid by a 3D wireframe, massing or rendered model. Type 3 are suitable for representing proposals where precise perception of scale of the printed image, and the highest levels of locational accuracy, are not necessary. If the key criteria for Type 4 cannot be guaranteed, then the visualisation will be classified as a Type 3. 'Type 3' should be clearly stated on all visualisations.

Table 4: Suitable photographic / print formats (Type 3):

Camera / lens	FFS + 50mm lens	Cropped frame + 28 or 35mm lens
Presented Field of View (H x V)	39.6° x 27°	Either 35mm = slightly narrower than FFS+50mm, or crop 28mm image to match FFS+50mm
Sheet size	A3	
Image size (mm)	390 x 260	
Enlargement relative to FFS / 50mm	100%	100 - 120%
Sheet size	Cylindrical Panoramic image @ A1 width	
	90° x 27° (VFoV as appropriate)	
Enlargement relative to FFS / 50mm	96%	
Image size (mm)	820 x 250 minimum (height as appropriate)	

Lens and Camera

4.4.2 Full-Frame Sensor cameras (FFS) are appropriate. Cropped-frame cameras (e.g. Canon APS-C / Nikon DX) are acceptable when a fixed lens of 35mm FL is used. Alternatively a 28mm lens could be used and the resulting photographs cropped to achieve the same FoV as a 50mm FL lens with an FFS. See Appendix 1.2. Note that different cropped-frame lens / camera combinations will result in slightly different FoV and enlargement factors.

Purpose

4.4.3 Type 3 visualisations are intended to represent design, form and context to a reasonable degree of objectivity and accuracy, one which can be understood and relied on by competent authorities and others. This category covers a wide range of applications including non-verifiable viewpoint locations, such as those from moving vehicles / drones and other such situations where the viewpoint coordinates cannot be replicated with the same degree of accuracy / precision as Type 4 visualisations. It would also be appropriate where photographs have been taken by a 3rd party, provided these are prepared in accordance with the principles set out in this guidance and supported by a clear methodology.

4.4.4 Type 3 visualisations should not be selected when printed scale representation is required.

4.4.5 Single images are planar (i.e., as captured by the camera). Alternative lens types may be considered - see Appendix 1.

4.4.6 Where single images can capture the site (e.g. 39.6° x 27°) and be presented at A3, they may be supported by two baseline panoramic images (maximum 60° HFoV) presented on an A3 sheet. This is purely to show the location of the full-size single image frame in its context and, as such, should be noted as being 'for context only'. Wide panoramas on an A3 sheet are too small to provide a representation of the proposed development. They do not replace baseline photographs, which should be presented at the same size and scale as their corresponding visualisations.

Presentation

4.4.7 Imagery will typically be presented as two related sheets: Baseline photograph and photomontage. These should be presented at the same size to allow direct comparison. A wireframe may be included to explain alignment between the 3D model and site features.

4.4.8 Visualisations should be accompanied by a Technical Methodology, setting out the criteria listed in Appendix 10.

Panoramas

4.4.9 Where panoramic images are required to capture the site for visualisation, they may be presented as cylindrical panoramas of up to 90° HFoV at A1 width with an image size of 820mm x 250mm (see Appendix 8). This sizing equates to around 96% image 'enlargement' (i.e. a slight reduction from the 100% reference). When a wider FoV than 90 degrees needs to be captured, this should be done by using adjoining A1 sheets.

Locational Accuracy

4.4.10 It is important to disclose the level of locational accuracy of Type 3 visualisations, which should be determined on the basis of proximity of viewpoint to the site and on Sensitivity of receptors / importance of the view. The level achieved should be clarified in the methodology and the same approach should be taken for all visualisations presented. Typically, horizontal accuracy of 1-2 metres can be obtained from aerial photography. However, this may vary according to the aerial photography source and location (see Appendix 14) and this should be considered when reporting on locational accuracy in the methodology.

Type 3 Summary

Type 3 visualisations will be appropriate for many planning applications, LVAs and LVIAs, where photomontage is required but a verifiable process and printed scale representation are not needed.

- Use a Full Frame Sensor camera with 50mm lens or cropped-frame sensor camera with 35mm or 28mm fixed lens.
- Images will typically be presented with a single frame on an A3 sheet, providing an enlargement in the range 100-120% subject to camera / lens combination.
- The enlargement factor should be stated on each page, together with the label 'Visualisation Type: 3'.
- For very wide linear infrastructure, consider presenting cylindrical panoramas up to 90° at A1 width, with multiple sheets for very wide panoramas.
- Accompany visualisations with a Technical Methodology (see Appendix 10).

4.5 Type 4: Photomontage / Photowire (survey / scale verifiable)

4.5.1 Type 4 visualisations are photomontages or photowires, produced using quantifiable data, with procedural transparency and appropriate levels of accuracy. This involves using a defined camera / lens combination and establishing the camera location with sufficient locational accuracy to enable accurate scaling and location of the 3D model within the view. In addition, the print presentation size can be determined to provide binocular image scaling when appropriate (see Section 3.8). Note that, due to the variable nature of digital viewing devices, images cannot be assumed to provide a perception of scale unless printed at the specified size. See Appendix 7 for more details. 'Type 4' should be clearly stated on all visualisations.

4.5.2 See Appendix 6 'Preparing Photomontages' and Appendix 8 'Panoramas'.

Lens and Camera

4.5.3 Base photography should be carried out with a Full Frame Sensor (FFS) camera and 50mm Focal Length prime lens, unless there are exceptional conditions where wider-angle lenses are required to fully capture the scene (e.g. tall tower blocks - see below). In such cases, any departures from FFS + 50mm FL should be explained and agreed with the competent authority.

4.5.4 Table 5 represents the range of approaches suitable for Type 4 visualisations. Note that the stated percentage enlargement figures are relative to a 50mm FL image printed on an A3 sheet at 390mm x 260mm image size (para 3.8.4, 100% Reference Image).

Table 5: Suitable photographic / print formats (Type 4)

Camera / lens	FFS + 50mm lens	
Option	1	2
Captured Field of View (HFoV x VFoV)	39.6° x 27°	
Image scaling (see 3.8)	'Monocular'	'Binocular'
Sheet size	Single image @ A3	
Projection (see App 8)	Planar	
Image size (mm)	390 x 260	
Presented Field of View (H x V)	39.6° x 27°	27° x 18.2°
Enlargement relative to FFS / 50mm	100%	150%
Sheet size	Panoramic image @ A1 width	
Projection (see App 8)	Cylindrical (for baseline and very wide linear infrastructure)	Planar
Presented Field of View (H x V)	90° x 27°	53.5° x 18.2°
Enlargement relative to FFS / 50mm	96%	150%
Image size (mm)	820 x 250 minimum (height as appropriate)	

Note that exceptions to lens and image sizes are acceptable if explained and agreed with the competent authority

Presentation

4.5.5 Imagery will typically be presented as three related sheets: Baseline photograph; wireline / wireframe or photowire composite; and photomontage. These should be presented at the same size to allow direct comparison.

4.5.6 Visualisations should be accompanied by a Technical Methodology, setting out the criteria listed in Appendix 10. In addition, a clear written description should be provided to explain the procedures involved in image capture and processing.

Locational Accuracy

4.5.7 For Type 4, the minimum level of locational accuracy is similar to the upper end of the Type 3 range.

4.5.8 The degree of accuracy should be determined on the basis of proximity of viewpoint location to the site and on Sensitivity of receptors / importance of the view. Typically, horizontal accuracy within 1-2 metres can be obtained from aerial photography. See Appendix 14.

4.5.9 In situations where the subject of the photomontage is close and the Sensitivity is high (typically in important urban and heritage contexts) high levels of locational accuracy may be required to establish intervisibility between the viewpoint, the subject of the photomontage and other elements in the scene, e.g. when assessing if a development interrupts a sensitive skyline or not. Such accuracy may be obtained from survey techniques providing sub-metre accuracy (see Appendix 11.4, survey-verified photography).

Image Scaling

4.5.10 The objective of Type 4 visualisation is to present a printed image which gives a realistic impression of scale and detail. Where scale-verifiable output is not possible (Appendix 1.1.7), verified photomontages can still be regarded as Type 4, provided they are supported by quantifiable data and a technical methodology, and agreed by the competent authority.

Table 5, Option 1: 100% enlargement

4.5.11 This is a 39.6° HFoV photograph presented within a 390 x 260mm frame. This option does not provide for binocular image scaling when printed. Nonetheless, it is included within Type 4 for the following reasons:

- where 150% enlargements would be problematic for large / close sites (due to impractical paper sizes), an option is still required for use in the planning process which maintains high levels of accuracy (e.g. levels 'A' or 'B' in Table 1);
- even though a 100% enlargement image will not provide 'binocular' perception scaling, it may still be useful and practical in its own right.
- once the 50mm / FFS combination is engaged, the EXIF metadata of the source RAW / JPG photographs can be interrogated and verified (as per SNH 2017), irrespective of how they are presented - see Appendix 11.2; and
- appropriately captured source photographs are capable of meaningful survey and verification when required - see Appendix 11.4.

4.5.12 In the majority of situations, and wherever context is important to understanding of the proposal, an A1 width 90° cylindrical baseline photograph will provide a 100% enlargement contextual reference.

Table 5, Option 2: 150% enlargement

4.5.13 SNH 2017 effectively requires an image enlargement of 150%, in other words 50% over that which is 'mathematically correct for monocular vision' (see Section 3.8). Option 2 of Table 5 corresponds with this approach. This is regarded as the default enlargement factor for Type 4 visualisations.

4.5.14 The SNH 2017 guidance is endorsed by the LI for windfarms and similar projects which are viewed in expansive landscapes over medium to far distances. Refer directly to the SNH 2017 guidance for full details and requirements.

4.5.15 The image capture and presentation process should be capable of being verified, in accordance with SNH 2017 guidance. See Appendix 11, Verified Photomontages.

4.5.16 As noted at 3.8.10, in mid- to smaller-scale landscapes or townscapes, enlargement factors around halfway between 100% and 150% may be a more appropriate. This guidance does not propose any definitive rule, but considers that this reduced level of enlargement may provide an option for consideration by practitioners and the competent authority.

4.5.17 In either case, the principle, of producing an image which represents the scale of the proposal, is maintained. The proposition, that different approaches may be applied to image scaling, recognises that this depends on context and distance. However, a consistent approach to image scaling should be applied within any project.

Other Approaches

4.5.18 There are circumstances where it may be appropriate to depart from using a 50mm lens on site and from setting up pages with a 150% enlargement. These are described below.

Wider Vertical Field of View (VFoV)

4.5.19 The proposed development, viewed at close quarters, may not be captured by a 50mm lens with FFS camera, or fit within the A3 or A1 width x A4 height page sizes - for example, a tall building or high-voltage overhead lines. Alternative lenses may be required in exceptional circumstances - see Appendix 1.

4.5.20 In such instances, alternatives such as increasing the vertical height of the page (to A2 landscape, A1 landscape width with A3 landscape or even A1 landscape width and height) may be appropriate. Reasons for adopting such dimensions should be set out in the Technical Methodology. Wherever practical, 150% enlargement should be maintained.

Wider Horizontal Field of View (HFoV)

4.5.21 The edge distortion of planar panoramas results in them being unsuitable for images with a wide HFoV. Where the required HFoV exceeds 53.5°, multiple planar panoramas of 53.5° may be butted, or overlapped by 25-50% to provide a wider total HFoV. The extent of overlap may be determined by the total HFoV to be shown. In either case (butting / overlapping) the approach should be clearly explained.

4.5.22 If there is a particular reason to show very wide panoramas, (for example, for linear infrastructure occupying a wide FoV) the use of cylindrical projection (Table 5, Option 1, A1 width) may be considered and, if justified, the reasons explained in the Technical Methodology and the projection set out clearly on the presentation page.

Type 4 Summary

Type 4 visualisations enable the highest level of locational accuracy and image scaling where required:

- For sites / settings which can be captured either as single images or panoramically, use a 50mm lens with Full Frame Sensor camera.
- If the site / setting cannot be captured with the 50mm lens (e.g. close, tall buildings), consider alternative lenses - see Appendix 1.
- Images will typically be presented with a 150% enlargement (27°@ A3, or 53.5° @ A1)
- The enlargement factor should be stated on each presentation page, together with the label 'Visualisation Type: 4'.
- Present Planar projection panoramas for views up to 60° HFoV.
- 100% size (39.6° HFoV @ A3) may be considered and agreed with the competent authority where higher levels of enlargement are not practical.
- For wider view angles, use overlapping or butted planar panoramas.
- For very wide linear infrastructure, consider presenting cylindrical panoramas up to 90° at A1 width, with multiple sheets for very wide panoramas.
- Wherever wider context is important to understanding of the proposal, include an A1 width 90° cylindrical baseline photograph.
- Accompany visualisations with a Technical Methodology (see Appendix 10) including a clear written description of procedures involved in image capture and processing.

4.6 Dynamic Visualisations

4.6.1 Emerging visualisation technologies such as Augmented Reality (AR) and Virtual Reality (VR) currently require specialist skills and technology / software and may have significant cost implications and may, therefore, be beyond the scope of many landscape professionals, their clients and competent authorities. However, as these technologies develop, they are likely to become more widely available and used.

Augmented Reality

4.6.2 Augmented Reality (AR) visuals typically use phones, tablets or headsets. AR visuals have the advantage of being able to present moving elements (such as vehicles or turbines) within the view, and, if used on site, of moving the viewpoint. Images can be captured on site and subsequently used off site. Depending on the viewing screen size, visuals will be presented at a range of scales, so care is needed when interpreting their outputs. Similarly, the cameras of such devices are likely to be wide-angle (in the region of 30-35° HFoV). Note that levels of locational accuracy can be improved with surveying techniques, and that specialist devices with precision lenses, or connected to digital cameras, may come into use. It is likely that, under such circumstances, AR could in the future satisfy the requirement of Type 3 visualisations.

Virtual Reality

4.6.3 Virtual Reality (VR) headsets use computer-modelled backgrounds rather than photographic backgrounds, due to their ability to move location within the model. This is a disadvantage in terms of realism, but an advantage in terms of being able to study movement within or around a development. As such, they present an alternative approach to visualising development. Subject to the quality of the hardware used, image resolution may be relatively poor, compared to print outputs.

Summary

4.6.4 AR and VR visuals are under constant development. Although their preparation and use is beyond the scope of this guidance, they are expected to become increasingly important and common in visualisation, as the technologies mature and improve. For more information on Augmented and Virtual Reality, refer to the LI Digital Realities Technical Information Note.

5 Further Reading

Best Practice Guidance

Landscape Institute and IEMA (2013) - Guidelines for Landscape and Visual Impact Assessment 3rd edition (GLVIA3)

Scottish Natural Heritage (2017) - Visual Representation of Wind Farms: good practice guidance (version 2.2) (SNH 2017)

The Highland Council (2016) - Visualisation Standards for Wind Energy Developments

London View Management Framework Supplementary Planning Guidance (2012)

Research

Alan Macdonald (2012) - Windfarm Visualisation

University of Stirling (2012) - Report on perception of scale and depth in landscape photographs

Appendices

Methodology

Equipment

On Site

Presentation

Supporting Information

Technical Information Notes (LI web site)

Appendix 1 - Camera Equipment

1.1 50mm FL + FFS - Visualisation Types 1,3,4

Cameras

1.1.1 The following specifications are based on a 50mm Focal Length (FL) and Full Frame Sensor (FFS) combination, and are suitable for all types of photography and visualisation. See 1.2 below for an alternative specification (cropped frame) which is acceptable for Types 1 and 3.

1.1.2 Whilst 35mm film itself is largely outdated for technical applications, it is worth being aware of the origin of the term 'Full Frame Sensor'. The point of reference for FFS as a term of specification is the frame size of pre-digital (35mm film strip width) film frames, which is 36mm x 24mm. Whilst Medium and Large Format camera equipment can be used for this work it is considered that this equipment is beyond the scope of this guidance.

Lenses

1.1.3 Lens / camera combinations result in images which capture a Field of View (FoV). The Horizontal Field of View (HFoV) is the angle between the left and right edges of the image. The Vertical Field of View (VFoV) is the angle between the top and bottom of the image. A 'standard' lens (50mm FL + FFS) in landscape orientation typically captures a HFoV of just under 40° and a VFoV of 27°.

1.1.4 50mm FL sits between 'wide-angle' lenses, which can create distortion towards the edges of images, and telephoto lenses, which can create an unnatural visual 'stacking' effect. Whilst both of these can be effective in artistic photography, the 40° HFoV image captured by a 50mm lens is regarded as being the closest to human eyesight, albeit that we typically have wider peripheral vision.

1.1.5 A fixed 50mm FL lens is considered the benchmark for landscape technical photography. A fixed FL lens ensures that the image parameters of every photograph are the same, simplifies the construction of panoramas, and ensures compatibility of photography for all viewpoints. In addition, 50mm FL lenses minimise optical distortion and allow for verification, where required (See Appendix 11).

1.1.6 Where a site or proposal would exceed the VFoV of a landscape-orientated photograph, the camera may be used in portrait orientation, giving HFoV 27° and VFoV 39.6°.

Non-50mm FL Lenses

1.1.7 If a 50mm FL lens cannot capture the view in landscape or portrait orientation (for example, if the highest point of the development is approaching 18° above horizontal) the use of wider-angled prime lenses should be considered, working through the following sequence of fixed lenses in this order: 35mm FL > 28mm FL > 24mm FL > 24mm FL Tilt-Shift. Tilt-Shift Lenses are considered at Appendix 13. In these unusual situations, the reasoning for the choice and the approach used should be documented, and the agreement of the competent authority should be sought (see Appendix 10 Technical Methodology).

1.1.8 Zoom lenses should not be used for the principal photograph from any location, but can sometimes be helpful for distant views to clarify detail, where that is not readily apparent in a 50mm lens image. If presented for such purposes, they should be shown alongside a 50mm FL photograph with a clear explanation that a zoom lens has been used, and with a statement as to the reasons for its use.

Lens quality

1.1.9 The optical quality of the lens is important. Despite high resolution sensors, it may be that the sharpness of a photograph is limited more by the quality of the lens than by the camera sensor's quoted megapixel count.

1.1.10 A simple check is on the speed / aperture of the lens. A lens with a large maximum aperture (e.g. f/1.8 or 'faster' - see Glossary), combined with good build quality, is generally a suitable lens.

1.1.11 A lens hood will assist in reducing unwanted flare when, for example, sunlight falls onto the front of the lens.

Sensor

1.1.12 FFS digital cameras set a photographic standard which is reliable, well-understood and consistent with professional requirements.

1.1.13 The pixel count of a sensor will determine the maximum resolution that could be achieved in a final image.

1.1.14 A camera with a fairly high resolution (typically 20 megapixel or more) will be required to produce sufficiently good-quality images to be reproduced at the required size. The critical requirement is that the camera should be capable of producing a sharp image when printed at the required page size.

Fig A1.1 *Illustration of Cropped-frame and Full-Frame Sensors (FFS): Canon 7D (cropped APS-C, left) and 6D (full-frame, right)*

1.2 Crop-frame sensor with fixed lens - Visualisation Types 1+3 only

Cropped-frame sensors

1.2.1 Whilst FFS is regarded as the professional standard for digital photography, cropped frame cameras have been developed as the 'pro-sumer' or entry level in digital photography for many years. The overall image quality (in normal lighting situations) is often regarded, for example in camera reviews, as comparable with, or only slightly inferior to, FFS.

1.2.2 The main difficulty arising with cropped-frame cameras is that the image sensor is some 1.5- (Nikon DX standard) to 1.6- (Canon APS-C standard) times smaller than a FFS (see Figure A1.1). Other cropped-frame sizes exist. Whilst image resolution (pixel count) can be maintained with a cropped frame, the smaller sensor effectively crops the image projected through the lens.

1.2.3 The size of a 'Standard' lens is dictated by its focal length in proportion to the diagonal of the film plate or digital sensor. Thus, for example, a fixed 50mm FL lens is regarded as a 'standard' lens on a FFS camera.

1.2.4 Therefore, if a 50mm lens is used on a cropped-frame sensor, because the sensor is smaller, the result is that the image is based on a smaller part of the scene, such that, effectively, it appears 'zoomed'. Thus a 50mm lens on a (1.6x smaller) APS-C camera will result in an image equivalent to 1.6 x 50mm, giving an 80mm effective FL. This (and the variations in cropped-sensor sizes across different brands and models) does not allow for the degree of control or certainty required for a verifiable process within Type 4 visualisations.

1.2.5 If a cropped-frame camera is to be used for Visualisation Types 1 or 3, then the use of a 35mm prime lens is recommended. This will result in photographs with slightly narrower FoV than for the 50mm / FFS benchmark and slightly increased enlargement factors. This is not problematic, provided the site can be captured within these FoVs. Alternatively, a 28mm fixed lens can be used and cropped to the equivalent of a 50mm / FFS FoV (39.6° HFoV).

1.2.6 Cropped-frame photography will present greater difficulties, if wide-angle (28-35mm FFS equivalent) images are required. In these situations, a much wider-angle fixed lens would be required, leading to increased levels of distortion.

1.2.7 Whilst most cropped-frame limitations can be overcome, doing so introduces more scope for error and demands a higher degree of technical competence than working with FFS cameras. For these reasons, the LI and regulators, such as SNH, specify the use of FFS for Type 4 visualisations and prefer it for Type 3.

Appendix 2 - Camera Settings

2.1 Camera Settings - Manual vs Auto

2.1.1 Auto camera settings may be appropriate for single images and may assist less-experienced photographers in capturing acceptable single images. However, auto-focus may focus the image on scene elements which are too far away (the horizon) or too close (e.g. foreground vegetation) and should be avoided.

2.1.2 Panoramic photography should be undertaken using manual controls to avoid the camera creating unwanted differences (focus, exposure, white balance, ISO) between adjacent shots of a panorama. This Appendix outlines appropriate manual settings, whilst the LI TIN 'Camera Auto Settings' explains the issues with Auto settings.

2.1.3 The following fixed (manual) settings are not prescriptive but will provide consistent results, which are essential for panoramic photography.

2.2 Settings

ISO

2.2.1 ISO measures the sensitivity of the image sensor. The lower the number, the less sensitive the camera is to light. Typically, ISO 100-200 will be appropriate on a clear bright day, with higher settings if light levels are low. Higher ISO settings will tend to introduce more image noise and reduce dynamic range.

Aperture

2.2.2 In most cases, the aperture should be set around f/5.6 - f/8 (roughly the middle of most lenses' range) to produce the sharpest image, although an aperture of f/11 - f/16 will provide the greatest depth of field.

Shutter Speed

2.2.3 As a simple rule of thumb, use shutter speeds (in fractions of second) well in excess of the focal length of the lens. For example, with a 50mm FL lens, aim for speeds of greater than 60th/second. Where zoom lenses are used to capture fine detail around the site for reference (not for principal photography) an 85mm FL lens should exceed 100th/second, and a 300mm FL lens should exceed 300th/second, etc.

2.2.4 This is less important when cameras are tripod-mounted, but camera shake (e.g. from a DSLR internal mirror lifting during exposure) can still occur, and its effects are minimised by suitably high shutter speeds. Use of a shutter release cable will reduce camera movement which might otherwise occur when the camera shutter button is pressed.

White Balance

2.2.5 Select an appropriate daylight setting e.g. Sun / Cloud / Shade (review at each viewpoint in case conditions change). Auto White Balance may vary the white balance from shot to shot and is particularly detrimental for panoramas (see Appendix 8).

Focus

2.2.6 For close sites / subjects, the focus should be close to the intervening distance. This will ensure that the sharpest focus occurs where it is most needed. Note that due to the lens depth of field, it is not necessary to focus at infinity in order to have distant objects in focus. For example, a 50mm lens set to f/5.6 and focussed at 15m distance, will result in distant objects being in focus. In addition, by focussing closer than infinity, more of the foreground will be in focus. For more information, search for 'hyperfocal distance'.

2.3 Night-time and low-light photography considerations

2.3.1 If agreed as a specific project requirement with the competent authority, night-time photography will require particular consideration and approaches. These are outlined in Appendix 5.

2.4 Image format: JPG / RAW

2.4.1 All digital cameras offer a range of formats in which the image will be stored on the camera's memory card. Typically these will be JPG at a variety of quality (resolution and compression) settings, and RAW at a variety of resolutions.

2.4.2 Choice of image format is discretionary, but to take advantage of its maximum available resolution, the camera must be set to its highest resolution and, in the case of JPG, minimum compression settings.

2.4.3 RAW formats store the contents of the sensor unaltered hence 'raw' together with a series of parameters recording the camera's current settings. Thus post-processing stages, such as white balance and sharpening, are recorded as parameters but not actually applied to the image. RAW provides the user with the maximum possible opportunity to get the best quality from the image and may be helpful for distant views of development sites, particularly in challenging lighting conditions.

2.4.4 The disadvantage of RAW over JPG is that the file sizes will be 2-6 times larger, requiring more storage space on memory cards and computers and also requiring more time and effort to post-process.

2.4.5 Note that some authorities specify RAW. Otherwise, the choice is down to the user and may be regarded as one of proportionality. Some cameras provide the option of simultaneously storing both RAW and JPG, which allows the choice of format to be made on an image by image basis, but of course requires even more storage space than RAW alone.

2.5 Post Processing for exposure

2.5.1 It can be a challenge to achieve acceptable levels of exposure of both a bright sky and a dark landscape. High Dynamic Range (HDR) photography typically combines three 'bracketed' images (correct, over- and under-exposed) to obtain a final image which has a higher dynamic range (better displays dark and light areas in the image) than can be obtained from a single exposure. Nikon's ADL, Canon's ALO, and other manufacturers' corresponding features achieve a similar effect in-camera, although these only work when shooting JPG, not RAW. The photographer may wish to consider this technique in difficult lighting situations, although it should never be taken so far as to produce a visible 'artistic effect'. It is also worth noting that post-processing of a RAW image allows for good adjustment of shadows and highlights to improve the appearance of the image and bring it closer to what is perceived by the naked eye, without the trouble of producing full HDRs.

Appendix 3 - Site Equipment

3.1 Tripods (Visualisation Types 3-4)

3.1.1 Tripods are used to assist with camera stability (to avoid camera-shake) and to provide levelling in the horizontal and vertical axes. When taking photographs with a view to creating stitched panoramic images, tripods provide adjacent images of consistent level and overlap.

3.1.2 It may be necessary for the camera to 'look up' or 'look down', especially in hilly terrain or close to tall existing or proposed objects. Such vertical orientation will not translate correctly into a stitched panoramic image, and should only be considered for single images. An alternative to 'looking up or down' is to use a 'tilt shift lens' - see Appendix 13. In the majority of situations the camera should remain level to avoid converging verticals, which can be more pronounced, especially when vertical structures are close to the viewpoint.

3.1.3 Camera height is fixed at 1.5m in SNH / THC wind-turbine guidance and this should be adhered to where that guidance is regarded as applying. For other project types, camera height should be set comfortably for the photographer and recorded / stated as noted at Appendix 10. Additional height may be required to represent a proposed change to a viewpoint's finished level e.g. a raised highway.

3.2 Camera mounts (Visualisation Types 3-4)

3.2.1 A Panoramic ('Pano') Head, mounted on top of a tripod, will control the angle between adjacent photographs. With a 50mm lens of approximately 39.6° view angle, setting a 20° interval between shots will give a 50% overlap between adjacent shots. Such an overlap will be useful when stitching photographs later, will minimise edge distortion, and also gives a helpful guide to the view angle of any given panoramic shots. However, it is for the practitioner to determine the amount of overlap which suits their hardware / software.

3.2.2 As noted previously, the camera may need to be mounted in portrait orientation to capture a greater VFoV in which case an overlap between images of around 50% i.e. 15° (or to suit hardware / software) would be suitable.

3.2.3 A correctly set-up Pano head eliminates parallax errors. For close subjects (or close foreground features such as fences) the Pano head allows the camera to pivot around the nodal point of the lens. This prevents parallax errors (where foreground objects appear to move relative to background objects as the camera is rotated) which would otherwise occur if the camera was set on a standard tripod mount.

3.2.4 A 'leveller' (or tribrach) is separate to the Pano head and allows the camera to be levelled in the horizontal and vertical planes. Levelling checked with a small spirit level on the mounting plate will generally be more accurate and easier to read than a bubble level mounted into the leveller. The camera can be rotated through 90° between level checks.

3.2.5 The levelling of the panorama will ensure a better match between the resultant camera image and your 3D model view.

3.3 Taking Panoramas (Visualisation Types 3-4)

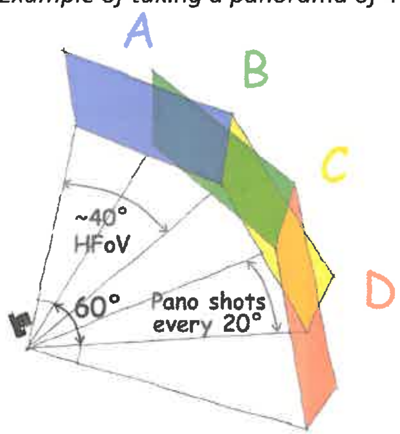
3.3.1 Set the exposure to be correct for the subject / site area, as this is the most important area of the panorama to have suitably lit. If there is no one subject, set the exposure for a point at 90° to the sun's direction (this is an average light level for a panorama). Note that shadows can be lifted (i.e. lightened) whereas clipped highlights cannot be recovered, so slight under-exposure may be useful for panoramas.

3.3.2 Taking photographs in a clockwise direction (left-to-right) will give consistency and avoid the Pano head unscrewing from the tripod. A further benefit is that when image thumbnails are viewed side-by-side, in image management software, they will appear in the correct sequence.

3.3.3 Use the detents on the Pano head to provide constant angles and overlaps between the photographs, such as the 20° with 50% overlap, suggested above.

3.3.4 As far as possible, avoid movement in the scene between adjacent images, such as pedestrian or vehicle movement.

Figure A3-1: *Example of taking a panorama of 4 shots with 20° overlap*



3.4 Recording camera position (Visualisation Types 3-4)

3.4.1 GPS-equipped cameras (with GPS function turned on) will record the location of the shot in the EXIF data, but typically with only around 5-10m accuracy. Hand-held GPS and most Smartphones will provide a similar level of positional accuracy. This is useful in areas with no other visible references (e.g. mountain sides) and when the subject is some distance away. Where visible fixed references are close to the camera location (e.g. trig points, gates, surface features) referring to aerial photography within a GIS system may provide greater positional accuracy for the photograph viewpoint than GPS. See Appendix 14 for comparisons of locational accuracy.

3.4.2 OS grid coordinates should be recorded where known, or converted from other (e.g. GPS latitude / longitude) positional data (for example by using UK gridreferencefinder.com website).

3.4.3 Where a tripod is used for Type 4 visualisations, it should be photographed in a way which assists future confirmation or verification of the viewpoint location. This is a useful technique for all tripod-based photography.

3.4.4 Where there are no visible references and standard GPS would not be of sufficient accuracy, enhanced GNSS (e.g. GNSS RTK) may be hired or provided by a surveyor. The highest levels of locational accuracy are relevant to Type 4 visualisations (survey-verifiable).

3.4.5 If the viewpoint position needs to be recorded accurately and a surveyor is not on site with the photographer, the position of the tripod can be marked (using a plumb line hanging under the tripod head) using spray paint or a survey nail and photographed so that the exact location of the viewpoint can be accurately relocated and surveyed at a later date.

Appendix 4 - In the field

4.1 Viewpoint selection and timing

4.1.1 Viewpoint selection approaches and criteria, for the purposes of photomontage for LVIA / LVA, are set out in GLVIA3 paras 6.16 - 6.28, in particular para 6.18. It is likely that a final selection cannot be made until the viewpoints have been visited and the captured photography is reviewed.

4.1.2 Considerations might include a need for evening / night photography or, in the case of Seascape effects, for morning, daytime or evening images. The illustration of seasonal variations, specifically differences in vegetation cover, should be demonstrated whenever possible and may be a requirement of the competent authority. In particular, instances where key views are available in winter, but not in summer, should be represented (see para 6.28 of GLVIA3). The role of the photographer is to locate the camera such that foreground screening does not obscure the site, unless that is a characteristic of the view / area which is intended to be illustrated.

4.1.3 Section 2 'Guiding Principles' states that photography should *"be based on good quality imagery secured in good, clear weather conditions wherever reasonably possible"*.

4.1.4 It is recognised that, occasionally, it may be difficult to meet this requirement, especially in more remote mountainous locations and in winter months. It is also recognised that the timetable for photography and visualisations may further constrain the ability to take good quality photography. Competent authorities should be advised of these difficulties and a reasonable compromise reached by mutual agreement. The landscape professional should not use 'poor weather' as an excuse for questionable photography and the competent authority should not unreasonably demand good clear weather conditions when the landscape professional has demonstrated reasonable endeavours to obtain good quality photography.

4.1.5 Views should include the full extent of the site / development and show the effect it has upon the receptor location. Additional photographs may illustrate relevant characteristics, such as degree and nature of intervening cover along a highway or footpath, without showing the site / proposal.

4.1.6 Consideration of private residential viewpoints is relevant to Residential Visual Amenity Assessment (RVAA) but generally LVIA will use public viewpoint locations (refer to GLVIA3 paras 6.16 - 6.17). See also Residential Visual Amenity Assessment (RVAA) LI TGN 2/19. Viewpoints on private land which is publicly accessible may be relevant, e.g. open gardens, monuments, communal access points, National Trust land etc.

4.1.7 Where feasible, plan and time site visits such that the sun is not directly over the site in the view, but will be to one side or behind. Planning site photography clockwise from NE to NW is advisable. This is particularly important in the winter when the sun is lower in the sky. Shielding the lens from direct sun (e.g. using a lens hood) is advisable to avoid flare.

4.1.8 Locating the site in advance, on Google Earth or other 3D software, may help locate it on the ground in built-up or open landscapes. Consider preparing draft renders of the 3D model from the proposed viewpoint locations to evaluate extent of visibility and height of development, to ensure that the whole development and appropriate context is captured.

4.2 Capturing the view

4.2.1 The proposal under consideration and its relevant landscape context will determine the FoV (horizontal and vertical) required for photography and photomontage from any given viewpoint. This will, in turn, determine whether a single-frame image will suffice or whether a panorama will be required. Good composition of the scene is important. Views may appear different in winter compared to summer, which may affect the exact location selected, so forward planning is useful if seasonal visualisations are to be prepared in future.

4.2.2 A well-considered approach to baseline photography is necessary in order to provide suitable quality photographs for the production of visualisations.

4.2.3 A 'standard' lens (50mm FL on a FFS camera) typically captures a HFoV of just under 40 degrees. This may be suitable for some purposes, but a single-frame photograph based on this FoV may not convey the breadth of visual information required to represent a proposed development and relevant context. Where it is greater than 40 degrees, a panoramic image, produced by the careful 'stitching' together of single-frame images, can provide a more informative representation of the visibility of a development in the landscape. (See Appendix 8 Panoramas).

4.2.4 As noted in Appendix 1, wider-angle lenses may be appropriate, for example, where tall buildings form part of the scene, but the scale of the presented image is also a consideration (see Appendix 7).

4.2.5 The general requirement is to capture enough of the scene to represent the landscape / townscape setting and the likely visibility of the proposal. Capturing 360° is not always necessary, but may assist in establishing the viewpoint's location and potentially assist in illustrating cumulative effects, if applicable.

4.3 Camera orientation

4.3.1 Where a single image can capture an appropriate HFoV, the view should be aligned to the centre of the development. This will help in matching the perspective of the photograph to that of any subsequent computer-generated image. If the photograph and image do not align, their perspective will not be an accurate match, particularly if, for example, the computer image is placed to the extreme left or right of the photograph.

4.3.2 There may be occasions when the proposed site needs to be offset, such as a view from a window, along an avenue of trees or a well-known 'framed' viewpoint, for example. Where this is necessary, the computer-generated image should use the same horizontal orientation as the photograph.

4.4 Recording image data

4.4.1 Data to be recorded should include: Camera model, Lens focal length, Date and Time. Note that these parameters will be automatically recorded in the EXIF dataset on most digital cameras. Date and time need to be set accurately on the camera. On a GPS-equipped camera, location may also be recorded in the EXIF data. Otherwise it may be recorded with external GNSS equipment.

4.4.2 Other factors which should be recorded in the field include weather, lighting conditions and direction of view - although these may be apparent from the photographs themselves and the location of the camera.

4.4.3 It should be noted that some information within the image, such as people (including children) and car number plates, when associated with time and locational data that has been recorded, could be regarded as 'sensitive information' and appropriate safeguards should be observed.

4.4.4 A full set of details, to be recorded and presented with the project photography overall, and for each viewpoint, is set out on Appendix 10 Technical Methodology.

Appendix 5 - Night-time Photography

The following is an extract from a forthcoming LI-supported publication: Landscape and Visual Assessment: Artificial Light and Lighting (with thanks to Karl Jones of the LI Technical Committee). It provides an outline of considerations specific to night-time photography for the purpose of LVIA.

5.1 Fieldwork

5.1.1 Fieldwork requires suitable weather conditions and consideration of the phase of the moon to get accurate sky darkness results and to accurately record views of the existing night time environment, noting that as temperatures cool in the evening, mist or rain may form. Online weather forecasts targeted for astronomers can assist with predicting the appropriate time to undertake the fieldwork (e.g. www.clearoutside.com or by using smartphone apps (e.g. www.metoffice.gov.uk/datapoint/showcase/scope-nights).

5.1.2 Before undertaking the fieldwork, ensure you know:

- the sunset time;
- where, within the study area, potential viewpoints that need to be checked (for day time and night time effects) are located;
- how to identify the main types of lighting (for recording accurately those already present at the site) and how existing lighting will appear in photographs;
- what potential existing night-time landscape features (e.g. prominent lit important architecture) maybe present;
- how long the night-time work is likely to take (factoring-in time for checking of photographs and the time needed for each exposure (generally taking tens of seconds per photograph); and
- the locations of likely sensitive night landscapes (e.g. dark-sky areas, existing light pollution, 'remote' policies).

5.2 Equipment

5.2.1 Additional equipment, beyond that normally required for daytime fieldwork may usefully include:

- a tripod (to allow long exposure shots to be taken without incurring fuzzy photographs), ideally with luminous or high visibility
- reflective strips on legs to prevent trip hazards;
- a camera lens hood (to avoid glare from lights of passing vehicles or other obliquely located sources of light);
- a head torch (working at night requires additional lighting whilst keeping hands free to work the camera, record notes etc.);
- a tablet (helpful to view photographs, on location, to ensure that the exposure and colour balance reflects the scene viewed with the naked eye, and to record differences);

- UV marker chalk or pegs and black light torch (useful to temporarily record and mark the exact location of daytime viewpoints, to reposition the camera to the same viewpoint in the dark – bearing in mind that the location can look very different in the daytime compared to the night time);

- spare batteries or portable battery charger (as it is generally significantly colder at night, batteries may discharge more quickly, e.g. for mobile phone and camera);

- warm clothing, PPE and appropriate safety equipment.

5.2.2 Further detail will be provided within the LI publication 'Landscape and Visual Assessment: Artificial Light and Lighting' on the topics of exposure, ISO settings etc. Such detail is beyond the scope of this guidance.

5.2.3 Any presented night-time photography should be accompanied by day-time photography from the same location and direction, to give a direct comparison. Photographs taken at half-hour intervals, from dusk to deep night, may be useful in sensitive locations - noting that only one viewpoint sequence can be taken per camera per day.

5.2.4 Note that SNH 2017, paras 174-177, provides useful guidance on illustration of lighting and night-time effects.

5.2.5 Notwithstanding that this is technical guidance, sensible health and safety procedures should be undertaken in respect of night-time work, including risk assessment, reviewing access, and lone working review.

Appendix 6 - Preparing Photomontages

6.1 Common requirements

6.1.1 A digital photomontage consists of a base photograph composited digitally with a computer-generated image of the proposal under consideration. This compositing process will typically include digitally blending the base photography with the computer-generated image, taking into account any masking by foreground features. Compositing necessarily requires digital manipulation, carried out with visual skill, judgement and objectivity.

6.1.2 Incorrect image production and presentation can render otherwise correctly photographed images unfit for purpose. It is crucial that the size of the proposal and its location within the scene depicted in the photograph are accurately represented. In order to achieve this, it is necessary to match the perspective parameters of the photograph accurately, to record viewpoint location and camera settings, and to use 3D software correctly. Additional reference photography whilst on site can be beneficial when existing items in the scene are to be removed as part of the proposals (e.g. the view 'behind' a building / tree to be removed).

6.2 Project stages

6.2.1 It may be necessary to illustrate different time periods associated with the proposal, such as upon completion, and with different stages of establishment of mitigation. Visualisation of the construction period may be relevant if it would be particularly lengthy and distinctly different from the completed project - for example, tall cranes in a sensitive landscape. This should be proportionate and be related to the LVIA / LVA and whether it identifies the construction period as a distinct issue.

6.2.2 Baseline and photomontage images should be produced with identical views presented at the same size, to aid comparison and consideration of the change illustrated.

6.2.3 Where the proposal is to be presented as photo-realistic photomontage, the lighting conditions (sunny, cloudy, direction of light and position of shadow) of the proposal should match the background photograph as far as practically possible.

6.2.4 Techniques for matching photography and 3D modelling are set out in Appendix 12.

6.3 Wirelines and Photowires

6.3.1 The accuracy of a photomontage may usefully be illustrated by means of a wireline image incorporating sufficient topographic or other features to allow a comparison to be made between the wireline and the photograph. The wireline should be presented as a separate image at the same size and scale as the main photograph / photomontage.

6.3.2 A visual presentation which is an overlay of wireline upon the photograph is known as a photowire. A photowire does not replace a photomontage where rendered texture and detail is required, but is sufficient to indicate scale and placement. Where the site cannot be seen from a viewpoint, a photowire could indicate the site's relative size and location within the view (for example, to confirm that it would be hidden from view or to indicate that it may be more visible in winter).

6.4 Relationship to London View Management Framework AVR Levels 0-3

6.4.1 The London View Management Framework (2012) proposes four levels of 'Accurate Visual Representation' (AVR), based on the degree of sophistication of the imagery representing the proposed development. The *graphical* approaches to producing the AVRs (photowire to photomontage) may be applied to Visualisation Types 3 and 4 in this guidance. Selection of these levels of detail should be based on what is required to illustrate the proposal, and may assist in taking a proportionate approach.

6.4.2 **AVR Level 0:** Location and size of proposal. This equates to a photowire and provides an outline of the proposal overlaid onto the photograph base.

6.4.3 **AVR Level 1:** Location, size and degree of visibility of proposal. This shows the massing of the proposal within a 3D context represented by the photograph - that is, what can and cannot be seen.

6.4.4 **AVR Level 2:** As level 1 + description of architectural form. This illustrates architectural form such as doors, windows and floors, and gives a sense of the form and shading of the development within its context.

6.4.5 **AVR Level 3:** As level 2 + use of materials. This is a fully rendered photomontage, usually photo-realistic with texture, shading and reflections as appropriate.

Figure A6-1: *Accurate Visual Representation (AVR) Levels 0-3 (Images ©Nicholas Pearson Associates)*

Appendix 7 - Media and Presentation

7.1 Digital vs Paper

The move towards digital

7.1.1 There is a clear move towards digital media in all aspects of the development process, which impacts on the issues surrounding visualisation presentation. Digital media is readily transferable and reproducible. It may be the case that, for many stakeholders, digital images are the only ones they are likely to see, for example when downloaded from planning portals. Paper-based presentation requires resources (paper, ink, printing) as well as means of transfer or delivery. For large projects with many viewpoints and baseline / wireline / photomontage versions, paper prints may present practical difficulties, particularly where panoramic images are required (Visualisation Types 3 and 4).

Benefits of paper

7.1.2 Paper prints have specific benefits. If based on high-resolution images and using good-quality printing techniques, they can present photomontages at higher resolution than screen-based equivalents of the same size. They are capable of being viewed on the desktop or out on site without technical equipment.

7.1.3 Importantly, they also fix the size of the image (independent of any 'viewing device') to allow a consistent impression of scale. All consideration of 'scale' (as at Section 3.8) only becomes meaningful when a visualisation is printed to the correct-sized sheet of paper.

Benefits of digital

7.1.4 Digital presentation has some benefits over paper, for example, the ability to zoom into an image (effectively magnifying it) and also the ability to switch between pages (e.g. of a PDF) or between multiple files, to obtain a clearer impression of the illustrated change than might be obtained from flipping between paper images.

7.1.5 Additionally images are easily accessible across the internet and can be accessed via file-sharing systems.

Issues with digital

7.1.6 The obvious issue with digital media is the variable screen size and resolution of the receiving devices, from phones to large, high-resolution screens. These potentially constrain the size of the image and result in uncertainty as to what size it should ideally be viewed at.

Best endeavours

7.1.7 Given that the image should contain information on its ideal viewing size, the digital user should attempt to view at or near that size, if it is within the capability of their equipment. It is not uncommon for computer monitors to have a width of around 500mm (laptops and tablets are usually smaller). Notwithstanding the issues noted above, the A3 landscape format is well-suited to this size of monitor. Wider images might be viewed in a two-monitor arrangement which mimics the width of an A1 sheet.

7.1.8 Where communication of scale is considered to be of great importance (this is the defining characteristic of Type 4 visualisations) then paper-based media will provide the most reliable impression of scale. However, manageability of paper may be an issue, and it is for competent authorities to determine their requirements accordingly.

Printed outputs

7.1.9 Inkjet printing, laser printing and digital press technologies all have different colour rendition and resolution issues. A minimum image resolution of 300 pixels per inch will generally be required for high-quality printing.

7.1.10 In most cases, given suitable photographic paper, inkjet printing will provide the highest resolution, colour depth and dynamic range of any print technology. Inkjet prints are also likely to smear / run if wet, but could be laminated / encapsulated to allow multiple use for site viewpoint visits - although this will prevent them being folded. Where the highest quality of printing is appropriate, consideration should be given to the use of inkjet technology, although commercial laser prints may be perfectly acceptable if good quality paper is used.

7.1.11 Critically, when producing documents for print, it is important to check that a print proof shows what you expect it to, that the image is sharp and that there is enough clarity and colour faithfulness to convey what is intended. Ensure that the final prints will be printed with the same printer used for the proofs.

7.1.12 At the request of the competent authority, and particularly for more sensitive sites, the photomontage producer should provide high-quality printed outputs which match the criteria specified above.

Digital outputs

7.1.13 These will typically be in the form of PDFs generated from graphics software. When creating PDFs, there are usually options to set DPI (re-sampling of images) and compression ratio to reduce the overall size of the output file. 300dpi should be the minimum for photomontages (ordinary photographs may be as low as 200dpi but clarity may suffer).

7.1.14 Multi-page PDFs are convenient, but the file size may exceed limitations for upload to planning portals (often 5MB, occasionally 10MB). Combining visualisations with plans etc. into a multi-page document is likely to result in large documents, unless high levels of compression are used. However, compression (usually based on JPG image compression) results in image artefacts which become increasingly visible with greater compression levels. This adversely affects image quality and should, therefore, be avoided.

7.1.15 A single page image-based A3 PDF can be created, with minimal compression, well below 5MB. For more sophisticated visualisations (e.g. Type 4 at A1 width) and where there is a limitation on file size, it follows that each page of a photomontage series (Baseline, Photowire, Photomontage) will need to be produced as a single, high-resolution, low-compression document.

7.1.16 Digital photo / panoramic viewers are an effective way of sharing panoramic images online. They re-project from cylindrical source images to a planar view on-screen. However, although used by some competent authorities and consultants, no standard approach has been widely adopted.

7.2 Accompanying information

Visualisation Type Methodology

7.2.1 This is discussed at Section 3.7. It is intended to provide an early basis for agreement, with the competent authority, as to the appropriate Visualisation Type(s) to accompany the application.

Technical Methodology

7.2.2 A Technical Methodology should be provided as an Appendix to Type 3 and 4 visualisations. This will assist recipients with understanding the level of technical approach and also explain reasoning for any departures from standards. This should be proportionate to the requirements of the assessment and the required images. See Appendix 10.

Information with each Visualisation

7.2.3 Appendix 10 'Per Viewpoint' lists the information which should support each viewpoint, to communicate the equipment used and the approach taken.

Viewpoint Locations

7.2.4 Viewpoints should be clearly located on a map-based figure. Location coordinates (eastings / northings) should be provided. It is helpful to provide small location maps as an inset to site photographs / photomontages, provided they take up a small amount of the page and do not dominate or obscure any of the photograph / photomontage content. See SNH 2017 Guidance for suitable examples.

Appendix 8 - Panoramas

8.1 Generally

8.1.1 Please refer to Section 4 on requirements for Type 3 and 4 visualisations. See also Appendix 11, Verified Photomontages.

8.1.2 All parties should recognise that printed panoramic images are an imperfect way of attempting to recreate the experience of viewing the breadth of a scene. Nonetheless, where it is important to communicate the wide-angle nature or context of the view, panoramas are preferable to limiting the view by cropping.

8.2 Lens distortion

8.2.1 Subject to software and workflow, it may be helpful to correct lens distortion before stitching images into a panorama.

8.3 Cylindrical Panoramas

8.3.1 Panoramic images are required to capture a wide field of view appropriate to certain types of more linear or widespread development (e.g. power lines, transport corridors, solar farms etc) and to provide sufficient landscape context. However, they do come with difficulties in respect of viewing printed images. Cylindrical images need to be curved around the viewer to represent real-world viewing angles. Alternatively they could be viewed flat by moving the head to maintain at a constant viewing distance across the panorama. Both of these options are unlikely to be followed by viewers. They are more likely to be viewed flat from a single position. This may not matter for distant viewpoints, but for close viewpoints (e.g. looking at a site across a road) cylindrical panoramas will look unrealistic. A third option is to use a panoramic viewer which re-projects the cylindrical panorama to planar, but these are not in common use.

8.4 Planar Panoramas

8.4.1 Planar projection overcomes the 'curved distortion' which can occur with a cylindrical image. A panorama projected as a planar image will provide a more realistic impression of the scale of a development, but only from an eye position which is specific and central to that panorama. There will be increasing distortion towards the edges of the panorama in order to maintain the correct impression when it is viewed flat. Planar projection should not, therefore, be used beyond a HFoV of around 60°.

8.5 Reprojecting

8.5.1 In SNH 2017 guidance, baseline photography is presented in cylindrical projection. It is helpful to work in cylindrical projection whilst creating wirelines and renders and matching them to background photography. They may then be re-projected to planar (rectilinear) for the presentation image. See Figure A8.1 below.

8.5.2 Cylindrical to planar projection may be achieved by a variety of software, for example: Hugin (open-source), Photoshop (with or without the Flexify plugin), The GIMP (with G'MIC (open-source) or Flexify plugins). No recommendations are made and searching online will reveal other options which will suit specific platforms and work flows.

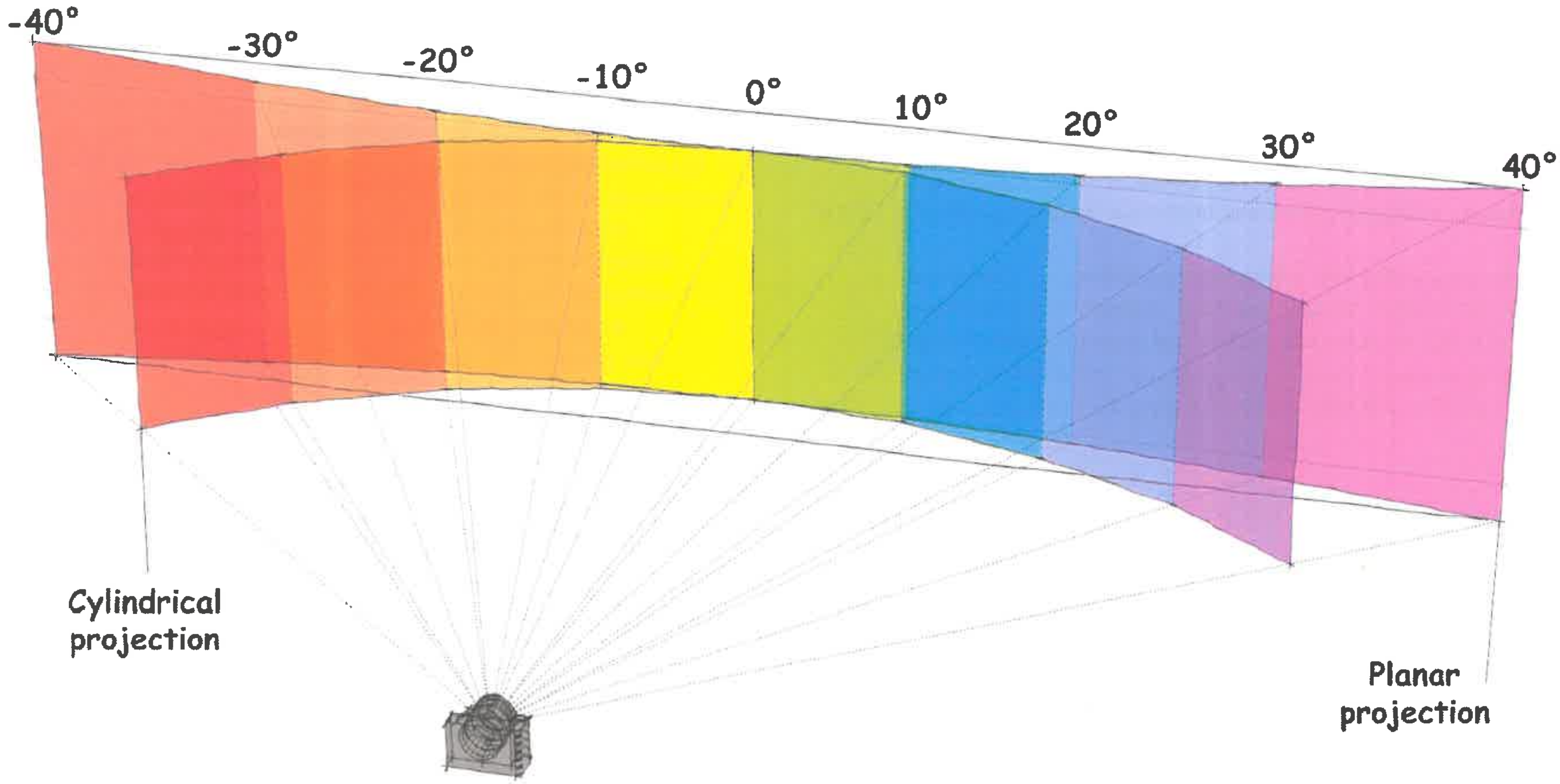


Figure A8-1: *Cylindrical to Planar Projection*

Beyond around 30° to either side of centre (60° HFoV) planar projection becomes increasingly distorted, both laterally (towards the outer edges) and vertically. This limits the usefulness of planar projection for wide panoramas and accounts for the limitation of 53.5° HFoV in SNH 2017 and Type 4 visualisations.

8.6 Calculating view angles

8.6.1 For a panorama created from overlapping frames taken with a stepped Pano head, the view angle can be determined mathematically, based on the stops on the Pano head (see Appendix 1 above). For example, with a 20° stop from centre to centre of adjacent frames, the HFoV of the panorama, from edge to edge, will equal (number of frames x 20°) + 20°, so 3 frames = (3 x 20°)+20° = 80°.

8.6.2 An alternative is to take and stitch a full 360° panorama at each location. Since the completed image must occupy 360° and the image width, in pixels, will be known, any angle can be calculated based on the horizontal count of pixels.

8.6.3 An approximate view angle may be determined from map or aerial data corresponding with what is visible within the panorama frame. For example, the Google Earth measurement tool shows the angle of any line relative to geographic north. Draw a line from the camera position to an object at the left side of the frame, note the angle (say 210°), repeat for the right side of the frame (say 290°) and deduct the first angle from the second angle (290 - 210 = 80° HFoV).

Appendix 9 - Acetates

9.1 Acetates

9.1.1 Acetates may be produced at A3 using a 39.6° HFOV photograph sized at 360mm x 240mm on the page. When viewed at the viewpoint on site, through one eye, the acetate, when held at 500mm from the eye, can be positioned for mathematically correct sizing for that viewpoint. This should confirm that the geometry of the image matches the real landscape.

9.1.2 Provided that the development overlay has been correctly positioned (scale and location) in the image, the acetate will verify the scale and location of development in the view.

9.1.3 Some authorities (for example, SNH) take the view that acetates do not convey any more useful information than a correctly-scaled paper photomontage. Both formats rely on the correct scaling and positioning of the development within the view.

9.1.4 Where a decision-maker considers that they need additional information about scale and position from a site viewpoint, which is not supplied by a paper photomontage, they may request an acetate, but acetates are not regarded as a standard requirement for inclusion in an LVIA or LVA.

9.1.5 The photographic image is usually presented in monochrome on the acetate, with the outline of the proposed development in colour (e.g. red, green) to highlight the proposed change.

Figure A9-1: *Acetate in use © Mike Spence*

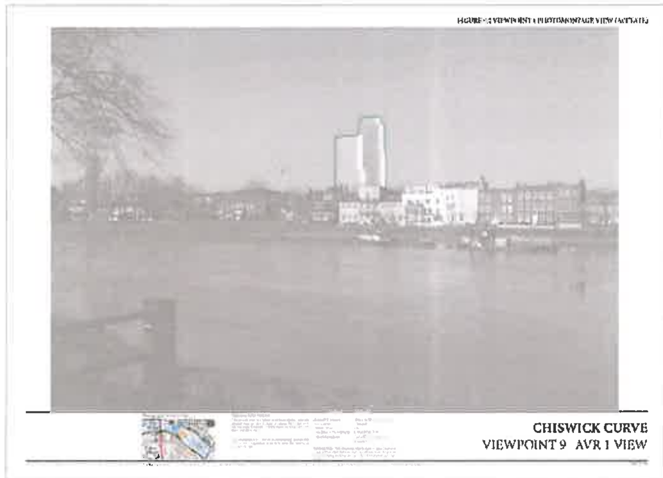


Figure A9-2: *Example acetate © Mike Spence*

Appendix 10 - Technical Methodology

Indicative Listing - For the project:

for the indicated Visualisation Types, this information should be supplied within an overall Technical Methodology

Visualisation Types 1	2	3	4	Photography	Example Responses
✓	✓	✓	✓	Visualisation Types Methodology (see 3.7)	
		✓	✓	Method used to establish the camera location (e.g. handheld GPS/GNSS, GNSS/RTK, survey point, visual reference)	Aerial photography in GIS system
		✓	✓	Likely level of accuracy of location (#m, #cm etc)	Better than 1m
		✓	✓	If lenses other than 50mm have been used, explain why a different lens is appropriate	28mm lens required to capture the height of the development from views 1 and 3
			✓	Written description of procedures for image capture and processing	
			✓	If panoramas used: make and type of Pano head and equipment used to level head	Manfrotto Pano head and leveller
			✓	If working outside the UK, geographic co-ordinate system (GCS) used (e.g. WGS-84)	N/A
				3D Model / Visualisation	
		✓	✓	Source of topographic height data and its resolution	Combination LiDAR + OS Terrain 5m
		✓	✓	How have the model and the camera locations been placed in the software?	Based on survey coordinates
			✓	Elements in the view used as target points to check the horizontal alignment	Existing buildings, telegraph poles, LiDAR DSM
			✓	Elements in the view used as target points to check the vertical alignment	Topography, existing buildings
			✓	3D Modelling / Rendering Software	*As used on project*
				Generally	
✓		✓	✓	Any limitations in the overall methodology for preparation of the visualisations?	Timing of photography e.g. winter / summer

Per Viewpoint:

this information to be provided on each page, within the photograph / visualisation figure notes

Visualisation Types 1	2	3	4	Photography	Example responses
✓	✓	✓	✓	Visualisation Type	Type 3
✓		✓	✓	Projection	Planar or Cylindrical
✓		✓	✓	Enlargement factor for intended sheet size	e.g. 100% @ A3 or 150% @ A1
✓		✓	✓	Date and Time of captured photography	3 March 2019, 13:05
✓		✓	✓	Make and model of camera, and its sensor format	Canon 6D, FFS
✓		✓	✓	Make, focal length of the camera lens(es) used.	Canon / Nikon / Sigma etc 50mm
✓		✓	✓	Horizontal Field of View (HFoV) of photograph / visual	39.6°
✓		✓	✓	Direction of View: bearing from North (0°) or Compass Direction	'90° from N' or 'Looking east'
		✓	✓	Camera location grid coordinates: eastings & northings to relevant accuracy; height of ground in mAOD	E123456, N654321 123m AOD
		✓	✓	Distance to the nearest site boundary, or key development feature, as most appropriate.	1200m to site boundary / turbine
			✓	Height of the camera lens above ground level and, if above 1.65m or below 1.5m, why?	1.5m
				Additional imagery	
		✓	✓	Baseline photograph	
			✓	A composite view generated by overlaying multiple layers of image data: the photograph, 3D model of terrain (LiDAR DTM) and / or 3D model of LiDAR DSM, 3D model of proposed development, 3D model of landscape mitigation. This can explain how the photomontage has been generated.	
			✓	A photograph of the tripod location to confirm the camera / tripod location	

Appendix 11 - Verified Photomontages

11.1 Introduction

11.1.1 There is no industry-standard definition as to what constitutes a 'verified photomontage' and when it is required. Two main applications of the term have come into use, which relate to:

a) verification of image scaling (SNH 2017) of the visualisation (11.2 below); and

b) survey-verification of camera / subject positioning at the viewpoint. These may also be referred to as Visually Verifiable Montages (VVMs), Verified Visual Images (VVIs) or, in the case of the London View Management Framework, Accurate Visual Representations (AVRs).

11.2 SNH 2017: Verification of Image Scaling

11.2.1 SNH's Visual Representation of Wind Farms Guidance (2017) allows for verification that the process described in its guidance has been correctly followed.

11.2.2 SNH 2017 states (para 117):

"In some cases the determining authority may wish to verify the accuracy of the image produced. This is possible using the original image data recorded by the camera (to check camera format and lens used) and a simple template (to check that the image dimensions have been correctly adjusted (by cropping and then enlarging)). This process is described in Annex E. Camera metadata should be provided by the applicant on request."

11.2.3 In the above statement, 'accuracy' refers to:

a) the FoV of the source photograph (based on a camera / lens combination FFS / 50mm); and

b) correct cropping and scaling of the photographs for presentation.

11.2.4 The LI concurs with this approach, where verification of image scaling is required.

11.2.5 SNH 2017 does not require survey-verified photography to determine the position and orientation of the camera, noting that *"167 - An accurate GPS position, taken when the photography was carried out, is almost always sufficient for wind farm applications"*.

11.3 Accurate Visual Representation (AVR)

11.3.1 Other guidance, such as the London View Management Framework Supplementary Planning Guidance (2012) states (para 463):

"An AVR is a static or moving image that shows the location of a proposed development as accurately as possible; it may also illustrate the degree to which the development will be visible, its detailed form or the proposed use of materials. An AVR must be prepared following a well-defined and verifiable procedure so that it can be relied upon by assessors to represent fairly the selected visual properties of a proposed development. AVRs are produced by accurately combining images of the proposed building (typically created from a three-dimensional computer model) with a representation of its context; this usually being a photograph, a video sequence, or an image created from a second computer model built from survey data."

11.3.2 The guidance goes on to require a methodology and information about each AVR including location and coordinates of the camera.

11.4 Survey-verified photography

11.4.1 Survey-verified photography involves using a surveyor, or survey equipment, to capture camera locations and relevant target points within the scene, which are then recreated in the 3D-model and used to match the camera image with a high degree of precision.

11.4.2 Surveying equipment allows the camera location and fixed target points in the view to be calculated down to centimetre accuracy. Highly accurate visualisations may be produced by correctly matching the 3D model camera position and geometry of the view to the original photograph, using pixel level data, resulting in a survey-verified photomontage.

11.5 Summary

11.5.1 Although the terminology is similar, there is a clear distinction between verification of image size and scaling (SNH 2017) and survey-verification of viewpoint / camera location and related data in order to allow resulting imagery to be verified. The first is concerned with image scale (see 3.8), the second with the accuracy of camera position and the precision of subsequent visualisation overlays.

11.5.2 Regarding positional accuracy, the LI takes the view that a proportionate approach is required. Where high levels of positional accuracy are essential to the validity and purpose of the photomontages being produced, for example in sensitive urban contexts, survey-verified photomontage may be required. In other situations, 1-2 metre accuracy, which may be achieved using aerial photography, may be sufficient - see Appendix 14 for further information. Where the subject matter is at close quarters, higher levels of accuracy will be required. However, where the subject is at distances beyond a few kilometres, the level of accuracy of standard GPS (at around 5m horizontal) may be sufficient, noting that ground / camera height can usually be derived more accurately from height data. As Global Navigation Satellite Systems (GNSS) are enhanced, and the cost of equipment reduces, higher levels of locational accuracy will become the norm.

11.5.3 In all cases, as stated at the beginning of this guidance, visualisations should provide a fair representation of what might be seen if the proposed development was built. The level of viewpoint location / camera position accuracy, and how it has been achieved, should be set out in the Technical Methodology (Appendix 10). Where the competent authority has particular expectations or requirements, these should be set out and agreed in advance of site visits.

11.5.4 Visualisation Types 3 and 4, discussed in Section 3 and 4 of this guidance, take account of a range of requirements for viewpoint locational accuracy.

Appendix 12 - Matching Photography and 3D Modelling

12.1 3D-modelling software-based matching

12.1.1 The combination of 50mm FL lens and FFS, is usually quoted as having a HFoV of 39.6°. However, there are no precise 50mm lenses and all models will have a range of effective focal lengths depending on the point of focus. Therefore the HFoV cannot be assumed to be 39.6°and may range from 37-42°. The practitioner should calculate HFoV for the sensor / lens combination being used, if they wish to use this data to match software-generated 3D models to the photographic image.

12.1.2 Given accurate FoV data and orientation, some 3D software is able to output visuals which are perfectly matched, in terms of FoV and pixel size, to the reference photographs. If this mathematical model is relied upon to determine the size of the visualisation within the photograph, the FoV must be known to a high degree of accuracy. Making assumptions as to FoV may result in renders which are out of scale with the background photograph, either larger or smaller.

12.1.3 Using software to directly provide a render, based on accurate FoV data and target points, there should be no need for resizing or repositioning, relative to the background photograph.

12.1.4 Care should be taken when using software or mathematical approaches to determine the size of the render within the photograph. A 'sense-check' will help ensure that overall placement is correct. For example, if there is a low foreground rise in the view, but the development is placed in front of it, when it should be behind, not only will it be in the wrong place geographically, but it will also appear to be too small, because what should be a distant object appears to be 'closer'.

12.2 Image matching

12.2.1 An alternative approach is to use key reference or 'target' points which occur within the 3D model and the background photograph. These will allow alignment and sizing of a visualisation to match the background photograph. It is important, however, if resizing a visualisation within a photograph, to retain its 1:1 aspect ratio. Alteration of the aspect ratio will result in a visual which is either too tall or too short, compared to its background photograph.

12.2.2 Resizing any object or layer in photo-editing software is likely to lead to some loss of resolution and blurring. Resizing should, therefore, be kept to a minimum by, for example, re-sizing in one step rather than in multiple increments. If the background photograph and rendered image are sufficiently high resolution, this is unlikely to be an issue. Some software, e.g. Photoshop, offers 'smart' objects: editing processes (such as resizing) which are non-destructive, with no noticeable loss of resolution. However, the optimal solution is to generate the rendered image to match the resolution of the photograph without resizing.

12.2.3 When using target points within the photograph and targets in the 3D model, these should be accurately geo-referenced, and vertical heights of 3D elements confirmed from either survey or terrain model data (e.g. LiDAR DSM).

Appendix 13 - Tilt Shift Lens

13.1 Tilt Shift Lens

13.1.1 The tilt shift lens is increasingly being used in architectural photography in urban locations. It can also be employed for taking photographs up or down slope. The lens comes in a range of focal lengths including 17mm, 24mm, 45mm and 90mm. The 24mm tilt shift is typically used for visualisation work where viewpoints are located close to a development and the normal range of prime lenses will not capture the proposed site (see example below).

13.1.2 The tilt function allows the lens to be swung about either a vertical or horizontal axis so that the axis of the lens is not perpendicular to the picture plane of the sensor.

13.1.3 The shift function allows the lens to be offset vertically or horizontally so that the axis of the lens remains perpendicular to the plane of the sensor but no longer passes through it centre point.

13.1.4 It is only the shift function which is relevant to photography and visualisations.

13.1.5 The tilt shift lens can be used to direct the eye upwards or downwards, depending on the selected portion of the overall view used. This can be used to (wrongly) accentuate the extent of sky or the extent of foreground in the view, resulting in an over-emphasis on the amount of sky or foreground in the printed image / visualisation, creating an unbalanced view towards a development which doesn't reflect what the camera, or the human eye, would see under normal circumstances.

13.1.6 Prime lenses have a single point of perspective in the middle of the single frame image. With the tilt-shift this point of perspective will vary depending on where the lens is positioned.

13.1.7 Before using a tilt shift, the normal suite of 50mm, 35mm, 28mm and 24mm prime lenses should be explored in both landscape and portrait orientation. Assuming the 24mm lens in portrait will not pick up the verticality of a proposed building, then the tilt shift can be employed.

13.1.8 Images produced with the tilt shift should be stated as such and be presented with clear markings on the image to identify the point of perspective. See examples on following page at Figures A13-1 and A13-2.

13.1.9 The reasons for using tilt shift should be clearly explained in the Technical Methodology.

Figure A13-1: *This image shows the use of a 24mm tilt-shift lens to capture the full vertical extension of the building, whilst avoiding converging verticals.*

In both cases the red arrows indicate the vertical and horizontal points of perspective (Optical Axis) whilst the 'graticules' represent the horizontal and vertical fields of view.

Figure A13-2: *This is a standard 24mm image, levelled horizontally, which does not capture the extent of the building. Tilting this camera/lens combination upwards would result in the vertical elements of the photograph appearing to converge.*

Appendix 14 - Locational Accuracy

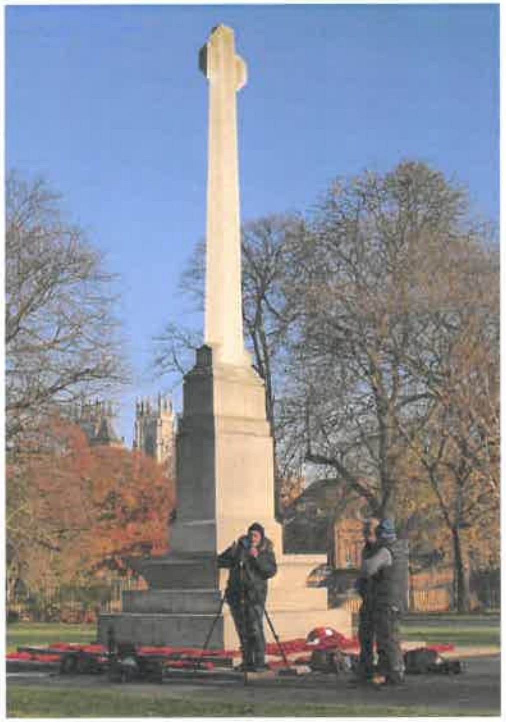
14.1 How much does locational accuracy matter?

If you are looking at an object 10m away, which is directly east of you (90° from north), and you move 1m north, the object will appear to shift by 5.7°, and will now be at an angle 95.7 degrees from north.

If the object is 100m away, it will appear to shift 0.57°, to 90.57° from north.

If the object is 1000m away, it will appear to shift 0.057°, to 90.057°.

If the object is 10,000m away, it will appear to shift 0.006°, to 90.006°.



Clearly, a small shift in location can make a large difference to the apparent location of objects when they are close to you. This is especially important due to the effect of parallax, or the apparent shifting of objects' positions based on how near or far they are from you.

In the photo of the War Memorial in Memorial Gardens, York, if we faced the memorial and stepped 1m to our right, we would no longer be able to see the south tower of York Minster.

War Memorial in Memorial Gardens, York, 2016

This is because the war memorial is close to us and appears to shift substantially, relative to a more distant object such as the Minster.

So if we wanted to accurately 3D model the geometry of the war memorial and match a render to the photograph above, we would need a very accurate understanding of our camera position (x,y,z or easting, northing, height). However, if we were modelling an extension to York Minster south tower, it would not be as critical to know our exact camera position.

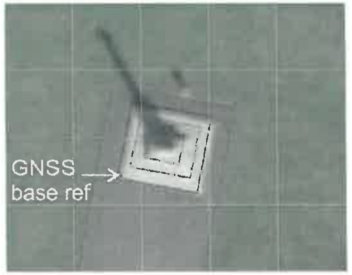
In summary, knowing the precise location of the camera, relative to the site, matters more when the subject (site) is closer to the viewpoint, than when it is further away.

14.2 How accurately can a viewpoint be located?

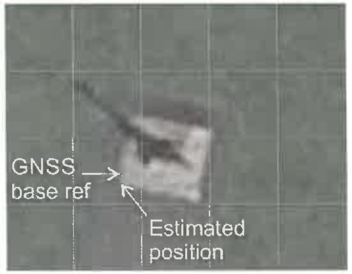
When undertaking research photography for this guidance, one location used was the stepped south-west corner of the War Memorial in Memorial Gardens, York (see photo and Aerial view, previous page). This was selected, in part, because it would be clearly visible in aerial photography. The following images show the location within GIS software, with some of the available means of identifying the location of the corner of the monument.

For each source of aerial photography, the corner position was visually estimated and compared to the base reference.

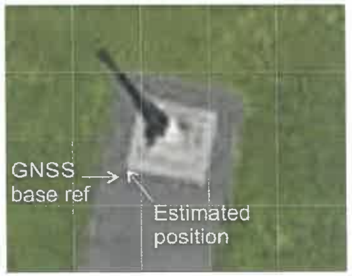
The images below have a 5m grid overlay. This exercise shows that dedicated survey equipment offers a high level of accuracy relative to mapped sources.



GNSS (without RTK), approx 0.18m accuracy. With RTK enhancement, this could have provided sub-cm accuracy. Position reported as E459833.69, N451917.82. Assumed as base reference (ref) for this exercise. Vector outline is OS MasterMap, corner is 0.352m from base ref. Aerial photography is OS Aerial hi-res (2007). Estimated position is 0.073m from base ref.



Aerial photography is Bing Imagery, accessed within GIS. Estimated position is 0.634m from base ref.

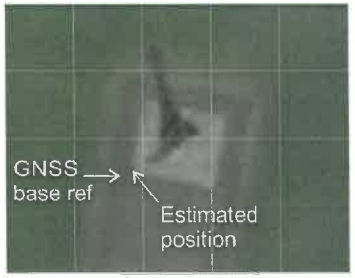


Aerial photography is Google Imagery, accessed within GIS. Estimated position is 0.785m from base ref.

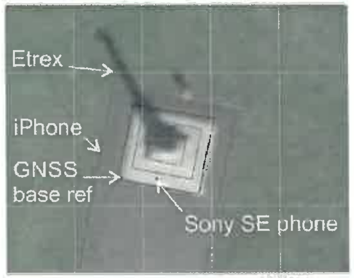
Hand-held GPS devices (all of which were allowed to 'settle') offered accuracy from around 8m to 2m.

Aerial photography varied subject to source: hi-res OS performing best in this instance (accuracy within tolerance of GNSS device) with other sources providing location within 1m from the base ref. Note that performance will vary by location and subject to date, accuracy and resolution of source - this exercise cannot establish the best source in all cases.

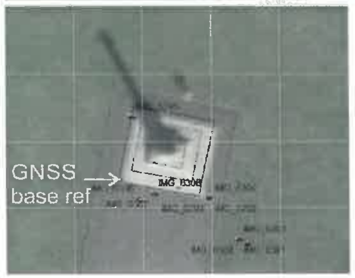
For this clearly-identifiable location, in an urban area with tall buildings and trees (which could compromise GPS signals), aerial photography proved to be more accurate than hand-held or camera GPS. However, the results might be reversed on an open mountainside with no distinguishing locational features.



Aerial photography is World Imagery, accessed within GIS. Estimated position is 0.785m from base ref.



GPS sources plotted against OS background. Reported coordinates were to the nearest metre: iPhone GPS 2.414m from base ref; Sony SE phone 2.478m from base ref; Garmin Etrex Vista HCx (GPS) 7.889m from base ref.



GPS sources plotted against OS background: Canon 6D internal GPS: multiple exposures at base location, recorded GPS coordinates are variable, average 5m from base ref.

This Guidance Note replaces LI Advice Note 01/11, 'Advice on Photography and Photomontage' and Technical Guidance Note 02/17, 'Visual Representation of Development Proposals'. It was prepared by members of the Landscape Institute (LI) Technical Committee, in consultation with LI members and technical experts experienced in photography, photomontage and landscape and visual impact assessment.

Meetings took place with, and comments were received from, the LI Technical Committee and other interested parties, including public sector representatives.

A consultation draft was produced in June 2018. Over fifty responses were received from practitioners and public authorities. Many respondents commented on the need for striking an appropriate balance between the principles of TGN 02/17 and ensuring that any visualisations were fit for purpose, depending on their role and use in the planning, development and consenting process, and including, when necessary, appropriate verifications. The result is this guidance, which combines TGN 02/17 with a thoroughly updated AN 01/11.

Consequently, this document provides a single, new LI Technical Guidance Note on the topic, which considers a range of approaches to visualisation.

It was prepared on behalf of the LI by a working group reporting to the Technical Committee.

We would also like to thank:

- Chris Hale of Nicholas Pearson Associates
- Matt Burnett of Scottish Natural Heritage
- Melanie Croll CMLI of Devon County Council
- Michelle Bolger CMLI

The copy editor was Gavin David CMLI.

This guidance is dedicated to the late Mark Turnbull, former chair of the LI Technical Committee.

Approved by LI Technical Committee

Landscape Institute
Charles Darwin House 2
107 Grays Inn Road
London WC1X 8TZ

https://www.landscapeinstitute.org