BEST PRACTICE GUIDE

VISUAL SIMULATIONS **BPG 10.2**

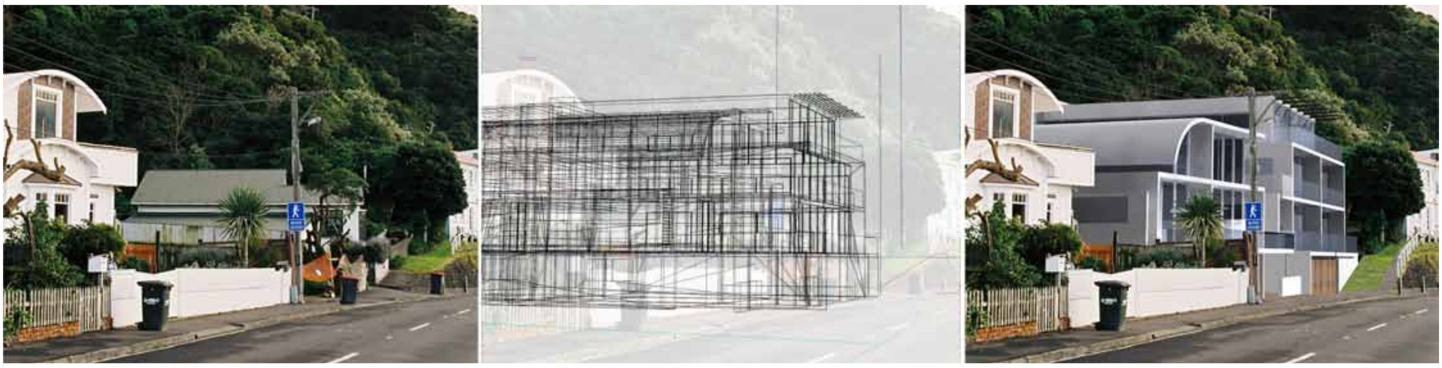

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Table of Contents

1 Background 2

2 Executive Summary 3

3 Visual Simulations 5

4 Viewpoints 6

5 Viewpoint Photography 8

6 Preparation of Visual Simulations 13

7 Presentation of Visual Simulations 14

8 Summary of General Principles 18

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Figure Acknowledgements

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VIEWPOINT 1

Existing View

Simulated View

As Built View

VIEWPOINT 2

Existing View

Simulated View

As Built View

VIEWPOINT 3

Existing View

Simulated View

As Built View

Visual Simulations can accurately portray in a realistic manner and in a realistic context, a proposed change or modification in the landscape. The illustrations above from three viewpoints show the existing view, the simulated view and the constructed outcome.

The application and use of visual simulations of this nature for consultation, assessment, design development and for assistance in RMA decision making processes can be extremely helpful to all parties.

The purpose of this guideline is to promote best practice standards and procedures in the preparation and use of visual simulations by the landscape profession.

1 Background

1.1 In August 2008, the New Zealand Institute of Landscape Architects (NZILA) Education Foundation hosted a Landscape Planning Initiative (LPI) in Christchurch. The purpose of the initiative, which was attended by over fifty practising landscape planners and landscape architects, was to discuss a range of Resource Management Act (RMA) matters relative to the preparation and presentation of expert landscape evidence at Council Hearings and Environment Court fixtures.

1.2 The major outcome from the Landscape Planning Initiative was the directive that a series of best practice notes be prepared, and that these should be aimed at landscape practitioners and decision makers involved in the planning, design and management of our diverse and distinctive landscapes. This technical guide for photomontage based visual simulations is the first in a series which will be progressively published by the NZILA.

1.3 Judges and Commissioners of the NZ Environment Court were invited to the opening session of the Christchurch LPI, and a number attended and offered observations from their experience, about issues surrounding the use of visual simulations in hearings before the Court. Following consideration of the draft guidelines the Court noted that, "It must be remembered by parties, counsel and witnesses that the document cannot receive formal approval from the Court, and also that every case proceeds on it's own merits, such that any given portion of the Guideline may or may not be found relevant or accurate in any situation in which reference is made to it".

1.4 The NZILA Education Foundation also acknowledges the Visual Representation of Windfarms, Good Practice Guidance document (29 March 2006), prepared for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors; and Advice Note 01/09 which deals with the use of photography and photomontages in landscape and visual assessments, published by the British Landscape Institute. These documents clarify many issues relative to photography and the preparation and presentation of visual simulations.

1.5 While the visual simulation technique referred to in this practice note uses a photomontage output, the technique involves considerably more than what is available in terms of the sometimes used "Photoshop" technique. The simulation approach outlined in this document is based on and reliant upon accurate 3D models and methodologies which ensure accurate representations on a photographic image.

2 Executive Summary

Visual Simulations

- The primary purpose of a visual simulation is to accurately portray, in as realistic manner and context as possible, a proposed activity, modification or change in the viewed landscape.
- Visual simulations are not "real life views" – they are, however, very useful tools to assist in the assessment and decision making processes whereby better informed and more transparent judgments on appearance and effects can be made.
- Visual simulations illustrate a two dimensional view of a proposed activity from a particular viewpoint as depicted in a photograph – not as it would appear as a three dimensional image as seen in the field with the human eye.

Viewpoints

- Photographic viewpoints must be carefully selected with respect to their representativeness and their significance.
- The number of viewpoints will vary depending on the nature and scale of the project and the number of locations required to provide a representative range of views.
- All viewpoints should be clearly identified and located on appropriate maps or plans with accompanying relevant viewpoint data.

Visibility Mapping

- Where digital ZTV (Zone of Theoretical Visibility) maps are used to assist in the determining the indicative pattern of visibility and/or the selection of simulation viewpoints, the following limitations must be clearly acknowledged –
  - i). Generally ZTV maps are based on bare ground lines of sight information – they do not take into account the screening effects of intervening vegetation or structures in the landscape.
  - ii). The accuracy of ZTV maps is limited by a map's contour interval. For example, the use of 20m contours that are standard on 1:50,000 scale topographic maps can, where they are the only source of height information, produce inaccurate results.
  - iii). ZTV maps do not show how a project will appear nor do they show the magnitude of visual effects – they simply show the indicative area and extent of potential visibility.

Viewpoint Photography

- Photography for use and presentation in visual simulations requires the use of appropriate photographic equipment, knowledge of the limitations of the technology and technical skills.
- While this guideline does not advocate a particular focal length lens or camera format for use in all situations, a 50mm focal length lens (or its digital equivalent) continues to be widely used in the preparation of visual simulations.
- When panorama views are used, the extent of both the completed panorama and of the individual frames that make up the panorama should be identified.
- Generally panoramas should not exceed the 124 degree horizontal primary field of view or the 55 degree vertical primary field of view.
- All relevant photographic parameters used to create a visual simulation should be presented in order to illustrate transparency, and allow the rationale to be open to scrutiny.

Preparation of Visual Simulations

- The steps involved in the preparation of a visual simulation, the software used, and other relevant date, limitations or assumptions made must be clearly identified and documented.

Presentation of Visual Simulations

- Simulations should be capable of being enlarged, reproduced and printed in a clear and readily understood manner.
- Information accompanying simulations should include all relevant viewpoint information, camera and photographic data, and all other information to enable the reader/viewer to understand the basis and parameters used in the preparation of the simulations.
- The reading distance, at which the photograph or simulation correctly reconstructs the perspective seen from the viewpoint location at which the photograph was taken, should be clearly stated on each image.
- For most landscape photography, an A4 or A3 size photographic image will produce an illustration that can be used by most people to view a particular scene in scale with its setting. For example, a photograph taken with a 50mm lens printed at a size of 360mm x 240mm (approximately A3 size) should be held at a distance of 500mm from the eye in order to replicate the scale of the image with the real scene. If a 28mm lens were used with the same sized printed image, the reading distance would be 280mm, and with a 100mm lens the reading distance would be 1000mm.

3 Visual Simulations

3.1 In recent years, techniques that illustrate change in the appearance of the landscape, including the addition of new activities or structures, have become increasingly reliant upon the use of computer based modelling technology (see Figure 1).

3.2 In New Zealand, these techniques generally involve photography based representations, generally referred to as visual simulations. While the common aim of these representations is to accurately and realistically illustrate the general appearance and context of modifications and/or changes in the landscape, visual simulations are not, and indeed can not be "real life views". Accordingly, visual simulations do not in themselves provide answers – they are simply very useful tools to assist in the assessment and decision making processes whereby better informed and more transparent judgements on effects can be made.

FIGURE 1

Existing View | Simulated View | Constructed View

3.3 The primary purpose of a visual simulation is to accurately portray, in as realistic a manner and context as possible, the proposed activity, modification or change. While in the past landscape assessment and landscape design studies have been aided by hand drawn sketches, diagrams and models, these illustrative techniques, along with the developing computer animation and video montage techniques, are not included within the scope of this particular guideline.

3.4 The visual simulation practice note has been prepared specifically for viewpoint based visual simulations where representation, accuracy and photographic realism (albeit with some limitations) are the prime objective.

3.5 While visual simulations can not replicate the "real experience" of being within the landscape, the accuracy of what is depicted, in terms of its relative position, elevation, scale and general appearance in the context of its landscape setting, can be portrayed in a manner that utilises the highest and most appropriate technical methodologies, specifications and skills.

3.6 Accordingly, the aim of the Best Practice Note for photomontage based Visual Simulations is –

To promote and encourage best practice standards and procedures for the production of photomontage based visual simulations, and to ensure the methods and techniques used in their preparation and presentation are technically accurate and credible.

3.7 The scope of this practice note includes the following -

- The selection of representative viewpoints
- Viewpoint photography
- The preparation of photomontage based visual simulations
- The presentation of photomontage based visual simulations

4 Viewpoints

4.1 Viewpoints are locations selected as being those places from where a proposed activity or development may be visible and is likely to result in noticeable effects on the landscape, the view, and potentially the people who experience that view.

Viewpoint Selection

4.2 The selection of viewpoints must be carefully considered with respect to their representativeness and their importance, for example, settlements, major public roads, and recreational and culturally significant areas. These locations can be supplemented by other viewpoint locations established in consultation with residents, community, special interest organisations and local councils.

4.3 The number of viewpoints will vary depending on the nature and scale of the project and the number of locations required to provide a representative range of views. All viewpoints should be clearly identified and their location shown on detailed viewpoint maps which illustrate the specific position, and orientation of the viewpoint, and the extent of the view relative to the proposed project. Viewpoint mapping may include illustration of the extent of visibility, along with other relevant and appropriate viewpoint and viewing data, such as the distance (or a range of distances) to an object or group of objects.

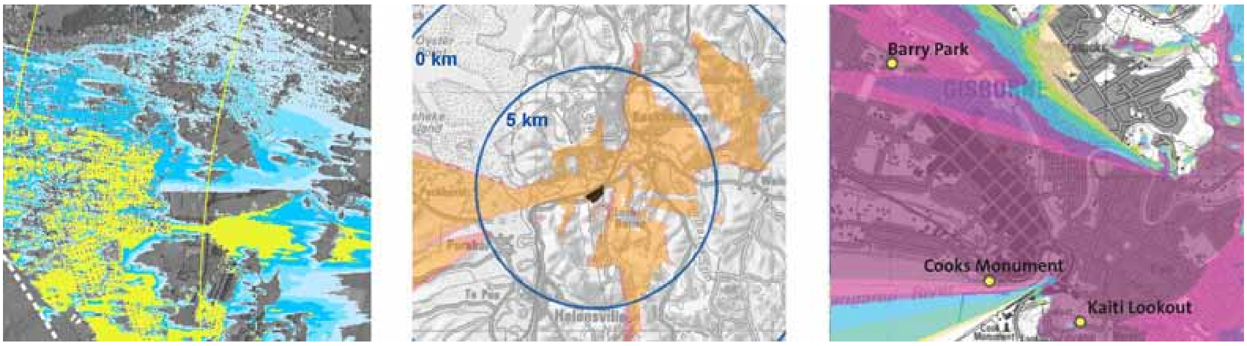
4.4 It is essential that all viewpoint information and conditions be recorded and made available in order that others may locate and visit the same sites for viewing and assessment purposes.

4.5 While the potential visibility and selection of viewpoints on some projects may be quite apparent, there are other projects where the extent and pattern of visibility and the selection of viewpoints can be difficult to determine without the aid of project based visibility maps.

Visibility Mapping

4.6 A technique using readily available digital terrain data is often used to establish Zones of Theoretical Visibility (ZTV)[1] maps. (see Figure 2) These maps are usually prepared as an overlay on a suitable base map of the study area, incorporating the potential area likely to be affected by the proposed development. ZTV maps are also a useful guide to the selection of possible simulation viewpoints. Depending on the nature and scale of the proposed development relative to its landscape setting characteristics, the area to be mapped can be relatively confined or quite expansive.

FIGURE 2 - ZTV Mapping



1 Visibility mapping is sometimes referred to as Intervisibility Mapping or maps showing Zones of Visual Influence (ZVI).

4.7 When using ZTV maps it is important to explicitly note the purpose and limitations of ZTV mapping in general, and with particular reference to the project at hand. In particular the following should be noted –

(i) ZTV maps indicate areas from where an activity or project may be visible within a defined study area – they do not and can not show how a project will appear, nor do they indicate the nature or magnitude of visual effects.

(ii) The accuracy of ZTV maps is limited by a map's contour interval. For example, the use of 20m contours that are standard on 1:50,000 scale topographic maps can, where they are the only source of height information, produce inaccurate results.

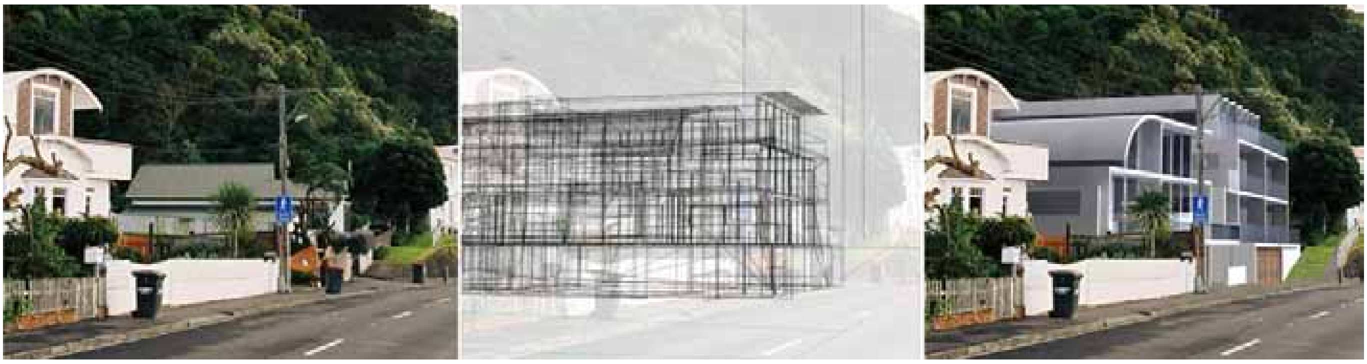
(iii) ZTV maps are based on lines of sight and as they are generated from "bare ground" topographic information - they do not take into account the screening effects of intervening vegetation and/or structures in the landscape. Laser based aerial surveys are now becoming available that can be used to obtain the height to tops of trees and buildings, thereby enabling greater levels of detail and accuracy to be achieved.

4.8 All input material including contour and elevation data, viewing height and project specifications need to be clearly identified and documented. The computer software and its limitations also need to be identified, along with confirmation as to whether the software incorporates curvature and atmospheric refraction calculations and other visibility relevant attributes or constraints.

5 Viewpoint Photography

5.1 Photographs are important visualisations, not only in their own right, but also as a component of other visualisations such as photomontages. Visual simulations, being illustrations that aim to represent an observer's view of a proposed development, combine photography, survey point data, and wire frame and digital project imagery to create a single photomontage (see Figure 3).

FIGURE 3



Existing View | Wireframe | Simulated View

5.2 Photographs are two dimensional images and can not replicate a three dimensional image or what a person would actually see and experience from any particular viewpoint. Light and atmospheric conditions as well as the time of day will influence the photography, and in particular the clarity of objects within the photograph (see Figure 4).

FIGURE 4

Morning Light | Afternoon Light

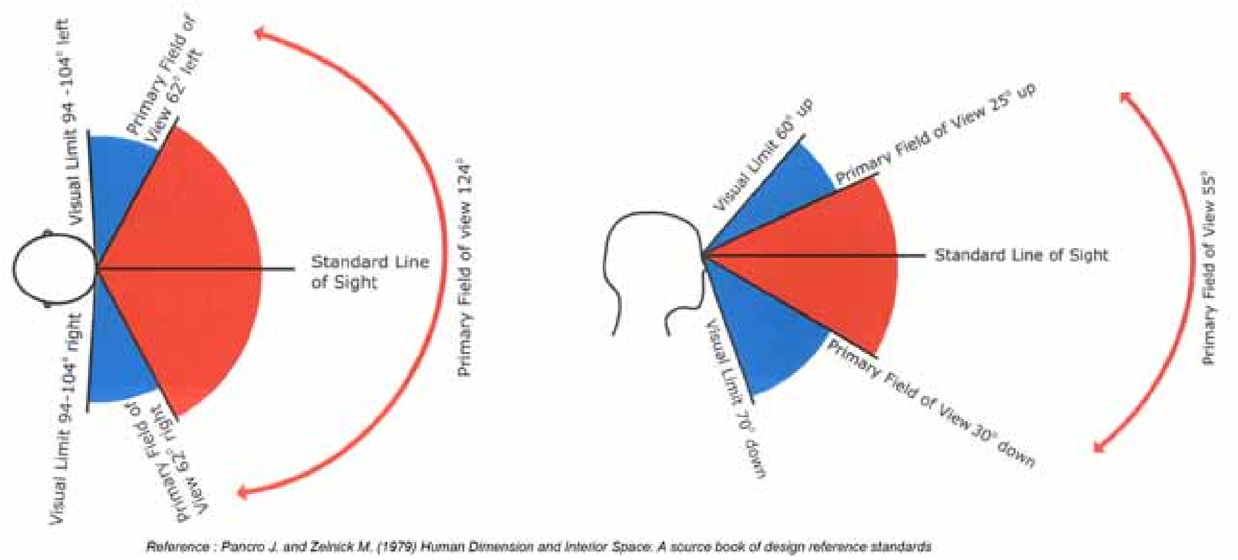
5.3 Notwithstanding this, visual simulations are important and useful tools that enable an activity or development to be represented, viewed and assessed from each viewpoint in a manner that would otherwise not be possible. Visual simulations are used to illustrate the likely view of a proposed development from a particular viewpoint, as would be seen within a photograph – not as it would appear to the human eye in the field.

5.4 Photography for use and presentation in visual simulations necessitates the use of appropriate photographic equipment, knowledge of the limitations of the technology, and skill. While this guideline does not specifically address photographic technique or how to take better photographs, it does cover some of the more technical issues and considerations relative to photography and the preparation and presentation of visual simulations.

Human Field of View

5.5 The term field of view describes the height and width of a view, or an image of a view. In terms of the primary human field of view, it is generally accepted that this is in the order of 124° horizontal and 55° vertical. Figure 5 graphically illustrates the primary human field of view relative to the field of view limits. And while the overall human field of view is around 200°, only a very small central area, the foveal view, will be seen in detail (6-10°). Therefore, a viewer must move their eye and head around in order to capture the full view. For this reason it is difficult to directly link and/or confine limits to photographic and simulated views. While a viewer may move their eyes and head around a field of view, a central point of focus can be identified.

FIGURE 5



Horizontal Field of View — Vertical Field of View

5.6 As viewers typically direct their attention over different widths of view, the size of the photograph required to represent a particular view may vary for different projects and viewpoints, depending on the specific characteristics of the view and the extent of the proposed activity or modification that needs to be included. In some instances a single frame photograph may capture all that is required, while in other instances it may be necessary to use a series of frames joined together to form a panoramic image (see Figure 6 overleaf). The difference in geometry between a single frame and a panorama may not be apparent, so photographs should be clearly identified as being either a single frame or a panorama. However, it is generally accepted that the horizontal field of view is 124°, and it is recommended that this angle of view not be exceeded, but rather a separate simulation that encompasses the area beyond the 124° be generated.

FIGURE 6

Field of View

5.7 While panoramic cameras are available, most panoramas are produced using conventional single frame photography and then digitally splicing the individual images together to form a panoramic view. A panorama manually spliced together from conventional planar photographs and viewed on a flat surface does not result in a true panorama, as it does not form a true cylindrical or rectilinear representation.. However, appropriate image editing software should have the ability to join each individual frame by applying rigorous mathematical transformations.

Lens Focal Length

5.8 The printed size of an image is independent of the focal length of the camera lens. Focal length does not alter the perspective of the image. The main difference that various focal lengths make is to change the extent of the image captured on the film or the digital sensor.

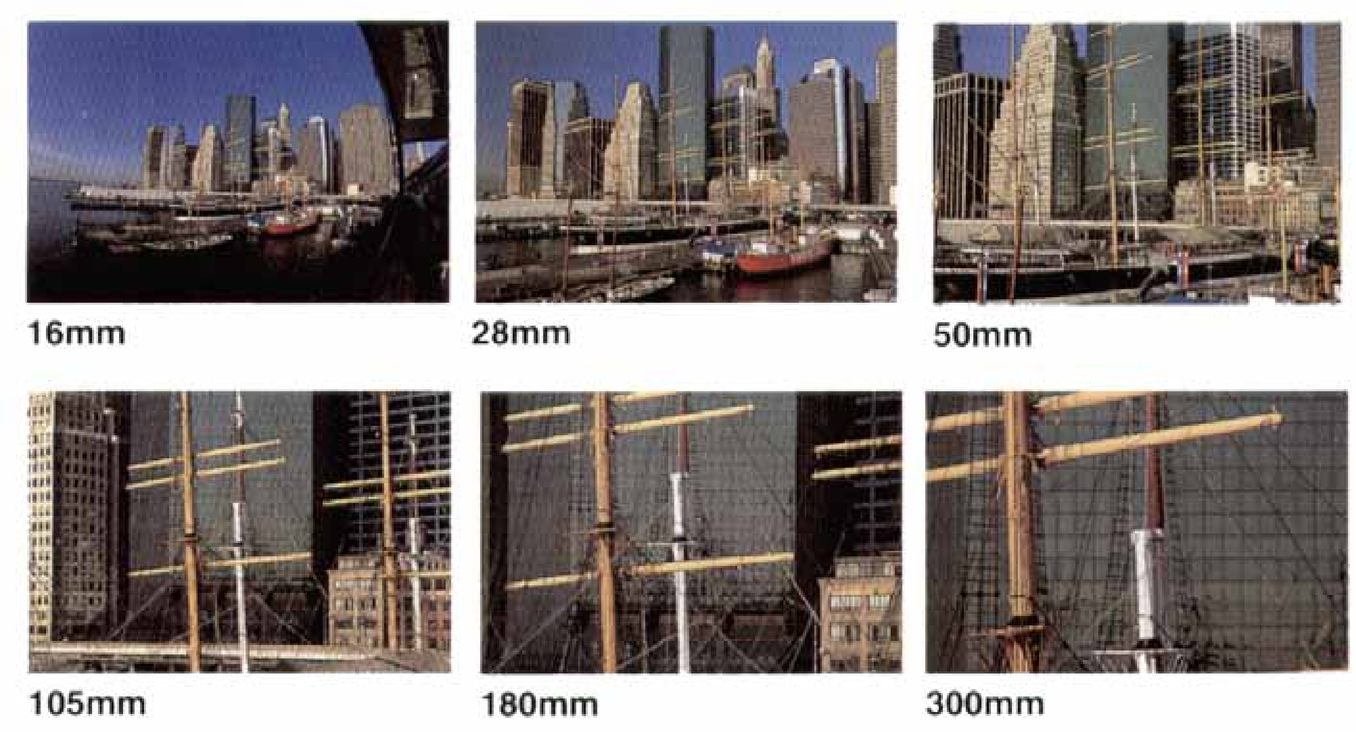
FIGURE 7

100mm Focal Length vs. 50mm Focal Length

5.9 Today good lenses should be relatively free of distortion and other defects. The image taken with a 100mm lens will be the same as the centre portion of that taken with a 50mm lens and enlarged to fill the whole frame (see Figure 7 on previous page). The printed size of an image is therefore independent of the focal length. If an image is defined in terms of its horizontal field of view and its correct viewing distance, then these parameters identify the printed size of the image for optimum viewing.

5.10 The larger image scale obtained by using a longer focal length lens is accompanied by a correspondingly smaller field of view in the image – Figure 8 illustrates this. Wide angle lenses of 28mm focal length or less are prone to distortion around the image margins and should therefore be used with caution.

FIGURE 8



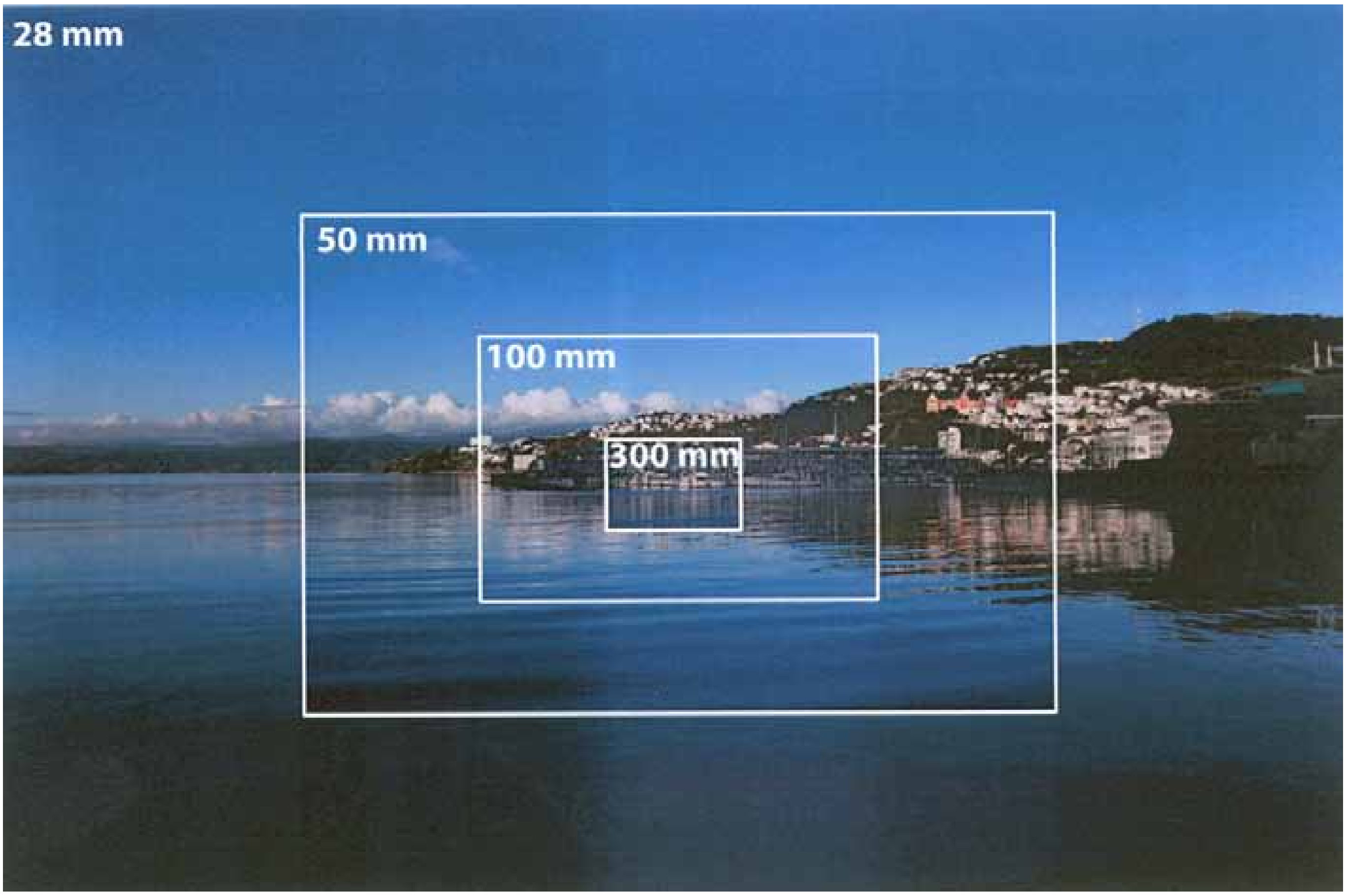
Focal Length vs. Field of View

Viewpoint Photography Summary

- Camera lenses of different focal lengths create images with different fields of view. None of these fields of view are the same as the human field of view. A camera lens does not encompass the same horizontal and vertical "degrees of arc" that is captured by human binocular vision. This is why a picture taken with a "non-human" receptor such as a camera does not represent what we actually see.
- To understand how illusions are created by lens size, one must understand depth of field, and how "depth of field" and "field of view" are related. As the millimetre specification (or focal length) of a lens is increased, it incorporates less field of view – some of the view to the left and right, and above and below, is cropped out. The view is not only less wide, it is also less deep.

- As the field of view is decreased, the amount of visible foreground is reduced in the image, whilst leaving the vanishing point of distant centre unaltered. It is this truncation of depth of field, which causes far objects in images to appear nearer to other physically closer objects in the scene. Figure 9 below shows the combined view when comparing 28mm, 50mm, 100mm and 300mm lenses.

FIGURE 9



Focal Length and Depth of Field

- The field of view of a 50mm lens is contained within the field of view of a 28mm lens because a 28mm lens has a greater field of view than a 50mm lens. The 28mm image has a correspondingly greater depth of field because it incorporates more foreground image. Photographs only represent a part of the primary human field of vision. However, photographs taken using a 28mm lens show a far greater portion of the primary human field of vision than a 50mm lens.

6 Preparation of Visual Simulations

6.1 Visual simulations are accurate representations built up from detailed contour and other data relative to the change or activity being proposed. The layout, position, scale, appearance and orientation can be accurately modelled for specific sites and localities, and depicted as a photographic montage. While variations in light and atmospheric conditions can influence the appearance and visibility of elements within the images, the simulation technique does provide an accurate representation of location, scale and general appearance, even though there may be variations in light and atmospheric conditions at various times of the day, differing seasons and under varying weather conditions.

6.2 The preparation of photomontage based visual simulations generally involves the following steps –

i) The selection of a range of representative viewpoint locations from which photographs will be taken.
Each camera viewpoint needs to be clearly identified and recorded in terms of its coordinates and elevation. In addition, appropriate reference points within the field of view also need to be identified, fixed and recorded.
The SLR camera used to take the photographs should be capable of producing photographs at a high resolution and clarity.

ii) A 3D digital terrain model of the site and its wider environs is then created using appropriate 3D CAD software.

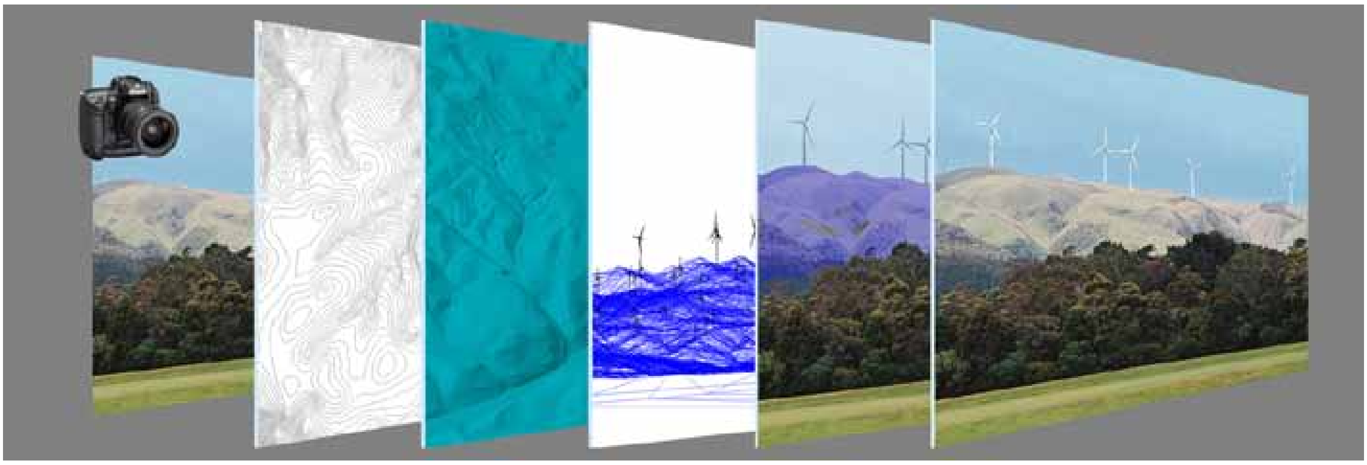
iii) A 3D computer model of the proposed activity or modification is then constructed and positioned within the 3D terrain model.

iv) Coinciding with the photographs taken in Step (i), the camera viewpoints are then registered within the digital terrain model using the survey fixed reference points and translated into the 3D wireframe computer model.

v) The 3D wireframe model is then superimposed over the photograph, utilising the known survey reference points and terrain features in order to register the two together.

vi) A fully rendered photo composite image is then produced.

FIGURE 10



From Photograph to Visual Simulation

6.3 As well as accurately placing the rendered image into the photograph, specialist software can replicate the sun and shadow effects as they were at the time the original photograph was taken.

7 Presentation of Visual Simulations

7.1 The factors that influence the manner in which photomontage based visual simulations are presented include:

- What is required to be simulated
- How and by whom the information will be used
- How the information is to be distributed
- Where the material will be used.

7.2 While the needs of the expert assessors require a high level of accuracy and clarity, the quality of the presentation needs to be sufficient to enable an informed assessment to be made. Notwithstanding this, the visual simulations will inevitably be used at public meetings, for consultation, and as an important component of any consent application documentation, in particular the Assessment of Environmental Effects (AEE). Accordingly, the simulations need to be capable of being enlarged, reproduced and printed in a clear and readily understood manner. Given the limitations of website and PowerPoint presentations, copies at a meaningful scale and image size, showing sufficient detail, need to be provided. Printing should be high quality paper.

7.3 Information accompanying simulations should include all relevant viewpoint information, camera and photographic data, and all other information to enable the reader/viewer to understand the basis and parameters used in the preparation and viewing of the simulations. Information of this nature should be shown on each simulation, particularly that information that assists in interpreting the visualisation. Other and more generic material can be included within the written assessment documentation.

Paper and Printing

7.4 Given the range of different printers and paper types available, to obtain the best results advice should be sought from specialist providers. Generally glossy paper, similar to photographic paper tends to produce the best images. If colour laser printing is used, a smooth white copy paper of 90 to 100gm weight will produce good copies.

7.5 In the reproduction of printed images (either colour or black and white), all reasonable steps should be taken to ensure copies are of a high quality, particularly when photocopied. Where photocopies (rather than original copies) are produced, this should be noted on the image.

Image Reading Distance

7.6 The reading distance is the distance at which the photograph or simulation correctly reconstructs the perspective seen from the viewpoint location from which the photograph was taken. Thus, with a photograph printed onto a transparent sheet, it would be possible to go to that viewpoint location and look through the image at the actual scene. Clearly if the photograph is held too close to the eye, the elements in the image will be too large. If, on the other hand, the image is held too far away, the elements will appear too small (see Figure 11 overleaf).

FIGURE 11

Image Reading Distance

7.7 A comfortable reading distance from where the viewer can alternate their view between the existing landscape and the simulation is 400-500mm. At shorter reading distances (300mm or less) the viewer can only focus on the simulation in front of them, or the existing view – not both at once. For most single frame landscape photography, an A4 or A3 sized photographic image will produce an illustration that can be used by most people to view a particular scene or simulation (in part or in full) in scale with its true setting.

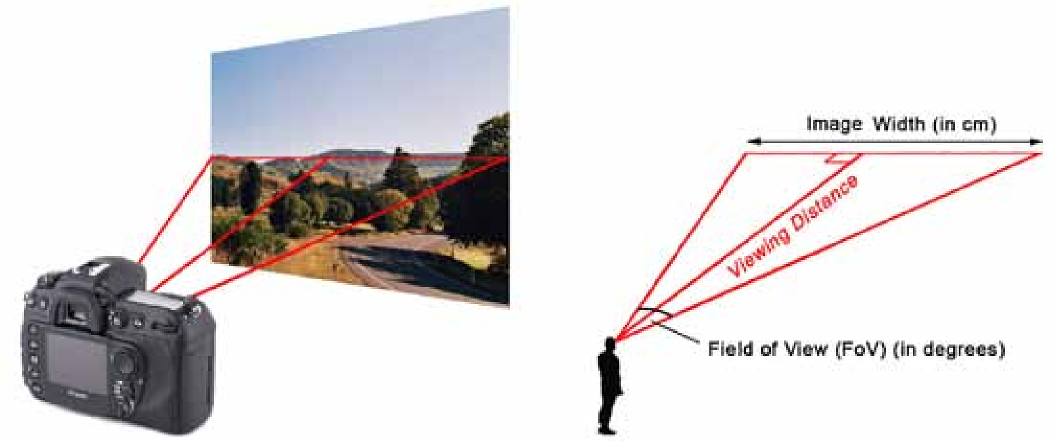
7.8 For example, a 50mm focal length lens using 35mm film would produce a 36x24mm image that would need to be viewed approximately 50mm from the eye. A simple scaling up of the image dimensions by a factor of 10 would result in an image 360x240mm and with a correct reading distance of 500mm. In other words, if a photograph is taken with a 50mm lens on a 35mm camera and the image is printed at a size of 360mmx240mm, standing at the point from which the photograph was taken, it will be possible to hold up the image at a distance of 500mm from the eye and see the photographic image line up with the real scene. Similarly a 180x120mm print will line up with the scene when held 250mm from the eye, however, for some people this will be too close to focus comfortably. Alternatively a 720x480mm image held 1000mm from the eye is further than the length of one's arms and therefore creates difficulties.

FIGURE 12

Reading Distance vs. Printed Size

7.9 The example noted above is based on a 50mm focal length lens. Where a 100mm lens is used, the field of view would be reduced. Likewise where a 28mm lens is used, the field of view would be increased. Figure 9 illustrates the change in the field of view with differing focal lengths. In the case of the 100mm lens, the reading distance of a 360mm wide image (albeit with a reduced field of view) would be approximately 1000mm. With a 28mm lens, the reading distance would be approximately 280mm.

FIGURE 13



Geometry of Image Reading Distance

7.10 The formula for calculating the correct reading distance is:

$$\textit{Reading Distance} = \frac{\textit{Image Width} \div 2}{\textit{Tangent (FoV} \div 2)}$$

7.11 The following table for single frame landscape photography shows the calculated reading distances for A4, A3 and A2 paper sizes:

LENS	HORIZ FoV [1]	PAPER SIZE	ACTUAL IMAGE SIZE [2]	READING DISTANCE [3]
28mm	65°	A4 A3 A2	277mm W x 185mm H 400mm W x 267mm H 574mm W x 383mm H	215mm 315mm 450mm
50mm	40°	A4 A3 A2	277mm W x 185mm H 400mm W x 267mm H 574mm W x 383mm H	380mm 550mm 790mm
70mm	29°	A4 A3 A2	277mm W x 185mm H 400mm W x 267mm H 574mm W x 383mm H	535mm 775mm 1110mm
100mm	20°	A4 A3 A2	277mm W x 185mm H 400mm W x 267mm H 574mm W x 383mm H	785mm 1135mm 1625mm
300mm	6°50'	A4 A3 A2	277mm W x 185mm H 400mm W x 267mm H 574mm W x 383mm H	2320mm 3350mm 4805mm

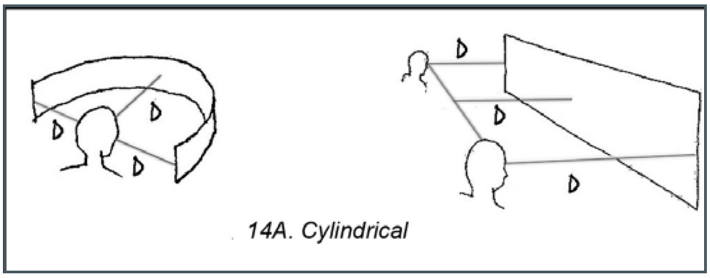
1 Horiz FoV = Horizontal Field of View of lens
2 Actual Image Size allows for a 10mm margin on either side of the standard 'A' series paper width (W).
3 Reading Distances have been rounded off

Viewing a Panorama

7.12 The ideal method of viewing a cylindrical panorama is with the image presented in a curved format, viewed at the correct radius from the centre of the curve (distance D in Figure 14A). If mounted on a flat surface, it should ideally be viewed by one repositioning along it's length, maintaining distance D as one moves.

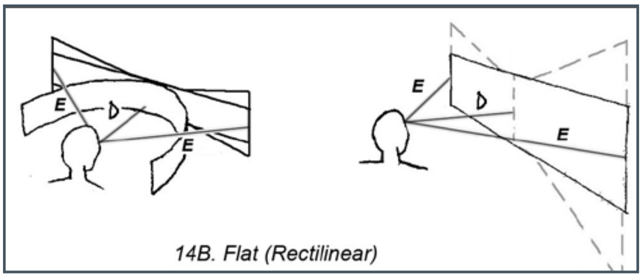
7.13 Where a planar or flat panorama is viewed, one must look directly at the centre of the image without moving one's head, and rely on peripheral vision to see the extremities of the image. Movement of the head to view the extremities of the panorama will result in a viewing distance that is larger than the optimum distance of D - shown as distance E in Figure 14B.

FIGURE 14A



14A. Cylindrical

FIGURE 14B



14B. Flat (Rectilinear)

Geometry of Panoramas

8 Summary of General Principles

8.1 In supporting the use of visual simulations as an effective and useful assessment and communication tool, the NZILA recommend, that when using this form of representation, photomontage based visual simulations must:

- be as accurate as possible in order to assist in the making of well informed and balanced judgments;
- be based on transparent, structured and replicable procedures that enable others to test and confirm the accuracy and credibility of the simulations;
- use techniques and explanations that best represent the project or scheme in its true environmental context in a fair and reasonable manner;
- be clear in its communication and be easily understood by non technical viewers.