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ATTORNEYS AT LAW

September 10, 2015

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Mr. David K. Wiesner, Esq.
NHPUC Staff Attorney
New Hampshire Public Utilities Commission
21 S. Fruit St., Suite 10
Concord, NH 03301

Re: SEC Docket No. 2014-04, Rulemaking

Dear Mr. Wiesner:

In advance of the planned public hearing to take comments on the Draft Final Proposal, there is a technical issue that I would like to bring to the attention of the Site Evaluation Committee (SEC or Committee) on behalf of Northern Pass Transmission LLC. As part of the information that an applicant must provide in Site 301.05 with respect to the effects of a proposed facility on aesthetics, subsection (b) sets forth the components of a visual impact assessment. Section (7), repeated below, addresses photo simulations, and now includes in the highlighted section a very specific requirement for the lens used to take the photographs and how the images will be used in simulations. Of great concern is that the requirement to take a photograph at a focal length of 50 mm, and then print it to "represent the equivalent of what would be taken with a 75 mm focal length lens," would produce a magnified depiction of the landscape, as if viewing it through a telephoto lens, contrary to what appeared to be the Committee's intent when it deliberated this issue.

Photosimulations from representative key observation points, and from other scenic resources for which the potential visual impacts are characterized as "high" pursuant to (6) above, and, to the extent feasible, from a sample of private property observation points within the area of potential visual impact, to illustrate the potential change in the landscape that would result from construction of the proposed facility and associated infrastructure, including land clearing and grading and road construction, and from any visible plume that would emanate from the proposed facility; photographs used in the simulation shall be taken at an equivalent focal length of 50 millimeters and represent the equivalent of what would be taken with a 75 millimeter focal length lens on a full-frame 35 millimeter camera and printed at 15.3 inches by 10.2 inches, or 390 millimeters by 260 millimeters; at least one set of photosimulations shall represent winter season conditions without the presence of foliage typical of other seasons.

The highlighted section appears to come from the Senate Bill 99 stakeholder process conducted by the Office of Energy and Planning. Specifically, the Pre-Rulemaking Process Aesthetics Workgroup Report, 1.0 Key Findings, Topic A – Visual Impact Analysis (VIA), specifically, Section 1.3 Alternative Proposals For Areas Without Agreement, stated:

Proposed standards for the preparation of visual simulations include:

- *Photographs used in the simulation shall be taken at an equivalent focal length of 50 mm (i.e., “normal view”).*
- *Simulations should represent the equivalent of what would be taken with a 75mm focal length lens on a full-frame 35mm camera and printed at 15.3"x10.2" (390x260mm) for hand-holding.*

The proposed standards were derived from a Scottish publication: *Visualization Standards for Wind Energy Developments*, which was published by The Highland Council (UK) in 2010. See Attachment A. The standard, which was not agreed to during the stakeholder process, does not appear to be based on any visual science but on a survey. As noted in the Final Report by the University of Stirling, issued May 17, 2012, (See Attachment B) 500 members of the public had been asked to specify which of seven different focal lengths, ranging from 50 mm to 110 mm, provided the most realistic representation of the scale and distance to a specific focal point. Eighty-two selected 70 mm and eighty-one selected 80 mm. The report noted that the “choice of focal length did not demonstrate a clear and systematic relationship with the distance to the focal point under consideration in the landscape” but it nevertheless concluded that an image produced at a 75 mm focal length is “considered to be broadly appropriate for wind farm visualization and that most likely to be acceptable to the largest proportion of the public.”

Relying on a slightly telephoto view, however, would seem to run counter to U.S. Department of Transportation guidance on the preparation of simulations. The *GUIDELINES FOR THE VISUAL IMPACT ASSESSMENT OF HIGHWAY PROJECTS*, prepared by the U. S. Department of Transportation, January, 2015, Appendix E: Field Reconnaissance Techniques, p. E-2, states:

Set the camera to the 50 mm equivalent focal length (zoom). This configuration is the de facto standard that approximates the average view cone and magnification of the human eye. However, the size of the area exposed by a 35mm film camera is 36 × 24 mm while the size of the area exposed by a digital SLR is smaller. Therefore, refer to the digital SLR manual to find out the dimensions of the camera’s picture size so that the 50mm equivalent focal length can be calculated.

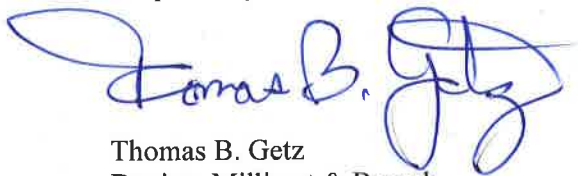
This approach is consistent with the work of Stephen R. J. Sheppard, an associate professor in the Department of Forest Resources Management and Landscape Architecture Program at the University of British Columbia, who concluded in *Guidance for crystal ball gazers: developing a code of ethics for landscape visualization*, that the use of a telephoto lens should be avoided. See, *Landscape and Urban Planning* 54 (2001) 183-199.

Finally, when discussing this issue at the SEC's April 2, 2015 deliberations, Mr. Oldenburg, Assistant Director of Project Development at the New Hampshire Department of Transportation, said:

I think having the normal view, the 50-millimeter, would give you a representation of what you would actually see, what it would actually look like. So I agree that some standard of what you would actually see should be developed. Tr., p. 129.

At best, the suggested requirement is confusing. A more problematic interpretation, however, would be that applicants are required to produce simulations that would give viewers an unrepresentative impression of the effect of the project on the landscape, thus exaggerating the visual impact. A finding by the SEC relative to aesthetic effects based on such "evidence" would therefore be fundamentally flawed. Accordingly, the highlighted portion of the rule should be revised by deleting: "and represent the equivalent of what would be taken with a 75 millimeter focal length lens."

Respectfully submitted,



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TBG:cs

Visualisation Standards for Wind Energy Developments

Leasachaidhean Lùth Gaoithe Inbhean Lèirsinneachd

PLANNING and DEVELOPMENT SERVICE



Am Faoilleach 2010
January 2010

VISUALISATION STANDARDS

INTRODUCTION

These standards have been produced to enable the Council to verify that photomontages submitted in support of planning applications and contained with Environmental Statements are accurate and clearly understood depictions of proposals so that the public and decision makers can make informed opinions and decisions. In order that the Council can verify submissions in accordance with the general principles of the Landscape Institute Advice Note 01/09, these standards contain very specific technical requirements and supported technical data.

While these standards have been produced with wind energy development in mind, the principles contained could apply to all submissions where panoramic photomontages are submitted.

1. SELECTION AND IDENTIFICATION OF VIEWPOINTS

1.1 Viewpoints for the assessment of impacts of a proposed development must be agreed in advance of the preparation of any visuals with The Highland Council, Planning and Development Service. Consultation is recommended with Scottish Natural Heritage and where appropriate, with local Community Councils. The location of viewpoints will be informed by site survey, mapping and predicted Zones of Theoretical Visibility (ZTV). Failure to do so shall result in abortive work, requests for additional visual material and delays in processing applications. We may also specify on a 1:1250 scale plan the exact viewpoint positions required and provide a reference photograph where considered necessary.

1.2 Although every effort will be taken to identify viewpoints early, we reserve the right to request viewpoints which may be of valid concern to Community Councils or the public during the consultation period.

1.3 The purpose of the selected and agreed viewpoints shall be clearly stated in the supporting Landscape and Visual Impact Assessment (LVIA) text. It should be clearly identified whether the viewpoint has been chosen for landscape assessment, visual impact assessment, cumulative assessment, sequential assessment, or to show a representative view for assessment of impact on designated sites, communities or individual properties (receptors).

1.4 All viewpoints should be free from any avoidable foreground objects and other obstructions such as fences, walls, gates, roadways, road furniture, parked cars, trees, shrubs or foliage.

2. MAP AND LOCATION INFORMATION

2.1 An overall map shall be provided to show the distribution of the selected viewpoints with the boundaries of the development site and turbine locations clearly marked. A detailed list of the viewpoint locations shall also be shown. An example page layout is shown in **Fig.1** on the following page.

2.2 Detailed viewpoint positions shall also be shown on an enlarged 1:25,000 digital Ordnance Survey extract to enable easy identification of the exact location showing direction and angles of view. The page should state the viewpoint number and title, the six figure grid reference, AOD level and the distance to the nearest turbine. A detailed written description of the viewpoint location should also be included. An example page layout is shown in **Fig.2** on the following page.

STROUPSTER WINDFARM

Site and Viewpoint Location Map

- Viewpoint 1 - Brabster (as in ES)
- Viewpoint 9a - A99 Lay-by north of Reiss (similar to ES)
- Viewpoint 23 - Dunnet Head Viewpoint (as in ES)
- Viewpoint 25 - A99, north of Auckengill
- Viewpoint 26 - Skirza, Freswick
- Viewpoint 27 - A99 / Canisbay Road Junction
- Viewpoint 28 - Duncansby Head Trig Point
- Viewpoint 29 - Duncansby Stacks, Hill of Crogdale
- Viewpoint 30 - Crow Hillock Trig Point, Nybster

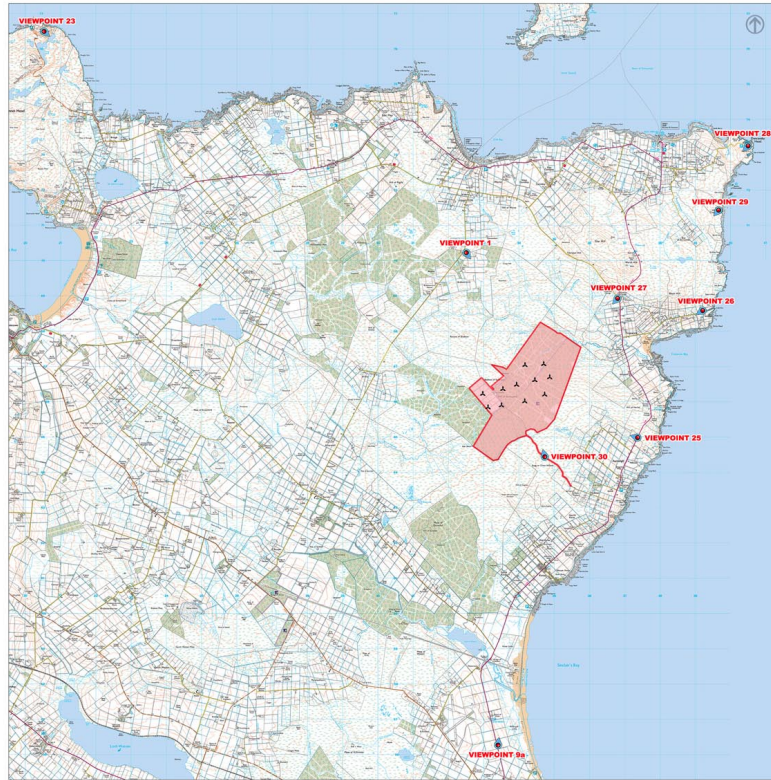
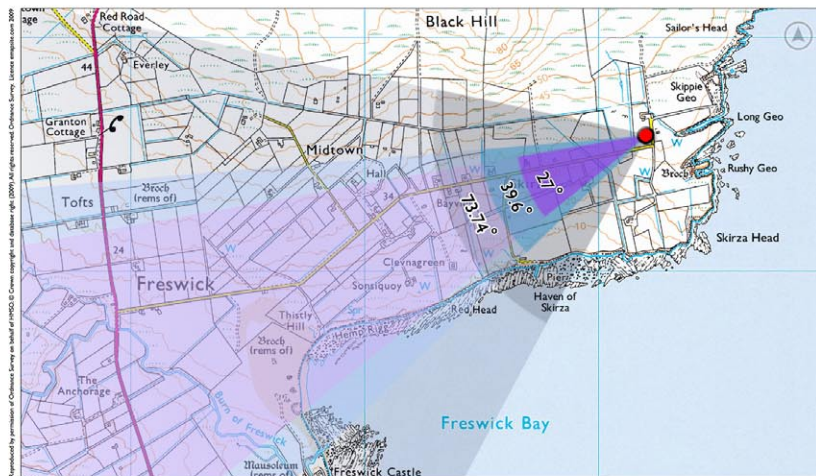


Fig.1

Viewpoint 26 - Skirza, Freswick (Southerly starting point for Duncansby Footpath)



Grid Ref: 339222 968541 Distance to nearest turbine: 4.72km AOD: 41.2m

Turn of the A99 to the right in Freswick on the road marked to Skirza. Travel to the end of the road where it makes a right angle bend to the left. Parking is possible on the corner and vehicles can be turned in the farmyard where the road terminates. The camera position is on the inside of the corner next to the fence.

Fig.2

3. PHOTOGRAPHIC STANDARDS

3.1 The Council places considerable importance on high quality professional photography. Photographic images which will form the base images for photomontage visualisations shall be taken in clear weather conditions with good visibility to show the 'worst case' scenario and be free of any avoidable foreground objects. Photographs taken directly into the sun or in poor lighting or poor weather conditions will not be accepted.

3.2 A 35mm Single Lens Reflex (SLR) film camera or a digital SLR camera with a full size sensor fitted with a fixed 50mm lens shall be used to produce single frame images. Images taken with a digital SLR camera fitted with a reduced size sensor will not be accepted.

3.3 All images, whether in single frame or panoramic format must be taken in landscape format to retain the correct vertical field of view characteristic of the focal length of the lens.

3.4 The turbines should be shown centrally within both the single frame image and the panoramic image unless otherwise agreed with the Council for a specific viewpoint.

3.5 Where composite panoramic photographs are taken, the camera should be fitted to a tripod mounted panoramic head and levelled in both vertical and horizontal axis. The applicant may be asked by the Council to submit a full set of the original single frame images from a randomly selected panorama to check that the image overlaps are even and consistent with the incremental settings and frame overlaps of a panoramic head.

3.6 The height of the centre of the camera lens above ground level shall be 1.5m.

4. PHOTOMONTAGE STANDARDS

4.1 Only Ordinance Survey DTM 5-metre Contour Data should be used to create the 3D computer generated terrain model. The use of 10-metre Contour Data will only be permitted in locations where the 5-metre data is not available. Written confirmation to support this should be submitted.

4.2 Computer renders for each viewpoint shall show the turbine blades facing the camera in an unsynchronised rotation. The lighting of the turbines shall be as photo-realistic as possible, taking into account the sun direction relative to the location and time of day the photograph was taken, sky conditions, light intensity, cloud shadow and turbine shadow.

4.3 In addition to turbines, significant borrow pits, control building(s), access tracks and significant land use change (e.g. forest removal) shall also be included.

5. VISUALISATION STANDARDS

5.1 Single frame images, as both colour prints and as transparencies, are required for Visual Impact Assessment (VIA) by the public, non-landscape professionals and decision makers in addition to any panoramas submitted as part of a LVIA carried out by a landscape professional.

5.2 The images shall be produced to the exact image sizes and page sizes so that the images can *"be based on a transparent, structured and replicable procedure, so that others can test and confirm the accuracy of what has been presented and thus establish trust"* as defined in the Landscape Institute Advice Note 01/09. Standardisation of image sizes enables us to check the accuracy of the visualisations and to make meaningful comparisons.

5.3 To replicate correct linear perspective in a photograph, a monocular viewing distance (*viewing with one eye*) can be calculated. Photographs are rarely viewed in this way and the binocular viewing distance (*viewing with both eyes*) equates to a natural and comfortable distance from the eyes which is approximately the diagonal measurement of the photographic print, regardless of focal length. We require both methodologies to be used.

5.4 For panoramic images which are used by landscape professionals for LVIA and single frame transparencies for on-site verification, a **monocular** viewing distance shall be specified. Single frame printed images for VIA by non-landscape professionals, the public and decision makers shall specify the **binocular** viewing distance.

5.6 For all single frame images including the central single frame image in any panoramic visualisation, electronic copies of the original images with embedded metadata shall be submitted for verification. In the case of 35mm film, contact prints shall be submitted with the guide sprockets clearly visible. This is further referred to in Section 7.

6. VISUALISATION REQUIREMENTS

(A) SINGLE FRAME PRINTED IMAGES

6.1 Single frame images for each viewpoint shall be submitted at the standard focal length of 50mm taken with a fixed lens in landscape format on a full size 35mm format sensor. In addition, single frame 70mm or 75mm focal length images should be provided for each viewpoint and either taken with the appropriate fixed lenses or extracted from the 50mm master using specialist 3D computer software.

6.2 Single frame images extracted from panoramas formed by cylindrical projection will not be accepted.

6.3 A 70mm focal length lens on a 35mm SLR is required for distances up to 1.5 kilometres from the viewpoint to the nearest turbine and a 75mm focal length lens for distances exceeding 1.5 kilometres. We may require additional focal lengths for long distance views.

6.4 If the full extent of the windfarm development cannot be contained within a field of view of a 50mm focal length, the images shall be centred on the nearest turbines.

6.5 If the full extent of the windfarm development can be contained within a field of view of a 50mm focal length but cannot be contained within the field of view for a 70/75mm focal length, the image shall be centred on the nearest turbines.

6.6 The printed image on an A3 page shall have a vertical height of 240mm and a horizontal width of 360mm to retain the 3:2 proportions of the single frame image. An image printed on an A4 page for the Non-Technical Summary (NTS) shall have a width of 270mm and a height of 180mm to retain the 3:2 proportions of the 35mm format.

6.7 The image page shall state how the images should be viewed. For a single frame image viewed normally with both eyes, the viewing distance shall be approximately the diagonal of the page. For an A3 size image, the recommended binocular viewing distance is therefore about 500mm and for an A4 image, the recommended binocular viewing distance is about 350mm, regardless of focal length.

6.8 The information panel at the bottom of the page should contain the following information: Viewpoint number, Figure number, location title, distance to nearest turbine, camera model, focal length, camera height, date and time of day the photograph was taken and the recommended viewing distances.

6.9 No other information or caveats shall be included in the information panel or elsewhere on the image page.

6.10 The A3 and A4 pages shall be laid out as shown in **Fig.3** and **Fig.4** on the following page.

A3 PAGE LAYOUT (Main Environmental Statements)



Fig.3 This image is for illustrative purposes only.

A4 PAGE LAYOUT (Non-Technical Summary only)



Fig.4 This image is for illustrative purposes only.

(B) A3 SINGLE FRAME TRANSPARENCIES

6.11 We have found that black and white acetate transparencies made from the 50mm single frame photomontages can be a very useful aid when used on site to allow verification and assessment by the Council's officers and Members. Applicants are required to submit transparencies of the 50mm single frame images for on-site verification and assessment.

6.12 The transparencies shall be printed so that the real landscape is clearly visible when the image is viewed at the correct viewing distance from the same viewpoint to enable accurate alignment of landscape features. The turbines should be shown in black profile, similar to that of a wireframe.

6.13 The transparencies should be laid out on an A3 sheet with an image size of 360mm x 240mm to conform with the recommended maximum viewing distance of 500mm, calculated on the image enlargement factor and the focal length of the original 35mm image. The image should clearly state that *"This image must be viewed with one eye from a distance of 500mm"*.

6.14 The information bar at the bottom of the page should contain the following information: Figure number (if appropriate), viewpoint number, location title, distance to nearest turbine, camera model, focal length, camera height, the date and time of day the photograph was taken and the exact viewing distance.

6.15 No other information or caveats shall be included in the information panel or elsewhere on the image page.

6.16 The A3 transparency pages shall be laid out as shown in **Fig.5** below.

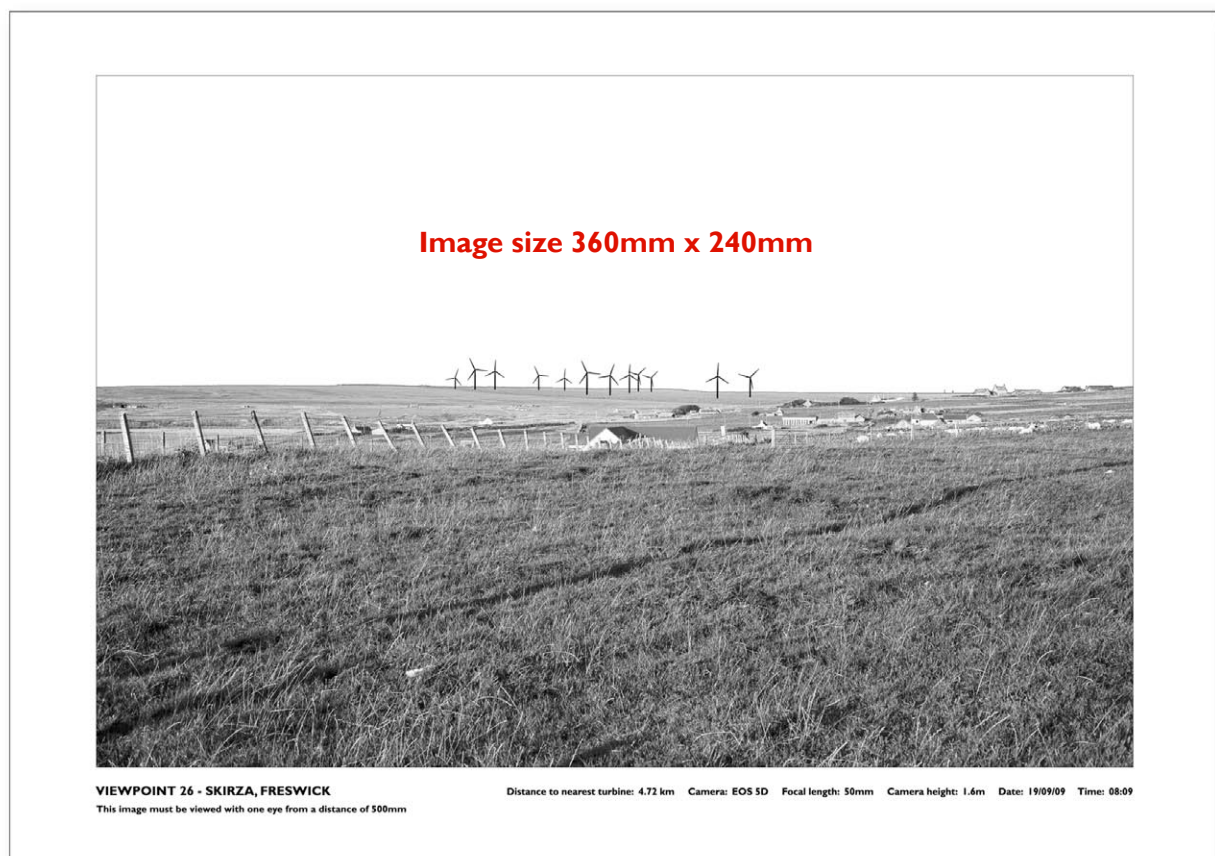


Fig.5 When viewed at the correct distance from exactly the same viewpoint, the viewer can assess the scale of the windfarm development in the wider landscape.

6.17 An explanation of how to create the transparencies is given on the next page.

TRANSPARENCY SPECIFICATION

Step 1 With the layered file of the 360 x 240mm colour image, remove the sky and any areas of water. Convert the background image to black and white and increase both the brightness and contrast. Add a 2 pixel black outline to the 'inside' of the adjusted image to define the landform similar to a wireframe outline. Convert the separate layer containing the turbines to solid black.

Step 2 Flatten the layers and add a 2 pixel frame around the 360 x 240mm image.

Step 3 Print the final image on matt photographic paper. Using a high quality colour laser printer such as the type available at professional output centres, copy the image onto an A3 clear acetate. It is important that the laser printer is set to 'black' and not colour mode.

It should be noted that the above brightness and contrast adjustments will be dependent on the original photograph, type of photographic paper and acetate used. The final image should be of sufficient transparency to enable the viewer to clearly and accurately align landscape features.

(C) PANORAMIC IMAGES

6.18 Panoramic images shall be a minimum image height of 144mm to meet the minimum monocular viewing distance requirement of 300mm. A minimum image height of 200mm is preferred.

6.19 Only photographs taken with a 50mm fixed lens taken in landscape format shall be combined to form a panoramic image.

6.20 The 50mm image shall not be cropped in any way, preserving the vertical field of view of 27 degrees so that the accuracy of the image can be verified by the metadata submitted with the original single frame image. (See Section 7)

6.21 The extent of the technically correct single frame 50mm image shall be clearly defined within the overall panoramic image.

6.22 If two panoramic images are shown on one A3 page, to conform with the minimum image height of 144mm, the images will fill the full height of the page allowing for a printed border. In such circumstances, the technical information relating to the images should be clearly stated on an extension to the A3 page.

6.23 The information box on the page should contain the following information: Figure number, viewpoint number, location title, distance to nearest turbine, camera model, focal length, camera height, the overall field of view, date and time of day the photograph was taken.

6.24 The information box on the visualisation shall have the following **'Health Warning'** clearly visible:

IMPORTANT VIEWING INSTRUCTIONS

This is a composite image made up of **X*** No. 50mm photographs joined together horizontally to form an overall field of view which is wider than that seen in detail by the human eye. For correct perspective viewing, this image must be viewed at an exact distance of **XXX***mm with **one eye** whilst curving the image in an **exact arc** of **XX***degrees. This image should only be assessed in the real landscape from the same viewpoint.

***X** Appropriate information to be added

6.25 No other information or caveats shall be included in the information panel or elsewhere on the visualisation page.

6.26 Panoramic visualisations shall not be used or included in any presentation for viewing on electronic screens or flat screen projections.

7. CAMERA METADATA

7.1 The original 50mm single frame photograph for each viewpoint shall be submitted for verification. For panoramic visualisations, the central 50mm photograph which forms part of the overall image shall also be submitted for verification.

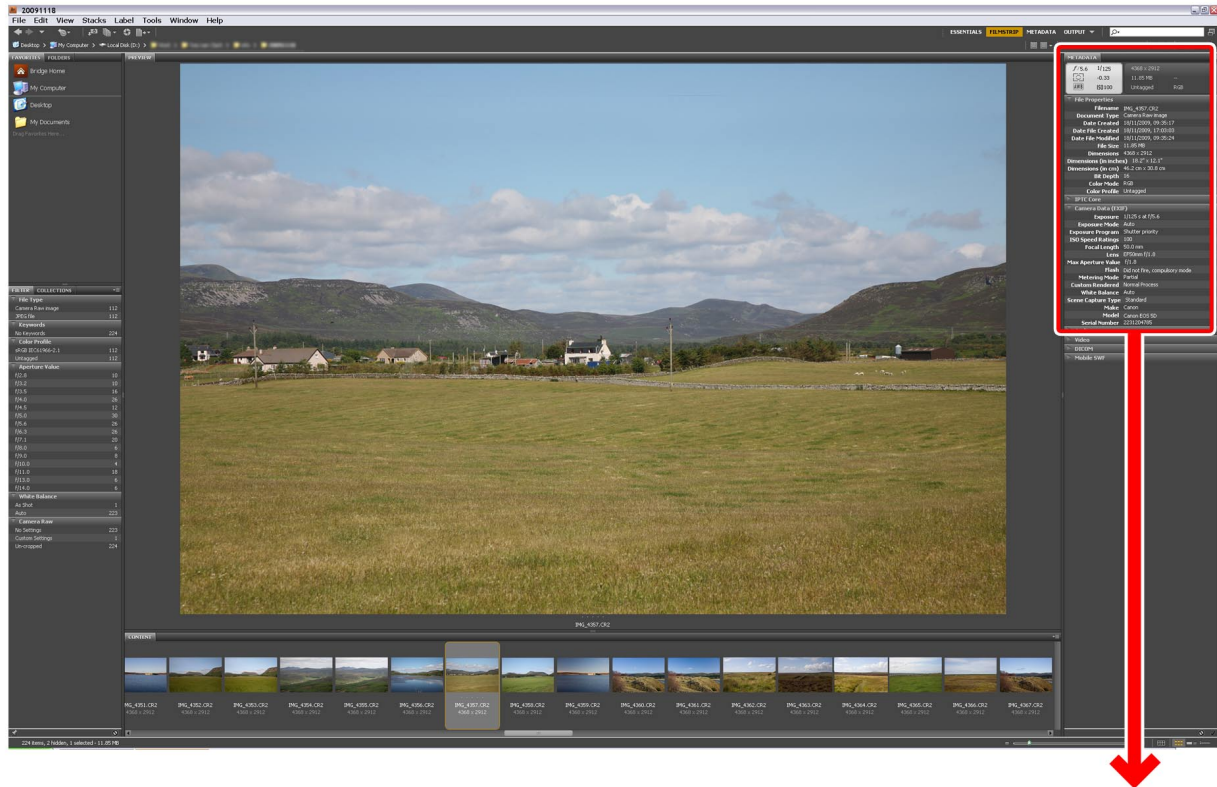


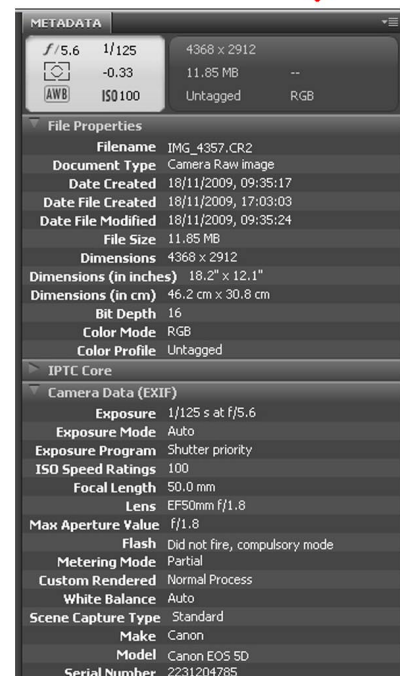
Fig.6 Typical image browser showing detailed metadata information for verification

7.2 The original photographic images with embedded metadata shall be submitted on CD-ROM in 'Camera RAW' format. Metadata for a photograph would typically include the date and time at which it was taken, along with details of the camera, lens, and settings such as focal length, aperture and exposure.

7.3 Any necessary image adjustment should be made in RAW format only.

7.4 Where a 35mm film camera has been used, the copy negatives or contact prints of the original images with the sprocket guides clearly shown should be submitted.

7.5 Applications shall not be processed until this important information is provided.



8. PRESENTATION FORMATS

(A) ENVIRONMENTAL STATEMENT – VOLUME OF VISUALISATIONS.

8.1 Full page A3 single frame images at 50mm, 70mm or 75mm focal lengths in accordance with the requirements in Section 6 for VIA by the public, planning officers and decision makers shall be provided in addition to the panoramic images for LVIA by landscape professionals.

8.2 The document shall be laid out in the following sequence: Contents page, overall site and viewpoint map, methodology statement, viewing requirements, followed by the detailed viewpoint maps and photomontage images for each viewpoint.

8.3 For each viewpoint, the pages shall be laid out in the following sequence:

- Detailed location plan.
- 50mm panoramic images and wireframes.
- 50mm single frame image.
- 70/75mm single frame image.

8.4 This document shall form a separate volume to the remainder of the Environmental Statement to make for ease of use during on-site assessment.

(B) NON-TECHNICAL SUMMARY

8.5 The Non-Technical Summary (NTS) for public consultations shall be in A4 format only and shall not include any folded A3 size pages.

8.6 The NTS is a summary of the EIA findings, therefore illustrations shall be limited to accurate depictions of the proposal. **Scenic views and non-specific promotional information and illustrations shall not be included.**

8.7 Visualisations for inclusion in a NTS shall be agreed in advance in consultation with SNH and Community Councils before the application is prepared. Failure to do this shall result in abortive work, requests for additional visual material and delays in processing applications.

8.8 The NTS must contain only single frame visualisations at focal lengths of 50mm and 70/75mm depending on distance to the development site. **Panoramic visualisations shall not be included.**

8.9 The NTS visualisations shall be available on CD-ROM as a PDF file in landscape format with a minimum resolution of 250 pixels/inch. The single frame visualisations shall also be easily downloadable in the same format and resolution from the applicant's web-site with file sizes not exceeding 3MB so that the public can easily download and view the images on computer screen and undertake their own printing for on-site assessments.

8.10 All photographs and photomontages of a proposed development included in the NTS of an Environmental Statement shall be printed as individual single frame images on an A4 page and shall be accompanied with an Ordnance Survey extract printed on a separate A4 page, clearly showing the viewpoint and the direction and field of view of both the 50mm image and the 70/75mm image as shown in **Fig.7** on the next page.

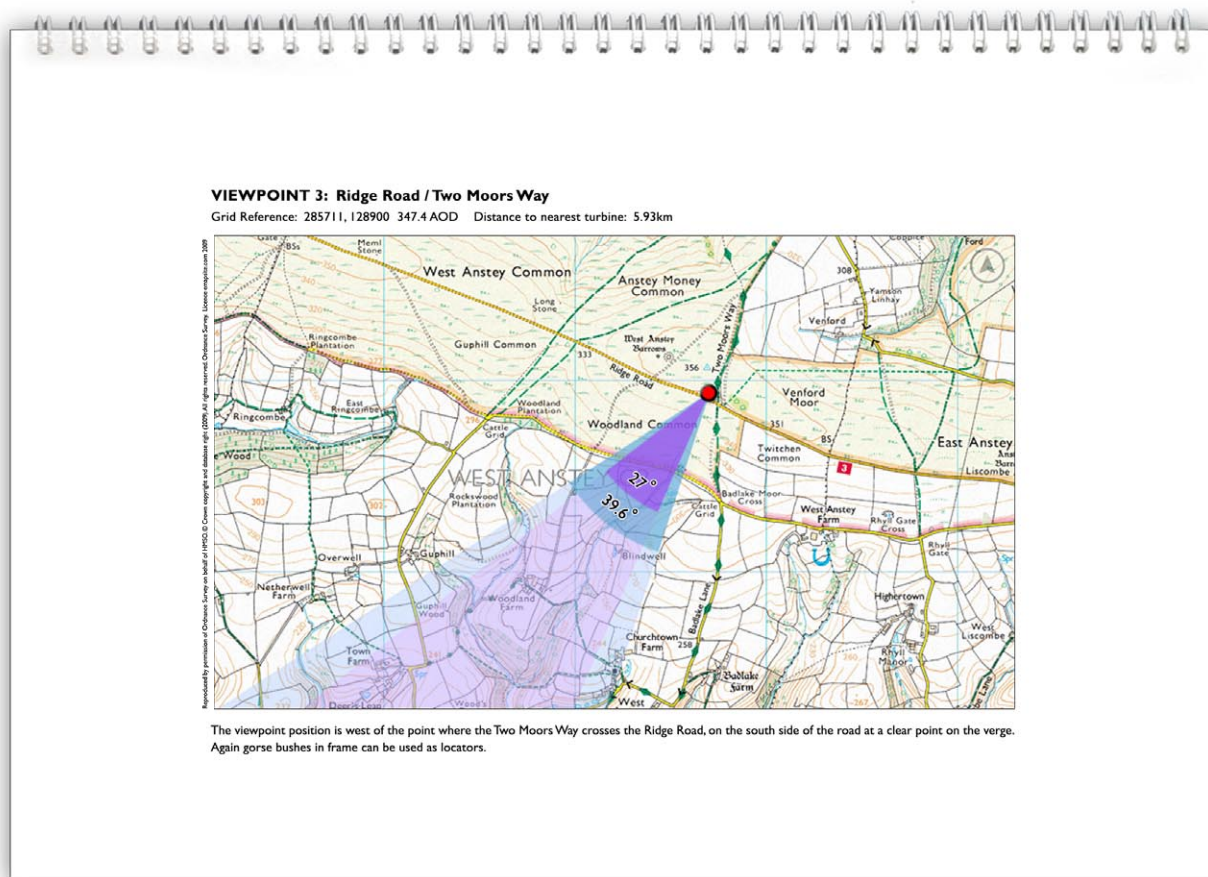


Fig.7

9. PRINTING STANDARDS & REQUIREMENTS

9.1 Full page photomontage images, location maps and the methodology statement which form part of the Environmental Statement shall be bound into one complete A3 document. This document shall form a separate volume to the remainder of the printed Environmental Statement to make site assessment more manageable.

9.2 Full page photomontage images and location maps which form the NTS should be bound into one complete A4 document.

9.3 One set of the photomontages shall be submitted printed on best quality smooth matt or satin finish photographic paper.

9.4 Further copies can be supplied using a high quality commercial laser printer or equivalent with a minimum resolution of 250 pixels/inch.

10. DELIVERABLES

10.1 A3 Environmental Statement - Volume of Visualisations

- Single frame photomontages, panoramic images, location maps and the methodology statement which form the visualisation section of the Main Environmental Statement should be bound into one complete A3 document.
- No less than 4 copies of the A3 document shall be submitted along with one master set printed on high quality photographic paper, in matt or satin finish.

10.2 A4 Non-Technical Summary

- Full page photomontage images and location maps which form the Non-Technical Statement should be bound into one complete A4 document.
- No less than 12 copies of the A4 document shall be submitted along with one master set printed on high quality photographic paper, in matt or satin finish.

10.3 CD/DVD-ROM

- One CD/DVD-ROM containing all the original 50mm single frame photographs with embedded metadata shall be submitted for verification purposes. In the case of panoramic visualisations, the single frame image which forms the central image shall be submitted for verification purposes.
- One CD/DVD-ROM containing both the Main Environmental Statement and the Non-Technical Summary as a PDF file in landscape format. High resolution photomontages for printing at a minimum of 250 pixels/inch with file sizes not exceeding 3MB per image shall be provided to enable ease of loading onto and downloading from the Council's e-planning system.

10.4 A3 Transparencies

- One set of black and white A3 transparencies of the 50mm focal length photomontages shall be submitted for site assessment and verification in accordance with the specification given on pages 6 and 7. Further sets may be required for on-site assessment by Committee Members should a site visit be arranged.

11. METHODOLOGY STATEMENT INFORMATION

11.1 Details of how photomontages have been prepared shall be provided. This information shall include details of computer programs used, photographic details, terrain data used and modelling methodology. Any limitations of the overall methodology shall be clearly stated.

11.2 Confirmation that all photographic images have been taken in landscape format and that the images have not been cropped in any way, thus retaining the vertical and horizontal fields of view characteristic of the stated focal length in the 35mm camera format.

11.3 Confirmation must be provided that the 50mm and the 70mm/75mm single frame images conform to the horizontal, vertical and diagonal fields of view as defined below.

Focal length (mm)	Horizontal field of view (degrees)	Vertical field of view (degrees)	Diagonal field of view (degrees)
50	39.6	27.0	46.8
70	28.8	19.5	34.3
75	27.0	18.0	32.0

11.4 Details of the photography shall be given including the weather conditions, the make and model of the full frame sensor 35mm format camera, make and focal length of the fixed lenses used and the make and type of the panoramic head used.

11.5 Confirmation that all the viewpoint locations specified by the Council have been visualised.

11.6 Confirmation that Ordnance Survey DTM 5-metre Contour Data has been used to create the 3D computer generated terrain model or that 10-metre Contour Data has been used where 5-metre data is not available.

11.7 Confirmation that the height of the camera lens above ground level is 1.5m.

11.8 Confirmation that the turbines shown in the photomontages and wireframes have been constructed in accordance with the dimensions stated in the Environmental Statement, and that the dimensions of the turbine column, nacelle, and blades fully conform with manufacturer's specification related to the turbine output and nacelle height. The Council shall require written and technically illustrated evidence of all the major dimensions from the proposed turbine manufacturer for verification.

11.9 If composite panoramic images are submitted the following additional information shall be provided:

- confirmation that a levelled panoramic tripod head has been used.
- details of the computer program that has been used for the panoramic stitching.
- the type of projection that has been used.
- details and workings of how the monocular viewing distance has been calculated.

Development Management
Planning and Development Service
The Highland Council

January 2010

email: planning@highland.gov.uk

GLOSSARY

AOD - Above Ordnance Datum. Used to specify heights above mean sea level on General Arrangement and other technical drawings. Usually specified in metres. (eg +62.0m.AOD)

Binocular - Viewing with both eyes.

Borrow Pit - An excavation dug to provide material (borrow) for fill elsewhere.

Camera RAW - A raw image file contains minimally processed data from the image sensor of a digital camera. Raw files are so named because they are not yet processed and therefore are not ready to be used with a bitmap graphics editor or printed.

CD/DVD-ROM - Optical disks for storage of digital information. DVDs are of the same dimensions as compact discs (CDs), but store more than six times as much data.

Cylindrical projection - An image projection occurs whenever a flat image is mapped onto a curved surface, or vice versa, and is particularly common in panoramic photography. Single frame images are joined either manually or using a computer program and formed onto a cylindrical plane. Cylindrical projections are also the standard type rendered by traditional panoramic film cameras with a swing lens. Cylindrical projections maintain more accurate relative sizes of objects than rectilinear projections, however this is done at the expense of rendering lines parallel to the viewer's line of sight as being curved (even though these would otherwise appear straight). <http://www.cambridgeincolour.com/tutorials/image-projections.htm>

DTM - Digital Terrain Model or Digital Elevation Model (DEM) is a digital representation of ground surface topography or terrain. A DTM can be represented as a raster (a grid of squares) or as a triangular irregular network. DTMs are commonly built using remote sensing techniques, but they may also be built from land surveying. DEMs are used often in geographic information systems, and are the most common basis for digitally-produced relief maps.

EIA - The term 'Environmental Impact Assessment' describes a procedure that must be followed for certain types of project before they can be given 'development consent'. The procedure is a means of drawing together, in a systematic way, an assessment of a project's likely significant environmental effects. This helps to ensure that the importance of the predicted effects, and the scope for reducing them, are properly understood by the public and the relevant competent authority before it makes its decision.

Embedded - Integrated with the digital image information.

Focal Length - A measure of the collecting or diverging power of a lens or an optical system. Focal length, usually designated f in formulas, is measured by the distance of the focal point (the point where the image of a parallel entering bundle of light rays is formed) from the lens, or more exactly by the distance from the principal point to the focal point.

Landscape format - A printing orientation that prints data across the wider side of the form. Contrast with portrait format.

LIA - Landscape Impact Assessment describes, classifies and analyses the **landscape effects** that are changes in the elements, characteristics, character and qualities of the landscape as a result of development. These effects can be positive (beneficial or an improvement) or negative (adverse or a detraction).

Linear perspective - A form of perspective in drawing and painting and photography in which parallel lines are represented as converging so as to give the illusion of depth and distance.

LVIA - Landscape and Visual Impact Assessment is an umbrella term for description, classification and analysis of landscape and visual effects.

Metadata - (Metadata, or sometimes metainformation) is “data about data”, of any sort in any media. Metadata for a digital photograph typically includes the date and time at which it was created and details of the camera settings (such as focal length, aperture, exposure). Full frame 35mm digital cameras record metadata in their digital images in both Camera RAW and JPEG formats.

Monocular - Viewing with one eye

Panoramic head - A panoramic tripod head is a piece of photographic equipment, mounted to a tripod, which allows photographers to shoot a sequence of images with precise overlaps around the entrance pupil of a lens to produce a panorama. The primary function of the panoramic head is to precisely set the axis of rotation about the entrance pupil for a given lens or focal length, eliminating parallax error.

PDF - Portable Document Format. PDF files have become a popular way to exchange platform independent documents which are viewable using the free Adobe Reader.

Pixels/inch - Pixels per square inch or ppi. A minimum of 250 pixels/inch is the resolution required to produce a high quality printed image. This is typically much greater than screen resolution which is 72 pixels per inch.

Photomontage - Technique by which a composite photographic image is formed by combining images from separate photographic sources.

SLR camera - A single-lens reflex (SLR) camera is a camera that uses a semi-automatic moving mirror system which permits the photographer to see what will be captured by the film or digital imaging system.

Turbine - Wind turbine or aerogenerator; including tower, nacelle and rotor.

VIA - Visual Impact Assessment describes, classifies and analyses the **visual effects** that are the changes in the appearance of the landscape as a result of development. These effects can be positive (beneficial or an improvement) or negative (adverse or a detractor).

Viewing distance - The distance from the point of projection to the image plane to reproduce correct linear perspective.

Wireframe - A visual model of an electronic representation of a three-dimensional object.

ZTV or ZVI - A Zone of Theoretical Visibility or Zone of Visual Influence is the area from which a development is theoretically visible. It is usually represented as a map using color to indicate visibility. Zones of Visual Influence are used to identify the parts of a landscape that will be affected by a development. They are of particular use to Landscape Architects in determining visual intrusion as part of an Environmental Impact Assessment. Zones of Visual Influence have been used extensively in wind farm development. A map will be created showing the number of Wind Turbine that are visible from a particular area. A cumulative Zone of Visual Influence is used to define the cumulative effects of many developments.

The Effect of Focal Length on Perception of Scale and Depth in Landscape Photographs

Implications for visualisation standards for wind energy developments

**Final Report
17 May 2012**

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1 EXECUTIVE SUMMARY

1.1 Background

1.1.1 In January 2010, The Highland Council published detailed and prescriptive standards for the production of visualisations for the visual impact assessment (VIA) of proposed wind energy developments. The purpose of this study was to independently field test and verify The Highland Council's visualisation standards. It was also anticipated that the results obtained would contribute to the future revisions of the standards as necessary.

1.1.2 In the course of this study, interviews were conducted with over 500 members of the public during the preliminary pilot investigation and the subsequent main survey (n=346) between June and November 2011. The participants were recruited at 8 viewpoints located in the Central and Highland regions of Scotland.

1.1.3 The participants were shown single frame A3 photographs of the surrounding landscape at 7 different focal lengths (50mm, 60mm, 70mm, 80mm, 90mm, 100mm and 110mm) and asked to specify which of the images, in their opinion, provided the most realistic representation of the scale and distance to a specific focal point (or area) located centrally in the landscape in all photographs.

1.2 Main findings

1.2.1 The focal length considered by the public as that providing the most realistic representation of landscape scale varied markedly between participants and to a lesser extent between different viewpoints. However, the vast majority of participants in the main survey (n=334; 96.5% of the sample) were of the opinion that a 50mm single frame image for visualisation made the specified focal point (or area) appear too small and too far away relative to its appearance in the actual landscape.

1.2.2 The focal length most frequently specified by participants as that providing the most realistic representation of landscape scale and distance was the 70mm photograph (n=82; 23.7%) although an almost identical number of participants chose the 80mm photograph (n=81; 23.4%). These findings were broadly consistent across all the landscape views considered during the study with one exception where the public more frequently selected the 90mm image.

1.2.3 The distribution of focal length preferences was slightly skewed towards the longer focal lengths considered in the study. Hence, the mean focal length calculated from the participants' responses was 79.3mm (± 1.58 mm) for all responses obtained. This ranged between 75.3mm (± 4.96 mm) and 89.5mm (± 3.88 mm) for individual landscape views. The median of all participant responses was 80mm, but this ranged between 70mm and 90mm depending on the view under consideration.

1.2.4 The participants' choice of focal length did not demonstrate a clear and systematic relationship with the distance to the focal point under consideration in the landscape but this warrants further investigation. It was noted, however, that the way in which the images are viewed has a significant effect on perceptions of landscape scale.

1.3 Conclusions

1.3.1 The results suggest that images produced at a focal length of between 70mm and 80mm generally provide the most realistic representations of landscape scale and depth at least for the type of views considered during this study.

1.3.2 The use of a single frame image produced at a 75mm focal length is therefore considered to be broadly appropriate for wind farm visualisation and that most likely to be acceptable to the largest proportion of the public. The prescription of a single focal length standard also has the advantage of simplicity and clarity for applicants.

1.3.3 The use of alternative images produced at focal lengths shorter or longer than 75mm might be appropriate in very specific circumstances depending on the landscape context under consideration.

1.4 Recommendations

1.4.1 On the basis of the results obtained in this study, the following recommendations are made in relation to standards for the visualisation of wind energy developments.

- Single frame images produced at a 75mm focal length should be used for wind farm visualisation in most circumstances. The use of an additional image produced at a 50mm focal length is unnecessary.
- The specification of a 75mm focal length for visualisations should be accompanied by a caveat that alternative images at shorter or longer focal lengths might be required for some views at the discretion of the planning authority.
- The provision of visualisations for use by professionals and members of the general public should always be accompanied by detailed and precise instruction not only on the intended purpose of the visuals but also how the images should be correctly viewed.

The full 33 page study report is available from The Highland Council at a cost of £60 incl. VAT. Payment can be made by credit/debit card by telephoning 01349 886605 OR in person at any of The Highland Council Service Points OR by credit transfer/on-line banking as follows:

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