A66 Northern Trans-Pennine Project
TR010062

7.28 Viaduct Visualisations Technical Note

Planning Act 2008

Infrastructure Planning (Examination Procedure) Rules 2010

Volume 7

14 February 2023

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A66 Northern Trans-Pennine Project Development Consent Order 202x

7.28 VIADUCT VISUALISATIONS TECHNICAL NOTE

Planning Inspectorate Scheme Reference	TR010062
Application Document Reference	7.28
Author:	A66 Northern Trans-Pennine Project Team, National Highways

Version	Date	Status of Version
Rev 1	14 February 2023	Deadline 4

CONTENTS

1 Introduction

1.1 Background and scope of work

1.1.1 This Technical Note gives a concise overview of the process involved in producing visual representations of a number of the proposed structures on the A66 NTP Project. It responds to a request made by the Examining Authority (ExA) at Issue Specific Hearing 2 (ISH2) Agenda Item 3.1 for additional visual material, to understand the form and visual appearance of the proposed viaducts in their landscape context.

1.1.2 The ExA specifically want to understand the appearance of the following structures:

- Trout Beck Viaduct (Scheme 0405 Temple Sowerby to Appleby).
- Cringle Beck Viaduct (Scheme 06 Appleby to Brough).
- Moor Beck Viaduct (Scheme 06 Appleby to Brough).

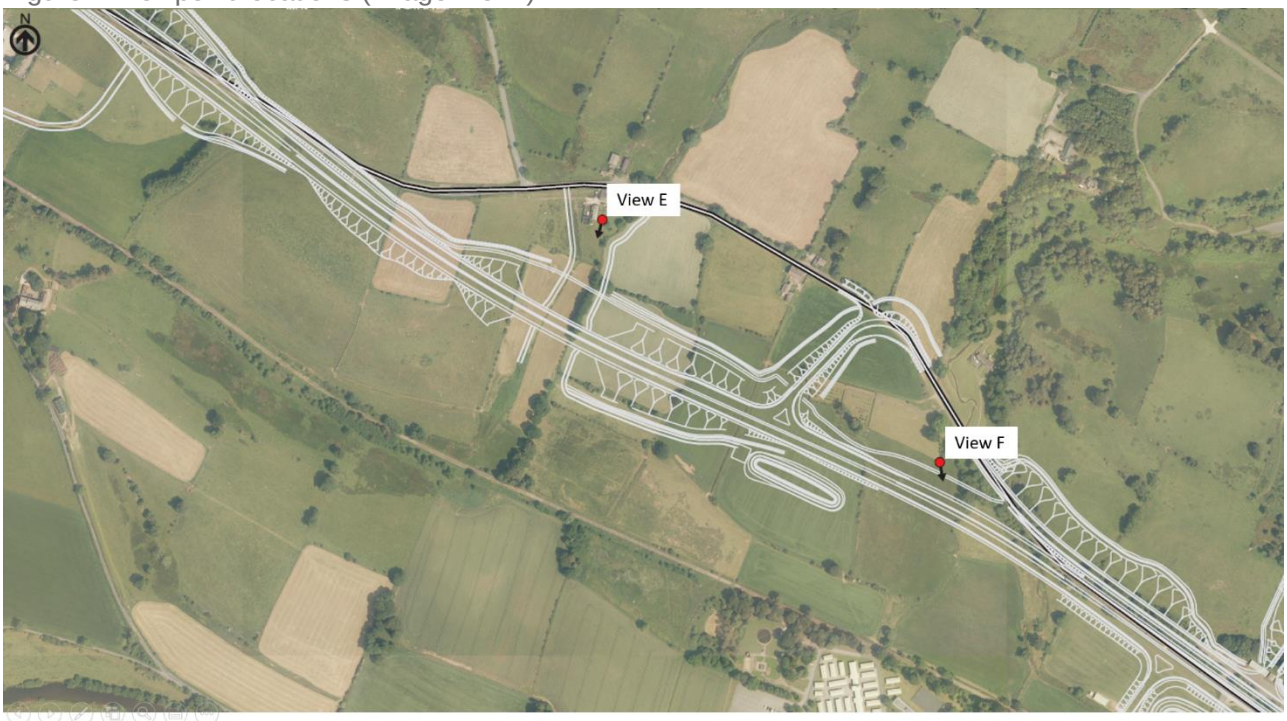
1.1.3 The ExA requested additional viewpoints and photomontages to illustrate these three key structures. The notes below are reproduced from the post-Hearing note produced by the Applicant (7.3 Issue Specific Hearing 2 (ISH2) Post Hearing Submissions for the Deadline 1 submission (REP1-009), with updated information in *blue italics*, as relevant. The viewpoint locations are also shown in Figures 1 and 2 (from the applicant's original post-Hearing submission for Deadline 1, document 7.3, updated to reflect the notes in the bullet points below):

- Viewpoint A: From existing viewpoint taken from the gate at Sleastonhow Farm looking south (ES VP 4.9a).
- Viewpoint B: View from the gated entrance to Sleastonhow Farm looking east/northeast. The Applicant has established that this will require permission to access private property. From initial assessment it looks like a clearer view might be available further along the lane at proposed Viewpoint C*. (Update: This was indeed the case - the ExA's proposed Viewpoint C below is far clearer and this is the one that has been taken forward in the task, becoming new Viewpoint B instead of C)*.
- Viewpoint C *(New B)*: Viewpoint proposed to address requirement for a photomontage of the structure from this location looking east. The Applicant has established that this will require permission to access private property. (*Update: Viewpoint C now removed, reflecting the notes above*)
- Viewpoint D: Proposed photo location from the footpath to the rear of Sleastonhow Farm as requested by Mrs Nicholson during the Hearing. (*Update: Final location was determined on site by the survey team confirming best available view of the structure along this section of footpath).*
- Viewpoint E: Viewpoint on the footpath south of Wheat Sheaf Farm, looking south to present the structure over Cringle Beck.

- Viewpoint F: Viewpoint from footpath 372/021 looking south to present the structure over Moor Beck.

Figure 1: Viewpoint locations (Image 1 of 2)

Figure 2 Viewpoint locations (Image 2 of 2)



2 Approach

2.1 Approach: Overview

2.1.1 Detailed consideration was given to how best to accommodate the ExA's request for visual information to understand the structures in their landscape context. The consideration was informed by the level of design resolution in the preliminary design in the DCO, the proximity of the ExA's requested viewpoints to the proposed structures and the requirement to communicate design intent through the images, rather than as an aid to assessment of impacts.

2.1.2 As set out in the Applicant's post-Hearing note (7.3 Issue Specific Hearing 2 (ISH2) Post Hearing Submissions), verified photomontages are a tool to aid impact assessment, rather than communication of design intent. Given that some of the locations requested by the ExA are very close (within 70m of the relevant structure and in the case of Moor Beck Viaduct, at a much closer distance) a photomontage would be of limited usefulness and the Applicant respectfully submitted that photomontages are not an appropriate means to represent the design in such locations. The Applicant therefore determined what it considers to be an appropriate means of visualisation to allow the ExA to better understand the preliminary designs of the structures in their landscape context, and what they could look like with the application of the relevant Design Principles set out in APP-302 Document 5.11 Project Design Principles (PDP). The Applicant considers the approach, which is summarised below, to provide an appropriate degree of information and to enable the proposed structures to be clearly understood in their landscape context. The approach also strikes a proportionate balance between showing how the PDP could be translated and integration with the landscape context, whilst also reflecting the preliminary stage of design the Project is currently at.

2.1.3 The Applicant undertook measured, surveyed photographs from the agreed viewpoints (or alternative publicly accessible viewpoints – see above – the viewpoints used were A, B, D E and F) and constructed and positioned within each panoramic image simple wireframe overlays of the structures to conform with relevant industry guidance, as set out in the Landscape Institute (LI) Technical Guidance Note 06/19: Visual representation of development proposals (LI TGN 06/19)[1].

2.1.4 This enabled the position, mass and scale of the structures to be shown as the basis for the illustrations. In order to provide more information as to how the structures could look and be experienced in context using the Design Principles defined in the PDP, the architectural illustrator (Richard Carman) was commissioned to provide artist's impressions from each viewpoint.

2.1.5 Richard Carman is a well-known architectural illustrator who has been working in this field since the 1980s, with a reputation for producing clear illustrations which neatly explain a project's design intent in its landscape

[1] [redacted]

context for communities and stakeholders. He produces images which are based on accurate information whilst capturing the perceptual and experiential qualities and aesthetic aspects of design intent.

2.1.6 Using the photographic material and wireframes as a basis for the illustrative representations, Mr Carman worked with the Project's Landscape Architecture Team, Scheme Design Leads and Bridge Engineers (the Design Team and Review Group) to determine that the images were correct and contained all of the relevant information to enable the preliminary design submitted with the DCO application to be understood from each location.

2.1.7 The approach is described in more detail, step by step, below.

2.2 Approach: Step by step

Step 1: Capture of measured/surveyed photographic images; production of initial renders

Step 1a) Photographic imagery capture

2.2.1 For each of the five viewpoint locations, and upon obtaining the relevant land access for the surveying/photographic data capture, measured and surveyed photography was undertaken in line with the approach set out in LI TGN 06/19. A series of overlapping images were captured and then stitched together using proprietary imaging software to create 180-degree panoramic images. The verified photographic image capture process used as set out below is in line with the relevant parts of the specification for LI Type 4 visuals (i.e. surveyed, measured and verifiable images), albeit that Type 4 visualisations/photomontages are not the output of this exercise. Furthermore, as these are not images which have been generated for Landscape and Visual Impact Assessment purposes, but rather for design communication purposes, single frame images were not used. The linear nature of the Project and the scale of the structures also required the use of panoramic photography to enable the structures to be properly shown in their landscape context.

2.2.2 Photographic imagery was captured on site for each viewpoint using the following approach:

- Where possible, the elements of the relevant Scheme (Scheme 0405 Temple Sowerby to Appleby for the Trout Beck Viaduct, Scheme 06 Appleby to Brough for the Cringle Beck and Moor Beck Viaducts) were positioned in the middle of the panorama. Photographs were taken in suitable weather conditions – clement weather and clear visibility. Photography was undertaken on 6th January 2023.
- The views have been photographed with a full frame digital Single Lens Reflex (SLR) camera with a fixed 50mm lens, to give the closest possible approximation of what the human eye would see. A Canon 6D Mark II camera was used.
- The camera was mounted in portrait format on a tripod with a panoramic head attached. The lens centre (its nodal point) was set at an eye level of approximately 1.6m to represent average viewer

eye height, although the camera height was adjusted as appropriate where features such as fences or hedges obscured the view.

- The camera's location was recorded using an X, Y, Z coordinate from the Trimble Total Station with offset to account for the lens. Camera setup was levelled using the levelling plate and levelling centre column.
- The Camera was set to manual focus; ISO100-400 with an aperture set to record an adequate depth of field (F8-F16) and white balance set appropriately to conditions.
- The camera was rotated between 10-20° to allow for a 50% overlap between each photograph. Photographs were captured in portrait format.
- Images were captured in High Resolution JPEG format which includes lens distortion correction.
- The photography and surveying were undertaken simultaneously in order to avoid problems with markers in soft ground moving or being removed altogether.

Field of view

2.2.3 For the structure under consideration, each viewpoint required a panorama using stitched individual images each with a field of view of 27/ 40 degrees. The extents of the structure and its relevant context determined the horizontal field of view required for photography and visualisation from any given viewpoint. Professional judgement based on experience of similar Projects was used to determine the required horizontal field of view to best represent the development from each viewpoint.

Verifiable surveying

2.2.4 The following techniques were used to verify the survey data:

- A Trimble Total Station was used by the surveyor to accurately record the camera position and also capture an array of selected survey reference points used to camera match and calibrate the photography. All survey points were captured in the British National Grid (BNG) co-ordinate system, recording an X, Y and Z co-ordinate for each.
- Each camera location was surveyed together with a series of clearly defined detail points within the image (e.g. corners of road markings, features on road signs, corners of building features etc.). Where a viewpoint did not contain many or any fixed targets suitable for surveying, temporary targets (ranging poles) were set up to allow the survey to be completed at the same time as the photography.
- Each image had a sufficient amount of clearly defined detail points taken across the width of the image and at near, mid and far distance (i.e. a balance of points across the photograph). Where possible these numbered between 8-12 points. Each detail point was given a unique number that related to the viewpoint number.

- The survey data was post-processed by the chartered surveyor to increase accuracy and then supplied in an Excel table for each set of viewpoint photography.
- A CAD file was generated, containing the detail points and camera positions.

2.2.5 An example of the stitched panoramic output from Step 1a) for Viewpoint A is reproduced in Figure 3, at reduced scale, for reference.

Figure 3: Example output from Step 1a for Viewpoint A

Step 1b) Development of preliminary renders to position the mass of the structures in the image as a basis for the illustrations

2.2.6 The next stage was to use available 3D digital modelling of the structure and its context and to position this in each image using proprietary 3D modelling software (3D Studio Max or 3DS Max), matching 'virtual' camera points with the survey points/ranging pole locations to position the model correctly in the image.

2.2.7 It should be noted that within the design development for the preliminary design for the DCO submission, 3D structures design and modelling only reached a certain point and much of the design detail was developed as 2D design information (plans, sections and elevations). As such the preliminary 3D model was used only to form a basis for the eventual composition of the illustrations (with reference to positioning, height, massing of structures and abutments/'landing points' only).

2.2.8 The notes below explain the process underpinning the model assembly and camera matching to position the model in the photographic images.

Model assembly

2.2.9 The following methods were used to assemble the 3D model:

- The surveyed X, Y, Z co-ordinates of reference points and the camera position were set up in the computer program 3DS Max.
- The preliminary 3D computer model of the Scheme as defined within the Scheme Description was used.
- The 3D computer model was georeferenced using supplied drawing data.
- Within the 3D software a virtual camera was set up using the co-ordinates provided by the surveyor and aligned with the reference markers.

- A 3DS Max model file for each viewpoint was assembled before rendering. The assembled model contains the relevant Scheme digital terrain model tiles and any structures, buildings or further elements (as defined above) that can be seen in the viewpoint, as relevant.

Camera matching

2.2.10 The following describes the process of 'camera matching' to create a virtual camera:

- The process of camera matching creates a virtual camera in the same location and height and pointing in the same direction as the physical camera used on site to capture the image.
- Each viewpoint has its survey points in place and the camera was set to the required field of view and view direction, generally between 75-90°.
- The process involved accurately positioning the 3D model of the Scheme within each existing view. This was achieved through a process of matching the surveyed points in the digitised image with those recorded by the survey team on the existing photographs.
- The survey points and specifications of the lens type relating to each view were also entered into 3DS Max.
- The survey points of the camera position and each clearly defined detail point (relating to specified objects in the view) were then highlighted on the digitised image.
- Once the process of camera matching was completed, the 3D model of the Scheme was accurately positioned within each of the views captured. This was achieved by rendering the camera matched 3D model of the Scheme within 3DS Max at the same size as the digitised existing view.
- To enable greater accuracy of real-life camera settings and the production of cylindrical projection wide angle panoramas which match the photography stitch, a plug-in programme called Vray was used. Each of the views was rendered using the Vray Rendering Engine software.
- Individual elements were rendered out using different map channels to create masks (for example mask for the digital terrain model, earthworks, fencing, shadows etc). These masks ensured each visible element of the Scheme could be independently selected when individually placed into the Adobe Photoshop file to create the renders which were used as a basis for the architectural illustrator's later work.

Producing the renders

2.2.11 The following describes the process of producing the renders which formed the initial basis for the architectural illustrator's images:

- The JPEGs were lens corrected and then stitched into a panorama using a cylindrical projection using Adobe Photoshop (see Figure 3).
- At this stage panoramas were checked for acceptability by the project landscape architect and any corrections noted for centring the images.
- The renders of the 3D model were superimposed onto the existing photographs in Photoshop.

2.2.12 An example of the output from this stage (for Viewpoint A) is shown in Figure 4.

Figure 4 Example render – Viewpoint A

2.2.13 The renders were then printed at A0 size as a basis for Mr Carman's work, to enable the required level of detail in the landscape context to be brought forward in the illustrations, and so that high quality reproductions of the artwork could be made at original and reduced scales as required.

Step 2: Artist commissioning and initial briefing process

2.2.14 The architectural illustrator Richard Carman was commissioned to undertake the production of the illustrations, as it was felt that his approach and artistic style (often working in watercolour) was appropriate and sensitive to this commission. His artistic approach has enabled the development of robustly produced illustrations which also reflect the current stage of preliminary design – a proportionate approach.

2.2.15 Mr Carman undertook an initial drive over of the A66 NTP route on 13th January 2023 to enable familiarisation and an understanding of the landscape context of the route and how the Project would fit within the landscape.

2.2.16 A collaboration and briefing workshop meeting was then held at the RSK Group's Hemel Hempstead office on 16th January 2023, between Mr Carman and members of the landscape design team from the A66 Integrated Project Team, Andrew Tempany (Chartered Landscape Architect and Technical Director at Stephenson Halliday, an RSK Company) and Chris Leeming (Chartered Landscape Architect and Senior Landscape Architect at Amey). At this briefing meeting, the relevant parts of the Schemes were explained and explored in detail, with reference to

the below sources of information from the DCO application, which were also made available for Mr Carman's use:

- APP-302 Document 5.11: Project Design Principles (PDP).
- APP-009 Document 2.3: Project Design Report.
- APP-041 Document 2.8: Environmental Mitigation Maps.
- APP-013 Document 2.5: General Arrangement Drawings Scheme 0405 Temple Sowerby to Appleby.
- APP-014: Document 2.5: General Arrangement Drawings Scheme 06 Appleby to Brough.
- APP-21: Document 2.7: Environmental Management Plan Annex B1 Outline Landscape and Ecology Management Plan (specifically the outline planting palettes).

2.2.17 Mr Carman was also provided with Aesthetic Appraisal Documents developed by the Scheme design leads, which directly informed a number of the Landscape Integration Design Principles in APP-302 Document 5.11. Further information on the Aesthetic Appraisal Documents and their purpose can be found in the Applicant's Deadline 3 Submission, *Overview of Design Process for Trout Beck Bridge, Cringle Beck Viaduct and Moor Beck Viaduct* (Document Reference 7.17, REP3-046). The documents provided to Mr Carman were:

- A66 NTP Aesthetic Appraisal Document – Trout Beck Bridge HE565627-AMY-SGN-S00-RP-CB-000013
- A66 NTP Aesthetic Appraisal Document – Scheme 06 Viaducts HE565627-AMY-SGN-S00-RP-CB-000014.

2.2.18 Having regard to the stage of design the Project is at, Mr Carman was provided with 2D preliminary engineering design drawings of the viaducts. These drawings included sections and elevations as appropriate, such as details of the proposed pier arrangements and siting. The drawings had been developed by the Scheme design leads and bridge engineers as part of the options development process, with regard to design and siting of structures and piers in proximity to the functionally linked watercourses of the River Eden Special Area of Conservation (SAC), and were incorporated into the Structures Options Reports produced during preliminary design. Further information on the Structures Options Reports and their purpose can be found in the Applicant's Deadline 3 Submission, *Overview of Design Process for Trout Beck Bridge, Cringle Beck Viaduct and Moor Beck Viaduct* (Document Reference 7.17, REP3-046).

2.2.19 Working with these drawings allowed the visual appearance, proportions, scale, mass and arrangement of piers, support beams, decks, parapets and guard rails to be confidently understood and interpreted in developing the illustrations. The preliminary 2D design drawings provided to support Mr Carman's work were as follows:

- Trout Beck Viaduct: Dwg HE565627-AMY-SGN-S0405-DR-CB-000023-Blue Option 3a-3b-3c GA.

- Cringle Beck Viaduct: Dwg HE565627-AMY-SGN-S06-DR-CB-000010-000010.
- Moor Beck Viaduct: Dwg HE565627-AMY-SGN-S06-DR-CB-000015-000015.

2.2.20 A series of other relevant project precedents (such as for the A96 scheme) were also shared for reference, and to guide the production of the illustrations.

2.2.21 Mr Carman then produced the illustrations following a three stage, iterative and collaborative process, with each stage reviewed by the Design Team - project landscape architects, key members of the Environment Team and the relevant Scheme design leads and bridge engineers - to ensure that the artistic interpretation of the available design information was correct. These three stages were as follows:

- Production of initial development roughs for the images for each viewpoint.
- Production of refined pencil sketch underlays for the eventual finished images.
- Production of watercolour images for each viewpoint.

2.2.22 The process underpinning these is summarised below, with an example of the outputs for Viewpoint A for each stage also shown, for reference.

Step 3: Production of initial development roughs for each image: Review 1

2.2.23 The renders produced in Step 1b) were used as a base to work from, with interpretation of the other Scheme design information and source material provided as described above. Use was also made of the GA drawings, plans, sections and elevations to scale from to build up the profile of the piers and ground planes etc, so that this data could be interpreted and worked up accurately when the drawing was overlaid on the renders described in Step 1b above. Working with this information, Mr Carman made initial preparatory/development roughs for each location. These took the form of rapid pen sketches to set out the interpretation of the spatial arrangement and articulation of the structure's design and relevant aspects of the integration design – landscape and environmental mitigation. The various elements of the structures were scaled both with reference to the supplied engineering GA drawings listed under paragraph 2.2.19 above and with reference to scaleable references on the model renders such as parapets and guard rails. A degree of interpretation was required in the development roughs, to correct the optical distortion which is inevitable with panoramic photographs produced in cylindrical projection. These development roughs were used as the basis for Review 1 with the Design Team, to confirm that the interpretation of the design was correct and that the rough development sketch contained all of the expected design elements before Mr Carman proceeded with the next stage.

2.2.24 Given that the baseline photography was captured in winter, it was agreed between Mr Carman and the Design Team that the eventual illustrations would also be winter illustrations. Proposed vegetation as part of the relevant Scheme was to be shown at a level of growth approximating to

year 15, to give an indication of the legacy appearance of the structures in their landscape context.

2.2.25 Comments from the Design Team and reviewers were captured in a spatially referenced form, on digitally marked up copies of the initial sketches, and communicated with Mr Carman via Teams call/screenshare, with further correspondence as required to provide resolution of technical queries which arose as the work progressed.

2.2.26 An example initial development rough/preparatory sketch is shown in Figure 5.

Figure 5: Example Development Rough for Viewpoint A

Step 4: Production of refined pencil sketch underlays for the eventual finished images: Review 2

2.2.27 Once the images were reviewed and the required refinements noted and agreed, Mr Carman next produced a more refined pencil underlay for each image. This would, subject to comments from the Design Team/reviewers and any corrections noted, be used as the basis for the eventual watercolour images.

2.2.28 An example output from this stage is shown in Figure 6.

Figure 6: Example pencil sketch underlay – Viewpoint A

Step 5: Production of watercolour images: Review 3 and sign off

2.2.29 Upon sharing and agreement of the review comments with Mr Carman, the next stage in his workflow was to transfer the pencil images to watercolour paper as a basis for the watercolour illustrations.

2.2.30 Two key points informed the production of this final stage of image production. These were:

- The need to show an appropriate and representative level of traffic using the highway and viaduct in each image, including Heavy Goods Vehicles; and
- How to represent the potential materiality of the structures, interpreting the Design Principles in the PDP and adding a degree of information which complemented these Design Principles, showing one way the Project and structures could be delivered to meet the requirements of the PDP. In this case and in consultation with the Scheme design lead and bridge engineer, and in the interests of showing a unified, landscape sensitive aesthetic and 'family appearance' for the structures in line with the PDP, it was agreed to show concrete piers, a weathering steel/cor-ten steel support beam (which could, subject to detailed design, also be painted steel, finished in a landscape appropriate hue) and concrete deck/parapet. A key consideration was to show the structures with a clean, uncluttered and coherent appearance, and to show one way in which the structures could be delivered. In the case of the Trout Beck viaduct, the preliminary engineering design (Dwg HE565627-AMY-SGN-S0405-DR-CB-000023-Blue Option 3a-3b-3c GA) had allowed for an option for arched spans to be formed into the steel support beam. It was felt appropriate to show this for the Trout Beck images, to reflect the PDP's principles calling for proportionally elegant appearance and using design details to subtly and perceptibly lighten a structure whose overall span is in the order of

400 metres. Relevant Design Principles in the PDP in the above respects include LI04-7 and 0405.03/0405.04.

2.2.31 The draft watercolour images were circulated to the Design Team and Review Group for final comments, so that the images could be finalised and signed off for issue. Upon completion, each image was large format scanned at a resolution of 300dpi and provided electronically, in JPEG, TIFF and CMYK formats.

2.2.32 An example of the output from this stage is shown in Figure 7.

Figure 7: Example watercolour illustration – Viewpoint A

2.2.33 The illustrations have been drawn at such a scale and scanned at sufficient resolution that their finer detail can be explored and ‘interrogated’. A zoomed in extract from the above visualisation is shown in Figure 8.

Figure 8: Zoomed in extract from illustration for Viewpoint A in Figure 6 above