Certification of View Analysis

Assessment report

Summary

Objectives
Richard Lamb and Associates (RLA) were engaged by the University of Sydney to peer review the view analysis by JPW and to provide certification of the adequacy and accuracy of block photomontages.

RLA reviewed the preliminary view analysis, advised on appropriate methodology for preparation of photomontages and on the views that should be given priority.

The views included three specifically required to be addressed based on consultations between the applicant and the Heritage Council of NSW, as required by the SEARs.

RLA determined that the views represented were comprehensive, representative, photographed in a standardised, professional way, the locations for which were surveyed.

The photomontages prepared under the direction of RLA were to satisfy the Land and Environment Court of New South Wales practice direction for photomontages and have a high level of fit of the 3D models with photographs used to prepared them.

Conclusions
The 3D wire frame models of the proposed building and existing landscape features were analysed and shown to have a high level of fit to the existing environment in the photographs used to prepare the photomontages.

Subject to the limitations imposed by the requirement of the Heritage Council for a panoramic view on the axis of the Bell Tower entry to the Quad, the panoramic image is a useful tool to address the relative scale and heights of the proposed building in relation to the Fisher Library.

Recommendations
JPW should be congratulated on the level of accuracy of the fit of the wire frame models of the survey and proposed building with the images used to prepare the block photomontages.

The block photomontages can be certified to be as accurate as is reasonable in the circumstances. They comply with the Land and Environment Court of New South Wales practice direction for photomontages, as required.

The preparation of the photomontages demonstrates best practice in achieving accuracy of representation.

Contents

1. Objectives of assessment

1.1 Purpose of this report

Richard Lamb and Associates (RLA) have been engaged by the University of Sydney to peer review a View Analysis Study by Johnson Pilton Walker (JPW) project architects, and to provide certification of the adequacy and accuracy of block photomontages which form the basis of the visualisation of the likely built form proposed in the redevelopment of the existing tennis courts site, resulting from construction of the proposed Chau Chak Wing Museum (the proposal) on the Fisher Tennis Courts site (the site). Redevelopment of the Site is the subject of a State Significant Development Application (SSDA) to the NSW Department of Planning and Environment as the consent authority.

1.1.1 Relevant experience

RLA have been involved in the preparation of visual analysis and heritage view studies in relation to many Major Project Applications, Urban Design studies and Planning Proposals and are familiar with this area. Dr Lamb's CV can be found on our website www.richardlamb.com.au. RLA have been involved in a number of planning proposals in Brookvale, Dee Why, Menangle, Harbord, Somersby, Gosford, Putney Hill, North Ryde, Homebush, Terrigal, Wentworth Point, Shepherds Bay, Gladesville, Yarrawarra and other locations. We have also been involved in a number of projects and planning proposals in which the Department of Planning and Environment or other government authorities have requested view analysis work and photomontage certification, the visualisation work for which we have supervised.

1.2 View analysis study

The View Analysis study by JPW addresses potential visibility and visual impacts on the public domain of the setting of the redevelopment proposal in the Camperdown Campus. The site is adjacent to University Avenue, north of Fisher Library and east of the Main Quadrangle (the Quad), the original and most important building, from an historical perspective, at the University of Sydney. The Site is the last green field site for a free-standing building of the scale required by a building to consolidate a significant proportion of the collections of existing museums on the campus.

The View Analysis study includes a series block model photomontages which show the proposed development as viewed from a range of public domain locations, including those associated with the formal axes of University Avenue and the Bell Tower entrance to the Quad, the continuation of the axis of University Avenue through to Victoria Park, the Great Hall, south west corner of the University Place, the northern axis of Eastern Avenue and the Parramatta Road entry to the Camperdown Campus adjacent to Baxter's Lodge.

The locations from which visualisations in the View Analysis study were prepared were based on a preliminary study by JPW which proposed a number of locations for analysis. Following consultations required by the SEARs for the SSD, between the University and the Heritage Council of NSW, further viewing locations were requested to be added to those in the preliminary JPW study (see Appendix 2).

1.3 Role of RLA in reviewing view analysis study

RLA were commissioned to review the preliminary View Analysis study, advise on appropriate methodology for preparation of photomontages and to advise on the views that should be

given priority in fairly representing the likely visual effects of the proposal on the most important viewing locations, while also meeting the concerns of the Heritage Council of 8 March, 2017 (see Appendix 2). Priority views are important viewing locations in the public domain based on the heritage and urban design significance of the view place. Potential effects on these views are important to understanding and assessing the likely visual impacts of the building in the SSDA.

Following the review and prioritisation of views by RLA, JPW prepared a series of photomontages to assist in analysis of the urban design and visual impacts of the proposed building envelopes. The photomontages (see Appendix 4) are both transparent and block models, including indicative representation of materials and retained vegetation, to show the building form and scale in an accurate and verifiable way that assists in the assessment of the merits of the application.

1.4 Specific objectives for RLA in this report

1. to verify that the viewing locations chosen for the preparation of photomontages are;
    - comprehensive of all of the relevant kinds of views affected;
    - representative of the relevant features in the composition of each kind of view;
    - captured by photographs taken in a standardised way with a camera of appropriate quality, on a tripod at a consistent lens height above ground, with a lens of appropriate focal length and of fixed focal length lens and at high resolution;
    - surveyed and geotagged, so the location of the camera and its height above ground can be added as a 3D reference point to the existing 3D model of the proposed building and landscape/topography.
2. To certify that the photomontages prepared are as accurate as is reasonable in the circumstances, consistent with the Land and Environment Court of New South Wales practice note for preparation of photomontages (see Appendix 3) and represent best practice, by satisfying the following criteria;
    - there is a good fit of the proposed building to existing survey data and items either on the survey or which can be added to it on RLA's advice, if necessary;
    - there is a good fit of the 3D model of the proposed building to items visible in the photographs, provided that they satisfy the criteria in (1) above;
    - the block model photomontages faithfully represent the likely location, height, bulk, mass and scale of the proposed building;
    - the rendering of the effect of vegetation, which would tend to screen or block views of the building in views from the east and partly from the south, for example, is representative of the likely effects on views.

1.5 Limitations

This report concerns only the process and methodology of preparation of the photomontages that accompany the SSDA and the certification that they represent best practice are a reasonable representation of the likely appearance of future development, if the project proceeds to the construction of the building in accordance with the plans in the SSDA.

2. Site and Project Description

2.1 The Site and Surrounds

The development site is located to the northeast of the University's grounds adjacent to the Parramatta Rd entrance, within the area currently used as the Fisher Tennis Courts site.

Parramatta Rd runs in an approximate east to west alignment and borders the site to the north. University Place that runs in a north south direction is located to the west, beyond which is the University's main Quadrangle Building. University Avenue borders the site to the south, with Victoria Park located beyond the University grounds to the east.

The main portion of the site consists of three tennis courts, to the north of which is a small weatherboard tennis pavilion building. An area of lawn is located to the east of the site.

The northern boundary between the University campus and Parramatta Rd features a retaining wall above which is a linear garden bed containing significant trees. Ground conditions of the area consist of a sloped garden bed.

The development site is bound on all sides by trees of varying significance.

Figure 1: Aerial view of site

2.2 The Project

Currently, the University's museums, galleries and collections are significantly fragmented and located in numerous buildings. The Project Proposal involves the co-location and consolidation of the Macleay Museum, Nicholson Museum and University Art Gallery as well as collections from a number of locations into a new single museum building to be known as the Chau Chak Wing Museum.

At the heart of the project is the University vision to:

- Upgrade the quality of Museum and Gallery facilities to promote object based learning and research.
- Create teaching and research space that can be shared across all faculties.
- Consolidate collections to promote education, research and conservation.
- Recognise and celebrate Aboriginal significance.
- Develop a healthy and sustainable Campus environment.
- Ensure equitable access to and through Campus.
- Respect the heritage “Sandstone University” significance.

The new museum building will be a four level facility comprising of:

- Gallery space;
- CERC (Collections Education Research & Conservation Facility) space;
- Collection storage and workshop areas;
- Staff offices, facilities and boardroom;
- Project and study rooms;
- A 200 seat Auditorium;
- Restaurant, café and terrace facilities;
- Loading dock; and
- Plant rooms.

Figure 2: Aerial view of site with indicative block model of proposal

3. Site analysis

3.1 The Site in relation to views

The Site is directly east of the northern part of the main Quad and the Great Hall, separated from it by the northern section of University Place. Surrounded by trees of varying significance, gardens and lawns, the site is of generally low existing visibility. It is however, exposed to views from some of the most important formal and historically significant viewing places in its vicinity,

Open and grassed, University Place, also known as the University Lawn, to the west of the Site is traversed east-west by three axial paths symmetrically arranged, that formally link to entries to the Quad. The central and most significant entry is below the Bell Tower, aligns with the widest path and is on the axis of University Avenue. The narrower paths to the east and west align to secondary entries. A later oblique path leads toward Fisher Library.

The Bell Tower and steps on the axial path below it which leads toward University Avenue and Victoria Park beyond, is perhaps one of the most important and photographed locations on the Camperdown Campus, as it is a favourite for photographs of recently graduated students and their families and is also favoured by tourists.

There is no similar formal axial relationship with the landscape of University Place between the Great Hall at the north-east corner, or the south-east and least formal entry to the Quad on its east side. However, the strict geometry of the Quad, openness of University Place and extensive setbacks between buildings, create many opportunities to experience the formal geometry and contrived views of and from the Quad, many of which would include aspects of the proposed building, such as the view from the steps to the Great Hall, or any of the entries to the eastern façade of the Quad.

The site is only of partial visibility from University Avenue and Fisher Library to its south, as it is screened by an avenue planting of heritage listed Port Jackson Fig trees. It is also screened to varying extents in views from the Baxter's Lodge entry from Parramatta Road. Screening by the trees extends down the axial path into Victoria Park, from which the site is at best only partly visible.

In views from the public domain outside the campus to the north on Parramatta Road, vegetation between the University fence and the Site also creates a significant screening or blocking effect.

3.2 Likely visibility of the proposed building

The proposed building is of a simple prismatic form as seen across University Place to the west and south-west, with a single massing and a single roof level continuing from west to east. The site falls significantly from west to east. Although of up to five internal levels partly or wholly above ground at the eastern end, the bulk of the building is below ground and eye level. Views of the building are likely to be confined to a small visual catchment as a result of the low overall visibility of the southern, northern and eastern elevations, which would remain significantly screened by existing, retained and future vegetation. The lowest, western elevation would be most visible and least screened, however that aspect of the building is of the lowest visual bulk.

3.2 Review of draft view locations

RLA reviewed the locations for further study and preparation of photomontages suggested by JPW, including the recommended location for a panoramic view to be prepared in response to a request from the Heritage Council (see letter at Appendix 2).

Based on an analysis of the sites of formal and contrived viewing locations, as well as informal locations, observation and preliminary photography and assessment of the appropriate standardised field of view to use, RLA considered that with only one exception, the viewing locations suggested by JPW were appropriate and encompass a representative sample, as well as the most important views to consider, with regard to the merits of the application. The only view rejected was a draft location south of the south-east corner of the Quad, in which the foreground, which has been filled in recent years to facilitate more level access to the roadway along the eastern side of the Quad, obscures part of the potential view of the setting of the proposed building.

The final view locations recommended for analysis are shown on Figure 1 in Appendix 1.

Table 1 below shows the access numbers of images captured by RLA to be used for the preparation of photomontages and a brief description of the location of the corresponding viewing place. The approximate location of the places from which images were captured is shown on Map 1. The locations and lens heights of the camera at each location where the views were photographed were surveyed by RPS Registered Surveyors.

Table 1: Photograph location and RLA image numbers

RLA photo No	View location (see Map 1)
RLA-8123	A: View location on axis of the northern end of Eastern Avenue
RLA-8118	B: View form south east corner of the Quad
RLA-8157CB (single frame photomontage study) RLA-8109 View C Pan 1A RLA-8110 View C Pan 1B RLA-8111 View C Pan 1C (three images used for panoramic photomontage)	C: Axial view on alignment of Bell Tower entry to the Quad, down path across University Place, aligned with University Avenue and path to Victoria Park
RLA-8131	D: View from the centre top step of the entrance to the Great Hall
RLA-8085	E: View from the Parramatta Road entrance to University Avenue adjacent to Baxter's Lodge
RLA-8092	G: View from the north side of Parramatta Road at the intersection with Arundel and Derwent Streets, opposite Baxter's Lodge
RLA-8101	H: View from the pathway into Victoria Park on the alignment of University Avenue and the Bell Tower entrance to the Quad

Map 1: University of Sydney Chau Chak Museum Wing
View locations and RLA image numbers

- (A) View A RLA image 8123
- (B) View B RLA image 8118
- (C) View C RLA images 8157CB and Pan1A 8109, Pan1B 8110, Pan1C 8111
- (D) View D RLA image 8131
- (E) View E RLA image 8085
- (G) View A RLA image 8092
- (H) View A RLA image 8101

Not to Scale

4. Regulatory context

The proposal is a State Significant Development pursuant to clause 3 and Schedule 2 of the *Environmental Planning & Assessment Regulation 2000* and clause 15 and Schedule 1 of *State Environmental Planning Police (State and Regional Development) 2011 (the SRD SEPPP)*.

The Secretary's Environmental Assessment Requirements (SEARs) for the SDD application have been issued by the NSW Department of Planning and Environment (see Appendix 1).

4.1 SEARs in relation to visual impacts

Key issue 3, Built Form and Urban Design requires address to the height, density, bulk and scale and setbacks of the proposal in relation to the locality and the surrounding development, topography and streetscape. Key Issue 4, Environmental Amenity, incudes a requirement to address view loss. Key Issue 8, Heritage, requires a view assessment, identifying significant views and potential impacts. Visualisation of the location, bulk, height and scale of the proposed building by way of accurately prepared and certified photomontages is an aid to assessment of the merits of the SSD application.

Other expert reports will consider the architectural, urban design and heritage impacts of the proposal in detail. This report considers the verification of the visualisation of the proposal in the SSDA in the form of photomontages, prepared to address specific visual matters under Key Issues 3, 4 and 8.

Requirements for Plans and documents include a view analysis/photomontages. This report considers the technology used in preparing the view analysis by JPW and provides certification that the photomontages represent best practice and are consistent with the standards in the Land and Environment Court of New South Wales practice note governing the preparation of photomontages for use in evidence.

4.2 Requirements of the Heritage Council of NSW

The SEARs require consultation during the preparation of the EIS with relevant authorities, including the Heritage Council of NSW, the Approvals Committee of which provided a response and request for analysis of the visual effects of the SSDA on three specific view locations (see Appendix 2).

The view locations for which verification is requested are the front of the Great Hall, view toward the loading dock from adjacent to Baxter's Lodge and a panoramic view from the central axis. The latter is assumed to be a reference to the view down University Avenue from the axis of the Bell Tower entry to the Quad.

The verification of the view from in front of the Great Hall requests that visualisations comply with the Land and Environment Court of New South Wales practice note (see Appendix 3). This standard has been adopted for all the views for which photomontages have been prepared in the SSDA, including the three requested to be considered by the Heritage Council of NSW.

The methods and results of visualisation of the SSD application as seen from critical viewing places are described and analysed in Section 5. Assessment of the accuracy of the photomontages prepared is presented in Section 6.

5. Methods and results

5.1 Verification of photomontages

RLA were requested by the University and JPW to provide guidance as to the preparation of verifiable photorealistic photomontages for the requisite view analysis which could guide assessment of the merits of the SSD application. The following advice was provided.

5.2 Principles of verification of photomontages

For the certification of photomontages, the fundamental requirement is that there is a 3-dimensional (3D) computer model of the proposed building development that can be accurately located and merged with representative photographs taken from key viewing places, to produce a photomontage.

The location and height of the 3D model of the building must be verified with respect to surveyed features of the existing development Site and the location of features of the surrounding environment, interpolated from aerial imagery.

A further aid required to assist in verifying the location and height of the proposed building is a 3D wire frame model of visible features of some of the existing buildings or other features on the Site or in its vicinity, based on a verified site survey.

The 3D models of the survey information and of the proposed building envelopes are then matched to and merged with digital photographic images of the existing environment.

The key to being able to certify the accuracy of the photomontage resulting from merging the 3D model and photographs is being able to demonstrate that the 3D model of the proposed building envelope has a good fit to known surveyed features of the existing development on the Site and of other fixed features which are visible in the photograph. Such features are either shown on the wire frame models of the survey in 3D, or interpretable from aerial imagery.

These principles for verification of the fit of a computer model to a photograph of the existing environment are reflected in the Land and Environment Court of New South Wales practice note for the preparation of photomontages for use in evidence.

A single image photograph is the best base onto which to fit the computer model of the building. This is because the conventions of perspective which are used by the computer software to generate a 3D image of the proposed development are relatively consistent with the geometry of a single photographic image, because both have a flat ground plane and one centre of view.

5.3 Focal length of lens for photographs

The camera images for the photomontages need to be of sufficient resolution for details to be visible at a relevant scale, taken with a lens of low distortion. The focal length of the lens used needs to be appropriate for the purpose and the focal length of the lens used to take the single frame photographs has to be known and standardised as far as is possible.

The reasons for using a specific focal length is determined by the vertical and horizontal scale of the subject of the view. The subject commonly contains elements of vastly different horizontal and vertical scale, for example a narrow road corridor in the foreground and the proposed buildings, all of which must be visible in each photograph.

It is conventional to use a 'normal' lens to take landscape photographs, for example a 50mm lens on a 35mm format film camera, as when reproduced in large format (eg. A3 size prints), the objects in the image appear of 'normal' scale in relationship to each other in the image. However, in photographing streetscapes and individual buildings, that convention cannot be adopted other than for relatively distant views. In the current project, distant views are useful to analysing the visual impacts of the proposal, but closer and mid-distant views are also necessary.

It is a common problem in architectural photography that in close views a building, or the appearance of a group of buildings in context, cannot be encompassed in a single image, for the reasons above. That is, the subject of the view is too large or too close to be captured in a single image with a 'normal' lens. It is critical in preparing 3D images, for example for use in photomontages, that the subject can be captured in a single image. This is because a composite image, such as one 'stitched together" electronically out of separate images which can encompass the whole field of view (for example a panorama), has un-reconcilable distortions in it.

Because a composite image is assembled from individual images with separate centres of focus and differing centres of perspective, a 3D model of a proposed development cannot fit it. The computer software that creates the composite image also creates the parts of the image where individual images are merged. It does not simply join the images together. A significant part of a merged image is therefore totally illusory: it does not exist in the world. It is therefore valid to use a wider-angle lens where there is a constraint on the field of view, as this avoids the problems above. Thus, a focal length of 35mm, or less, is commonly necessary for architectural photography.

A single frame image, recommended as the base for photomontages, has a single centre of focus and perspective. This is critically important, because the 3D model prepared in the computer, which is to be merged with the photographic image, must rely on similar geometry and perspective to the lens used, to achieve an acceptable level of fit to the photograph. The focal length of the lens used to take the image from which the photomontage will be derived is not critical, as long as it is known and standardised. The focal length of the lens makes no difference to the accuracy of fit of the proposed building to the photographic images.

A further reason for choice of focal length with regard to visual impacts concerns the composition of the view containing the view subject. It is necessary for images used to demonstrate the principles of visual impact to contain the components of the view that comprise the composition, context or setting of the subject. In this project, the main issues of visual impact concern not only the appearance of the proposed building, but also the potential scale of the building in relation to others and often as viewed in an expansive context, for example as seen down the axis of University Avenue from the Bell Tower entry to the Quad.

A 35mm focal length was therefore adopted as the standard focal length for all of the photography for preparation of photomontages by JPW. This was judged to be adequate for every view, including a representative view centred on the axis of University Avenue as seen

from the Bell Tower entry to the main Quad. However, in that view, the building is only partly visible with the horizontal field of view of the image that also contains part of Fisher Library.

In relation to the view from that location, in consultation with the University as required by the SEARs, the Heritage Council had requested that a panoramic view be prepared to show the relationship between the proposal and the Fisher Library, in the same view. As a practical matter, it is not possible to represent the composition of that view at the same focal length as the other views in the Visual Analysis Study. The horizontal field of the view requested is so extensive that even a wide angle lens would not encompass that view, without the effect of decreasing the size of the buildings to an unacceptable level and distorting the spatial qualities and horizontal geometry of the view.

It was therefore decided that an indicative photomontage would be prepared for that view, using a panoramic image, 'stitched together' electronically. Using the same focal length adopted for all the other views, the field of view required three images to be used, with an overlap of approximately 20% between images. To overcome as far as possible the problem of fitting the 3D model of the building into the stitched image, RLA advised JPW that the 3D model of the building had to be fitted into only one image, first (the left image of the three to be used for the panoramic photomontage). After the fit was shown to be correct, the three images were to be merged electronically and the image cropped and rendered to remove missing areas of sky at the periphery.

It should be noted that the panorama prepared in this way would still have some internal distortions as noted above and is indicative only and not an accurate or certifiable image. However, as long as the limitations are understood, it is still a useful tool to give an impression of the relative contribution of the new building to the composition of the view, compared to the Fisher Library extension, as a scale object of relevance.

5.4 Requirements for photography

For the purposes of preparing verifiable photomontages, the base photographs must be taken with a professional quality camera, typically a digital SLR, in a standardised way. The camera is mounted on a tripod, levelled horizontally and vertically and the photographs taken with a fixed focal length lens (see above) at high resolution in JPG and also in RAW format. The reason for capturing RAW format images at the same time as JPG is that the RAW images have not been processed, smoothed or otherwise altered in taking the image and are therefore the best images to use if some amendments of colour balance, contrast or colour matching need to be done, post-capture, for the sake of consistency across images.

RLA took the photographs in to be used by JPW to prepare the photomontages, using a Canon EOS 5D DSLR full-frame camera with a fixed focal length 35mm lens, set at 1.6m to the centre of the lens above ground level. The images were provided at 22.2 MP resolution in JPG and in RAW format, to JPW. The 35mm focal length photographs used for all of the photomontages have a horizontal field of view of 54.4 degrees.

5.5 Requirements for surveying

To satisfy the requirements of the Land and Environment Court of New South Wales practice note for preparation of photomontages, the location and level of the camera lens taking the photographs must be surveyed. The XYZ coordinates of the camera are added by the surveyor to the existing survey and exported to the model that includes the 3D model of the

proposed building. The necessary survey work was carried out by RPS registered surveyors under the direction of RLA.

5.6 Checking the photomontage accuracy

The accuracy of the fit of the computer model to the photographs for the photomontages should be checked in more than one way, following the importing of the survey data and the computer model into the same 3D space. After this process, the survey data and 3D model of the proposed building can be visualised as a wire frame model. The wire frame is then aligned with physical features visible in the photographic image as the first step to demonstrate accurate fit of the proposed building to the base image.

The model is checked for alignment and height with respect to the surveyed fixed features which are visible in the images. The location of the camera can also be checked with respect to the coordinates of the camera location that is provided by the surveyor. In this way, provided there are a requisite number of 3D reference points visible in the photographs for matching, there is a cross check in both directions. Camera matching requires a minimum of five 3D reference points to be visible in any view.

It is not possible for a perfect fit to occur, because of minor distortions that occur with the camera lens in the periphery of the images, abstractions that occur in the survey data and because of significant differences that occur in the visibility of reference objects caused by the distance between the view place and the item used as a reference point.

Given the relatively small visual catchment of the proposed building and short viewing distances in the case of this application, there are unlikely to be any significant miss-matching errors caused by these factors.

5.7 Method of preparation and alignment of the 3D model of the proposal

The method adopted by JPW in preparing the photomontages was as follows:

The design of the proposed building is prepared in CAD. A 3D model of the building is set up using the CAD files in Microstation software. Survey data of the area including the site is imported into Microstation, including a wide range of potential 3D reference points such as buildings, roads, paths, gutter lines, retaining walls, light stanchions etc. The 3D model of the building and survey also includes the camera locations from which images to use for photomontages were captured. At each view location, a camera position is set up by adding 1.6m, or the height of the camera lens at each view location, to represent standard standing eye-height.

To test the fit of the model to the photographs, the centre of view of each photograph is determined to establish the bearing or target line to the centre of view with respect to the camera location. As the field of view of the lens, aspect ratio and horizontal and vertical pixel count of the image are known, the 3D computer model can then be matched to the camera location and also to features of known items on the survey that are visible in the base photograph.

For the first stage of matching, the computer model is purely a wire frame, or a series of points on the model connected by straight lines. The wire frames are colour coded to distinguish between the proposed building, existing buildings and landscape features of various kinds in

the model. No surfaces are represented, so as not to obscure potential reference items in the photographic image.

For each view to be represented by a photomontage, the fit of the wire frames to the photographic images was tested. Fixed structures and items represented by individual data points on the survey were used wherever possible to test the match to the 3D model, such as buildings, light stanchions, straight sections of kerbs, walls, etc. in preference for items that are represented more abstractly on survey, such as vertically or horizontally curved structures, garden beds or trees.

The method of preparation and alignment of the 3D model of the proposal was demonstrated to RLA by JPW at the wire frame model stage. Following approval of this stage by RLA, JPW prepared block model photomontages, showing the location, massing, size, shape and form of the proposed building as a simple, filled model.

The final block model photomontages are attached to this report at Appendix 4. Each block model view is accompanied by the original view by RLA and the wire frame model that shows the fit of the model to the existing environment.

6. Assessment

6.1 Accuracy of fit of the 3D model to the single photographs

Inspection of the wire frame models of the proposed building in relation to existing features visible in photographic images and identifiable in the survey data, shows a high level of fit. As there are far more than the requisite minimum number of five 3D reference points visible in any of the views to assist in testing the fit, it was concluded that the 3D models in each view could then be filled and rendered, confident in the knowledge that the model is accurately located relative to the existing environment shown in the base photographs.

6.2 Fit of the 3D model in the panoramic image from view location C

For reasons explained above in Section 5, the fitting of the wire frame model into the panoramic image requested by the Heritage Council from view location C cannot be verified to the same level of accuracy as the fit to the single-frame image from that location. JPW adopted the instruction given by RLA, that the model should be merged with only one image in the panorama, to minimise distortion caused by the 'stitching' algorithms in the software used to create the composite panoramic image. After fitting the model to the single image to be used, the other two images necessary to produce a 3-image panoramic view were stitched together with it to create the required composite image.

The three images use are at the same focal length as the other block model photomontage views, ensuring that there is a similar representation of the relative scale of the proposed building to other features in the views.

A wire frame model of the survey that includes other buildings and landscape features in the two subsidiary images is not used in this case, as it would not fit correctly into the composite image and would be distracting. The composite image presents a useful analytical representation of the scale and form of the proposed building in relation to other features of the scene, including the Fisher Library, as required.

The requested panoramic photomontages are included as the last set in Appendix 4.

6.3 Ghosted and block photomontages

Photomontages based on the 3D model which was demonstrated to fit accurately into the base photographs were then prepared by merging the computer and photographic images, taking into account the screening effects of retained vegetation.

The photomontage are in two forms: ghosted and block models. The ghosted photomontages show the building as a transparent fill to the model, as an aid to assessment of the extent to which the building would hide or obscure the current landscape behind, for example vegetation and also buildings south of Broadway and in the southern CBD.

The block photomontages are in the form of opaque models of the proposed building that have sufficient contrast and detailing to indicate the likely future appearance of the building. The materials, shadow fall and proposed landscape for the proposal has not been rendered to a high level of detail. The block photomontages however, give a clear understanding of the size, location, form, materials and character of the building.

7. Conclusions and Recommendations

7.1 Conclusions

RLA analysed the initial visual analysis prepared by JPW and found that with the exception of one viewing location, the analysis encompassed the relevant kinds of views affected by the proposal. The baseline for the views analysis based on photomontages was considered to be comprehensive and representative.

Photography for the photomontages was standardised and undertaken by RLA and the locations were surveyed, to ensure compliance with the Land and Environment Court of New South Wales practice direction for photomontages.

JPW prepared the 3D model of the proposed building and a much larger area of the adjacent locality, including the view places used to capture photographs. When the first stage of matching of the 3D model was undertaken RLA determined that there was a requisite high level of fit to the photographic images.

The ghosted and block photomontages of the proposed building, being based on the 3D model fitted to the photographs, show a high, industry standard, level of accuracy.

Although not certifiable as accurate, the panoramic photomontages required by the Heritage Council are a useful analytical tool to interrogate the relative scale and heights of the building in relation to the Fisher Library. The building and the library are also partly visible in the single frame image photomontages prepared for View 3.

7.3 Recommendations

RLA commend the photomontages to the NSW Department of Planning and Environment as demonstrating a high level of attention to detail, accuracy, comprehensiveness and compliance with the Land and Environment Court of New South Wales practice direction for photomontages.

Taking all relevant matters into account, RLA consider that the photomontages prepared in the visual analysis study by JPW demonstrate best practice in the field. We consider that they are as accurate as is reasonably possible in the circumstances and that they deserve certification as accurately scaled and located 3D representations of the likely appearance of the proposed building.

Appendix 1: Secretary's Environmental Assessment Requirements (SEARs)

1

Secretary's Environmental Assessment Requirements

Section 78A(8A) of the *Environmental Planning and Assessment Act*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7894
Proposal Name	Chau Chak Wing Museum
Location	The University of Sydney, Camperdown Campus
Applicant	The University of Sydney
Date of Issue	6 September 2016
General Requirements	The Environmental Impact Statement (EIS) must meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 the *Environmental Planning and Assessment Regulation 2000*. Notwithstanding the key issues specified below, the EIS must include an environmental risk assessment to identify the potential environmental impacts associated with the development. Where relevant, the assessment of the key issues below, and any other significant issues identified in the risk assessment, must include: • adequate baseline data; • consideration of potential cumulative impacts due to other development in the vicinity; and • measures to avoid, minimise and if necessary, offset the predicted impacts, including detailed contingency plans for managing any significant risks to the environment. The EIS must be accompanied by a report from a qualified quantity surveyor providing: • a detailed calculation of the capital investment value (CIV) (as defined in clause 3 of the Environmental Planning and Assessment Regulation 2000) of the proposal, including details of all assumptions and components from which the CIV calculation is derived; • an estimate of the jobs that will be created by the future development during the construction and operational phases of the development; and • certification that the information provided is accurate at the date of preparation.
Key issues	The EIS must address the following specific matters: **1. Statutory and Strategic Context** – including: Address the statutory provisions contained in all relevant environmental planning instruments, including: • State Environmental Planning Policy (State & Regional Development) 2011; • State Environmental Planning Policy (Infrastructure) 2007; • State Environmental Planning Policy No. 33 – Hazardous and Offensive Development; • State Environmental Planning Policy No. 55 – Remediation of Land; and • Sydney Local Environmental Plan 2012. *Permissibility* Detail the nature and extent of any prohibitions that apply to the development. *Development Standards* Identify compliance with the development standards applying to the site and provide justification for any contravention of the development standards.

2

Campus Improvement Program 2014 - 2020
In accordance with section 83D(3) of the *Environmental Planning and Assessment Act 1979*, demonstrate that the proposal is not inconsistent with the development consent granted for The University of Sydney Campus Improvement Program concept proposal (SSD 6123).

2. Policies
Address the relevant planning provisions, goals and strategic planning objectives in the following:

- NSW State Priorities;
- A Plan for Growing Sydney;
- NSW Long Term Transport Master Plan 2012;
- Sustainable Sydney 2030;
- Sydney's Bus Future 2013;
- Sydney's Cycling Future 2013;
- Sydney's Walking Future 2013; and
- Healthy Urban Development Checklist, NSW Health.

3. Built Form and Urban Design

- Address the height, density, bulk and scale, and setbacks of the proposal in relation to the locality and the surrounding development (including SSD 6123 Campus Improvement Program building envelopes), topography and streetscape.
- Address design quality, with specific consideration of the overall site layout, streetscape, open spaces, façade, rooftop, massing, setbacks, building articulation, materials, colours, landscaping and Crime Prevention Through Environmental Design Principles.
- Demonstrate design excellence in accordance with the design excellence provisions of *Sydney Local Environmental Plan 2012*.
- Detail how services, including but not limited to waste management, loading zones, and mechanical plant are integrated into the design of the development.

4. Environmental Amenity
Detail amenity impacts including solar access, acoustic impacts, visual privacy, view loss, overshadowing, lighting impacts and wind impacts. A high level of environmental amenity for the surrounding locality must be demonstrated.

5. Transport and Accessibility
Include a transport and accessibility impact assessment that provides, but is not limited to, the following:

- details of the current daily and peak hour traffic, public transport, pedestrian and cycle movements and existing traffic and transport facilities provided within the vicinity of the site;
- provision of current staff and visitor parking on site;
- an assessment of future transport needs associated with the development, including a clear understanding of the travel task for all modes at different times of the day (peak and off peak) and weekends;
- an estimate of the total daily and peak hour trips generated by the proposal, including vehicle, public transport, pedestrian and cycle trips;
- the adequacy of public transport, pedestrian and bicycle infrastructure to meet the likely future demand of the proposed development;
- measures to promote travel choices for students, staff and visitors - this includes describing the measures to be implemented to promote sustainable means of transport usage, car sharing scheme, pedestrian and bicycle linkages, end of trip facilities and bicycle parking provisions;
- the daily and peak vehicle movements impact on nearby intersections, with consideration of the cumulative impacts from other approved developments in the vicinity, and the need/associated funding for upgrading or road improvement works (if required);