SOLAR LIGHT REFLECTIVITY ANALYSIS

INTERCONTINENTAL SYDNEY REFURBISHMENT

WD237-01F03(REV2)- SR REPORT

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Prepared for:

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DOCUMENT CONTROL

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October 11, 2016	Initial.	0	AW	KP	MC
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EXECUTIVE SUMMARY

This report presents the results of a detailed study for the effect of potential solar glare from the proposed redevelopment of the Intercontinental Hotel, Sydney. The analysis has been undertaken based on the architectural drawings prepared by Hassell, received December 15, 2016.

This study identifies any possible adverse reflected solar glare conditions affecting motorists and pedestrians within the local surrounding area, boat drivers and occupants of neighbouring buildings. If necessary, recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with the controls for solar glare from the Sydney City Council Development Control Plan (2012).

A site survey has been undertaken to obtain photographs of the critical sightlines of motorists on the surrounding streets. These photographs are calibrated and are able to be overlaid with a glare meter, which allows the extent, if any, of potential solar glare reflections from the subject development to be determined.

The results of the study indicate that, to avoid any adverse glare to motorists and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the following is recommended:

- Blinds be installed on all east facing windows on Level 9 of the subject development which have a view of the cortile roof.
- All glazing used on the external façade of the development should have a maximum normal specular reflectance of visible light of 20%.

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (ie: less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. Note also that, for any painted or powder-coated metallic surfaces on the exterior façade of the development, the maximum normal specular reflectance of visible light for those types of surfaces is in the range of 1% to 5%, which is well within the abovementioned limit.

With the incorporation of these recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians and motorists in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity for the Sydney City Council Development Control Plan (2012).

CONTENTS

1 METHODOLOGY

This study assesses compliance with the controls for solar glare from the Sydney City Council Development Control Plan (2012).

The reflectivity analysis of the subject development has been carried out using the technique published by Hassall (1991). The limiting veiling luminance of 500 cd/m^2 for the comfort of motorists, as suggested in Hassall (1991), has been adopted as a basis of assessing the glare impact from the subject development. In meeting this criterion for vehicle motorists, conditions will also be satisfactory for pedestrians. The glare impact on occupants of neighbouring buildings is also discussed in this assessment.

The various critical glazed aspects were determined for the development and are shown in Figure 1. Solar charts for each of these critical glazed aspects are presented in Appendix B, and these are used to derive the check zones which are shown in Figures 2a and 2b. The check zones highlight the areas that are potentially affected by solar reflections from each critical glazed aspect. It should be noted that the check zones shown in Figures 2a and 2b do not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in Section 2 of this report.

Study point locations are selected within the check zone areas where motorists are facing the general direction of the subject development. These are shown in Figures 2a and 2b. For each of the study point locations, photographs have been taken from the viewpoint of motorists using a calibrated camera. Views from the study point locations are presented in Appendix A of this report. A scaled glare protractor has been superimposed over each photograph.

The glare protractor is used to assess the amount of glare likely to be caused and to provide a direct comparison with the criterion of 500 cd/m^2. Alternatively, the glare protractor can be used to determine the maximum acceptable reflectivity index of the façade material of the development for the glare to be within the criterion of 500 cd/m^2.

If it is found that a section of the subject development will be within the zone of sensitive vision of a motorist at a selected study point location (the central area of the glare protractor), the glare protractor is used to determine what the maximum normal specular reflectance of visible light should be for the glazing or any other reflective material used on that section of the façade of the development to ensure that solar glare will not cause discomfort or threaten the safety of motorists or pedestrians, and hence to allow the subject development to comply with the relevant planning control requirements.

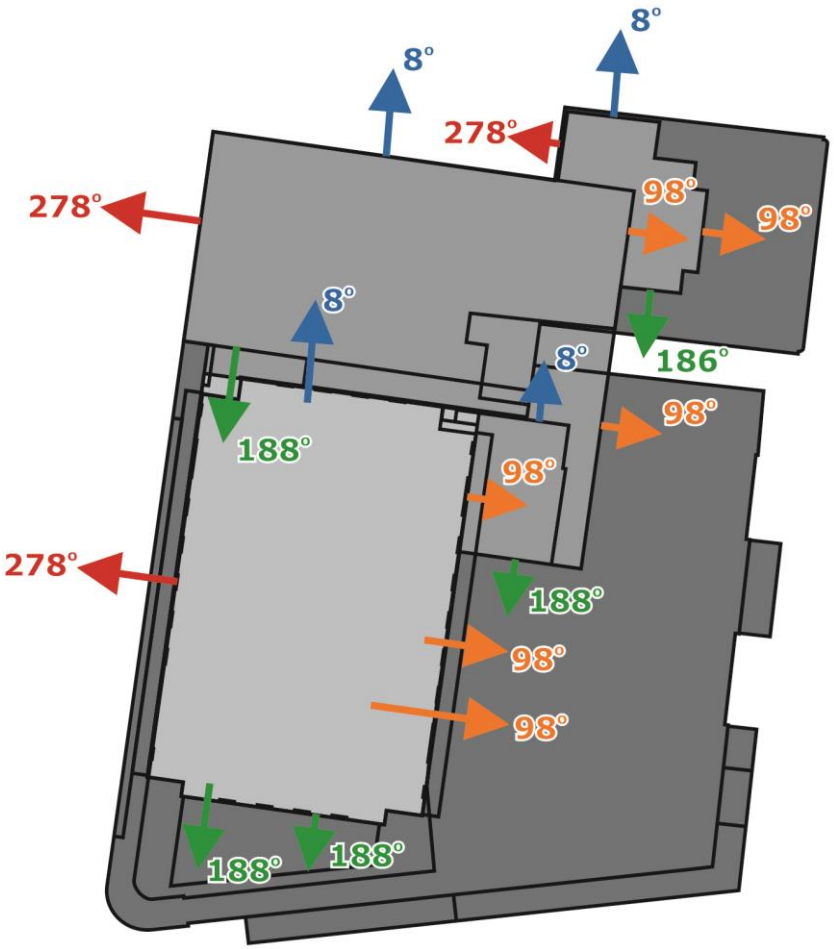

Figure 1: Critical Glazed Vertical Aspects for Modified Sections of the Development

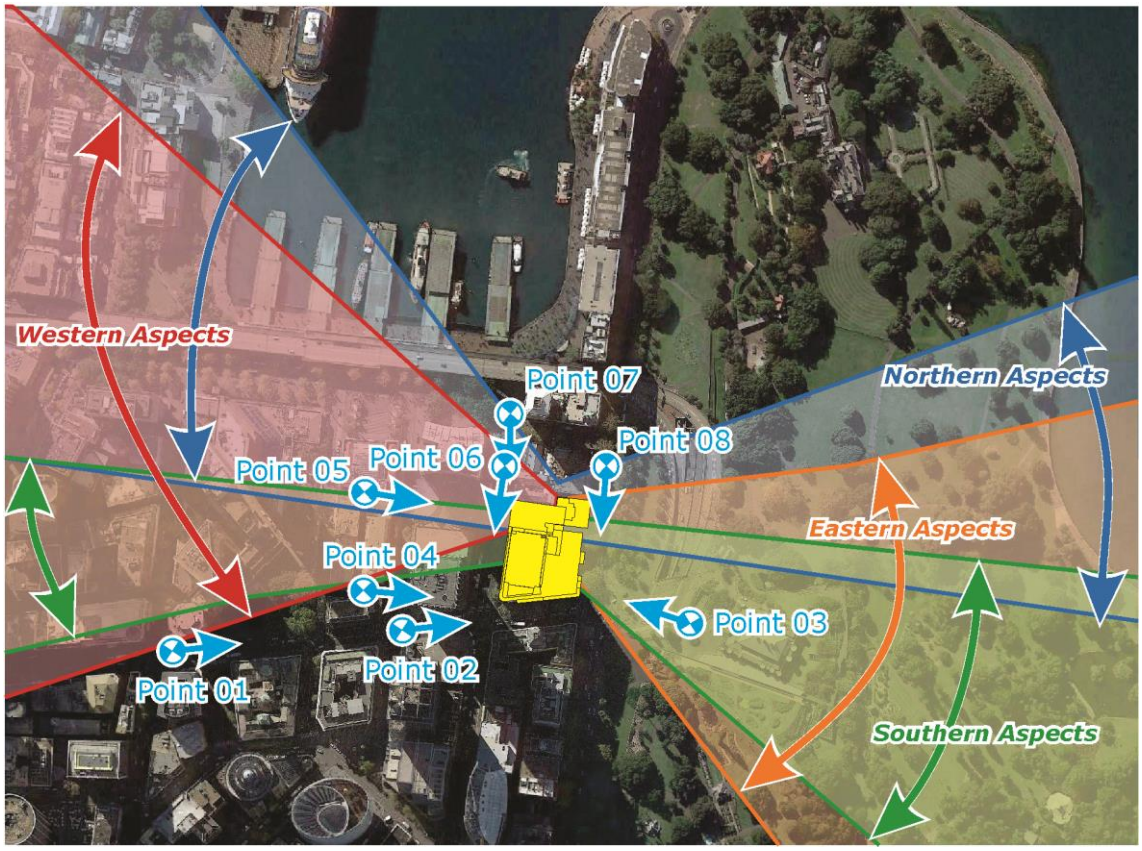

Figure 2a: Check Zones and Study Point Locations – New Ballroom
(the check zones are the areas where glare could potentially be observed from vertical aspects)

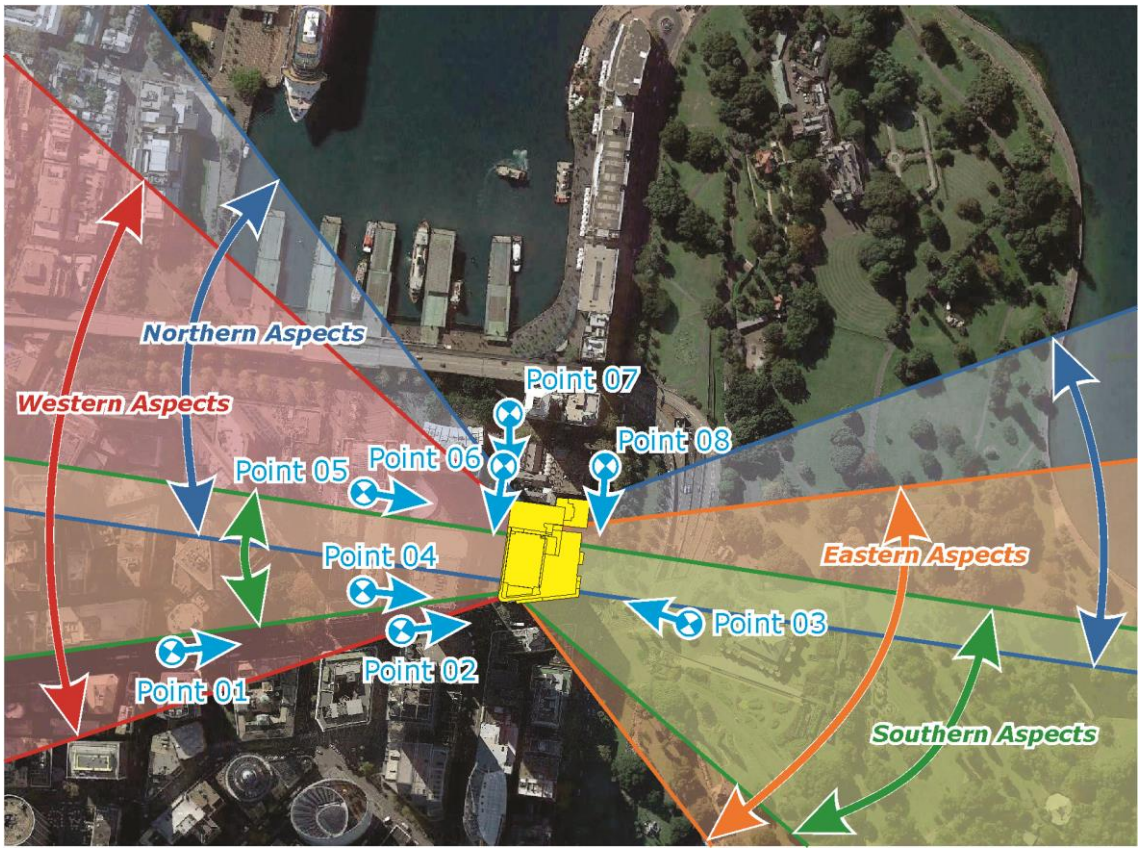

Figure 2b: Check Zones and Study Point Locations – Hotel Tower
(the check zones are the areas where glare could potentially be observed from vertical aspects)

2 ANALYSIS

2.1 Impact onto Motorists and Pedestrians

From the study of the check zones shown in Figure 2, a total 8 street level locations have been identified for detailed analysis. A summary of the location of each study point, and the vertical aspects of the subject development which could potentially reflect solar glare to each study point location, is shown in Table 1 below. Note that, as mentioned in Section 1, the check zones shown in Figure 2 does not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in the following sub-sections.

Table 1: Aspects of the Proposed Development that could reflect Solar Glare to each Study Point

Study Point	Location and Viewpoint	Aspect(s) of the Development
1	Bridge Street – heading east	Southern and western aspects
2	Bridge Street – heading east	Southern and western aspects
3	Conservatorium Road – heading north-west	Southern and eastern aspects
4	Loftus Lane – heading east	Southern and western aspects
5	Custom House Lane – heading east	Northern and western aspects
6	Phillip Street – heading south	Northern and western aspects
7	Phillip Street – heading south	Northern and western aspects
8	Macquarie Street – heading south	Northern and eastern aspects

2.1.1 Drivers heading west along Bridge Street

Points 1 and 2 are located along Bridge Street, to the west of the development site. These points represent the critical sightlines of drivers heading east along Bridge Street at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoints of drivers at these locations were obtained using a calibrated camera. Each photograph has been scaled to enable the glare meter to be overlaid onto these images, as shown in Figure A1 and A2 Appendix A.

An analysis of the viewpoints at Points 1 and 2 indicates that the modified sections of the subject development are visible but are not within the zone of sensitive vision of motorists at these locations. Hence, there will be no adverse solar glare from the modified glazing observed by motorists or pedestrians heading west along Bridge Street.

2.1.2 Drivers heading north-west along Conservatorium Road

Point 3 is located along Conservatorium Road, to the east of the development site. This point represents the critical sightlines of drivers heading north-west along Conservatorium Road at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of drivers at this location was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figure A3 of Appendix A.

An analysis of the viewpoint at Point 3 indicates that the modified sections of the subject development are visible but are not within the zone of sensitive vision of motorists at this location. Hence, there will be no adverse solar glare from the modified glazing observed by motorists or pedestrians heading north-west along Conservatorium Road.

2.1.3 Drivers heading east along Loftus Lane

Point 4 is located along Loftus Lane, to the west of the development site. This point represents the critical sightlines of drivers heading east along Loftus Lane at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of drivers at this location was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figure A4 of Appendix A.

An analysis of the viewpoint at Point 4 indicates that the subject development will not be visible and is not within the zone of sensitive vision of motorists at this location. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading east along Loftus Lane.

2.1.4 Drivers heading east along Custom House Lane

Point 5 is located along Custom House Lane, to the west of the development site. This point represents the critical sightlines of drivers heading east along Custom House Lane at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of drivers at this location was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figure A5 of Appendix A.

An analysis of the viewpoint at Point 5 indicates that the modified sections of the subject development are visible but are not within the zone of sensitive vision of motorists at this location. Hence, there will be no adverse solar glare from the modified glazing observed by motorists or pedestrians heading east along Custom House Lane.

2.1.5 Drivers heading south along Phillip Street

Points 6 and 7 are located along Phillip Street, to the north of the development site. These points represent the critical sightlines of drivers heading south along Phillip Street at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoints of drivers at these locations were obtained using a calibrated camera. Each

photograph has been scaled to enable the glare meter to be overlaid onto these images, as shown in Figure A6 and A7 Appendix A.

An analysis of the viewpoints at Points 6 and 7 indicates that the modified sections of the subject development are visible but are not within the zone of sensitive vision of motorists at these locations. Hence, there will be no adverse solar glare from the modified glazing observed by motorists or pedestrians heading south along Phillip Street.

2.1.6 Drivers heading south along Macquarie Street

Point 8 is located along Macquarie Street, to the north of the development site. This point represents the critical sightlines of drivers heading south along Macquarie Street at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of drivers at this location was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figure A8 of Appendix A.

An analysis of the viewpoint at Point 8 indicates that the subject development will not be visible and is not within the zone of sensitive vision of motorists at this location. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading south along Macquarie Street.

2.2 Glazed Cortile Roof

A further analysis has been undertaken for the effect of potential glare from the glazed cortile roof on Level 8. The results of this analysis indicates that due to the shallow angle of roof, the specular reflectance of the roof when observed from the subject development or neighbouring buildings will be significantly greater than the normal specular reflectance of the roof material. However, as the roof has a shallow angle and is on Level 8, adverse glare from the cortile roof will not be observed by pedestrians or motorists on the surrounding streets. Furthermore, the subject development will shade the cortile roof during the afternoon when adverse solar glare could otherwise potentially be observed by occupants of neighbouring buildings. Nonetheless, to mitigate adverse solar glare from the cortile roof being observed by occupants of the subject development during the morning, it is recommended that blinds be installed on all east facing windows on Level 9 which have a view of the cortile roof.

2.3 Boat Drivers on Circular Quay

When viewed form boat drivers on Circular Quay, an analysis of the check zone diagrams presented in Figures 2a and 2b indicates that solar glare could potentially be observed from the modified sections of the subject development by boat drivers docking at Wharfs 4, 5 and 6. However, further analysis indicates that the modified sections of the subject development will be more than 10^{o} outside the direct line of sight of boat drivers docking at Wharfs 4, 5 and 6, and hence will be outside the zone of sensitive vision of boat drivers at these locations. Hence, there will be no adverse solar glare observed by boat drivers on Circular Quay.

2.4 Occupants of Neighbouring Buildings

Our past experience involving more than 250 projects, and also research by Rofail and Dowdle (2004), tends to indicate that Buildings which cause a nuisance to occupants of neighbouring buildings are those that have a normal specular reflectivity of visible light greater than 20%. This seems to justify the suggested limit of 20% reflectivity by many local government authorities and state planning bodies.

Hence a general recommendation is made that all glazing and other reflective materials used on the façade of the subject development have a maximum normal specular reflectivity of visible light of 20% to avoid adverse solar glare to occupants of neighbouring buildings.

2.5 Typical Normal Specular Reflectivity from Building Surfaces

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (ie: less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. The following sub-sections provide some general reflectance values of more reflective materials used on building facades.

2.5.1 Glazed Surfaces

A glazing supplier will be able to provide information on the maximum normal specular reflectance of visible light of different types of glazing. Some typical reflectivity values of different types of glazing are listed as follows:

- Clear float glass – typically 5% to 8%
- Low-e solar control glazing – typically 8% to 12%
- Other types of compliant performance glazing – up to 20%

2.5.2 Painted and/or Powder-Coated Metallic Surfaces

In the event that some portions of the external façade of the development feature power-coated or painted metallic surfaces, it is not expected that adverse glare will be observed from those surfaces since the maximum normal specular reflectance of visible light of these types of façade materials range from 1% to 5%. This is well within the maximum limits specified in previous sections of this report.

3 CONCLUSION

This report presents the results of a detailed study for the effect of potential solar glare from the proposed redevelopment of the Intercontinental Hotel, Sydney. The analysis has been undertaken based on the architectural drawings prepared by Hassell, received December 15, 2016.

This study identifies any possible adverse reflected solar glare conditions affecting motorists and pedestrians within the local surrounding area, boat drivers and occupants of neighbouring buildings. If necessary, recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with the controls for solar glare from the Sydney City Council Development Control Plan (2012).

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With the incorporation of these recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians and motorists in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity for the Sydney City Council Development Control Plan (2012).

REFERENCES

Hassall, D.N., 1991, "Reflectivity, Dealing with Rogue Solar Reflections", (published by author).

Phillips, R.O., 1992, "Sunshine and Shade in Australasia", Sixth Edition, CSIRO Publishing.

Rofail, A.W., and Dowdle, B., 2004, "Reflectivity Impact on Occupants of Neighbouring Properties", International Conf. on Building Envelope Systems & Technologies, Sydney.

City of Sydney, 2012, "Sydney Development Control Plan 2012"

APPENDIX A - GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

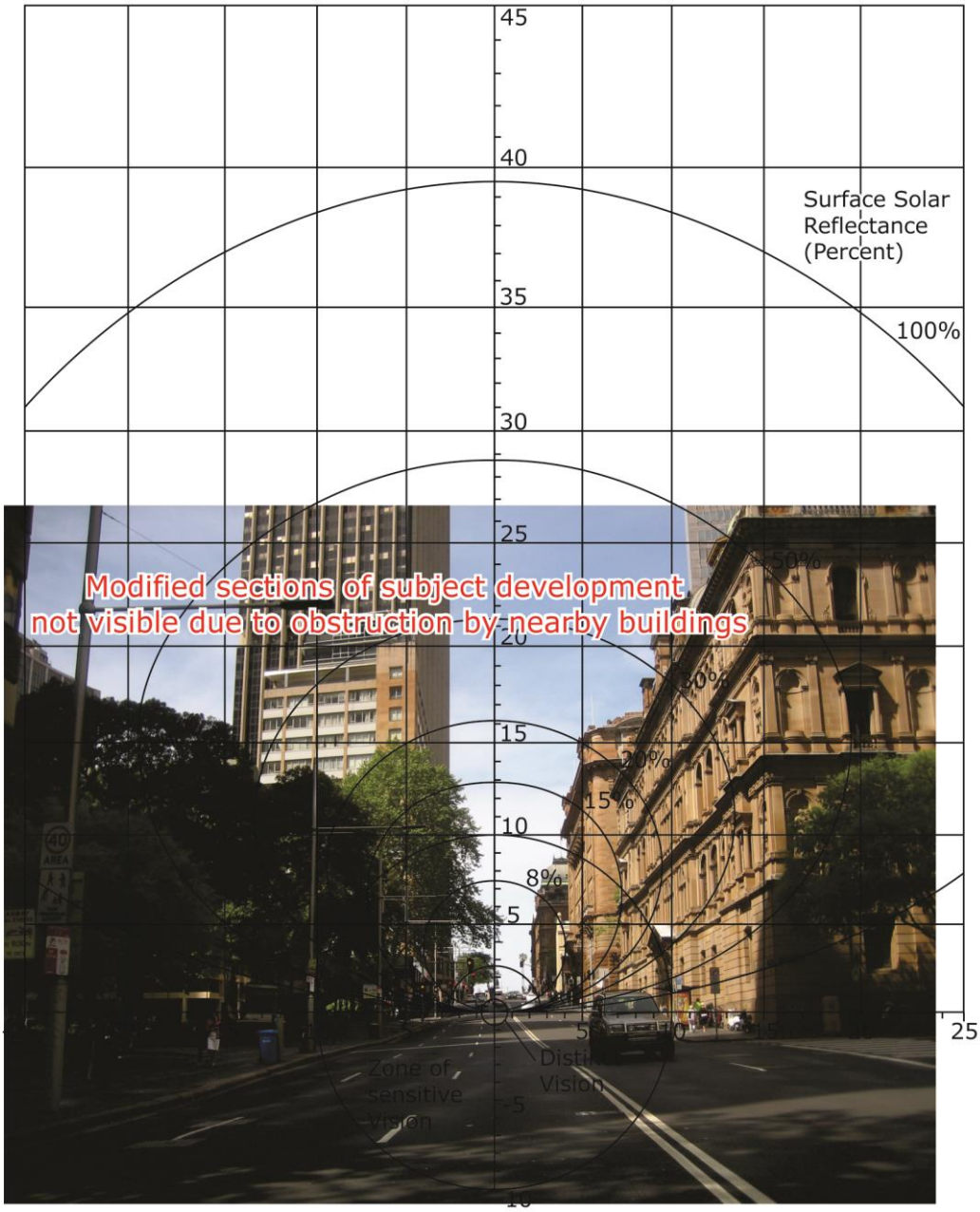

Figure A1: Glare Overlay for Point 1

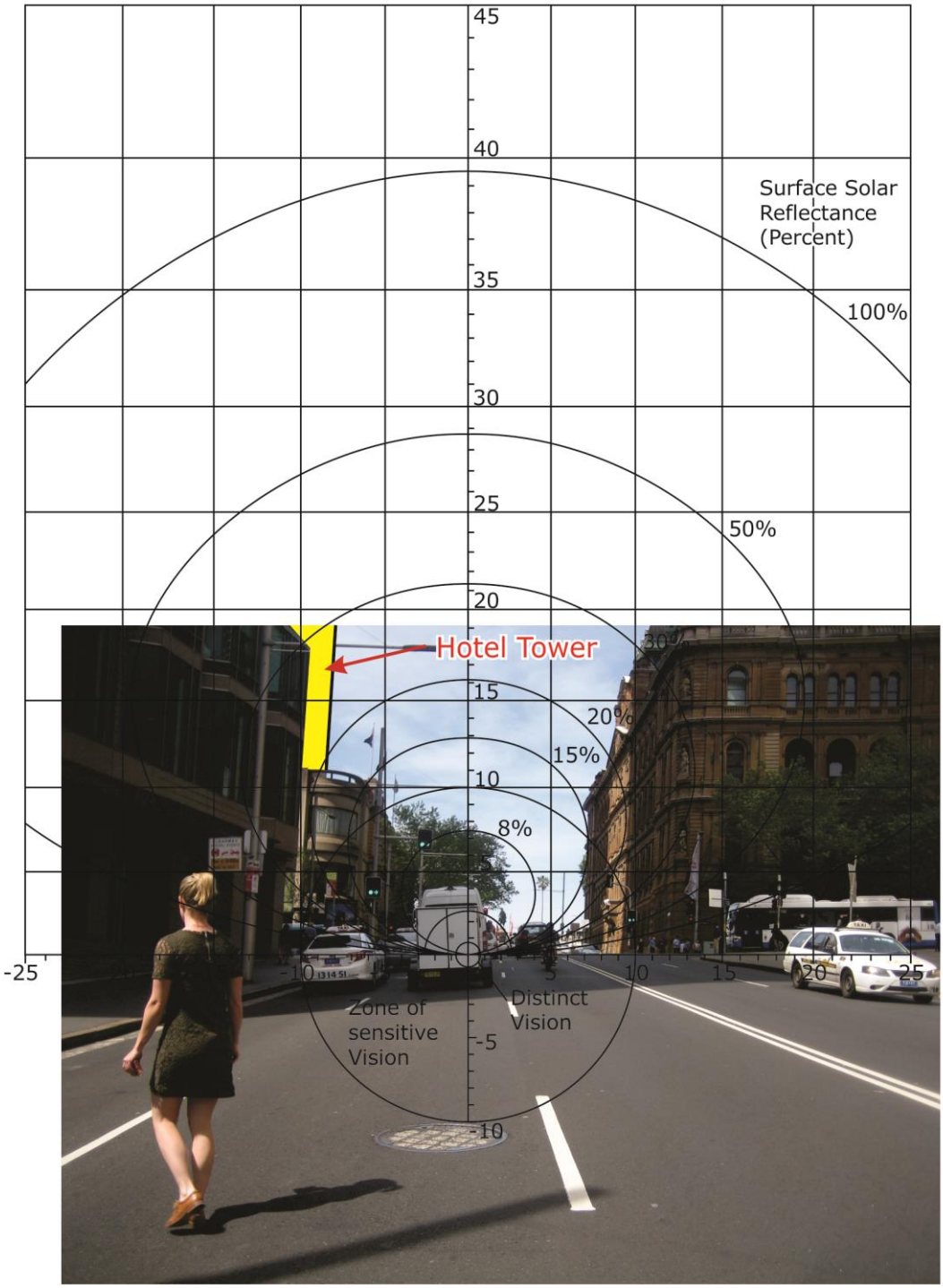

Figure A2: Glare Overlay for Point 2

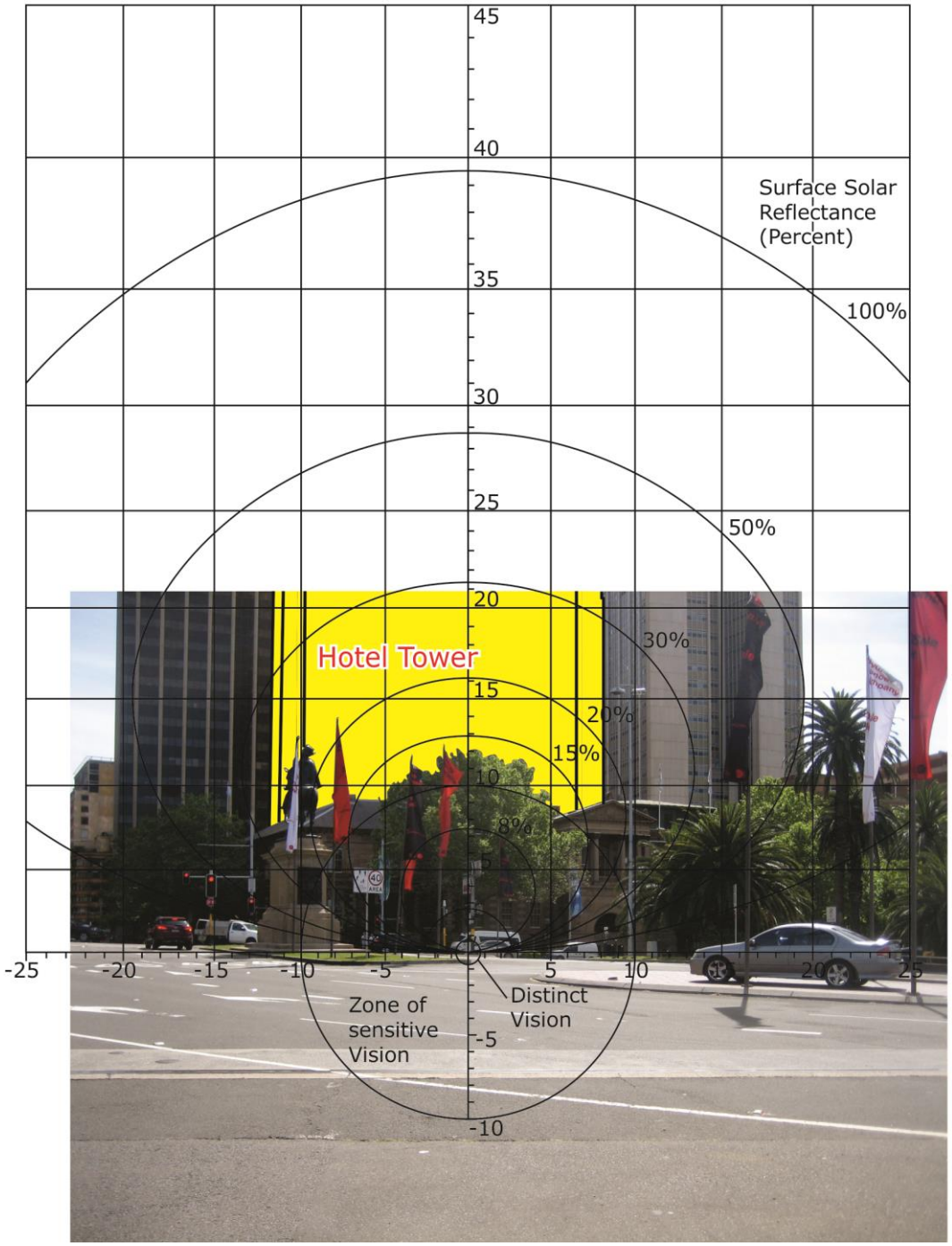

Figure A3: Glare Overlay for Point 3

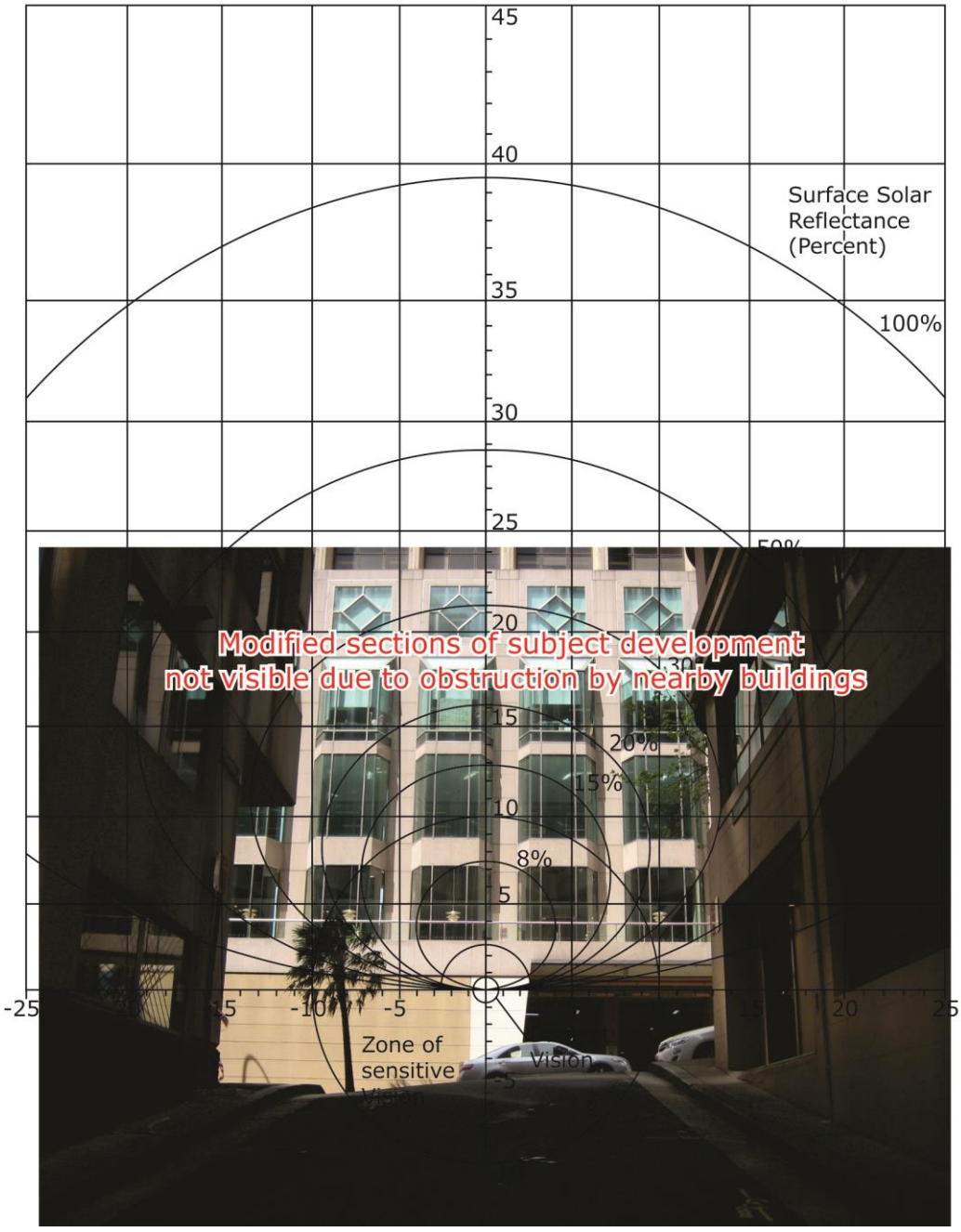

Figure A4: Glare Overlay for Point 4

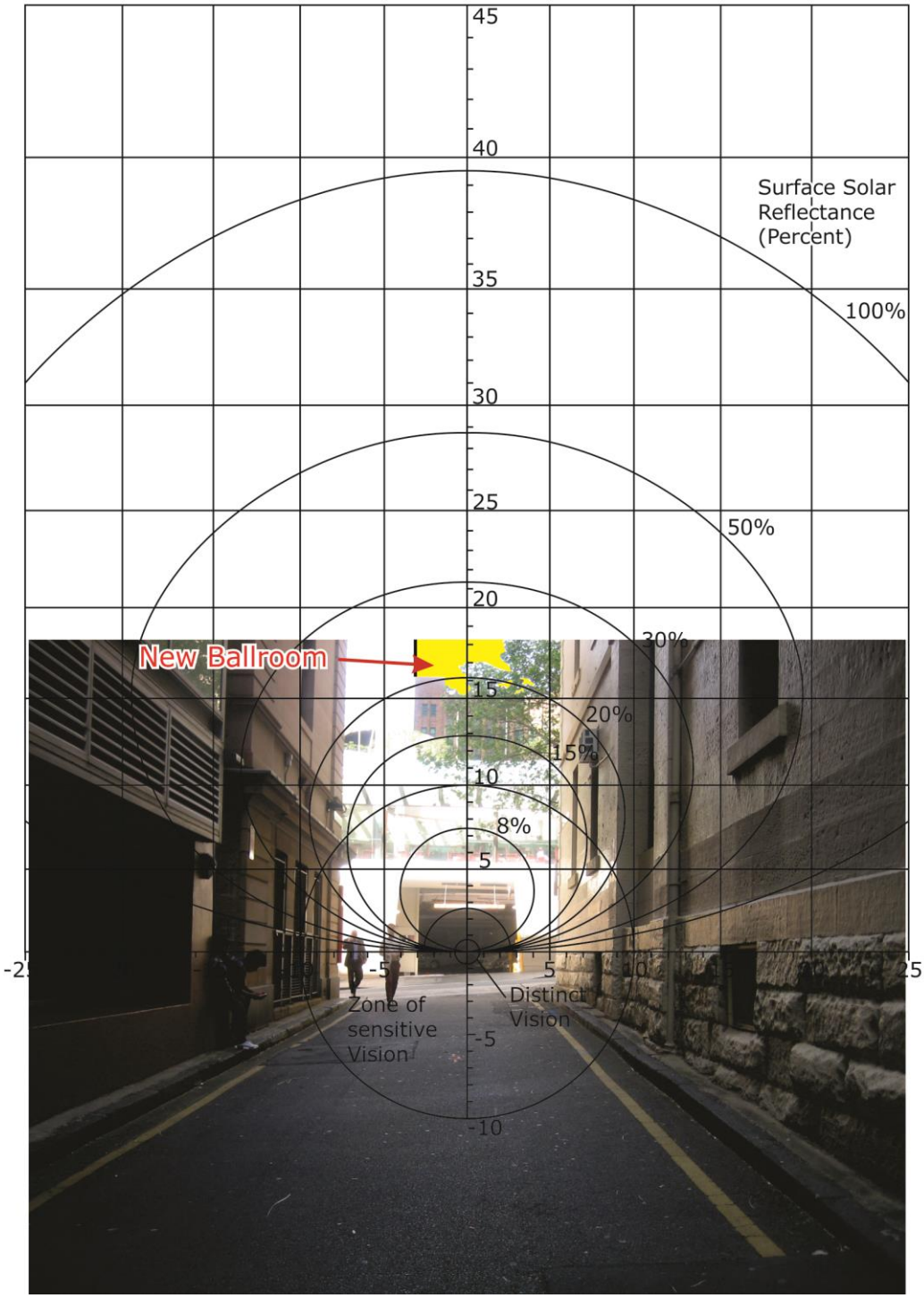

Figure A5: Glare Overlay for Point 5

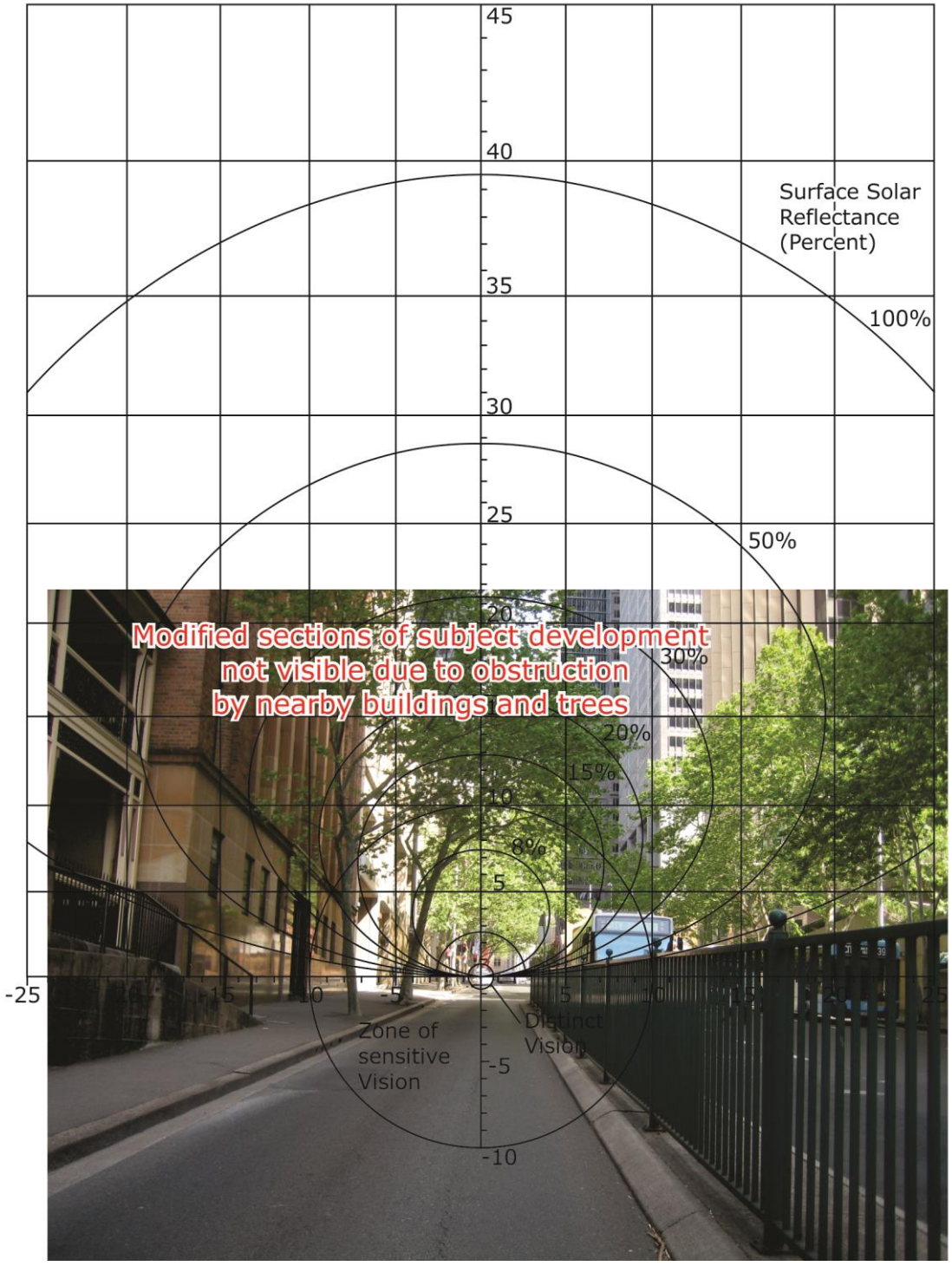

Figure A6: Glare Overlay for Point 6

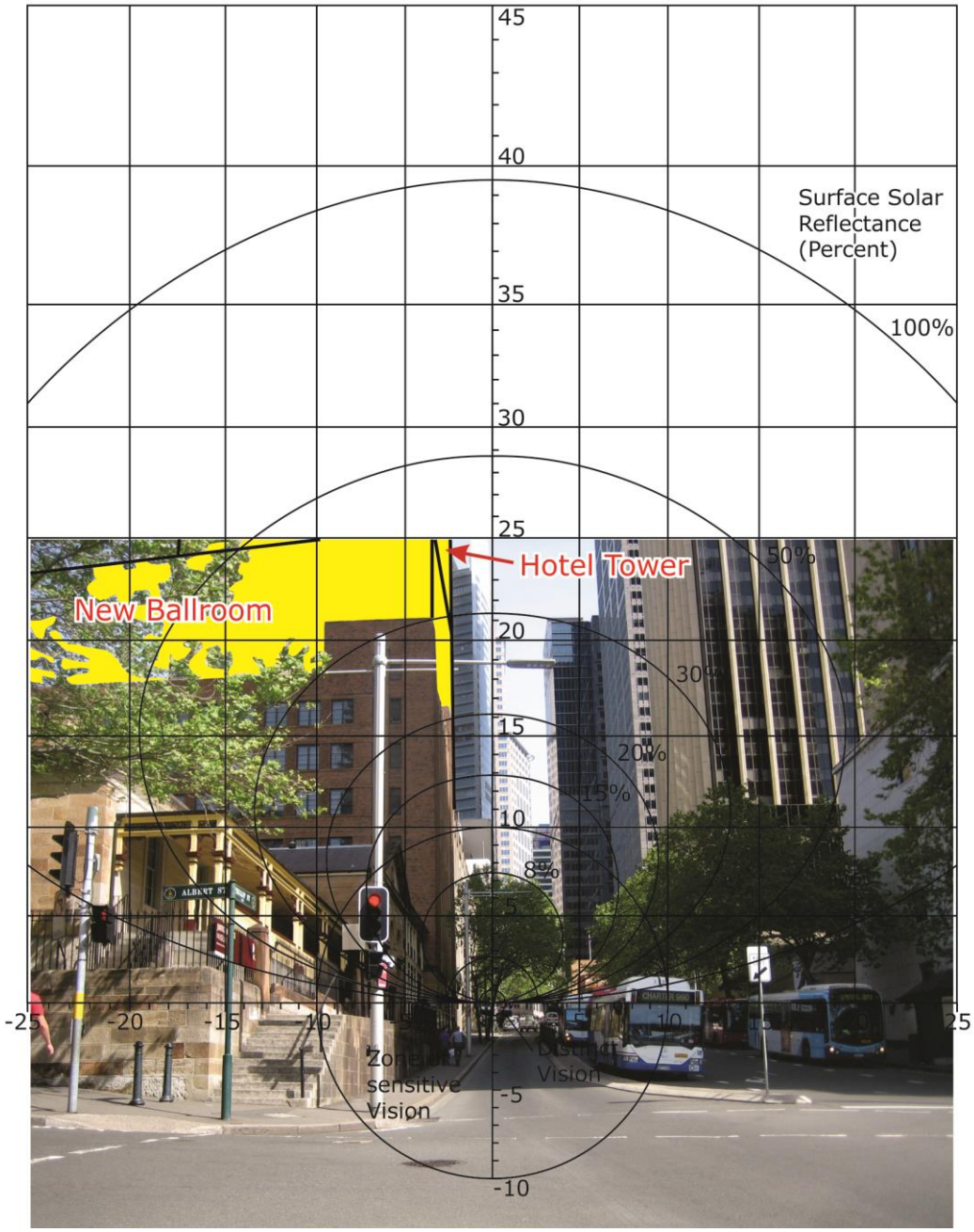

Figure A7: Glare Overlay for Point 7

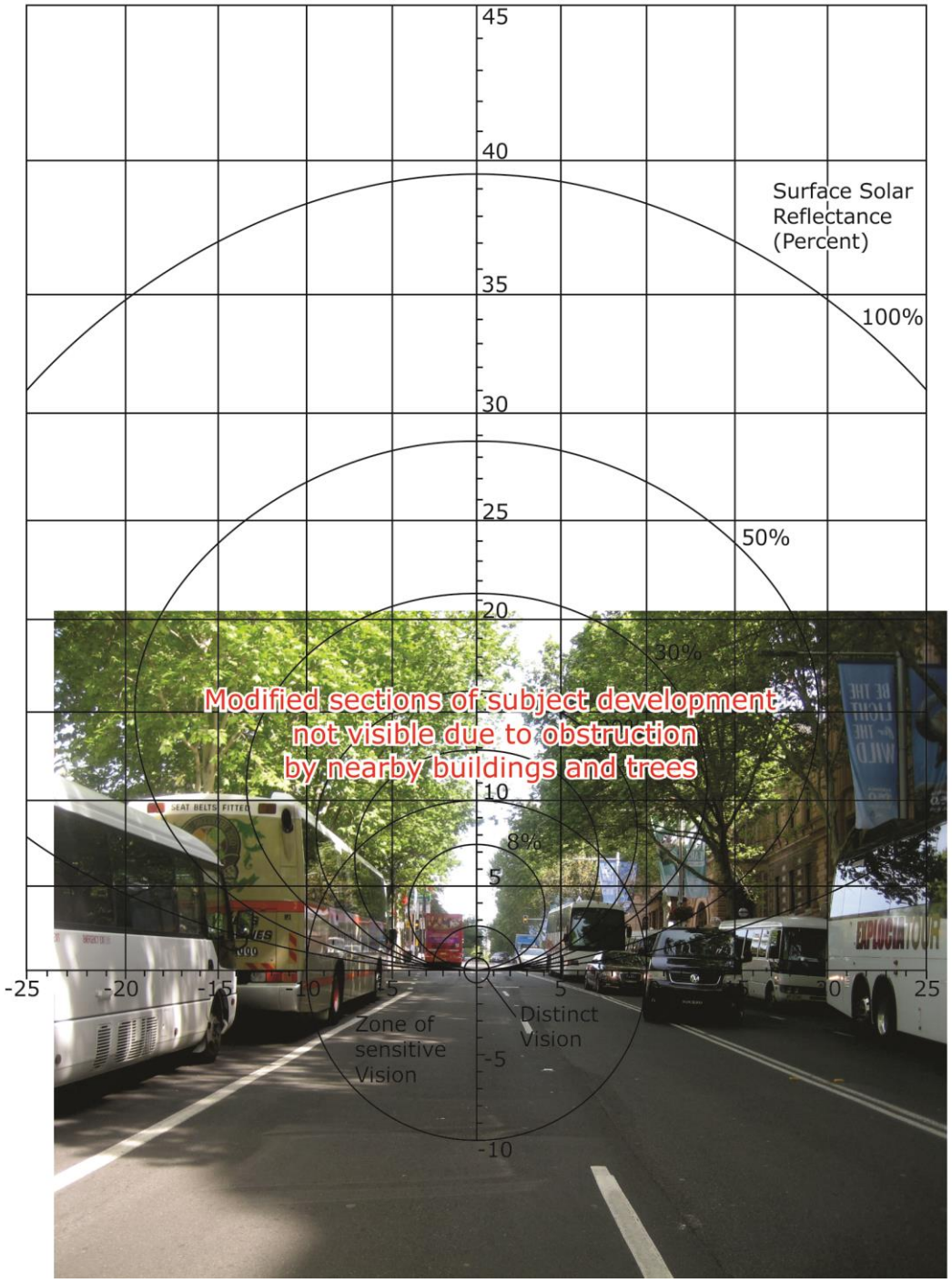

Figure A8: Glare Overlay for Point 8

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

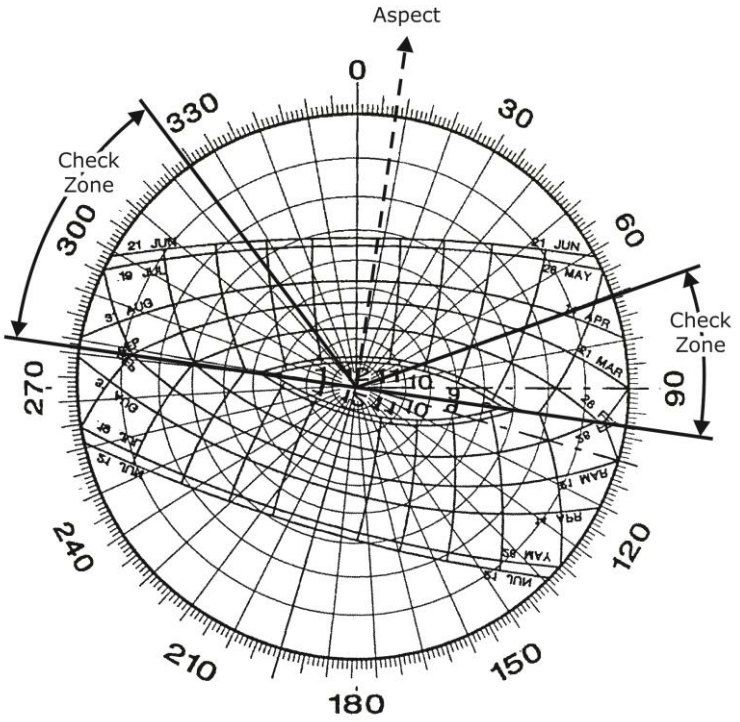

Figure B1: Sun Chart for Aspect 008º

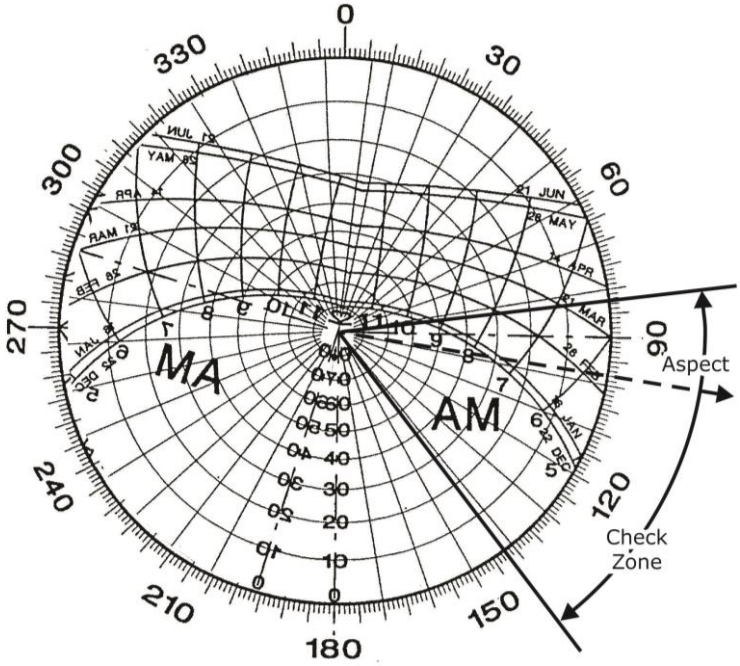

Figure B2: Sun Chart for Aspect 098º

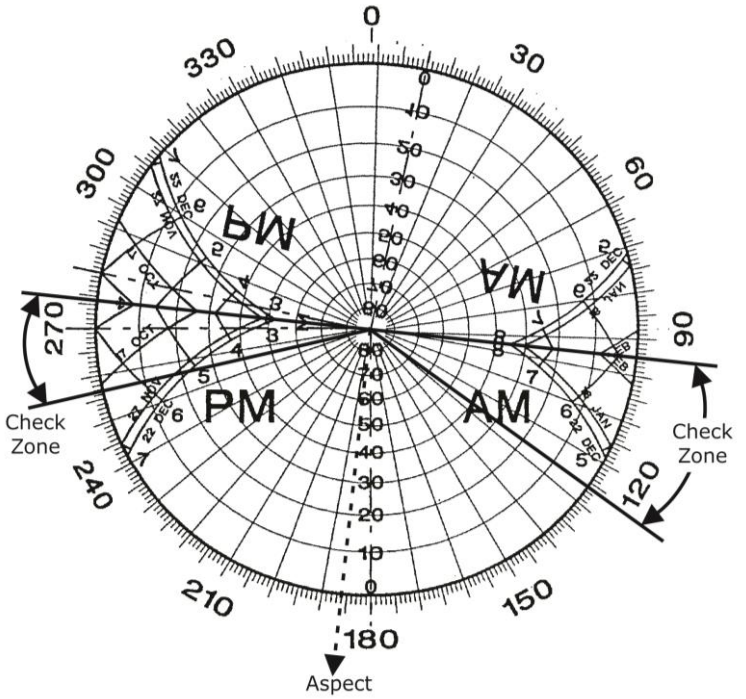

Figure B3: Sun Chart for Aspect 186º

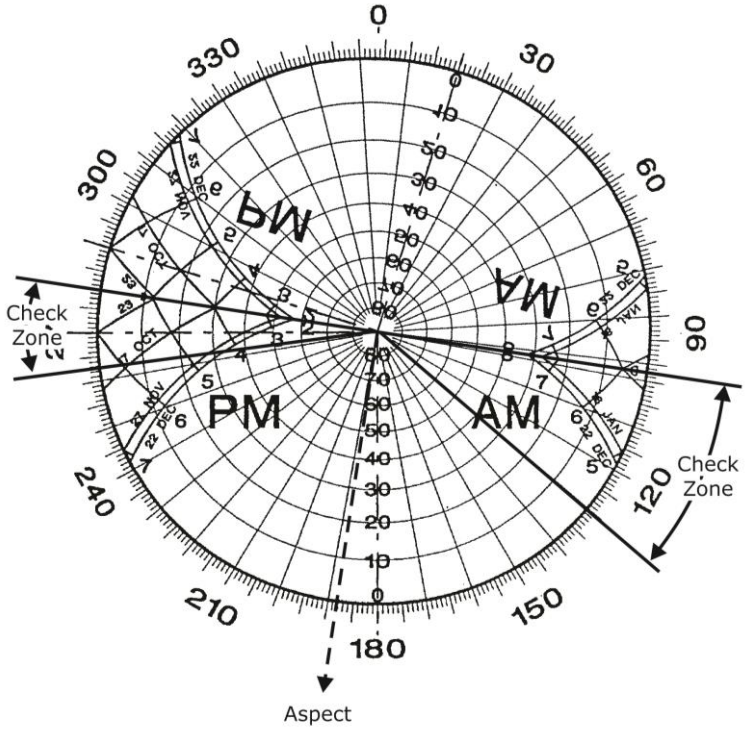

Figure B4: Sun Chart for Aspect 188º

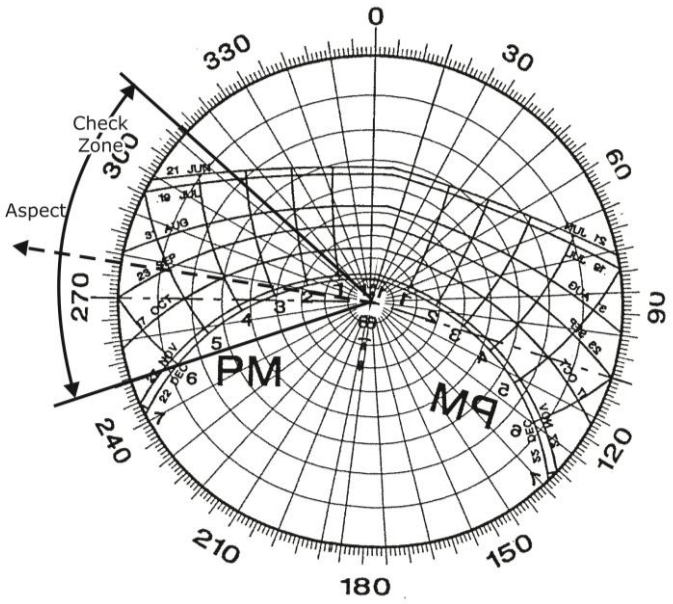

Figure B5: Sun Chart for Aspect 278°

APPENDIX C - STANDARD SUN CHART FOR THE SYDNEY REGION

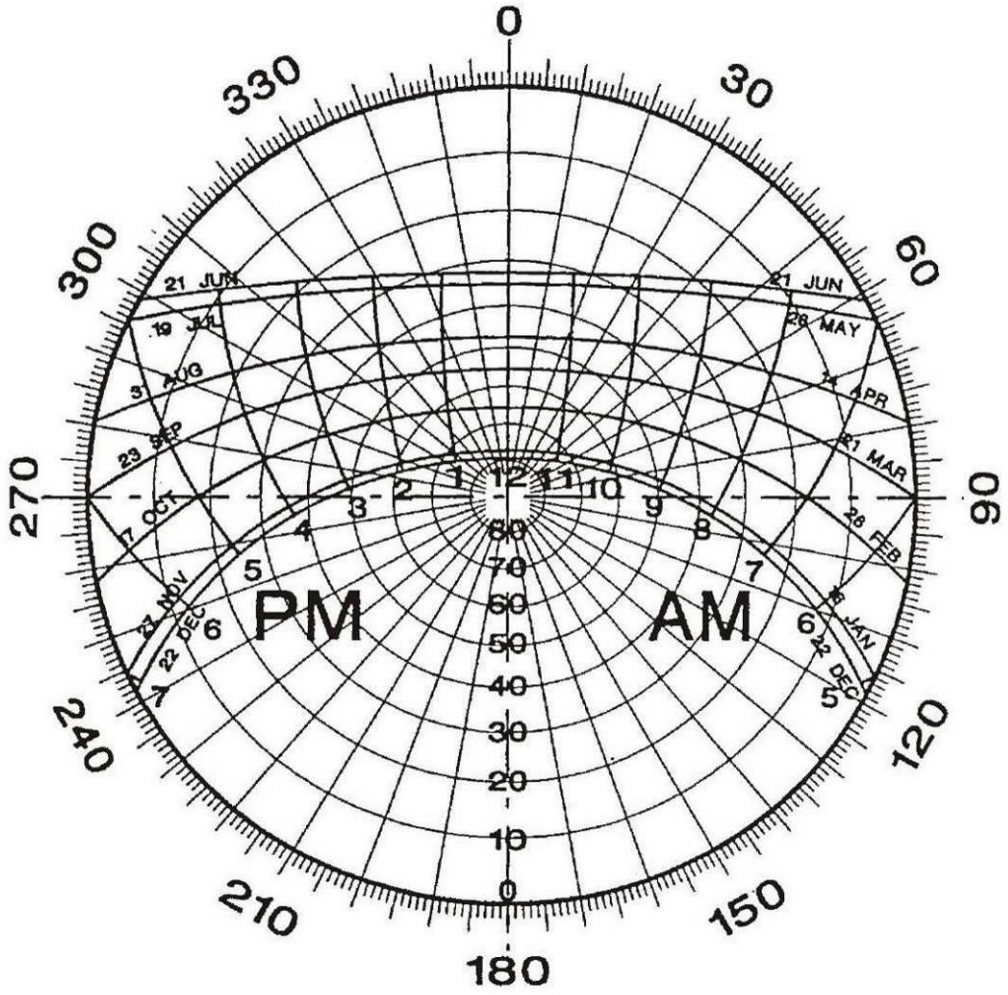

Figure C1: Standard Sun Chart for the Sydney Region