SOLAR LIGHT REFLECTIVITY ANALYSIS

SSD 7081 - FACULTY OF ARTS AND SOCIAL SCIENCES BUILDING, UNIVERSITY OF SYDNEY

WC968-01F02(REV1)- SR REPORT

MAY 2, 2016

Prepared for:

Lendlease PTY LTD

30 The Bond, 30 Hickson Road

Millers Point, NSW 2000

WINDTECH Consultants Pty Ltd ABN 72 050 574 037
Head Office: 607 Forest Road, Bexley, NSW 2207, Australia
P +61 2 9503 0300 **E** reception@windtech.com.au **W** www.windtech.com.au

Sydney | Abu Dhabi | London | Melbourne | Mumbai | New York | Shanghai | Singapore

DOCUMENT CONTROL

Date	Revision History	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
April 21, 2016	Initial.	0	KL	TR	MC
May 2, 2016	Referenced SSD 7081. Modified methodology section.	1	MC	TR	MC

EXECUTIVE SUMMARY

This report presents the results of a detailed study for the effect of potential solar glare from the proposed development known as the Faculty of Arts and Social Sciences Building (SSD 7081), located at the University of Sydney, Camperdown Campus. The analysis has been undertaken based on the architectural drawings prepared by the project architect Architectus, received during April 2016.

This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians and to 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 it is recommended that the glazed aspects of the development should have a maximum normal specular reflectivity 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 Figure 2. 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 Figure 2 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 Figure 2. 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 locations of the study points were deliberately chosen such that the photographs taken at these locations represent the critical sightlines of motorists on the streets surrounding the development.

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.

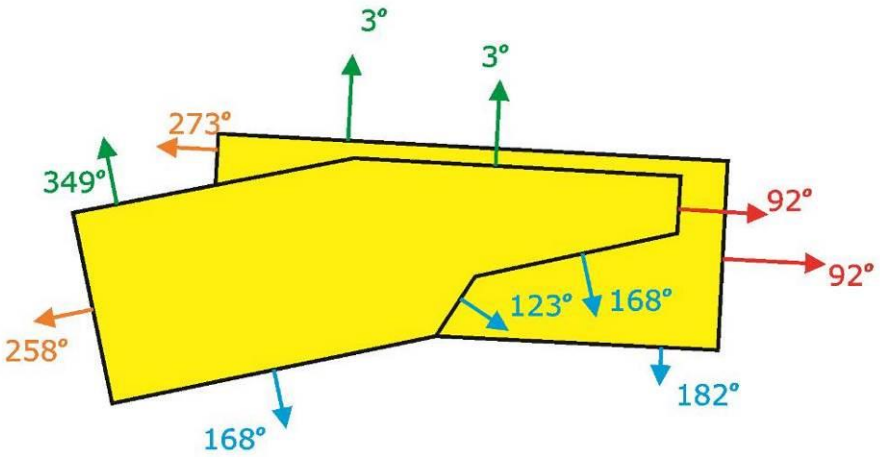

Figure 1: Critical Glazed Aspects of the Development

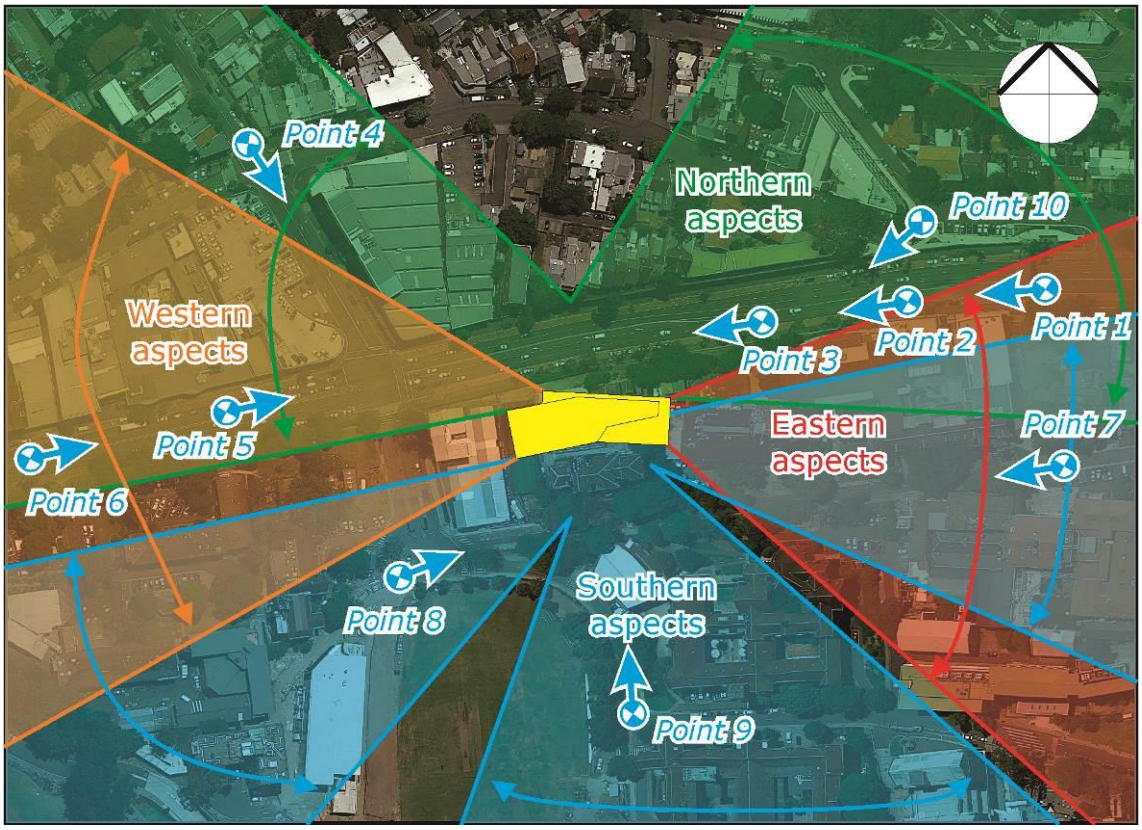

Figure 2: Check Zones and Study Point Locations

(the check zones are the areas where glare could potentially be observed)

2 ANALYSIS

2.1 Impact onto Motorists and Pedestrians

From the study of the check zones shown in Figure 2, a total 10 street level locations have been identified for detailed analysis. A summary of the location of each study point, and the aspects of the subject development 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 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 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	Parramatta Road, heading west	Northern and Eastern aspects
2	Parramatta Road, heading west	Northern aspects
3	Parramatta Road, heading west	Northern aspects
4	Ross St, heading south	Northern aspects
5	Parramatta Road, heading east	Northern and Western aspects
6	Parramatta Road, heading east	Northern and Western aspects
7	Science Road, heading west	Southern and Eastern aspects
8	Regimental Dr, heading east	Southern aspects
9	Western Ave, heading north	Southern aspects
10	Arundel St, heading south	Northern aspects

2.1.1 Drivers heading west along Parramatta Road

Points 1, 2 and 3 are located along Parramatta Road, to the north-east of the development site. These points represent the critical sightlines of drivers heading west along Parramatta Road 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, A2 and A3 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoints at Points 1, 2 and 3 indicates that the northern aspects of the subject development are visible but are not within the zone of sensitive vision of motorists. Hence, no adverse solar glare will be observed by motorists or pedestrians heading west along Parramatta Road.

2.1.2 Drivers heading south along Ross Street

Point 4 is located along Ross Street, to the north-east of the development site. This point represents the critical sightlines of drivers heading south along Ross 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 A4 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 4 indicates that the subject development is not visible and is not within the zone of sensitive vision of motorists. Hence, no adverse solar glare will be observed by motorists or pedestrians heading south along Ross Street.

2.1.3 Drivers heading east along Parramatta Road

Points 5 and 6 are located along Parramatta Road, to the west of the development site. These points represent the critical sightlines of drivers heading east along Parramatta Road 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 A5 and A6 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoints at Points 5 and 6 indicates that the subject develop is not visible and is not within the zone of sensitive vision of motorists. Hence, no adverse solar glare will be observed by motorists or pedestrians heading east along Parramatta Road.

2.1.4 Drivers heading west along Science Road

Point 7 is located along Science Road, to the east of the development site. This point represents the critical sightlines of drivers heading west along Science 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 A7 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 7 indicates that the subject development is not visible and is not within the zone of sensitive vision of motorists. Hence, no adverse solar glare will be observed by motorists or pedestrians heading west along Science Road.

2.1.5 Drivers heading east along Regimental Drive

Point 8 is located along Regimental Drive, to the south-west of the development site. This point represents the critical sightlines of drivers heading east along Regimental Drive 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 glare meter overlaid onto the viewpoint at Point 8 indicates that the subject development is not visible and is not within the zone of sensitive vision of motorists. Hence, no adverse solar glare will be observed by motorists or pedestrians heading east along Regimental Drive.

2.1.6 Drivers heading north along Western Avenue

Point 9 is located along Western Avenue, to the south of the development site. This point represents the critical sightlines of drivers heading north along Western Avenue 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 A9 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 9 indicates that the southern aspects of the subject development are visible but are not within the zone of sensitive vision of motorists. Hence, no adverse solar glare will be observed by motorists or pedestrians heading north along Western Avenue.

2.1.7 Drivers heading south along Arundel Street

Point 10 is located along Arundel Street, to the north-east of the development site. This point represents the critical sightlines of drivers heading south along Arundel 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 A10 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 10 indicates that the subject development is not visible and is not within the zone of sensitive vision of motorists. Hence, no adverse solar glare will be observed by motorists or pedestrians heading south along Arundel Street.

2.2 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.

2.3 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.

2.3.1 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%

2.3.2 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

An analysis has been undertaken to assess the potential for solar glare from the proposed development known as the Faculty of Arts and Social Sciences Building (SSD 7081), located at the University of Sydney, Camperdown Campus. The analysis has been undertaken based on the architectural drawings prepared by the project architect Architectus, received during April 2016.

This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians and to 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 it is recommended that the glazed aspects of the development should have a maximum normal specular reflectivity 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.

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.

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

APPENDIX A - GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

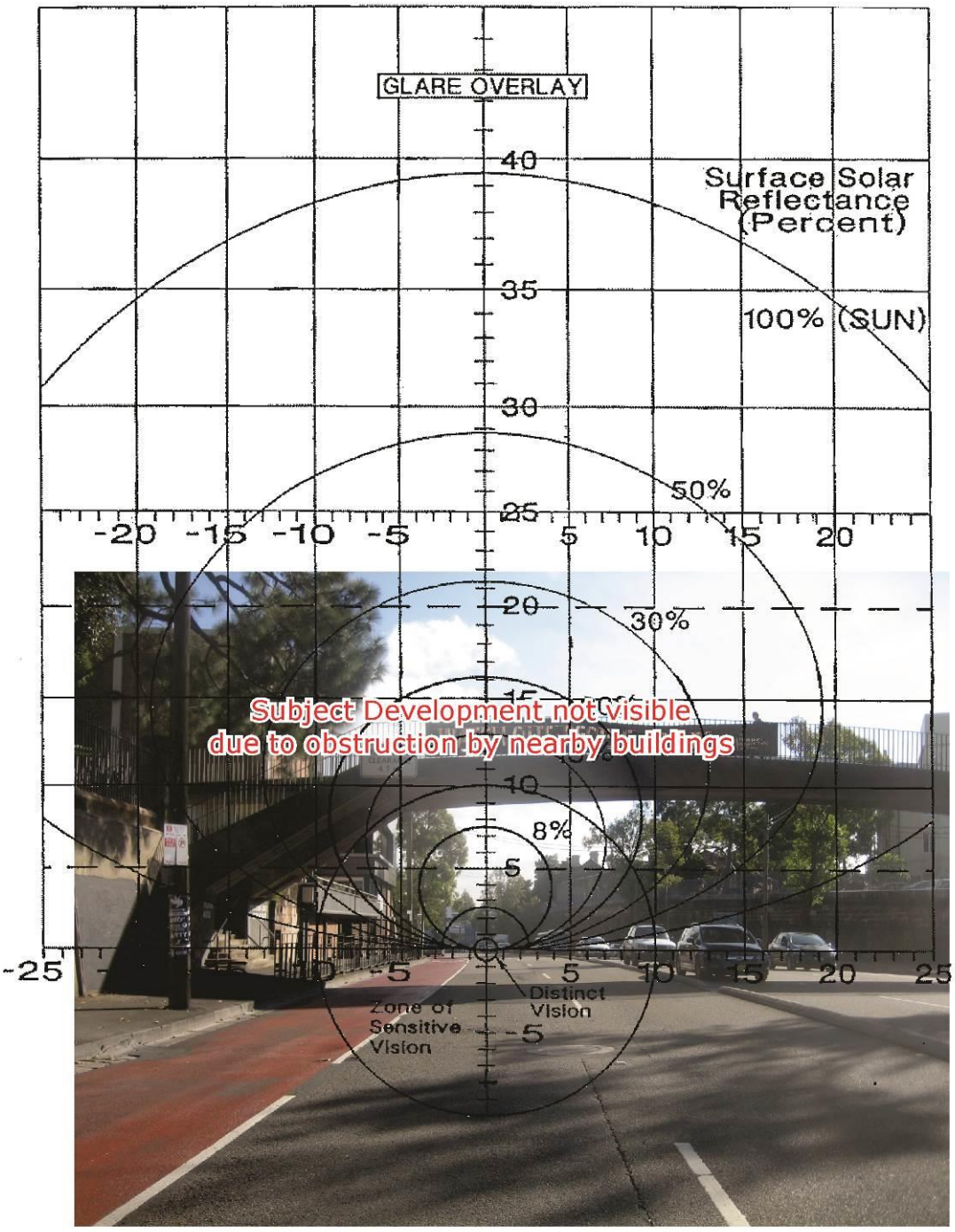

Figure A1: Glare Overlay for Point 1

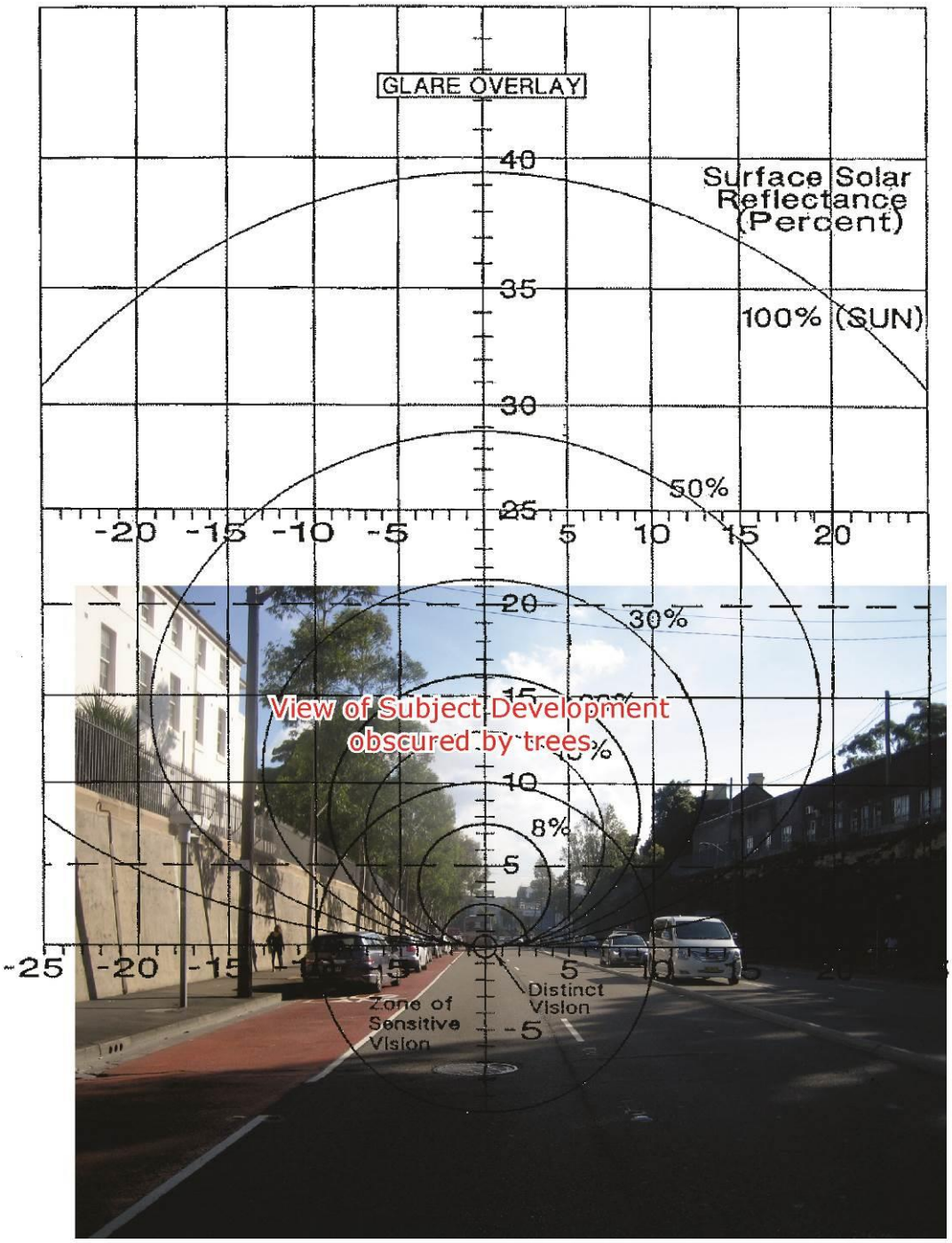

Figure A2: Glare Overlay for Point 2

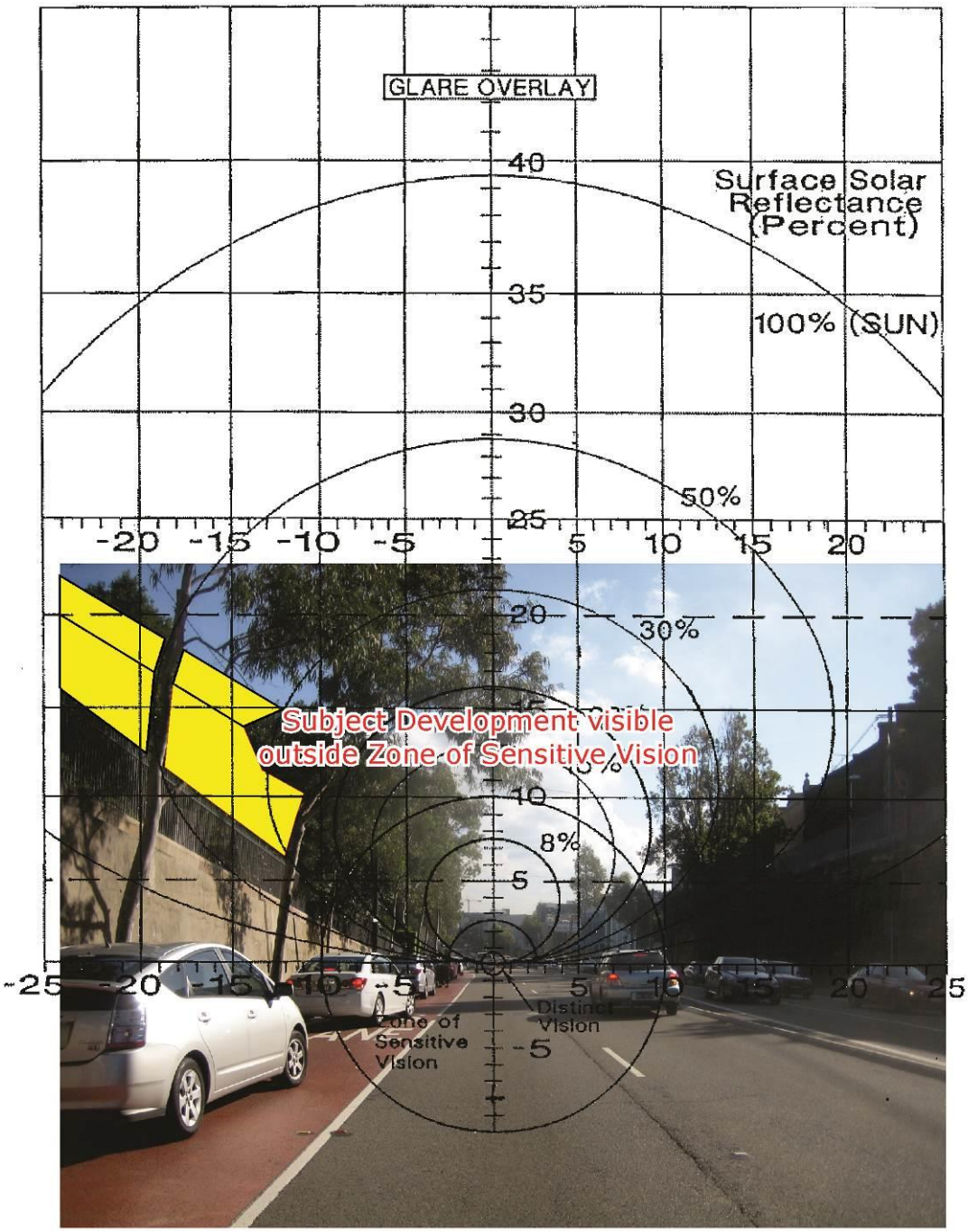

Figure A3: Glare Overlay for Point 3

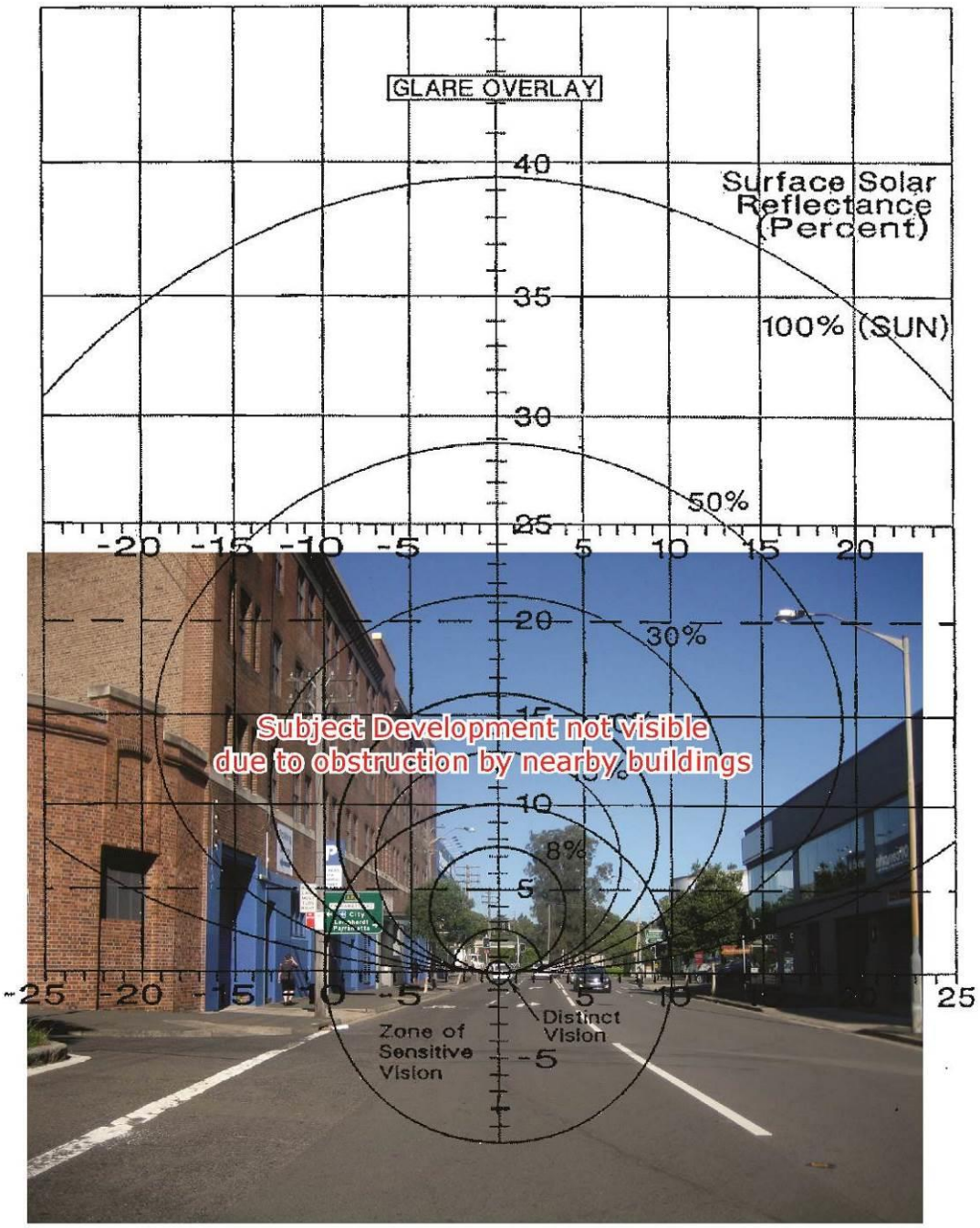

Figure A4: Glare Overlay for Point 4

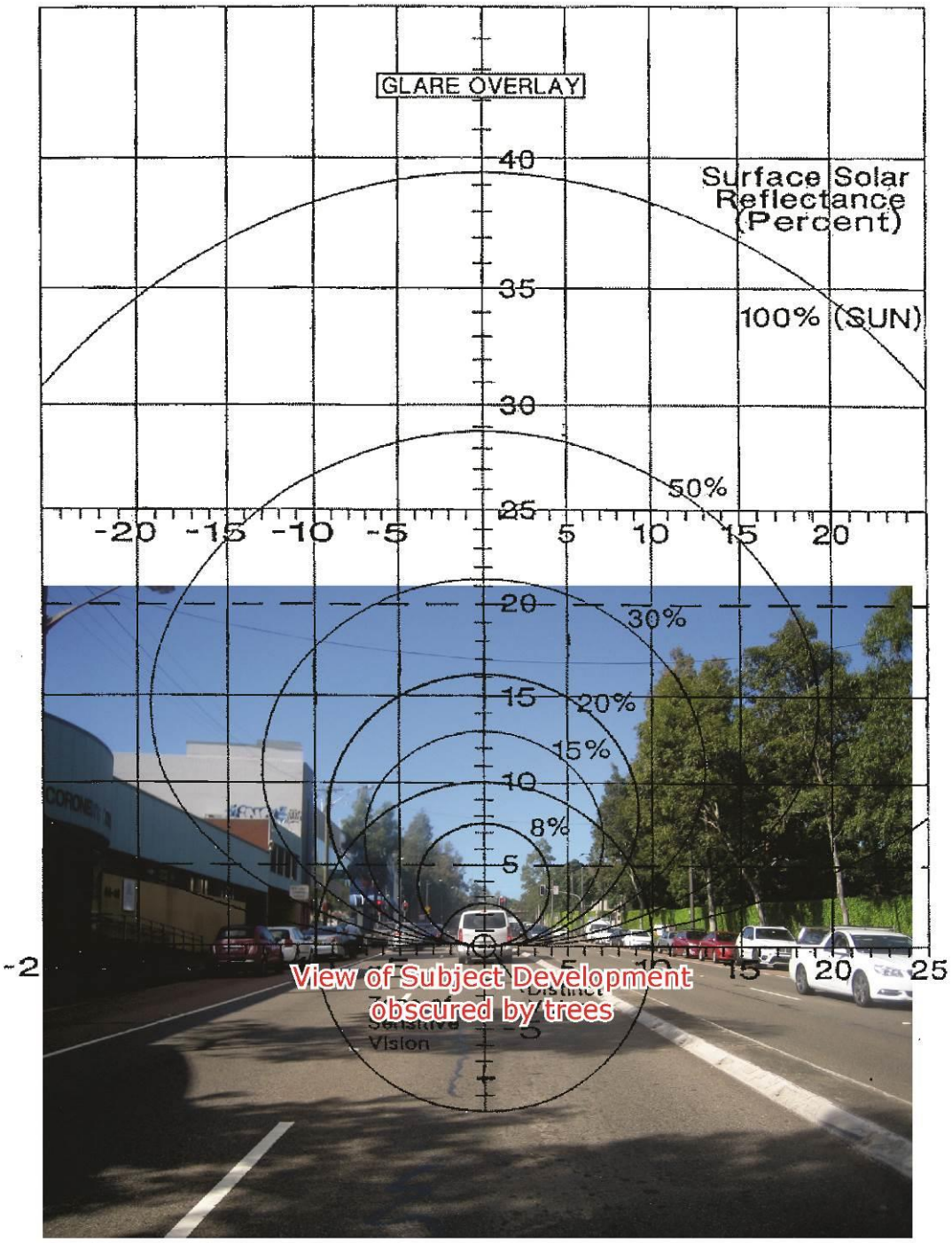

Figure A5: Glare Overlay for Point 5

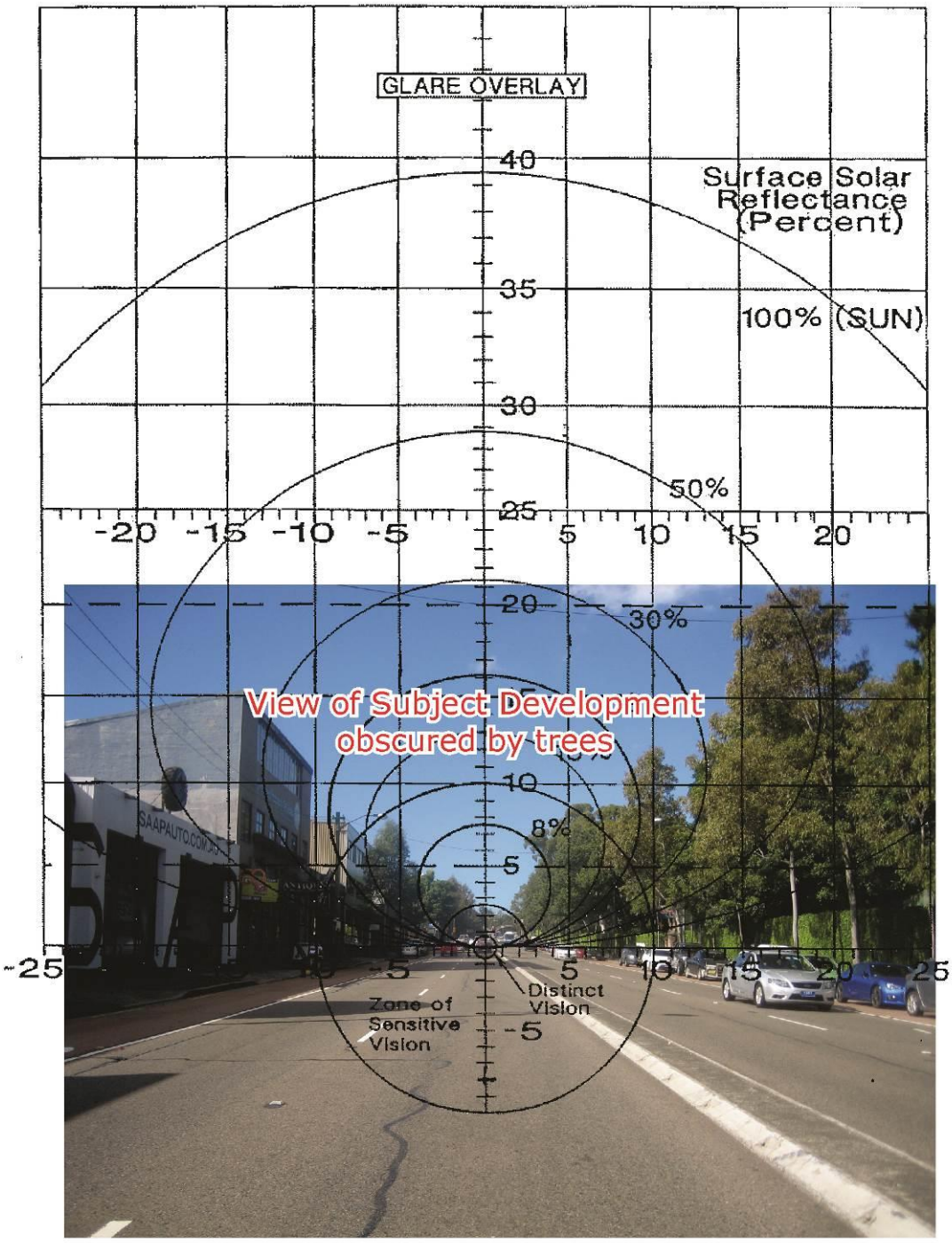

Figure A6: Glare Overlay for Point 6

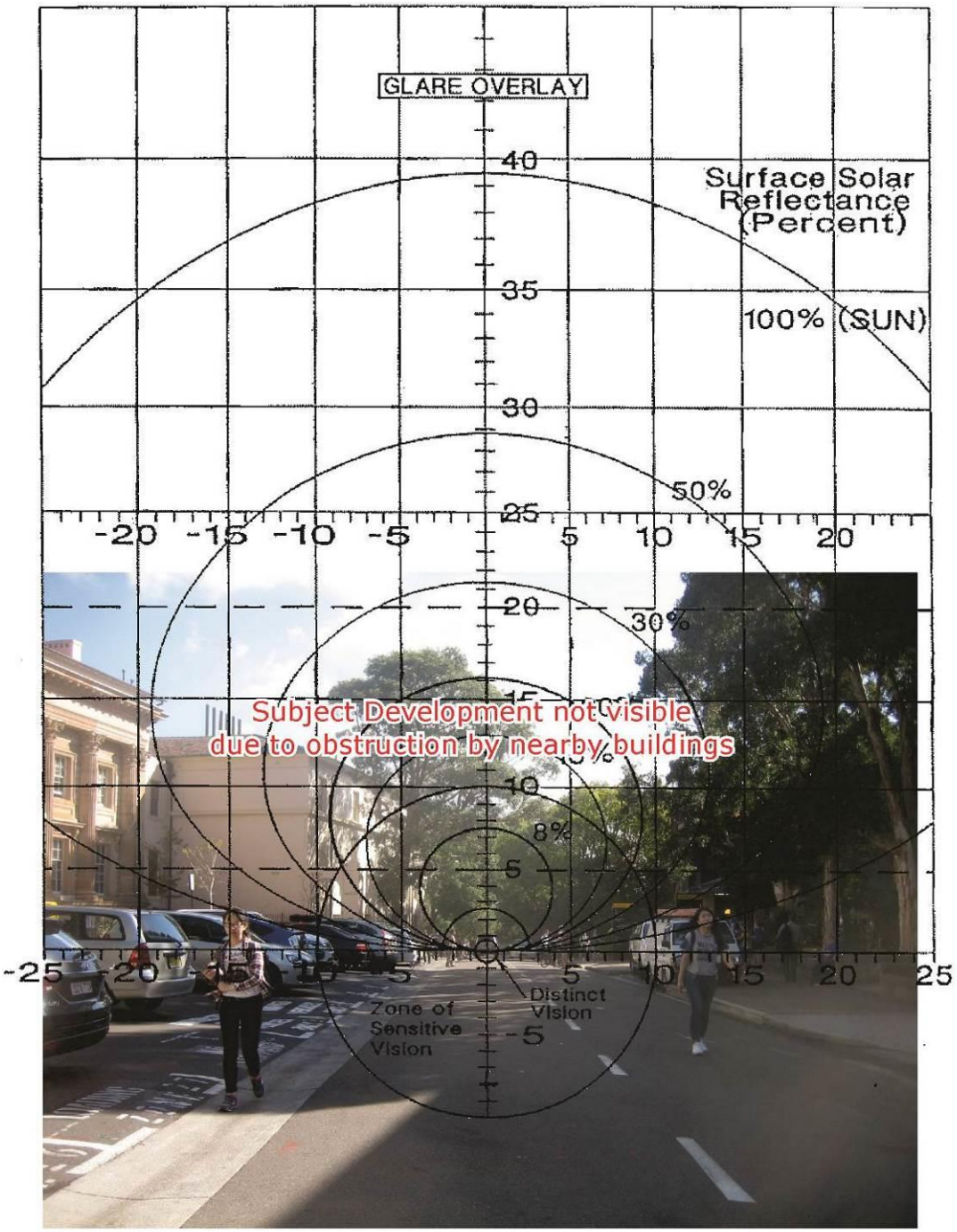

Figure A7: Glare Overlay for Point 7

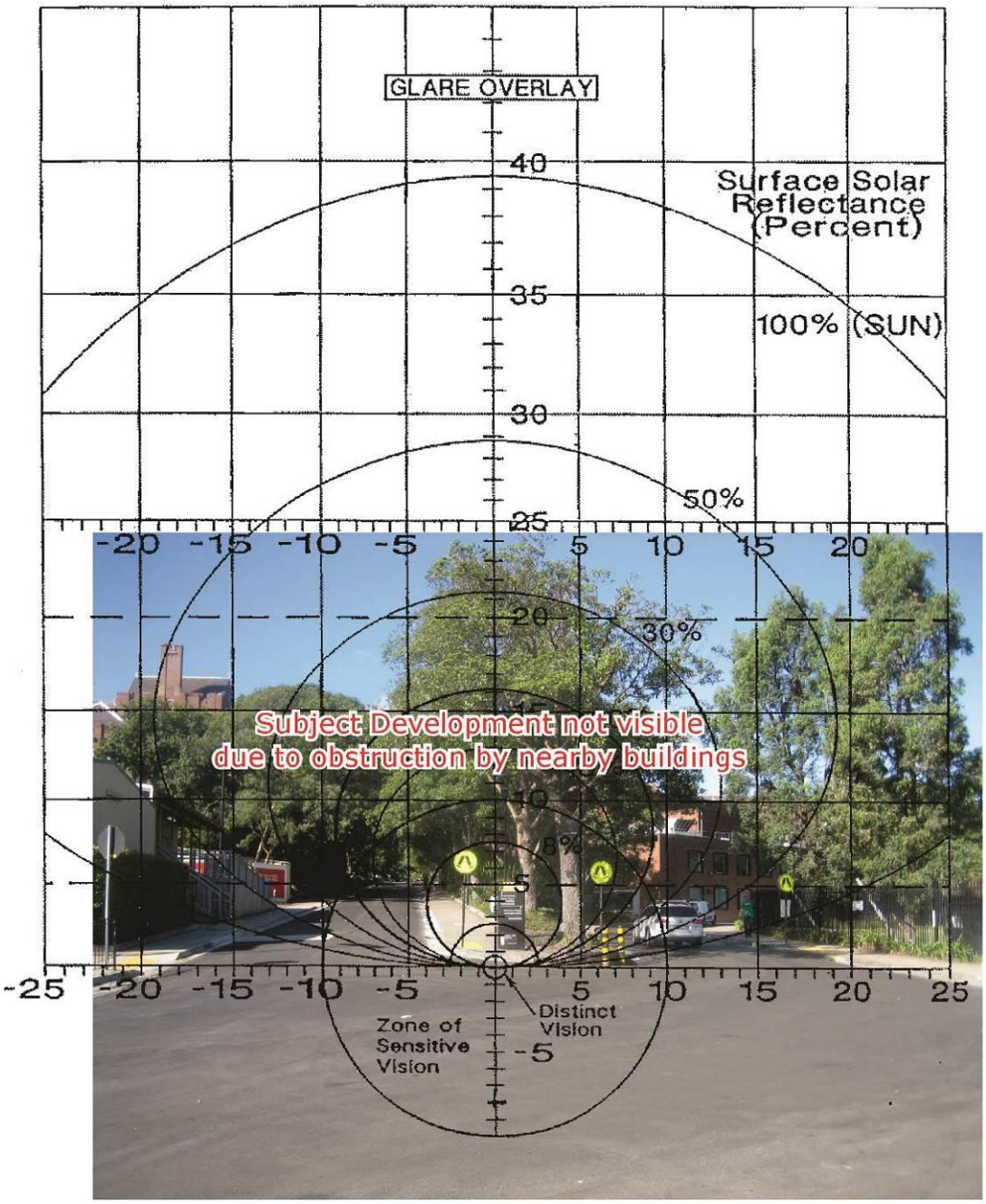

Figure A8: Glare Overlay for Point 8

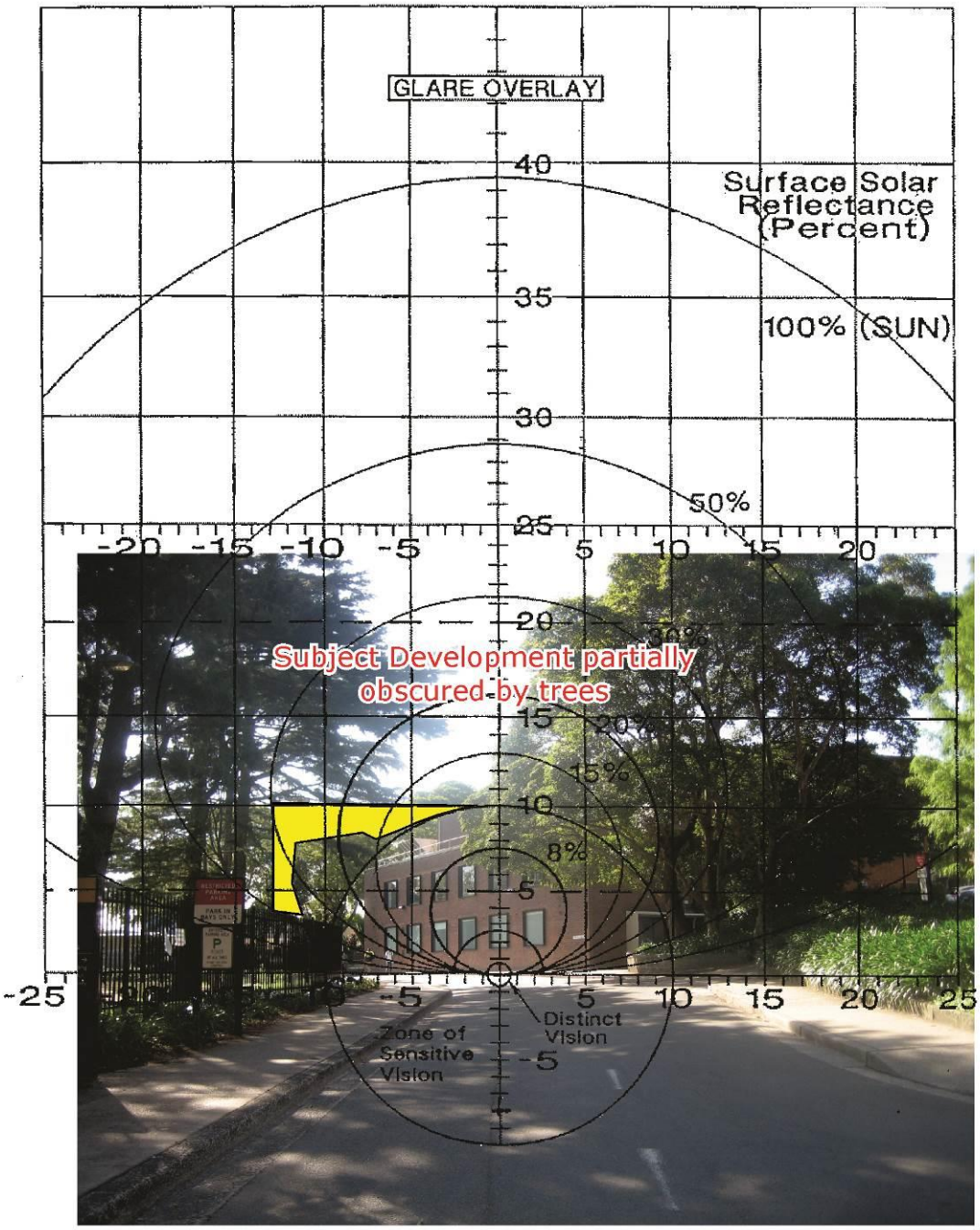

Figure A9: Glare Overlay for Point 9

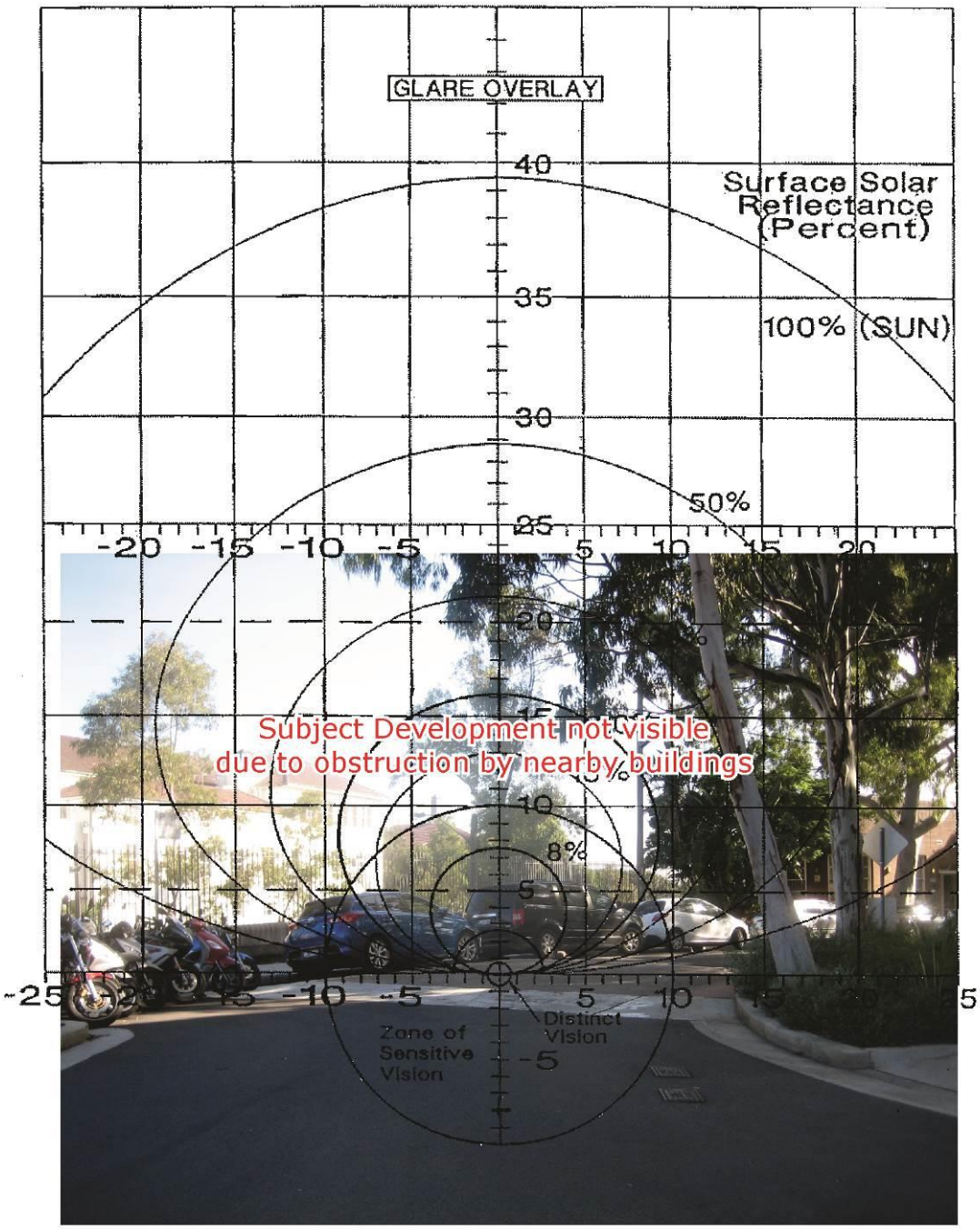

Figure A10: Glare Overlay for Point 10

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

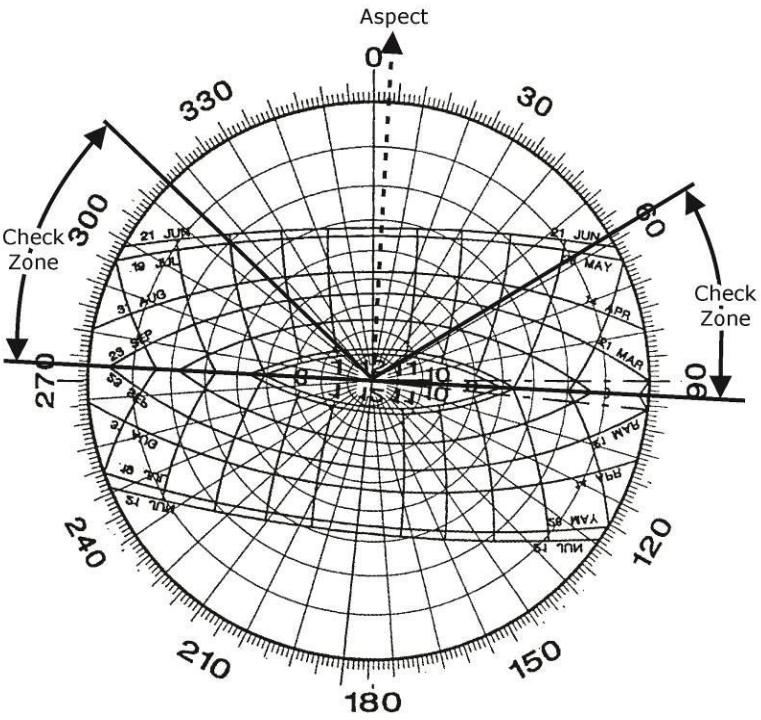

Figure B1: Sun Chart for Aspect 003º

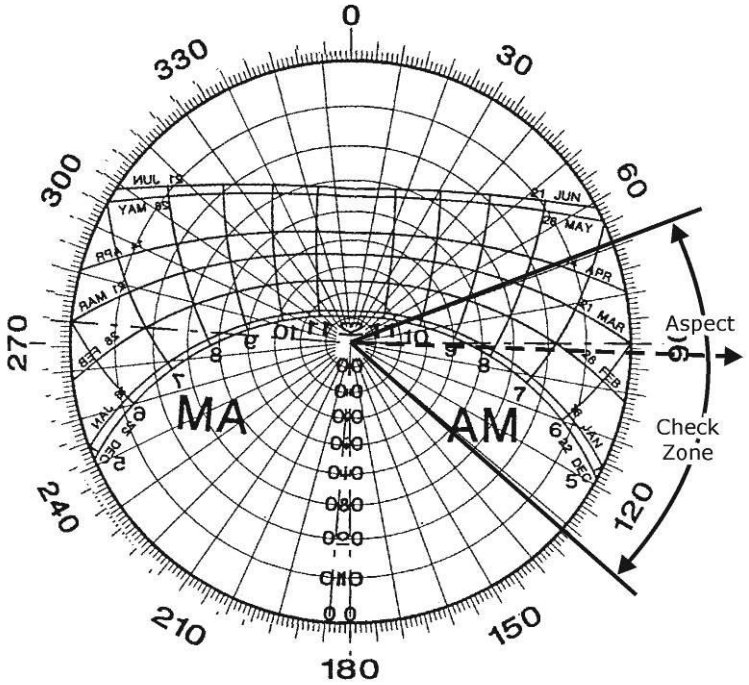

Figure B2: Sun Chart for Aspect 093º

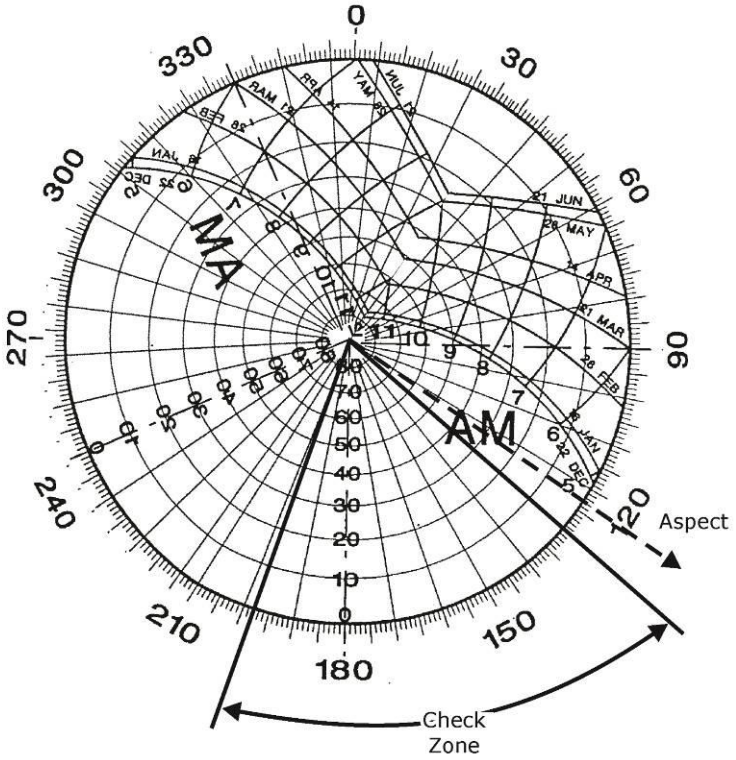

Figure B3: Sun Chart for Aspect 123º

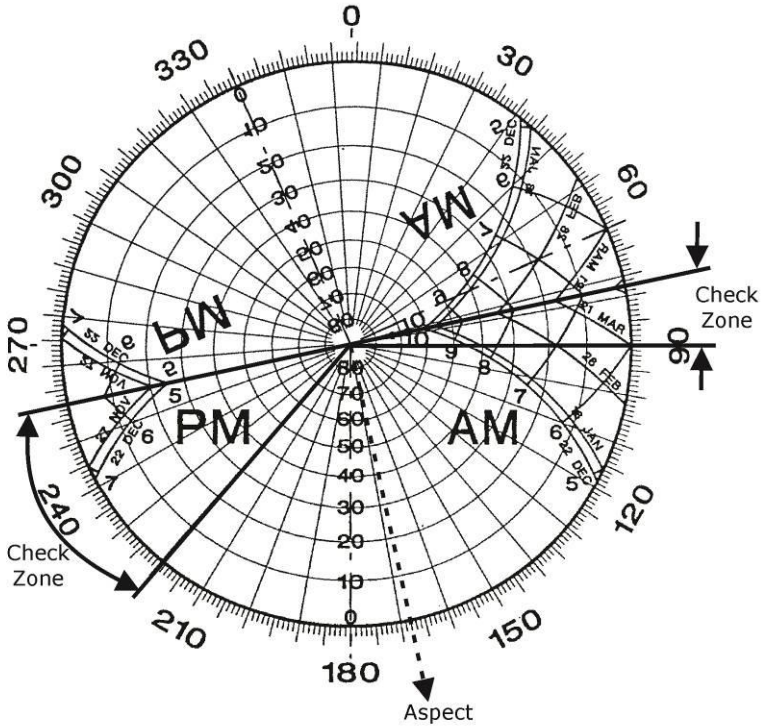

Figure B4: Sun Chart for Aspect 168º

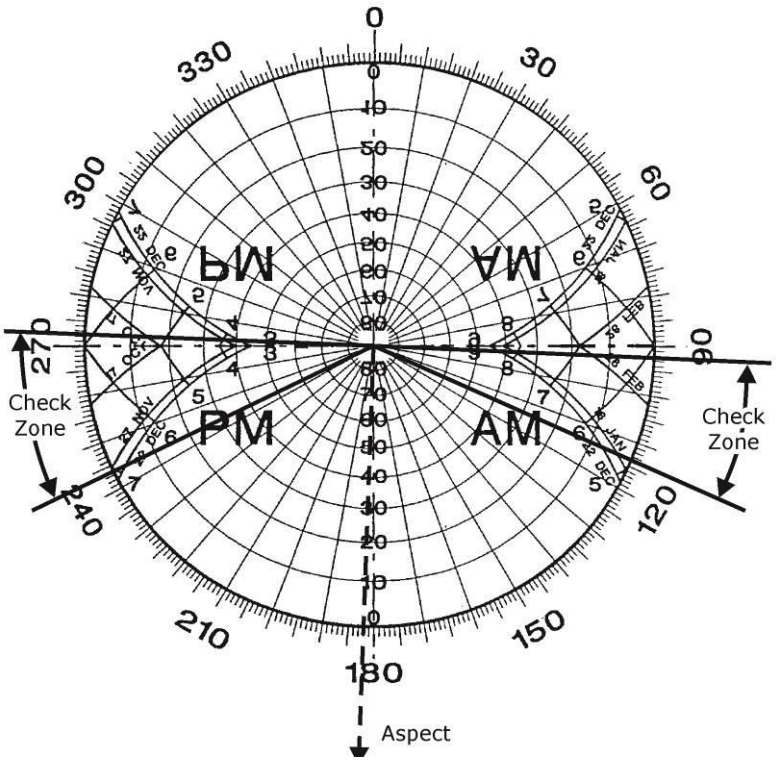

Figure B5: Sun Chart for Aspect 182º

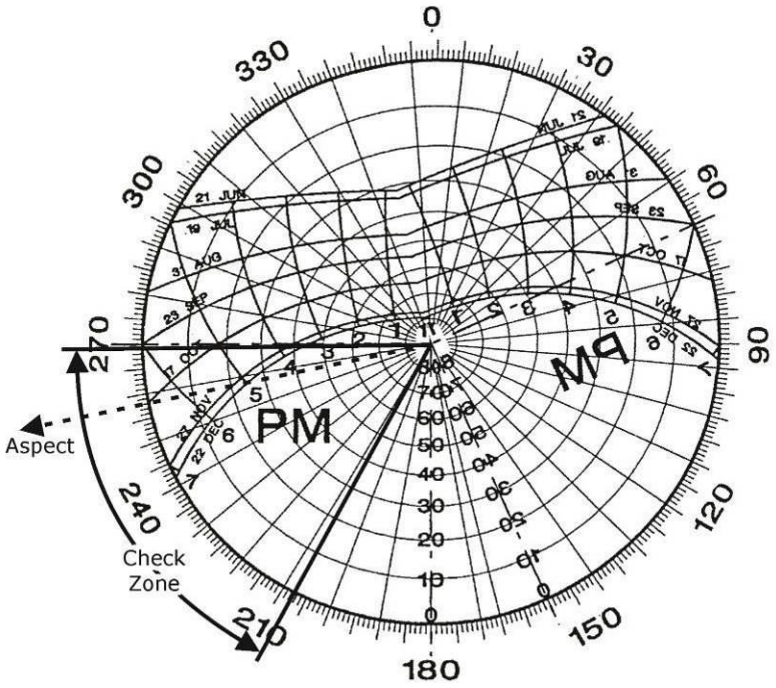

Figure B6: Sun Chart for Aspect 258º

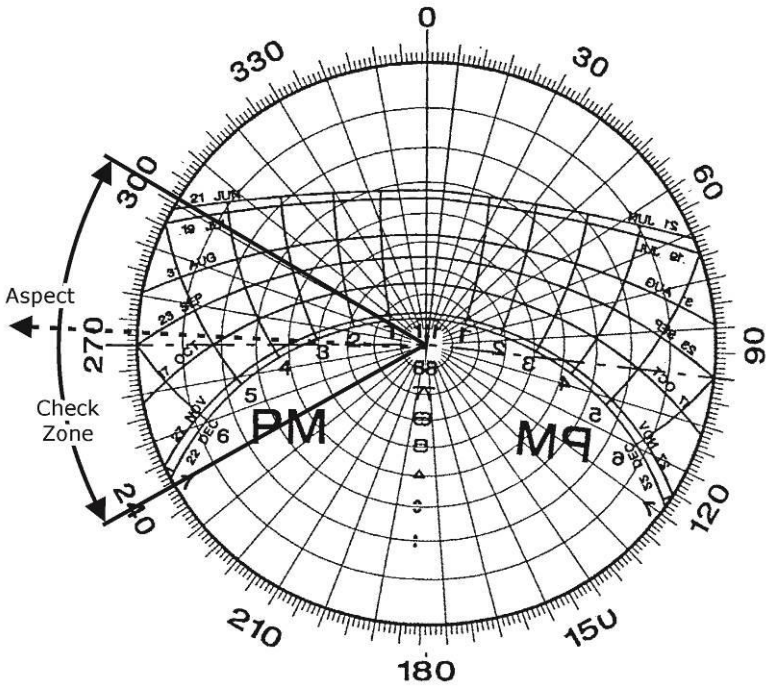

Figure B7: Sun Chart for Aspect 273º

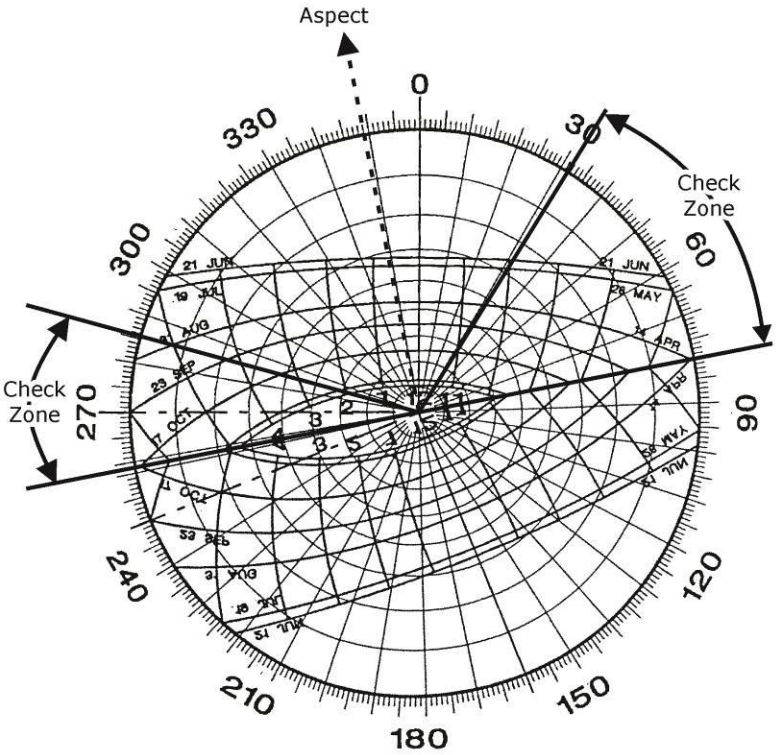

Figure B8: Sun Chart for Aspect 349º

APPENDIX C - STANDARD SUN CHART FOR THE SYDNEY REGION

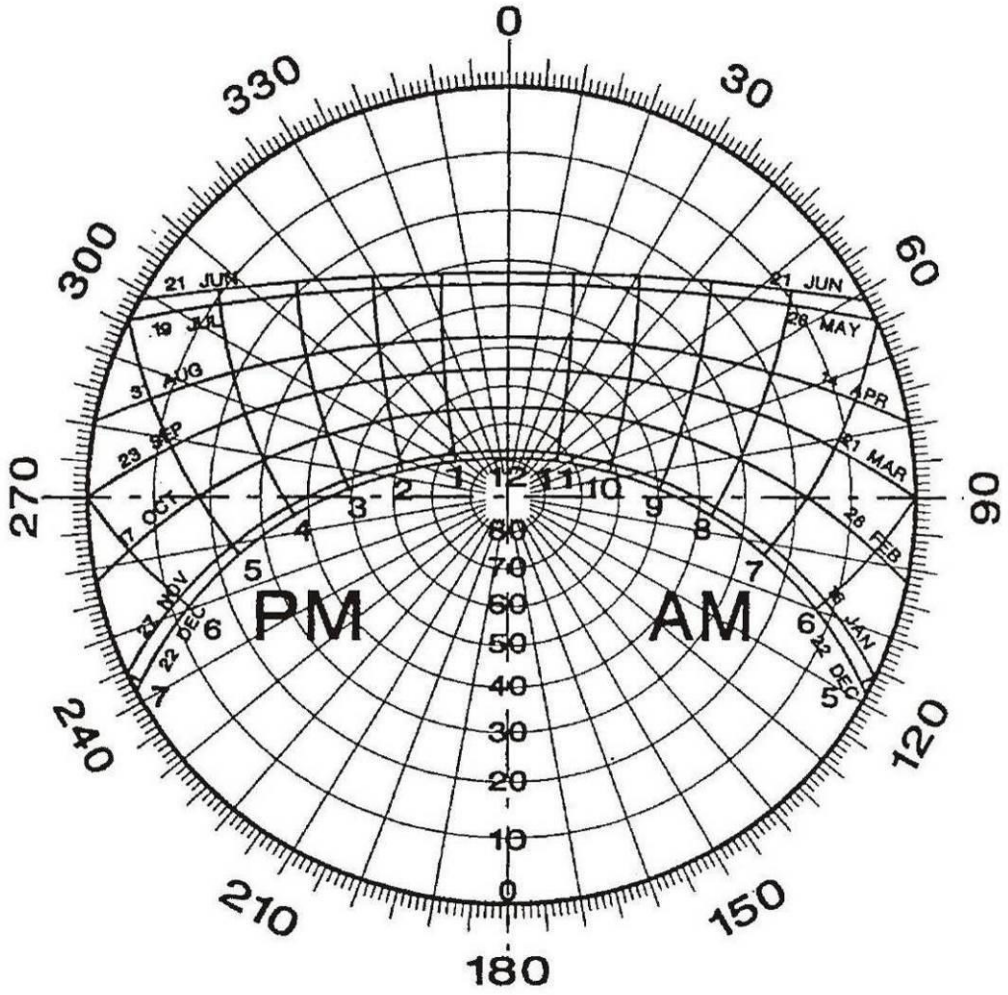

Figure C1: Standard Sun Chart for the Sydney Region