SOLAR LIGHT REFLECTIVITY ANALYSIS

175-177 CLEVELAND STREET, REDFERN

WC210-01F02(REV0)- SR REPORT

8 OCTOBER 2014

Prepared for:

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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 development located at 175-177 Cleveland Street, Redfern. The analysis has been undertaken based on the architectural drawings prepared by the project architect Ghazi Al Ali Architects received during October 2014. This study identifies any possible adverse reflected solar glare conditions affecting drivers and pedestrians, and occupants of neighbouring buildings, within the local surrounding area. If necessary, recommendations are made to mitigate any potentially adverse effects.

This study assesses compliance with the controls for solar glare from the State Environmental Planning Policy No. 65 (SEPP65, Part 03 (Building Design) for Building Amenity), which is also known as the Residential Flat Design Code. The study also addresses the provisions in the City of Sydney DCP 2012, which are essentially the same as the SEPP65 requirements.

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

The results of the study indicate that, to avoid any adverse glare to drivers and pedestrians on the surrounding streets, train drivers, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the following recommendations should be incorporated:

- The anodised aluminium screen on the eastern aspect of the Roof should have a maximum normal specular reflectance of visible light of 11%.
- The glazing and anodised aluminium screen on the northern aspect of the development, on Ground Level, Level 1 and Level 2, should have a maximum normal specular reflectance of visible light of 11%.
- The anodised aluminium screen on the north-western aspect of the development, on Levels 1, 2 and 3, should have a maximum normal specular reflectance of visible light of 14%.
- All other materials 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 surfaces on the external façade of this building are the glazing and anodised aluminium screen. 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 and/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 recommended limits.

Hence, with the incorporation of the abovementioned recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians or motorists in the surrounding area, train drivers, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from SEPP65 and the City of Sydney DCP 2012.

CONTENTS

1 METHODOLOGY

This study assesses compliance with the controls for solar glare from the State Environmental Planning Policy No. 65 (SEPP65, Part 03 (Building Design) for Building Amenity), which is also known as the Residential Flat Design Code. The study also addresses the provisions in the City of Sydney DCP 2012, which are essentially the same as the SEPP65 requirements.

The reflectivity analysis of the subject development has been carried out using the technique published by Hassall (1991). The limiting veiling luminance of 500 candelas per square metre for the comfort of vehicle drivers, 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 drivers, conditions will also be satisfactory for pedestrians. The glare impact onto occupants of neighbouring buildings is also discussed in this assessment.

The various critical aspects were determined for the development and are shown in Figure 1. Solar charts for each of these critical aspects is 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 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 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.

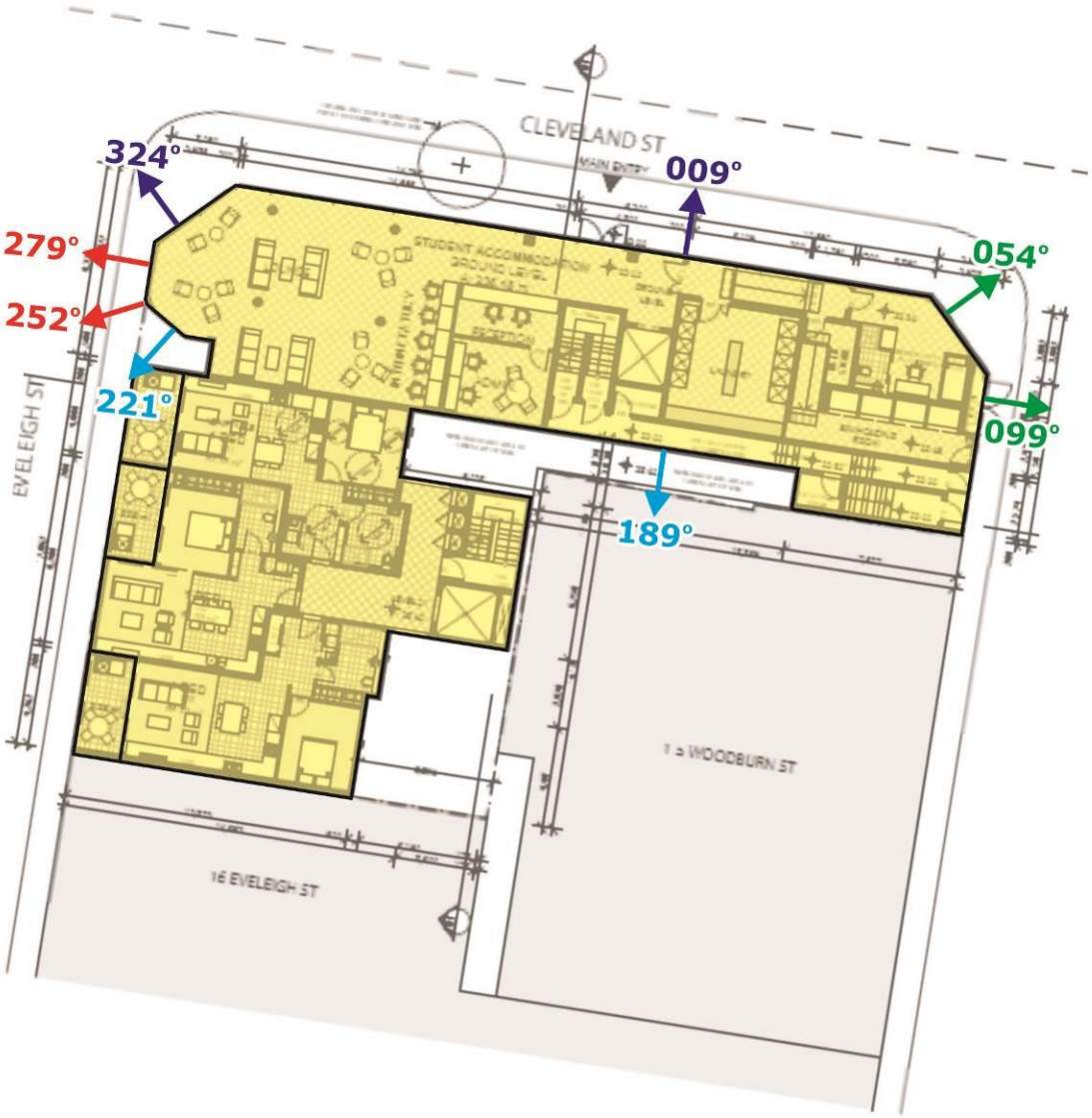

Figure 1: Critical Aspects of the Development

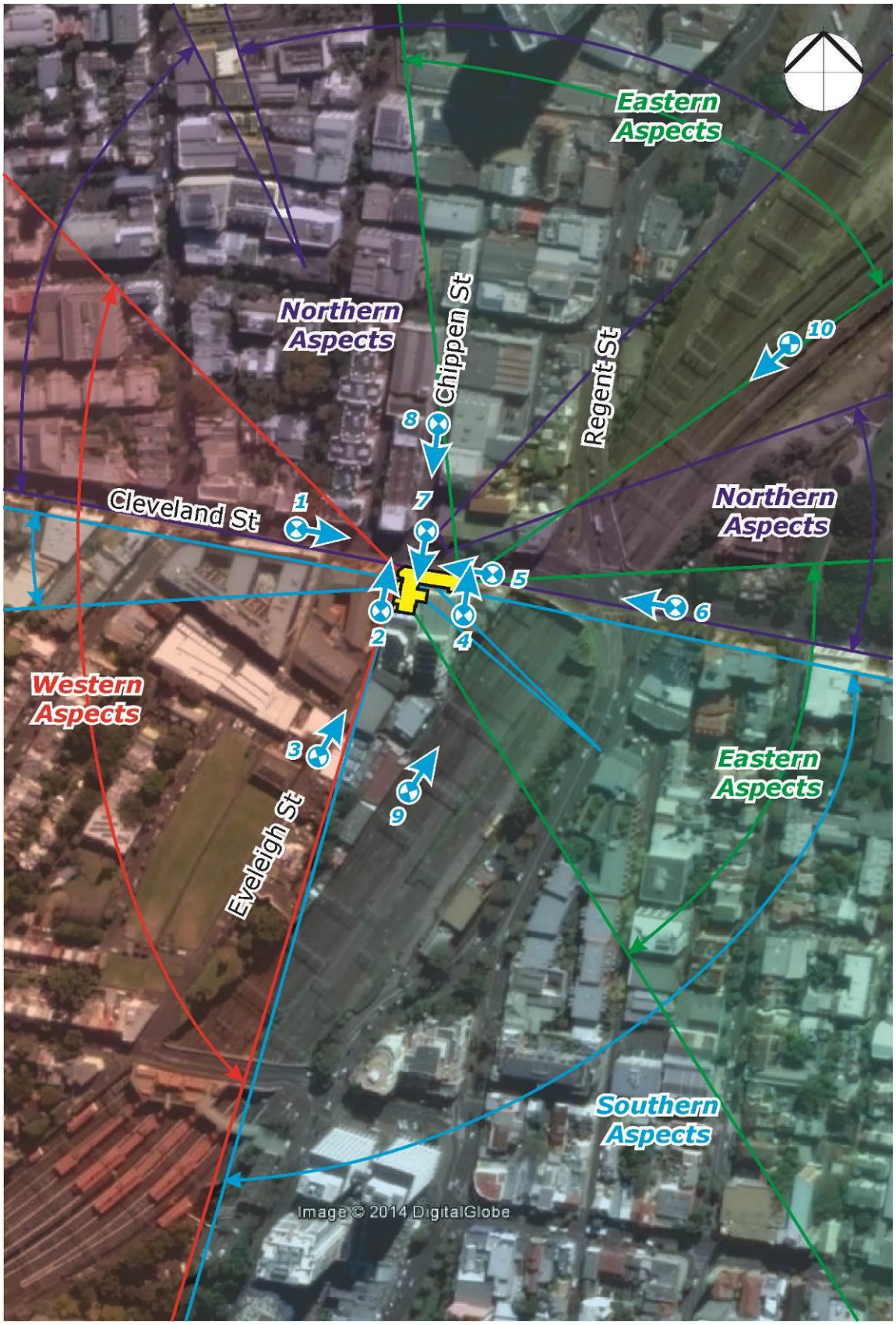

Figure 2: Check Zones and Study Point Locations of the Development
(the check zones are the areas where glare could potentially be observed)

2 ANALYSIS

2.1 Impact onto Drivers and Pedestrians

From the study of the check zones shown in Figure 2, a total of 8 street locations, and 2 viewpoints for train drivers, 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 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	Cleveland Street, heading east	Northern and western aspects
2	Eveleigh Street, heading north	Western aspect
3	Eveleigh Street, heading north	Southern and western aspects
4	Woodburn Street, heading north	Southern and eastern aspects
5	Cleveland Street, heading west	Northern and eastern aspects
6	Cleveland Street, heading west	Northern and eastern aspects
7	Chippen Street, heading south	Northern aspect
8	Chippen Street, heading south	Northern aspect
9	Railway line, heading north	Northern and western aspects
10	Railway line, heading south	Southern aspect

2.1.1 Drivers heading east along Cleveland Street

Point 1 is located on Cleveland Street, to the west of the development. This point represents the critical sightline of drivers heading east along Cleveland Street. 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 this image, as shown in Figure A1 of Appendix A. The view of the proposed development is also overlaid onto the image.

An analysis of the glare meter overlaid onto the viewpoint at Point 1 indicates that, although the northern aspect of the subject development will be visible, the view of the development is outside the zone of sensitive vision of motorists. Hence there will be no adverse solar glare observed by motorists or pedestrians heading east along Cleveland Street from the façade of the subject development.

2.1.2 Drivers heading north along Eveleigh Street

Points 2 and 3 are located along Eveleigh Street, to the south of the development. These points represent the critical sightline of drivers heading north along Eveleigh Street. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers at these locations were obtained using a calibrated camera. The photographs have been scaled to enable the glare meter to be overlaid onto the images, as shown in Figures A2 and A3 of Appendix A. The view of the proposed development is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoint at Points 2 and 3 indicates that the view of the study building will not be within the zone of sensitive vision of motorists. Hence there will be no adverse solar glare observed by motorists or pedestrians heading north along Eveleigh Street from the façade of the subject development.

2.1.3 Drivers heading north along Woodburn Street

Point 4 is located on Woodburn Street, to the south of the development. This point represents the critical sightline of drivers heading north along Woodburn Street. 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 this image, as shown in Figure A4 of Appendix A. The view of the proposed development is also overlaid onto the image.

An analysis of the glare meter overlaid onto the viewpoint at Point 4 indicates that the view of the development will not be within the zone of sensitive vision. Hence there will be no adverse solar glare observed by motorists or pedestrians heading north along Woodburn Street from the façade of the subject development.

2.1.4 Drivers heading west along Cleveland Street

Points 5 and 6 are located along Cleveland Street, to the east of the development. These points represent the critical sightline of drivers heading east along Cleveland Street. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers at these locations were obtained using a calibrated camera. The photographs have been scaled to enable the glare meter to be overlaid onto the images, as shown in Figures A5 and A6 of Appendix A. The view of the proposed development is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoint at Points 5 and 6 indicates that the northern, north-eastern and eastern aspects of the subject development will be visible and within the zone of sensitive vision of motorists. However, through further analysis it has been determined that Point 6 is not located within the north-eastern check zone. Nonetheless, to ensure that no adverse glare is observed by motorist or pedestrians heading east along Cleveland Street, it is recommended that:

- The anodised aluminium screen on the eastern aspect of the Roof should have a maximum normal specular reflectance of visible light of 11%.
- The glazing and anodised aluminium screen on the northern aspect of the development, on Ground Level, Level 1 and Level 2, should have a maximum normal specular reflectance of visible light of 11%.

With the incorporation of the abovementioned recommendations, the subject development will not cause adverse solar glare to be observed by motorists or pedestrians heading west along Cleveland Street.

2.1.5 Drivers heading south along Chippen Street

Points 7 and 8 are located along Chippen Street, to the north of the development. These points represent the critical sightline of drivers heading south along Chippen Street. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers at these locations were obtained using a calibrated camera. The photographs have been scaled to enable the glare meter to be overlaid onto the images, as shown in Figures A7 and A8 of Appendix A. The view of the proposed development is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoint at Points 7 and 8 indicates the north-western and northern aspects of the development will be visible and within the zone of sensitive vision of motorists. However, through further analysis it has been determined that Points 7 and 8 are not within the northern check zone. Nonetheless, to ensure that no adverse glare is observed by motorist or pedestrians heading south along Chippen Street, it is recommended that the anodised aluminium screen on the north-western aspect of the development on Levels 1, 2 and 3, has a maximum normal specular reflectance of visible light of 14%.

2.1.6 Train Drivers heading north along the Railway Line

For train drivers heading north along the railway line, the proposed development will not be within the sensitive zone of vision as it is greater than 10^{o} outside of the sight line of train drivers. Hence there will be no adverse solar glare observed by train drivers heading north along the railway line from the façade of the subject development.

2.1.7 Train Drivers heading south along the Railway Line

For train drivers heading south along the railway line, the proposed development will not be visible within the zone of sensitive vision as it will be obscured from sight by the existing buildings along Cleveland Street. Hence there will be no adverse solar glare observed by train drivers heading south along the railway line from the façade of the subject development.

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 Potential for Glare from 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:

- Typical clear glazing – around 5%
- Low-e solar control glazing – around 8% to 12%

2.4 Potential for Glare from 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.

2.5 Potential Glare from the Anodised Aluminium Screens

It is noted that, for large portions of the northern, north-eastern and north-western aspects of the subject development, anodised aluminium screens are proposed on the external façade. This material, which is not painted or powder-coated, could potentially exceed the maximum normal specular reflectance of visible light values specified in the preceding sections. If the supplier is not able to provide this value for this particular material, the maximum normal specular reflectance of visible light can be measured by testing a sample in a specialised laboratory test.

3 CONCLUSION

An analysis has been undertaken to assess the potential for solar glare from the proposed development located at 175-177 Cleveland Street, Redfern. The analysis has been undertaken based on the architectural drawings prepared by the project architect Ghazi Al Ali Architects received during October 2014. This study identifies any possible adverse reflected solar glare conditions affecting drivers and pedestrians, and occupants of neighbouring buildings, within the local surrounding area. If necessary, recommendations are made to mitigate any potentially adverse effects.

This study assesses compliance with the controls for solar glare from the State Environmental Planning Policy No. 65 (SEPP65, Part 03 (Building Design) for Building Amenity), which is also known as the Residential Flat Design Code. The study also addresses the provisions in the City of Sydney DCP 2012, which are essentially the same as the SEPP65 requirements.

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Hence, with the incorporation of the abovementioned recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians or motorists in the surrounding area, train drivers, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from SEPP65 and the City of Sydney DCP 2012.

REFERENCES

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

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

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

State Environmental Planning Policy No. 65 (SEPP65), "Residential Flat Design Code", Department of Infrastructure, Planning and Natural Resource, NSW Planning Department, 2002.

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

APPENDIX A - GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

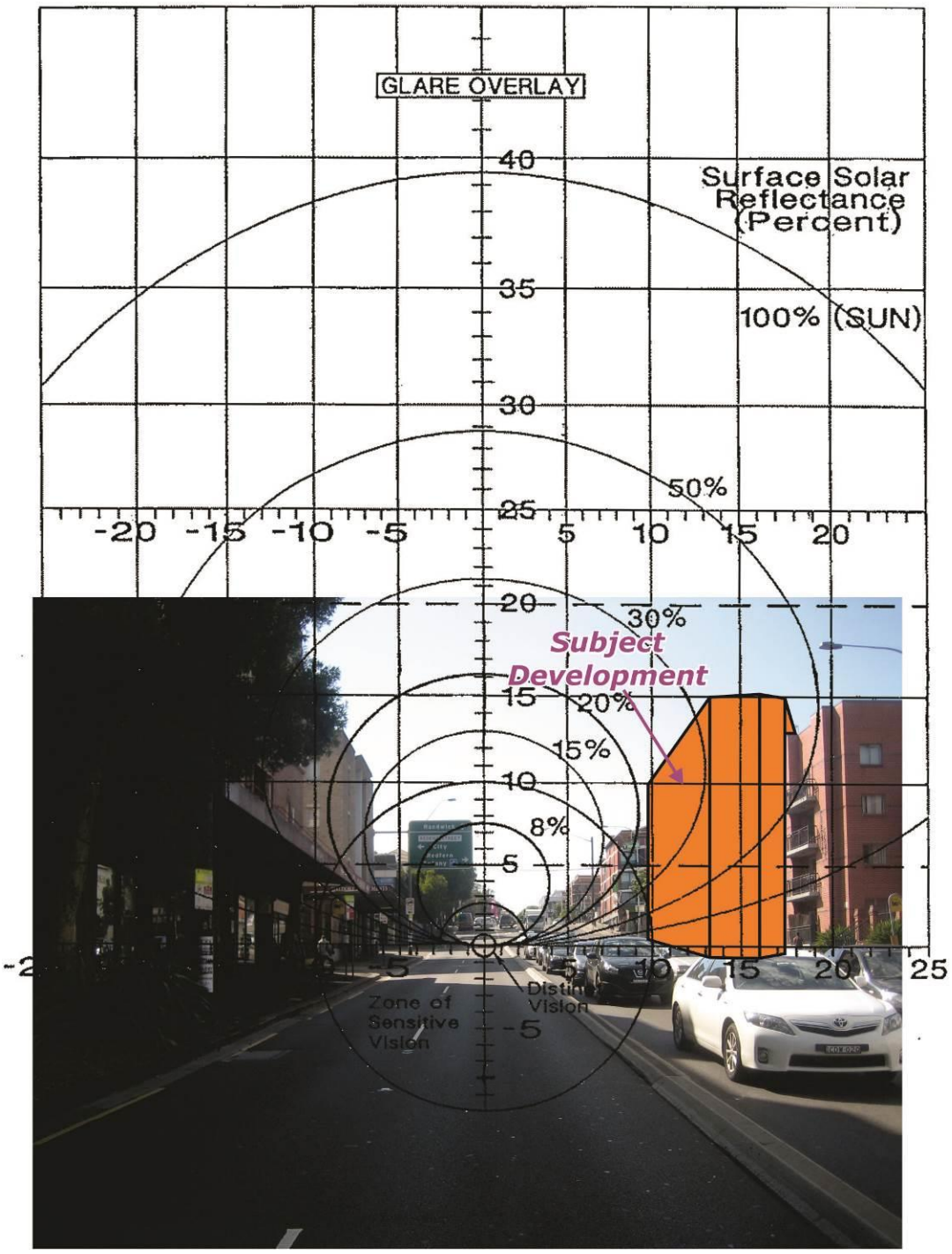

Figure A1: Glare Overlay for Point 1

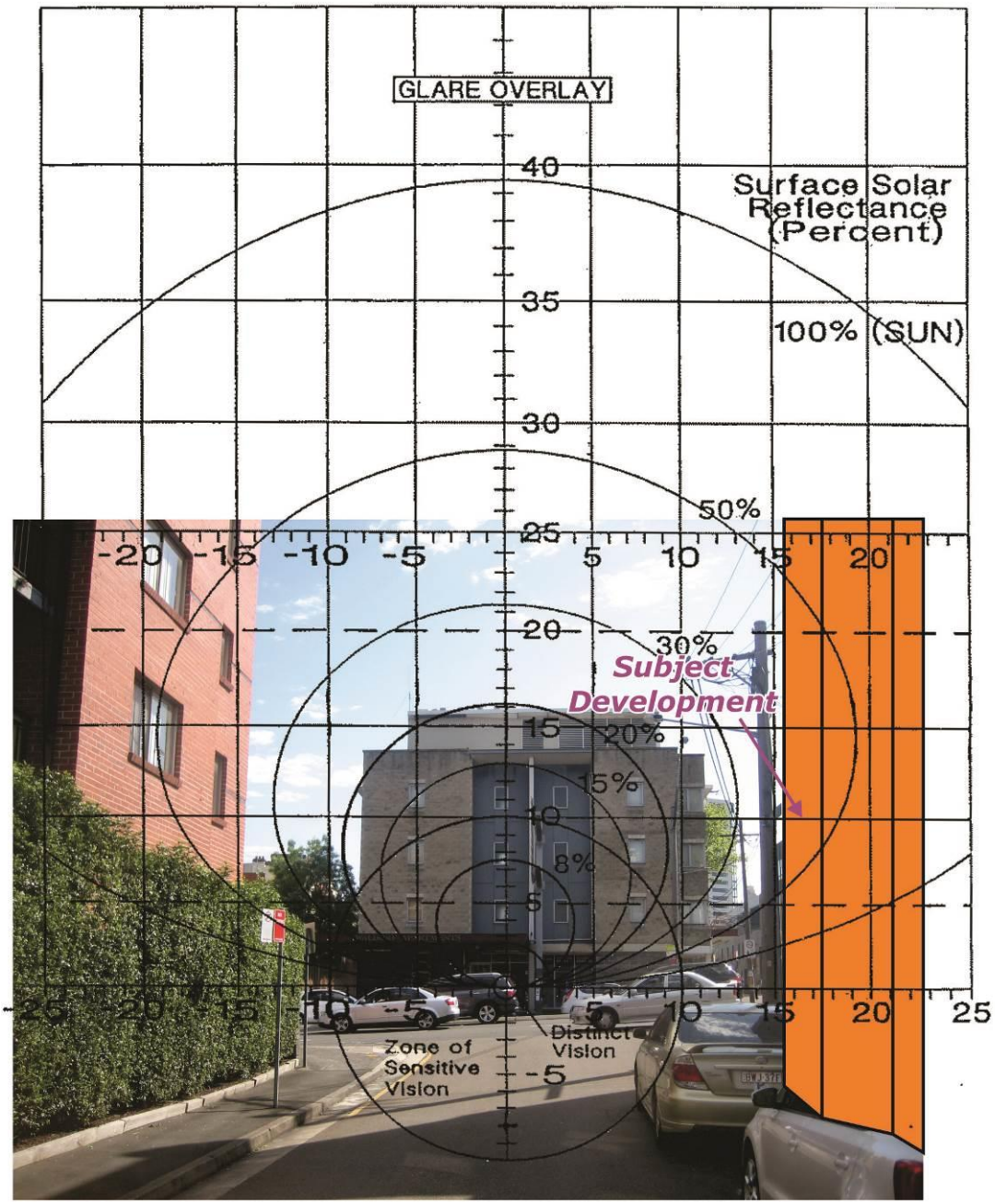

Figure A2: Glare Overlay for Point 2

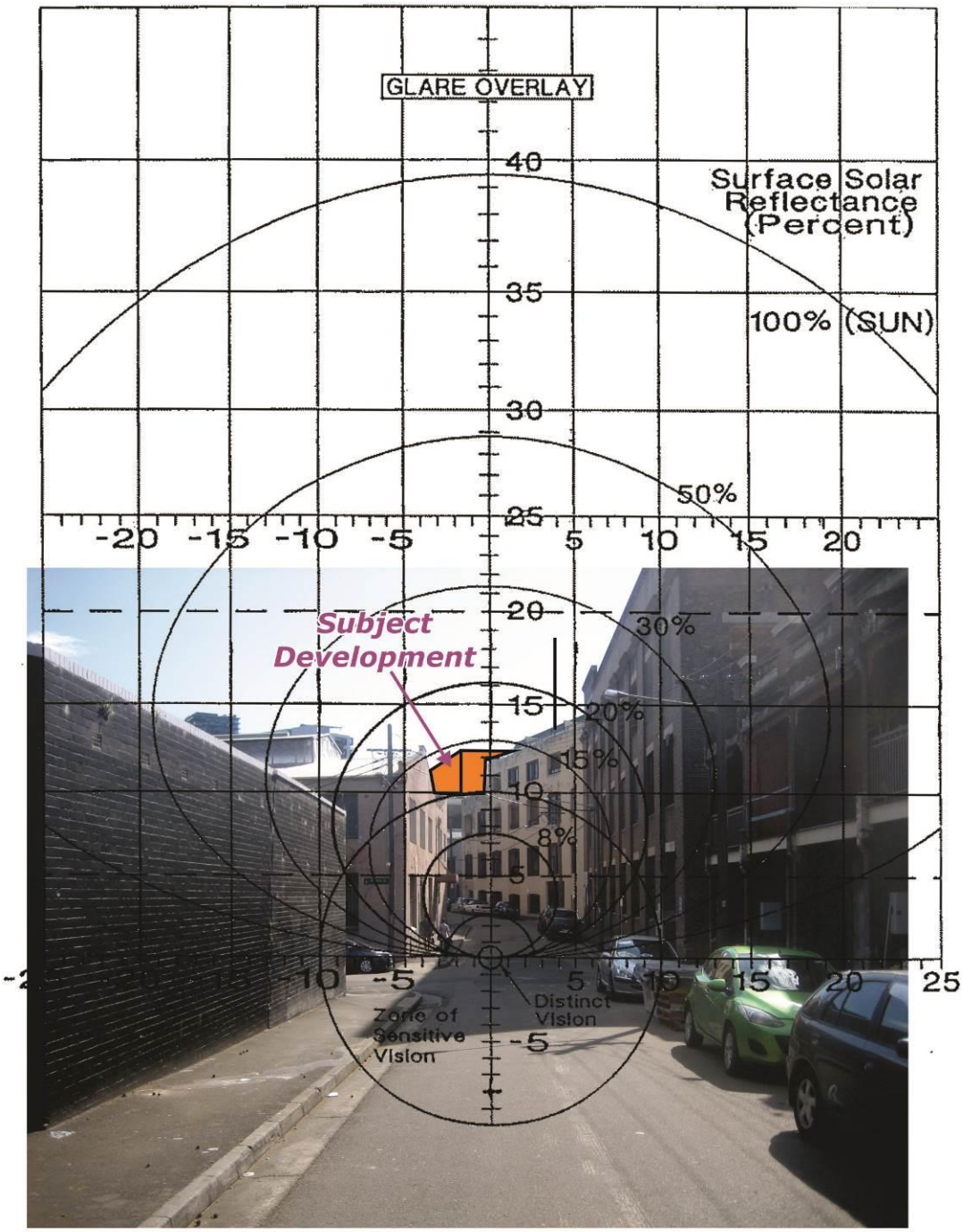

Figure A3: Glare Overlay for Point 3

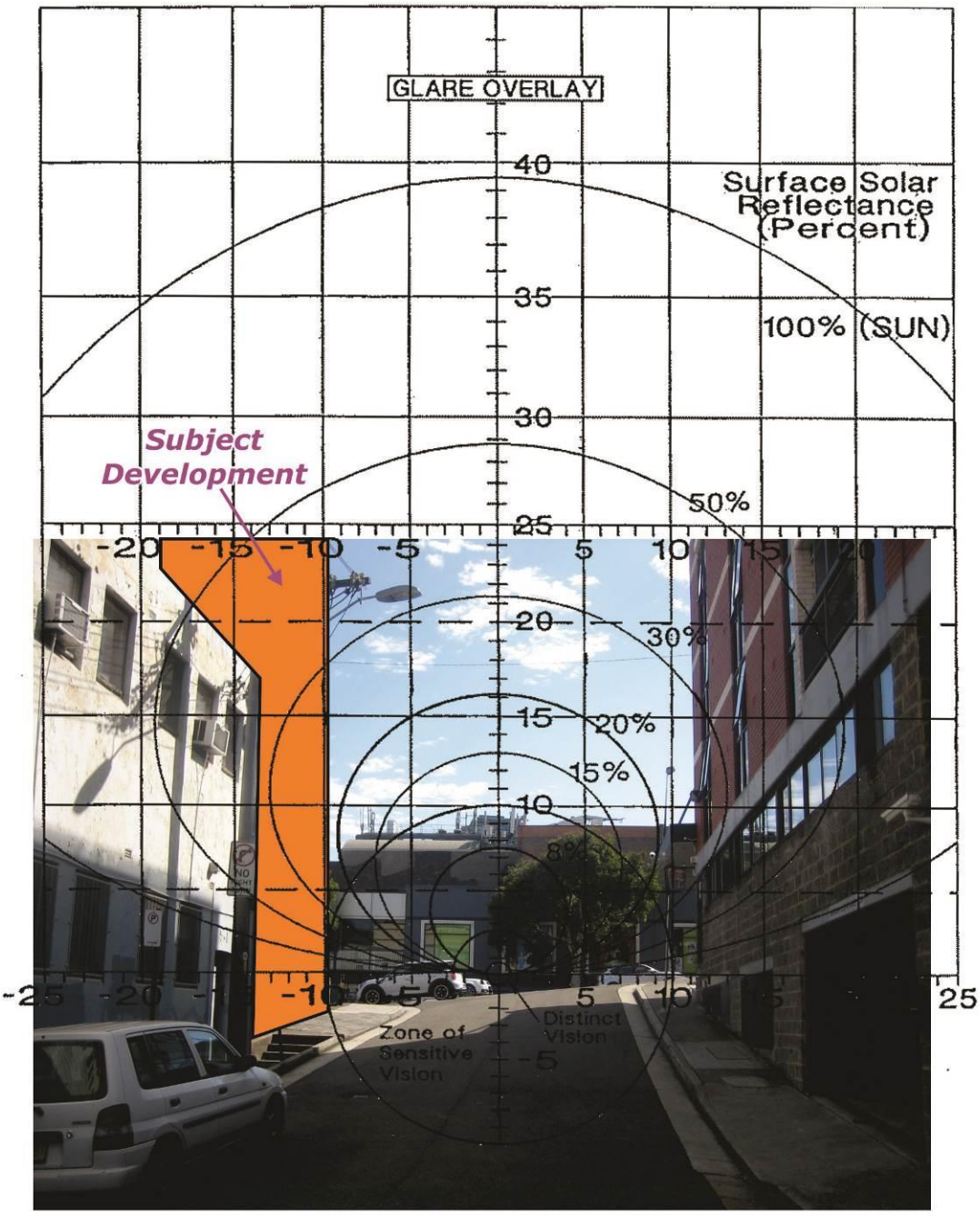

Figure A4: Glare Overlay for Point 4

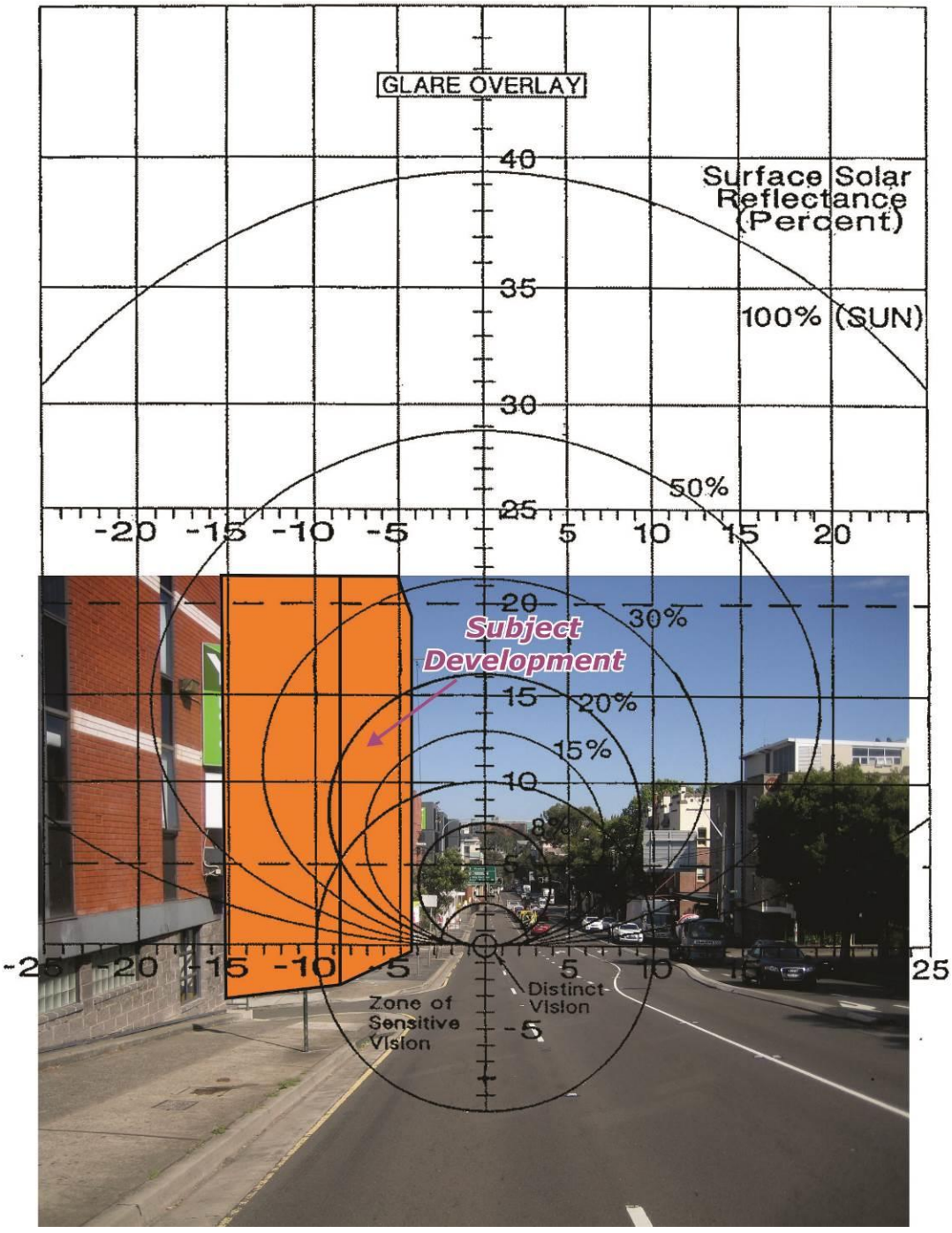

Figure A5: Glare Overlay for Point 5

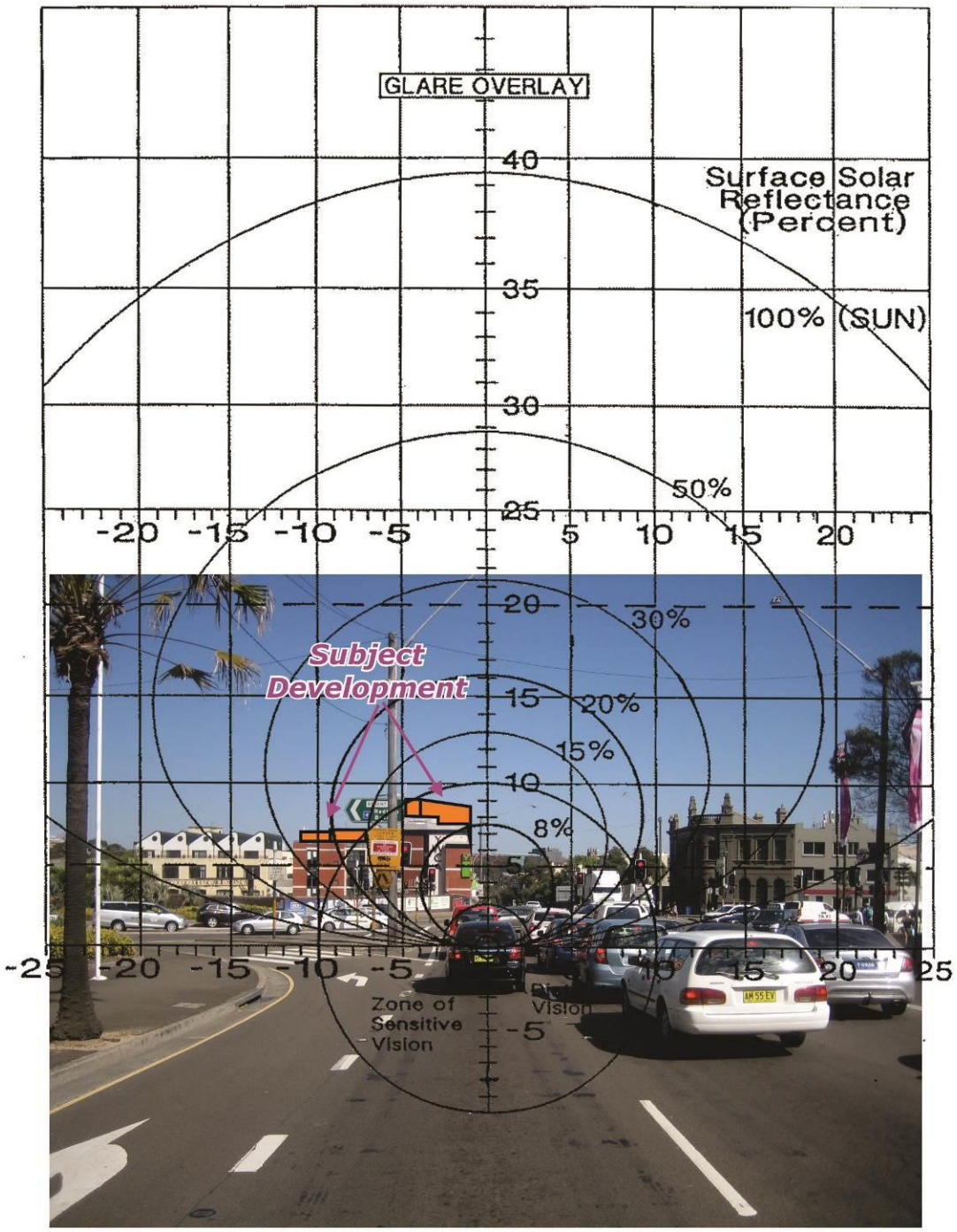

Figure A6: Glare Overlay for Point 6

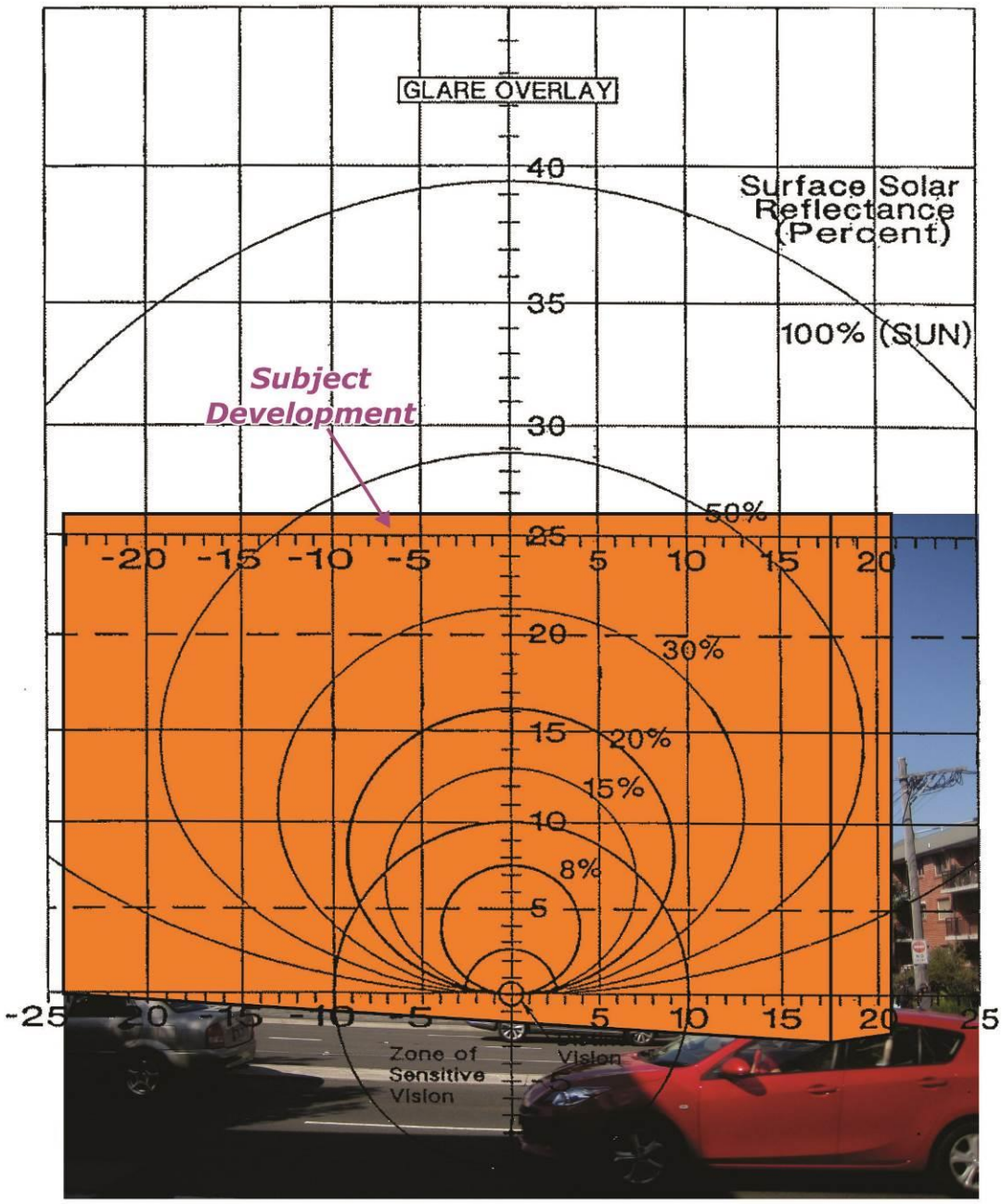

Figure A7: Glare Overlay for Point 7

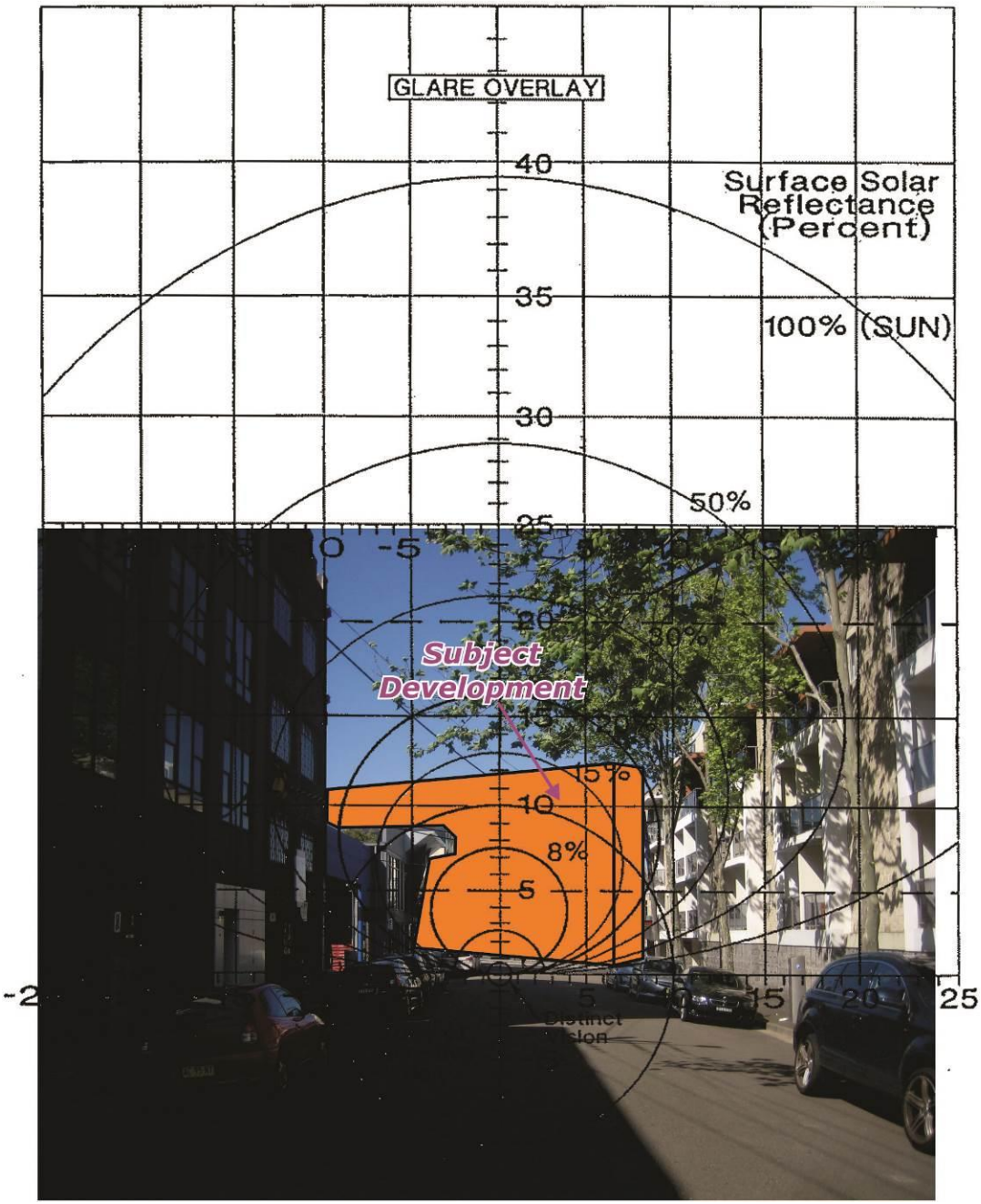

Figure A8: Glare Overlay for Point 8

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

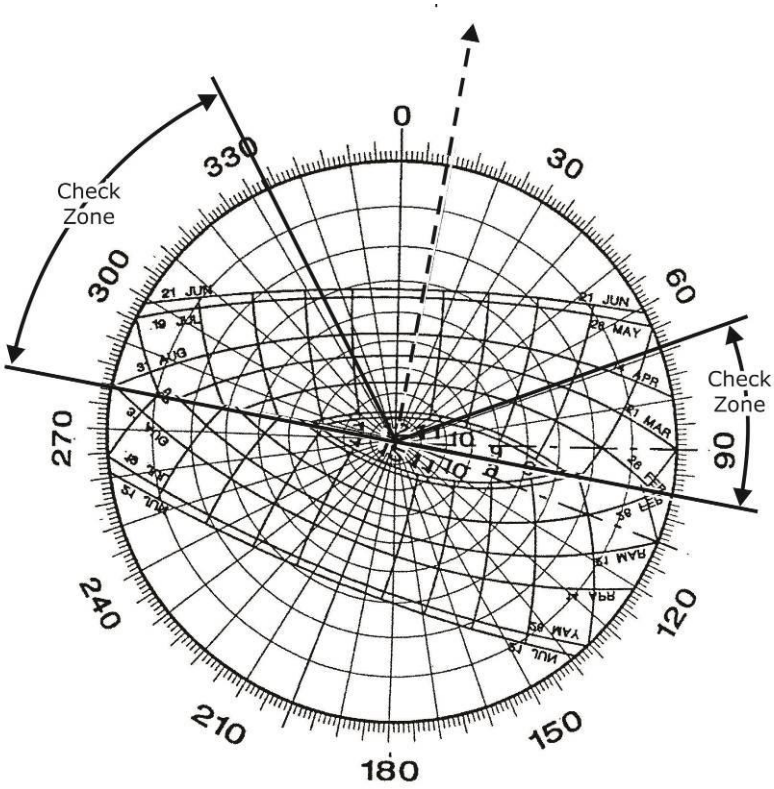

Figure B1: Sun Chart for Aspect 009°

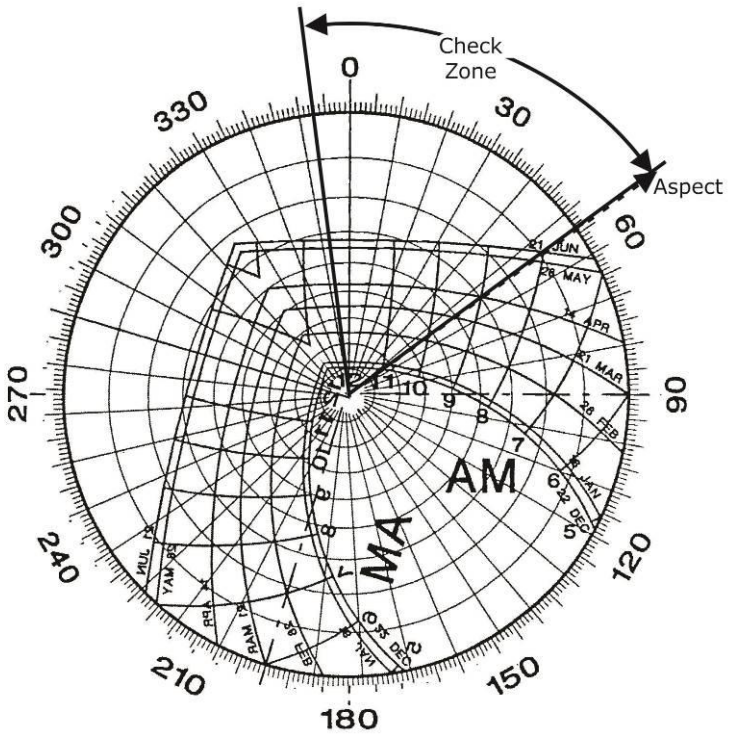

Figure B2: Sun Chart for Aspect 054°

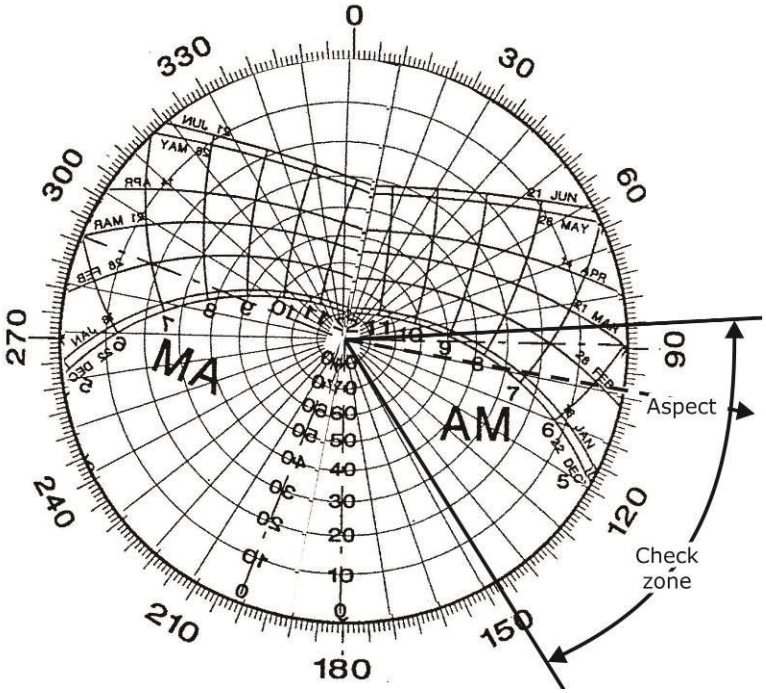

Figure B3: Sun Chart for Aspect 099°

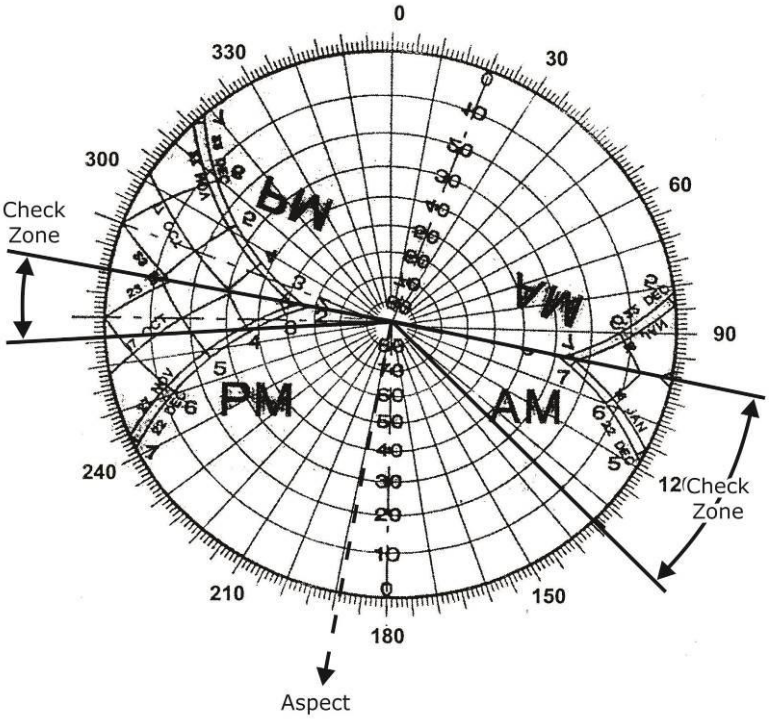

Figure B4: Sun Chart for Aspect 189°

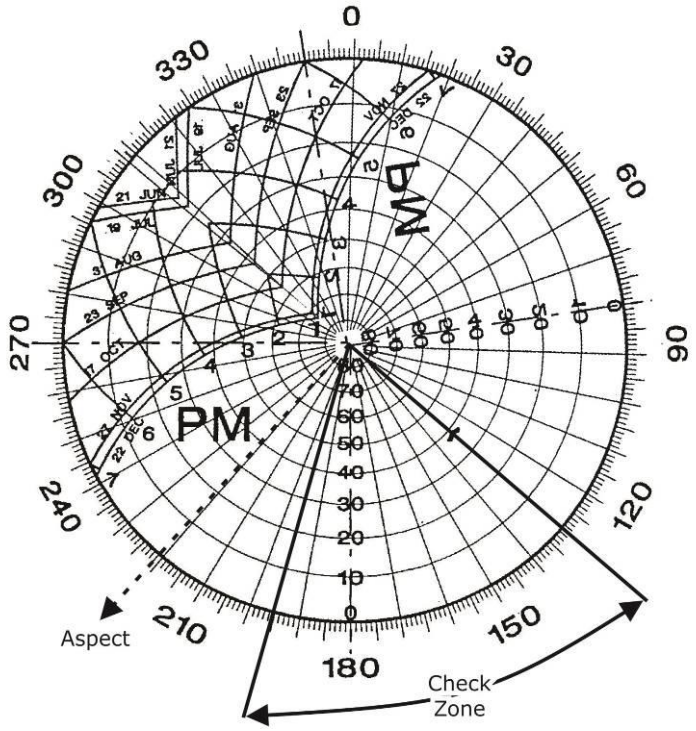

Figure B5: Sun Chart for Aspect 221°

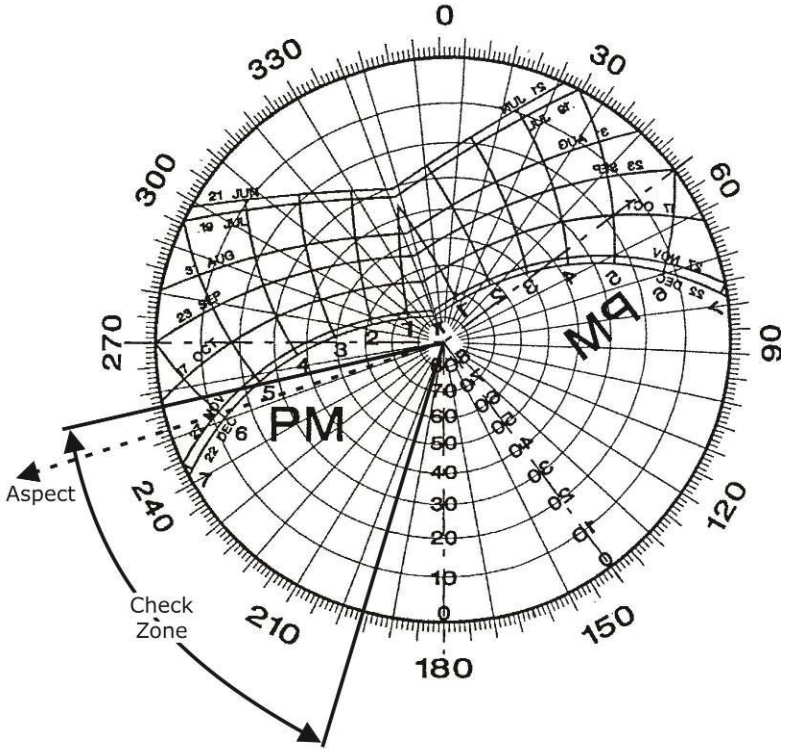

Figure B6: Sun Chart for Aspect 252°

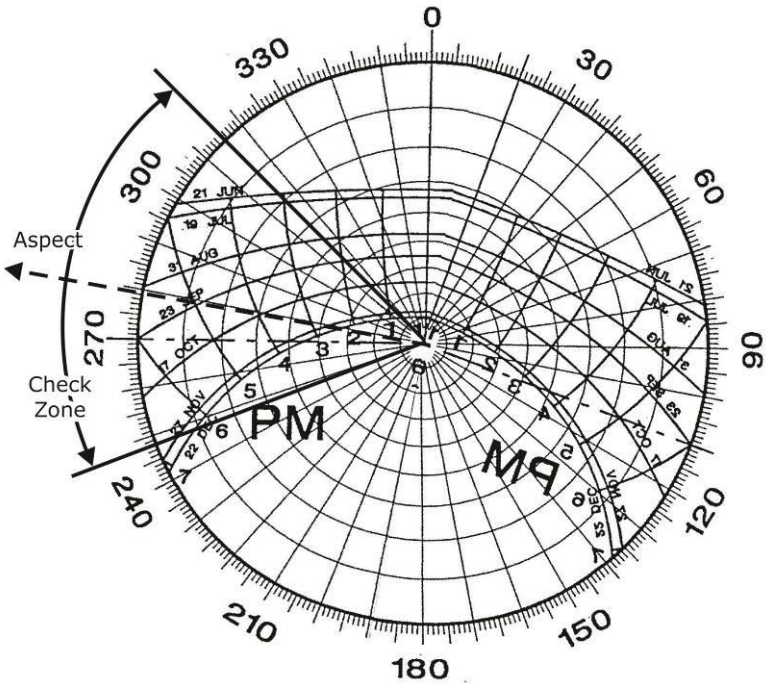

Figure B7: Sun Chart for Aspect 279°

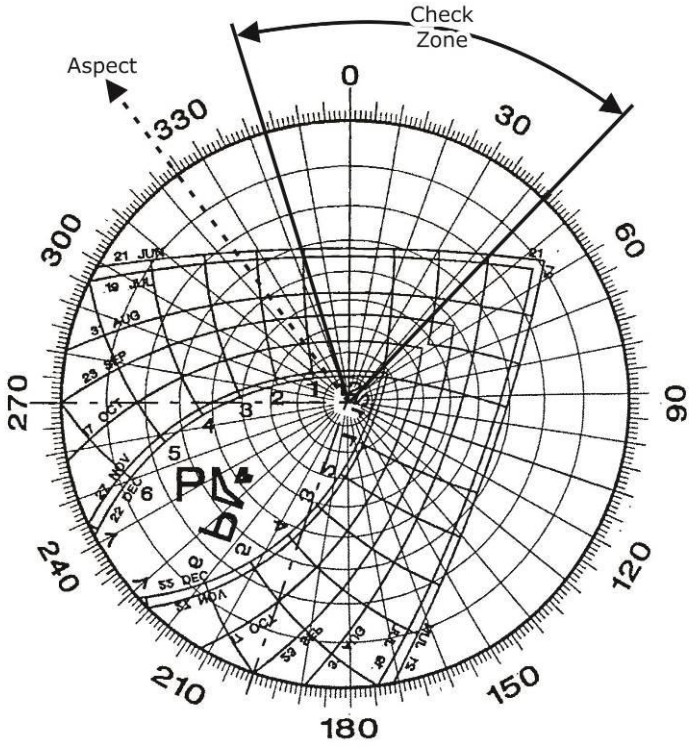

Figure B8: Sun Chart for Aspect 324°

APPENDIX C - STANDARD SUN CHART FOR THE SYDNEY REGION

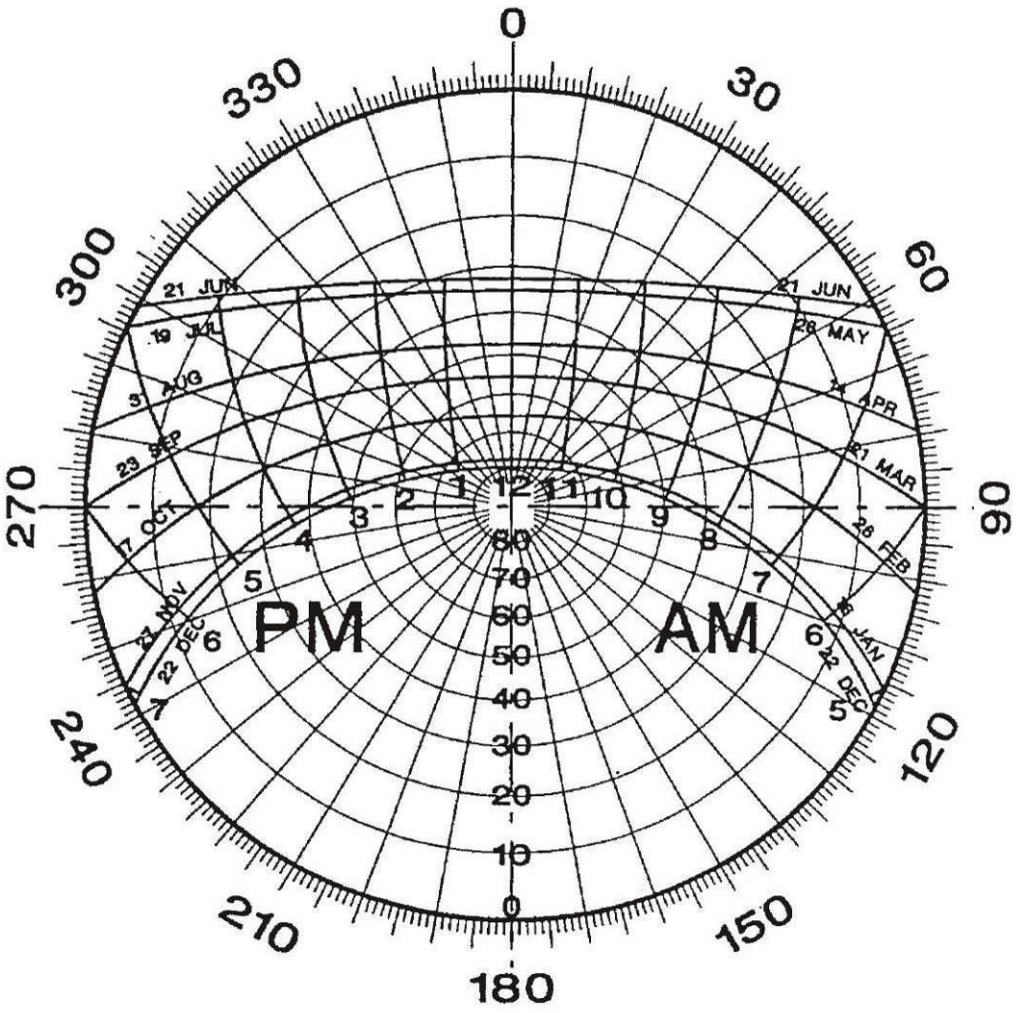

Figure C1: Standard Sun Chart for the Sydney Region