SOLAR LIGHT REFLECTIVITY ANALYSIS

12-24 STANLEY STREET KOGARAH

WD979-01F03(FINAL)- SR REPORT

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Prepared for:

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DOCUMENT CONTROL

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April 23, 2018	Initial	0	EV	AB	TH
April 27, 2018	Corrections + new drawings	1	EV	AB	TH
May 7, 2018	-	FINAL	EV	AB	TH

EXECUTIVE SUMMARY

This report presents the results of a detailed study for the effect of potential solar glare from the proposed development located at 12-24 Stanley Street Kogarah. The analysis has been undertaken based on the architectural drawings prepared by the project architect Scott Carver received April, 2018. This study assesses compliance with the controls for solar glare from the State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG), and from the City of Sydney Development Control Plan 2012.

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.

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:

- The maximum normal specular reflectance of visible light for the glazing used on the building façade and windows of the 174° and 189° aspects for Ground Level through to Level 04 should be 11% and the maximum glazing used on the balustrades should be 8%.
- The maximum normal specular reflectance of visible light for the glazing used on the Ground Level balustrades located along the southern face of the development should be 8%.
- The maximum normal specular reflectance of visible light for the glazing used on the building façade and windows of the 9° and 84° aspect, located along the northern face of the development, should be 11% and the maximum glazing used on the balustrades should be 8% for the Ground Level through to Level 06.
- The maximum normal specular reflectance of visible light for the glazing used on the building façade and windows of the 99° aspect from Ground Level through to Level 10 should be 11% and the maximum glazing used on the balustrades should be 8%.
- The maximum normal specular reflectance of visible light for the glazing used on the southern façade and southern windows of the 264° aspect from Level 09 to Level 10 should be 11% and the maximum glazing used on the balustrades should be 8%.

- All other 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 (i.e.: 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.

CONTENTS

1 METHODOLOGY

This study assesses compliance with the controls for solar glare from the State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG).

The reflectivity analysis of the subject development has been carried out using the technique published by D.N. Hassall (1991). The limiting veiling luminance of 500 cd/m^2 for the comfort of motorists, as suggested in D.N. 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 proposed 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 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 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.

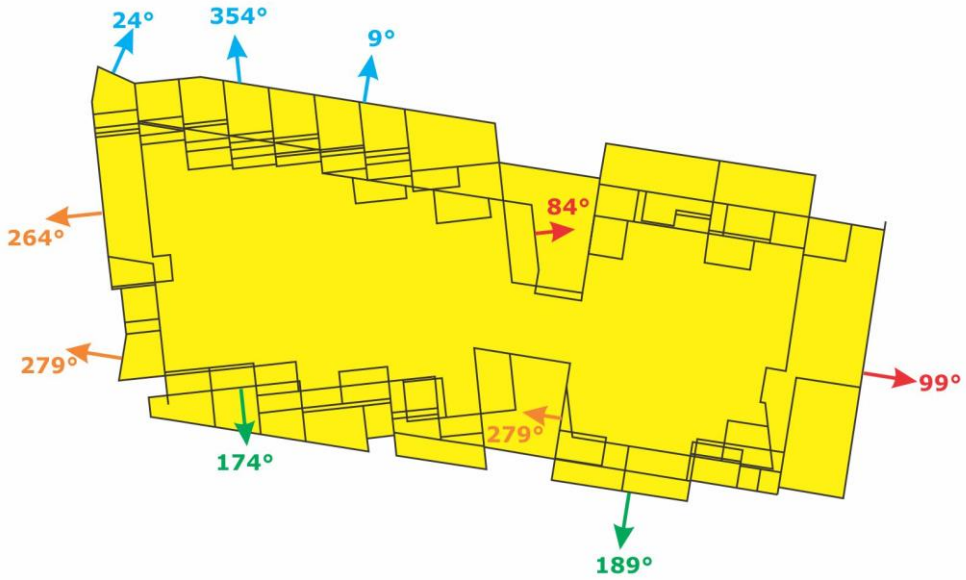

Figure 1: Critical Glazed Aspects of the Subject Development

Figure 2: Check Zones and Study Point Locations for the Development

2 ANALYSIS

2.1 Impact onto Motorists and Pedestrians

From the study of the check zones shown in Figure 2, a total of 11 street level locations have been identified for detailed analysis. A summary of the location of each study point, and the aspects for the development that could potentially reflect solar glare to each study point location, is shown in Table 1 below. Note that, as mentioned in Section 1, 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 Development that could reflect Solar Glare to each Study Point

Study Point	Location and Viewpoint	Aspect(s) of the Development
01	Stanley Lane – Heading West	Southern and Eastern Aspects
02	Stanley Street – Heading West	Northern, Southern and Eastern Aspects
03	Baxter Lane – Heading West	Southern and Eastern Aspects
04	Baxter Avenue – Heading West	Northern, Southern and Eastern Aspects
05	Baxter Lane – Heading West	Northern, Southern and Eastern Aspects
06	Baxter Avenue – Heading West	Northern, Southern and Eastern Aspects
07	Victoria Street – Heading South-West	Northern Aspect
08	Harrow Road – Heading South-East	Northern and Western Aspects
09	Victoria Street – Heading North-East	Southern and Western Aspects
10	Regent Street – Heading North-East	Western Aspect
11	Regent Street – Heading North-East	Western Aspect

2.1.1 Drivers heading west along Stanley Lane

Point 01 is located along Stanley Lane, to the east of the development site. This point represents the critical sightlines of drivers heading west along Stanley Lane at this location. A site survey of this point has been undertaken, and photographs showing the viewpoint of drivers at this location 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 Figure A1 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 01 indicates that the subject development is visible and the 84°, 99°, 174° and 189° aspects fall within the check zones and the zone of sensitive vision of motorists. For the 84° aspect, the angle of incidence of the sun's rays passes through the building form and is not expected to influence motorists from this direction. However, drivers heading in the opposite direction down Stanley Lane may experience adverse glare from the balustrade of the 264° aspect which is the same balustrade of the 84° aspect. Hence to ensure that adverse solar glare does not affect motorists or pedestrians heading west along Stanley Lane, it is recommended that the normal specular reflectance of visible light for the glazing used on the Ground Level balustrades located along the southern face of the development should be a maximum of 8%.

In addition, it is recommended that the normal specular reflectance of visible light for the glazing used on the façade and windows of the 99°, 174°, 189° aspect for Levels Ground through to 04, located along the southern face of the development, should be a maximum of 11% and the maximum glazing used on the balustrades should be 8%.

2.1.2 Drivers heading west along Stanley Street

Point 02 is located along Stanley Street, to the east of the development site. This point represents the critical sightlines of drivers heading west along Stanley Street at this location. A site survey of this point has been undertaken, and photographs showing the viewpoint of drivers at this location 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 Figure A2 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 02 indicates that the subject development is visible and the 9°, 24° and 84° aspects fall within the zone of sensitive vision of motorists. However further analysis indicates that only the 9° and 84° aspects are within the check zones at this location. To ensure that adverse solar glare does not affect motorists or pedestrians heading west along Stanley Street, it is recommended that the normal specular reflectance of visible light for the glazing used on the façade and windows of the 9° and 84° aspect, located along the northern face of the development, should be a maximum of 11% and the maximum glazing used on the balustrades should be 8% for the Ground Level through to Level 06.

2.1.3 Drivers heading west along Baxter Lane

Points 03 and 05 are located along Baxter Lane, to the south-east of the development site. These points represent the critical sightlines of drivers heading west along Baxter Lane at these locations. A site survey of the 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 A3 and A5 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Points 03 and 05 indicates that the proposed development will not be visible at these location. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading west along Baxter Lane from the proposed development.

2.1.4 Drivers heading west along Baxter Avenue

Points 04 and 06 are located along Baxter Avenue, to the east of the development site. These points represent the critical sightlines of drivers heading west along Baxter Avenue at these locations. A site survey of the 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 A4 and A6 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 04 indicates that the proposed development will not be visible at this location. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading west along Baxter Avenue at Point 04.

An analysis of the glare meter overlaid onto the viewpoint at Point 06 indicates that the subject development is visible and the 99^{o} aspect falls within the check zones and the zone of sensitive vision of motorists. To ensure that adverse solar glare does not affect motorists or pedestrians heading west along Baxter Avenue, it is recommended that the normal specular reflectance of visible light for the glazing used on the façade and windows of the 99^{o} aspect from Level 07 to Level 10 should be a maximum of 11% and the maximum glazing used on the balustrades should be 8%.

2.1.5 Drivers heading south-west along Victoria Street

Point 07 is located along Victoria Street, to the north-east of the development site. This point represents the critical sightlines of drivers heading south-west along Victoria Street at this location. A site survey of this point has been undertaken, and photographs showing the viewpoint of drivers at this location 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 Figure A7 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 07 indicates that the proposed development will not be within the zone of sensitive vision at this location. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading south-west along Victoria Street from the proposed development.

2.1.6 Drivers heading south-east along Harrow Road

Point 08 is located along Harrow Road, to the north-west of the development site. This point represents the critical sightlines of drivers heading south-east along Harrow Road at this location. A site survey of this point has been undertaken, and photographs showing the viewpoint of drivers at this location 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 Figure A8 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 08 indicates that the proposed development will be visible and within the zone of sensitive vision of motorists at this location. However further analysis indicates that the portion of the aspects which are within the zone of sensitive vision will be significantly obstructed by densely foliating trees and other planting. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading south-east along Harrow Road from the proposed development.

2.1.7 Drivers heading north-east along Victoria Street

Point 09 is located along Victoria Street, to the south-west of the development site. This point represents the critical sightlines of drivers heading north-east along Victoria Street at this location. A site survey of this point has been undertaken, and photographs showing the viewpoint of drivers at this location 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 Figure A9 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 09 indicates that the proposed development will not be within the zone of sensitive vision at this location. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading north-east along Victoria Street from the proposed development.

2.1.8 Drivers heading north-east along Regent Street

Points 10 and 11 are located along Regent Street, to the south-west of the development site. These points represent the critical sightlines of drivers heading north-east along Regent Street at these locations. A site survey of the 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 A10 and A11 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Points 10 and 11 indicates that the subject development is visible and the 174°, 189°, 264° and 279° aspects fall within the

zone of sensitive vision of motorists. Further analysis indicates that only the 264° aspect is within the check zones at these locations. The apartments contributing to the adverse glare are those located along the southern façade of the development. However, the angle of incidence of the sun's rays passes through the building form. As a result, apartments between Ground Level through to Level 09 are expected to be suitable for pedestrians and motorists at these two points.

Conversely, the angle of incidence may be unobstructed vertically for higher apartments. Hence, to ensure that adverse solar glare does not affect motorists or pedestrians heading north-east along Regent Street, it is recommended that the normal specular reflectance of visible light for the glazing used on the façade and windows of the 264° aspect from Level 09 to Level 10 should be a maximum of 11% and the maximum glazing used on the balustrades should be 8%.

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.

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.

State Environmental Planning Policy No. 65 (SEPP65), 2015, "Apartment Design Guide", NSW Department of Planning and Environment.

APPENDIX A - GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

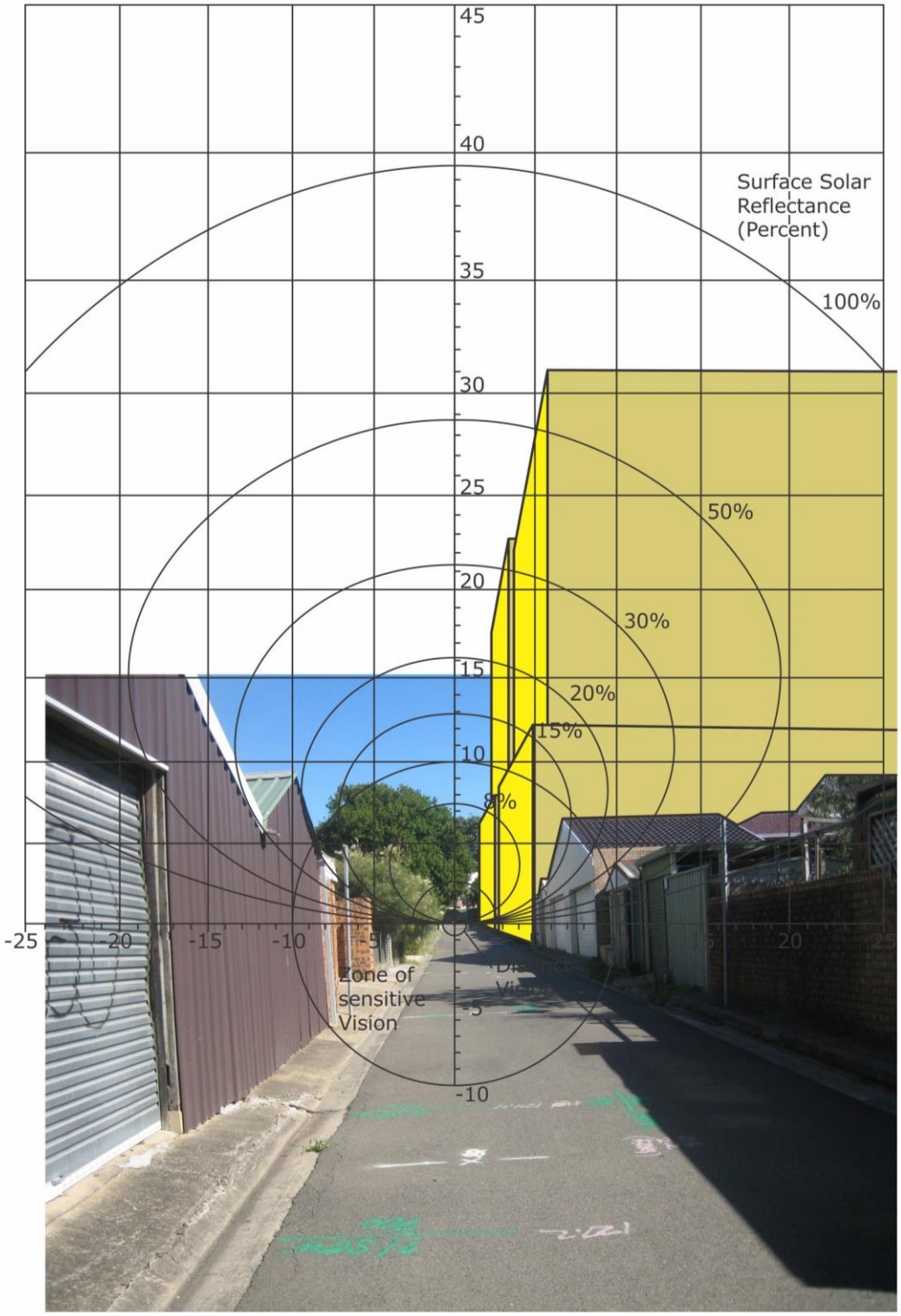

Figure A1: Glare Overlay for Point 01

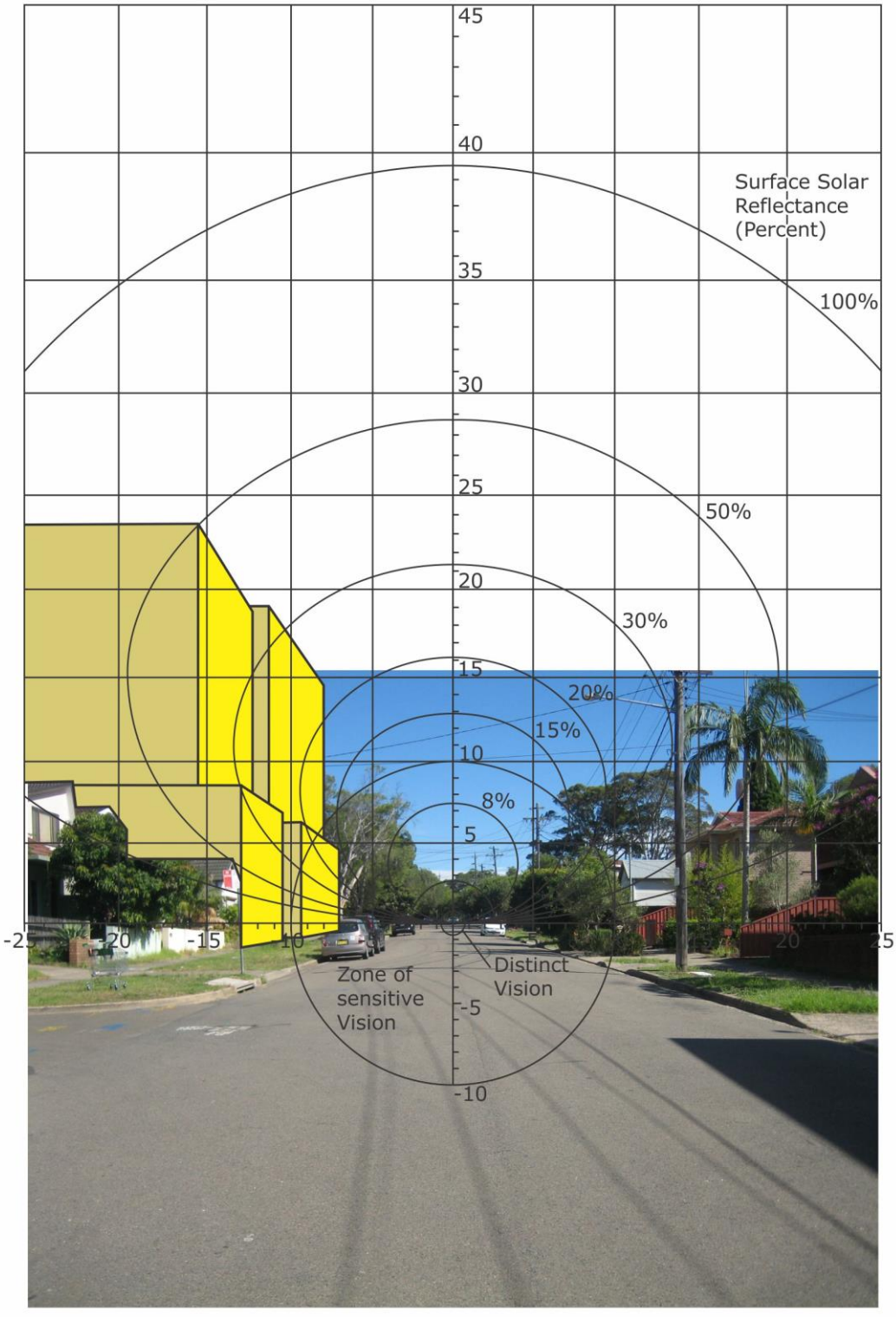

Figure A2: Glare Overlay for Point 02

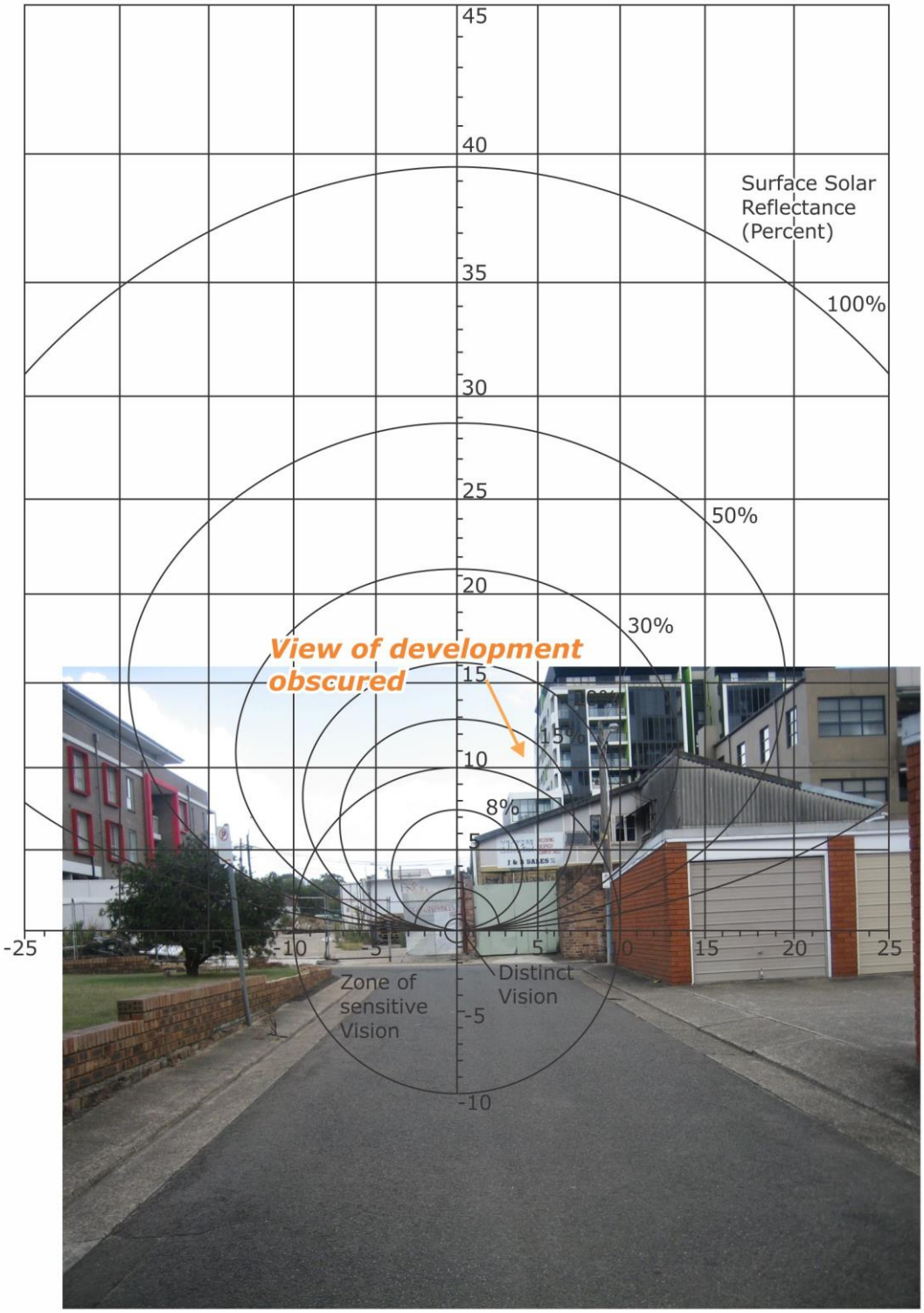

Figure A3: Glare Overlay for Point 03

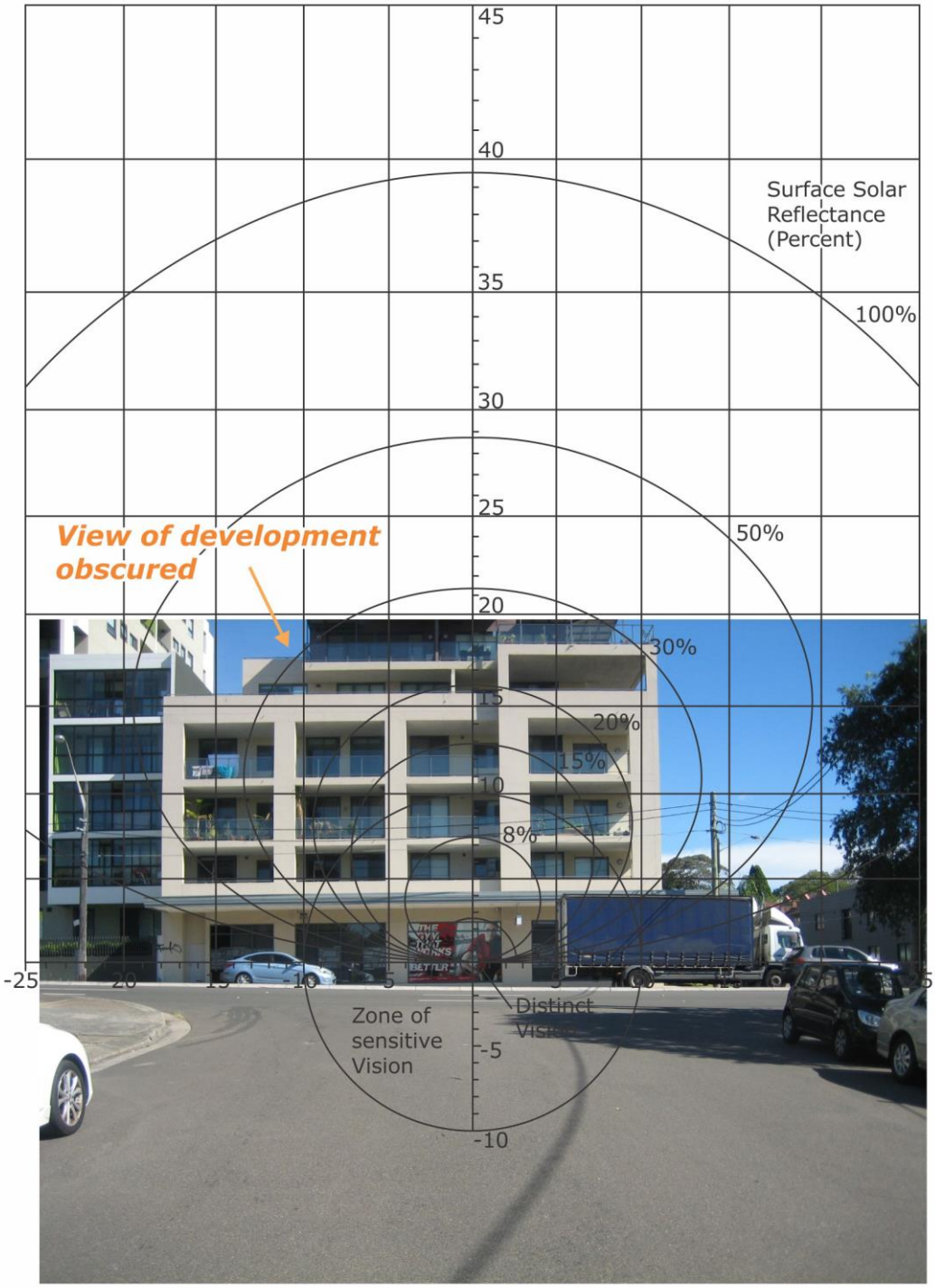

Figure A4: Glare Overlay for Point 04

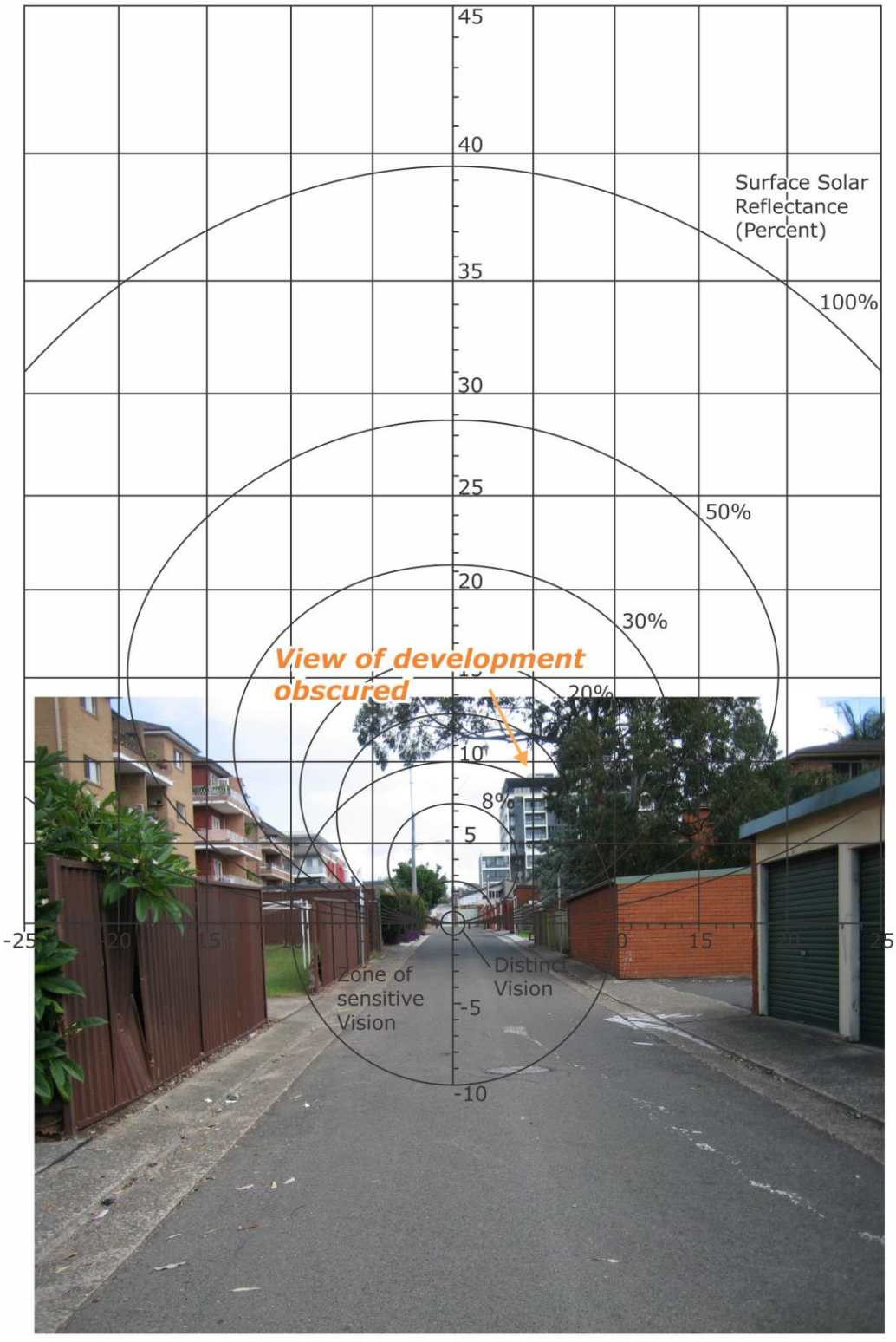

Figure A5: Glare Overlay for Point 05

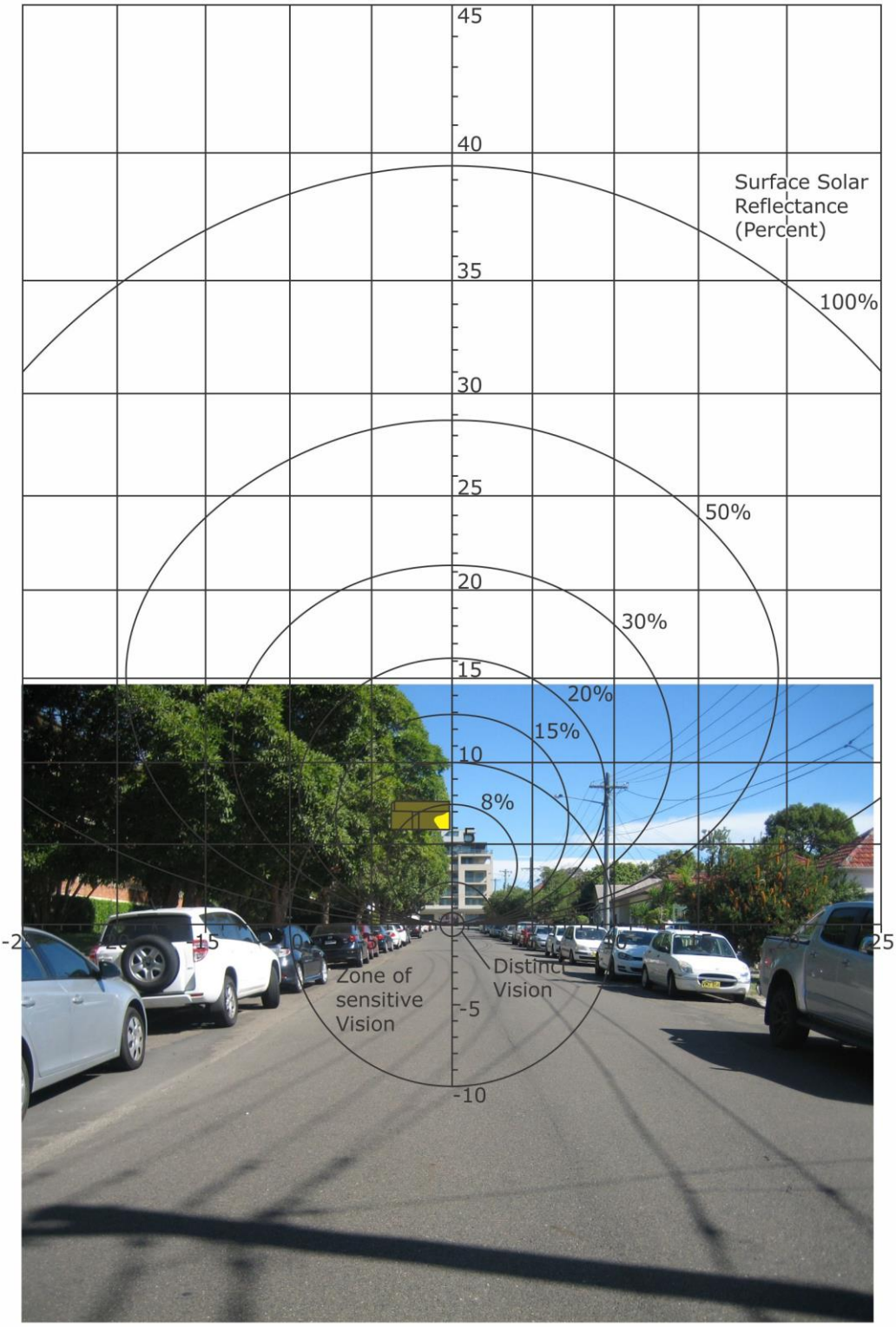

Figure A6: Glare Overlay for Point 06

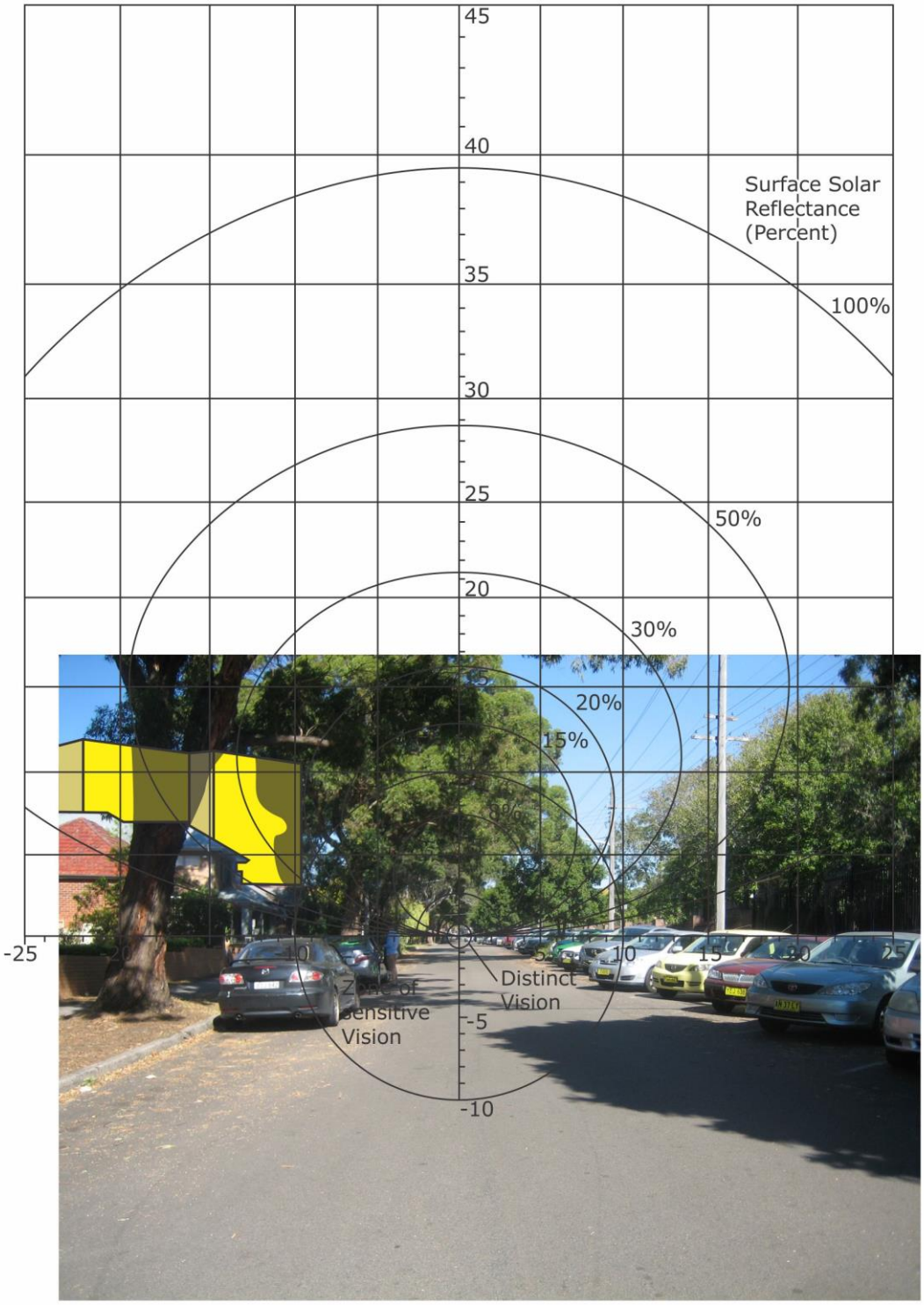

Figure A7: Glare Overlay for Point 07

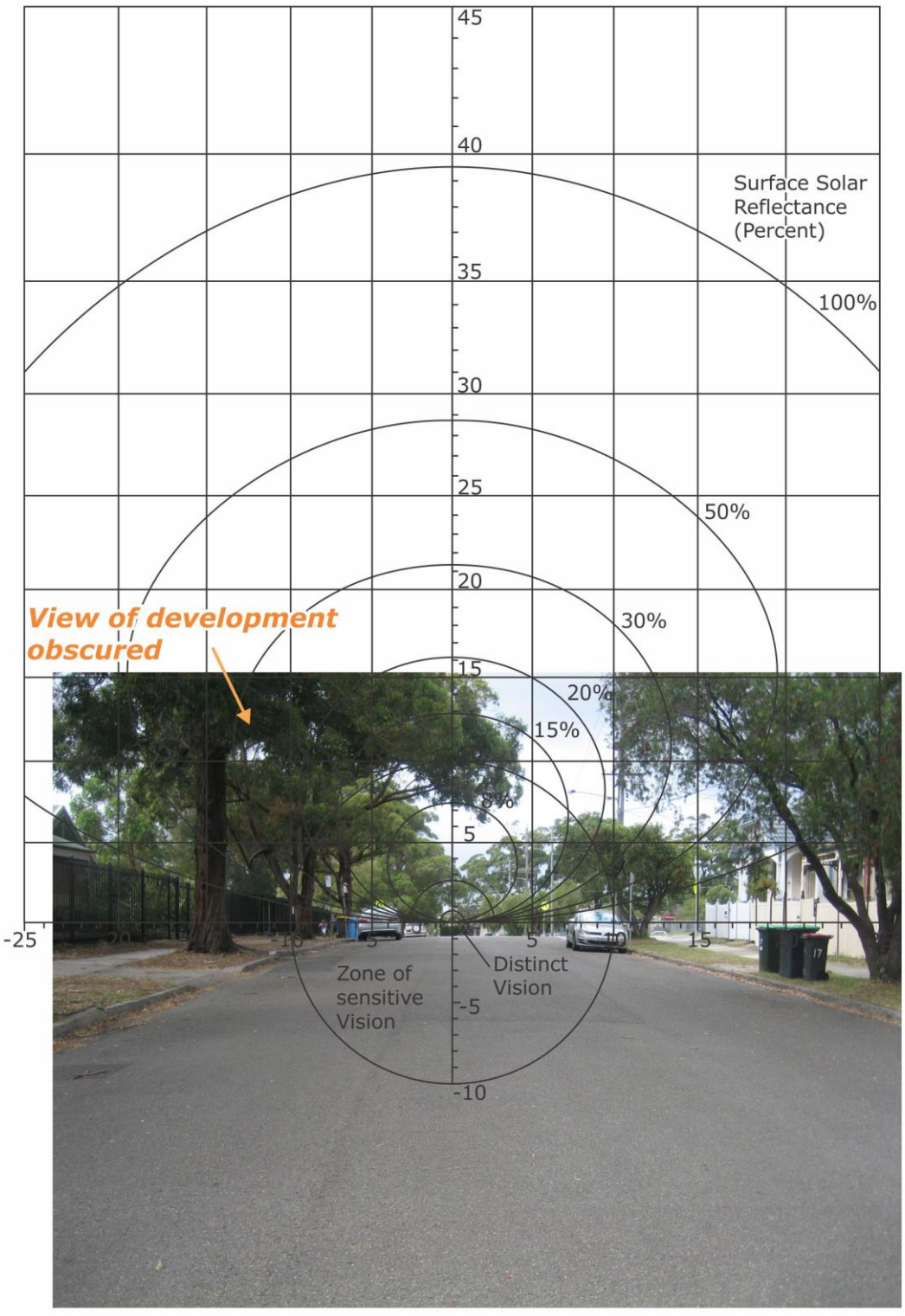

Figure A8: Glare Overlay for Point 08

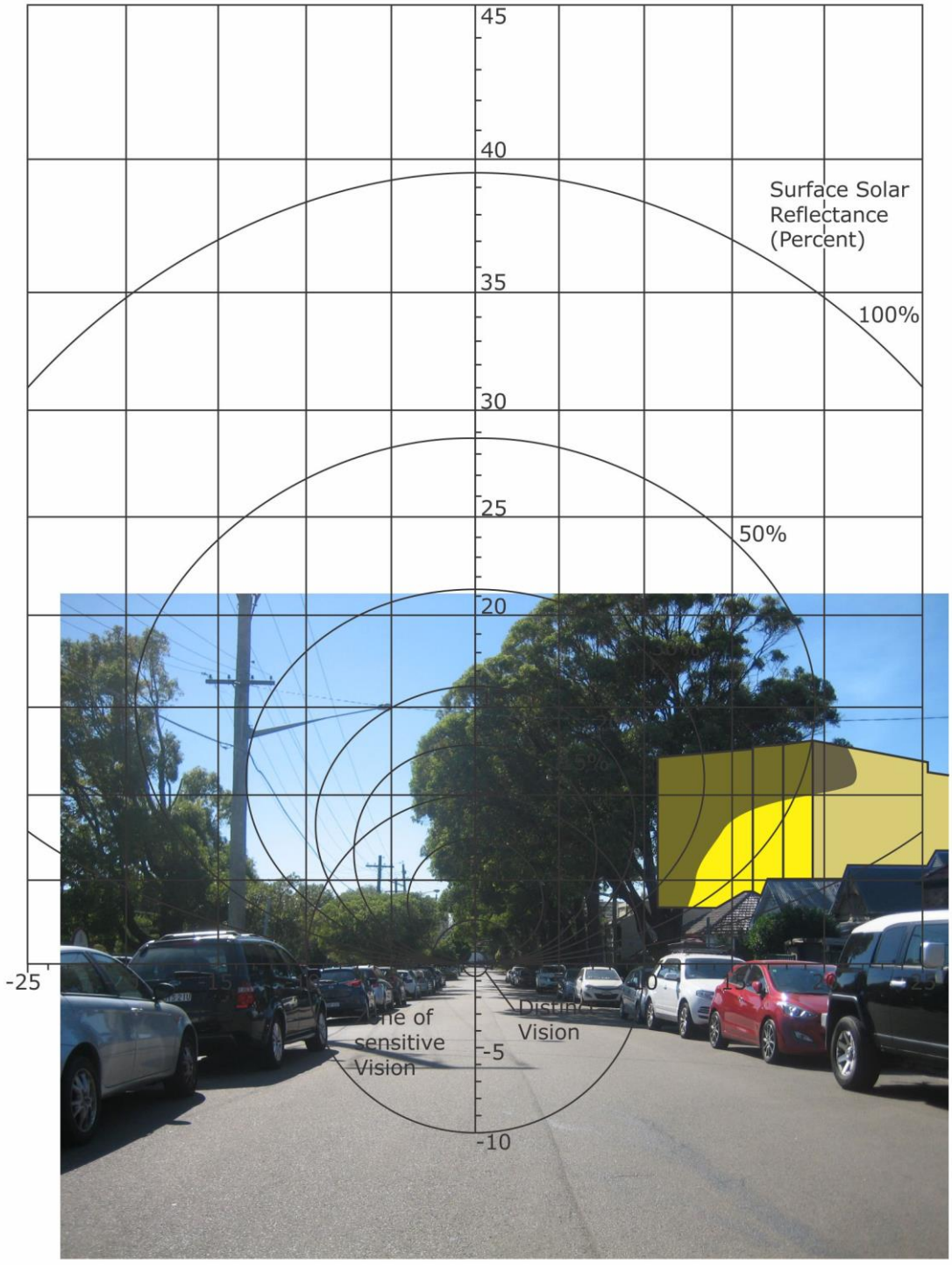

Figure A9: Glare Overlay for Point 09

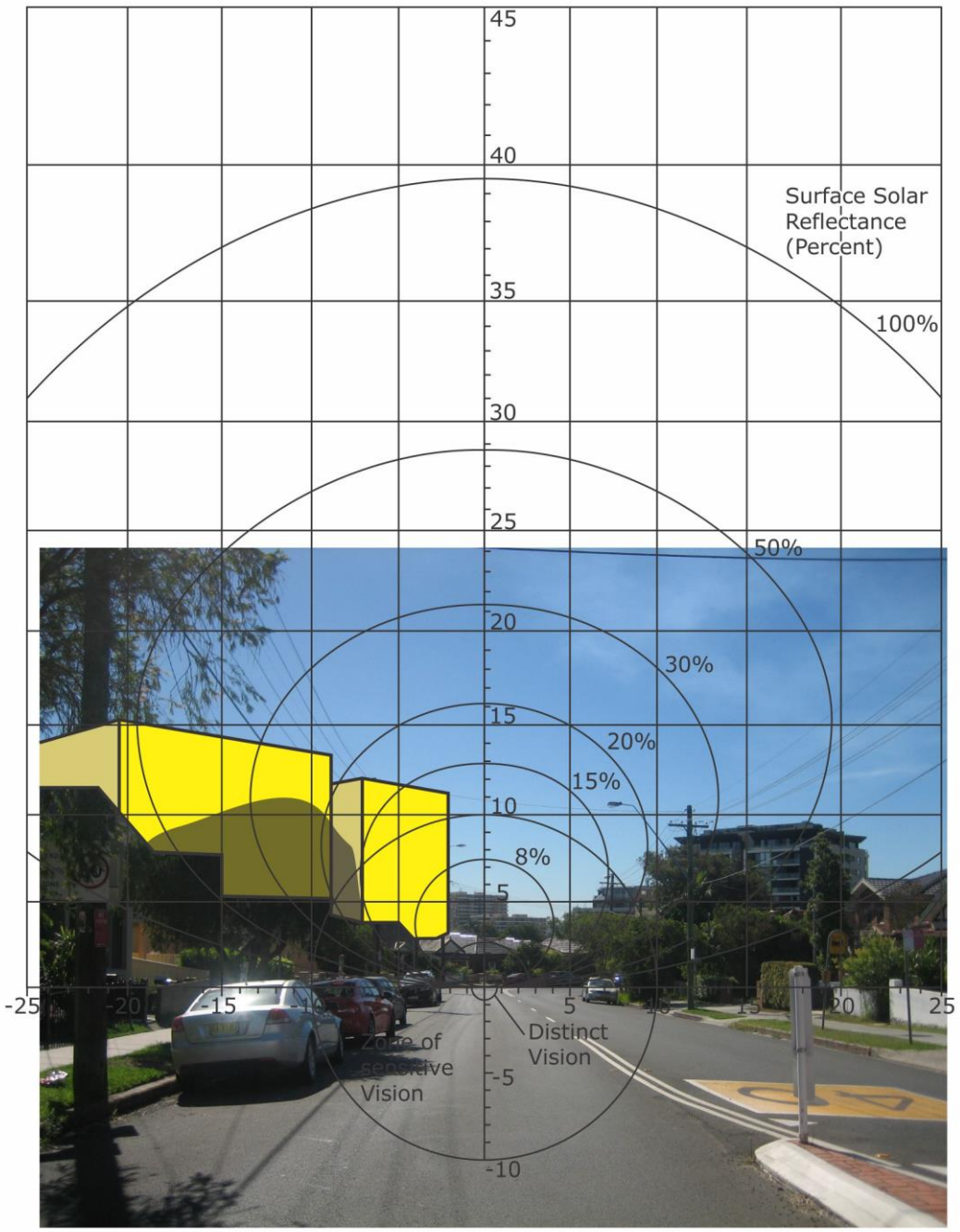

Figure A10: Glare Overlay for Point 10

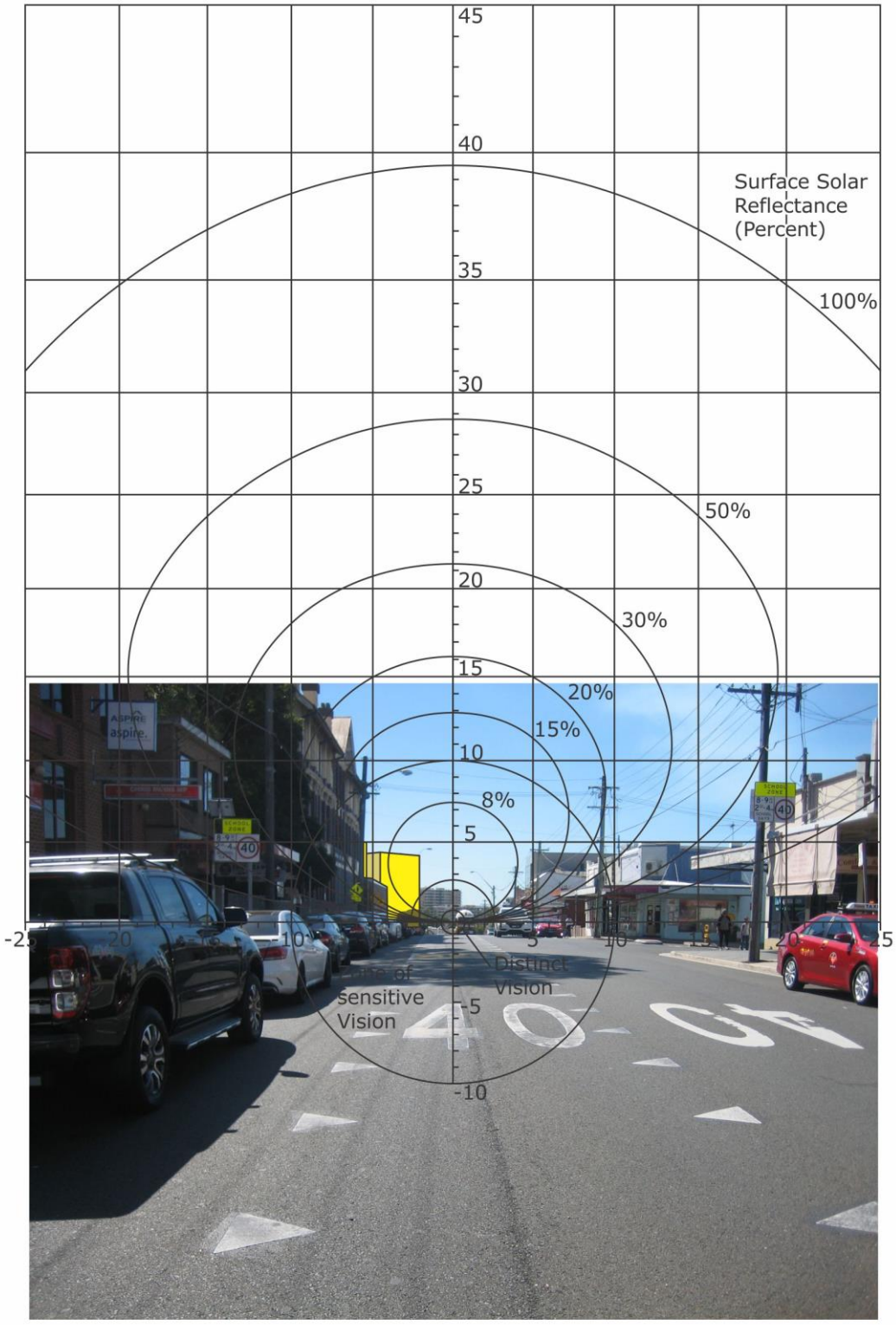

Figure A11: Glare Overlay for Point 11

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

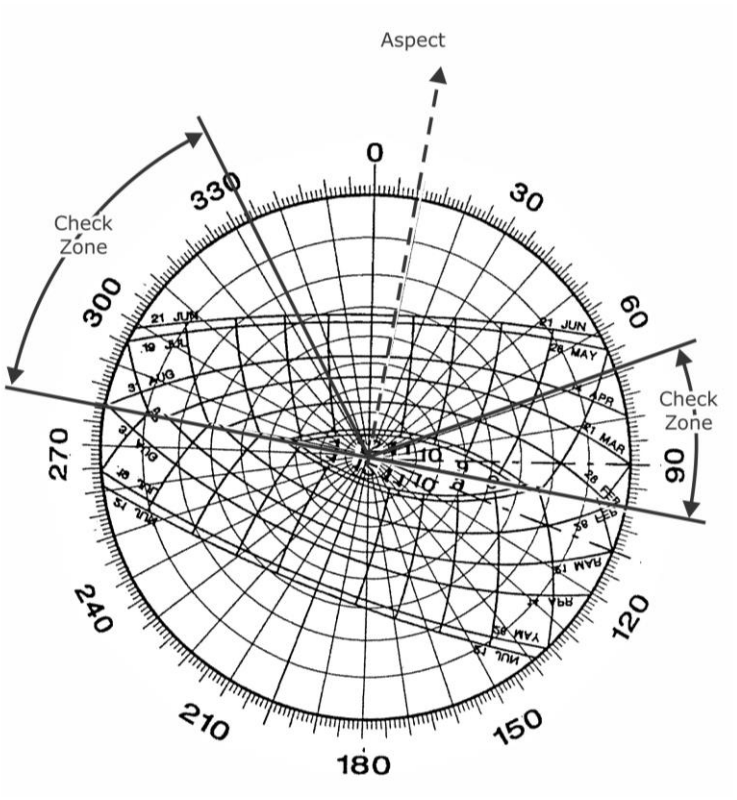

Figure B1: Sun Chart for Aspect 009°

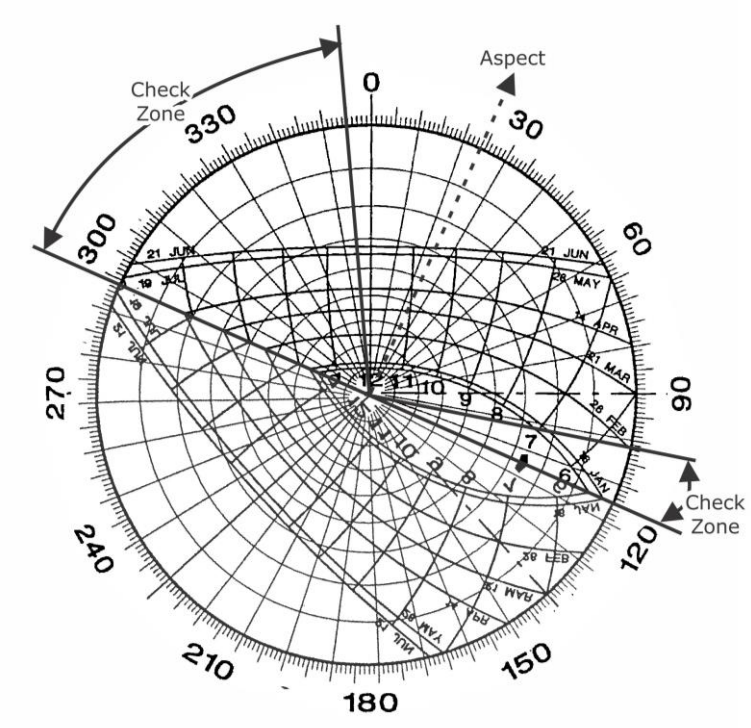

Figure B2: Sun Chart for Aspect 24°

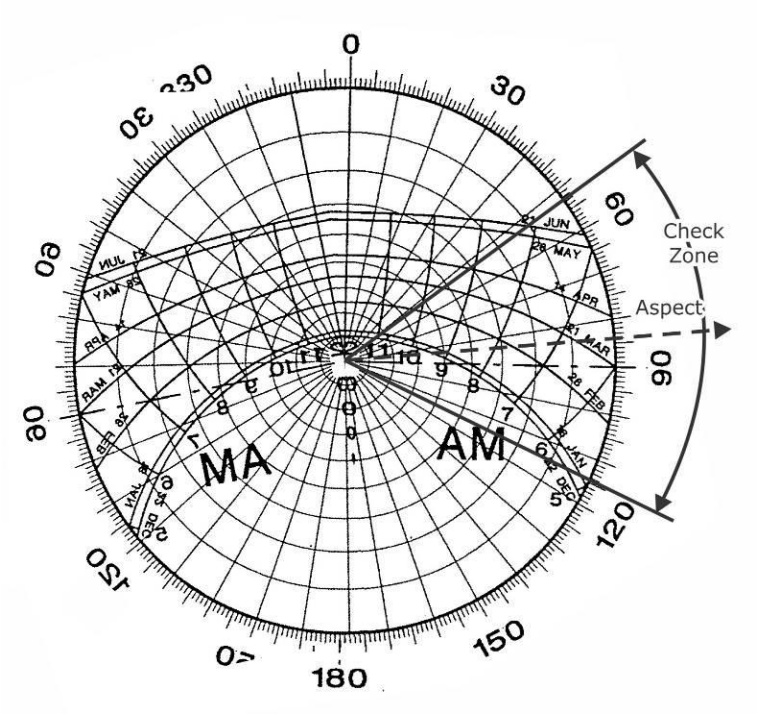

Figure B3: Sun Chart for Aspect 084º

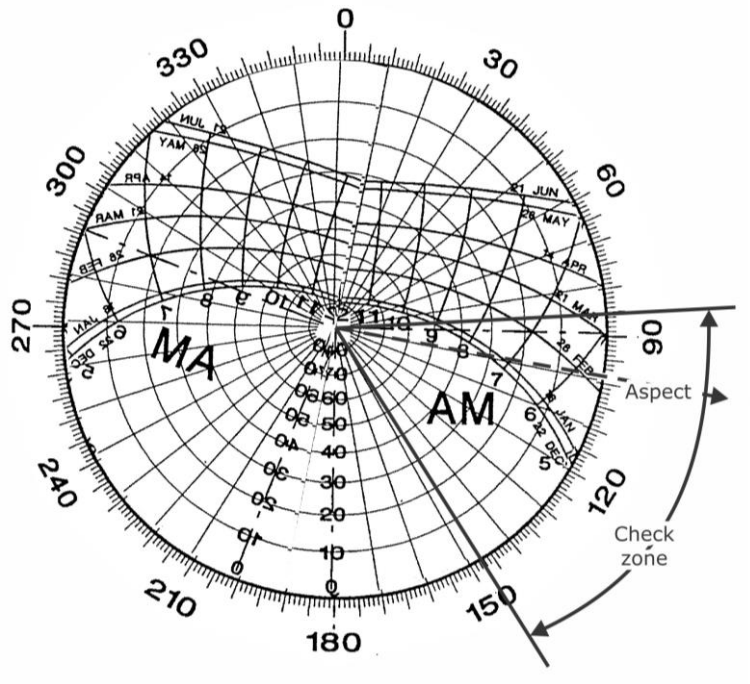

Figure B4: Sun Chart for Aspect 99º

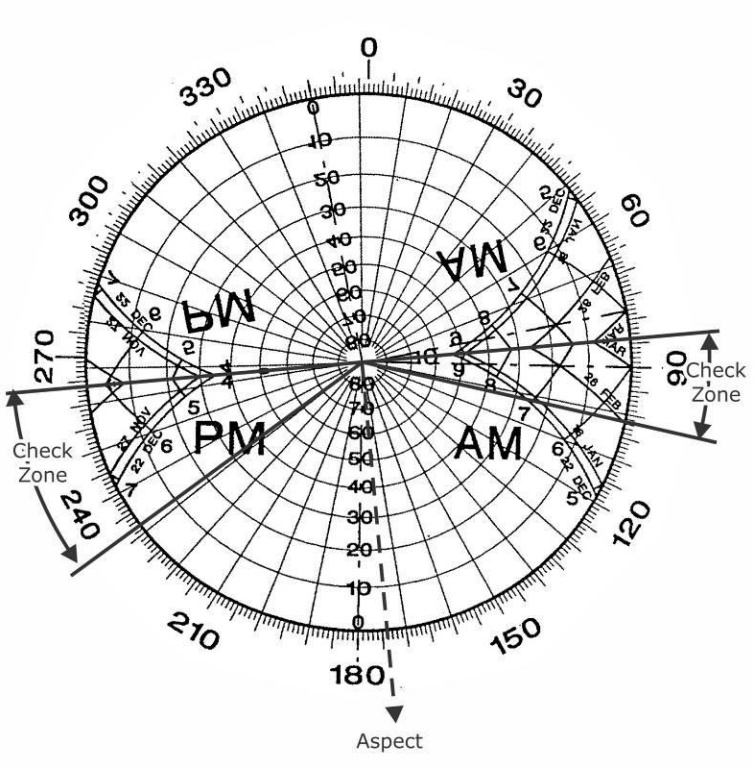

Figure B5: Sun Chart for Aspect 174º

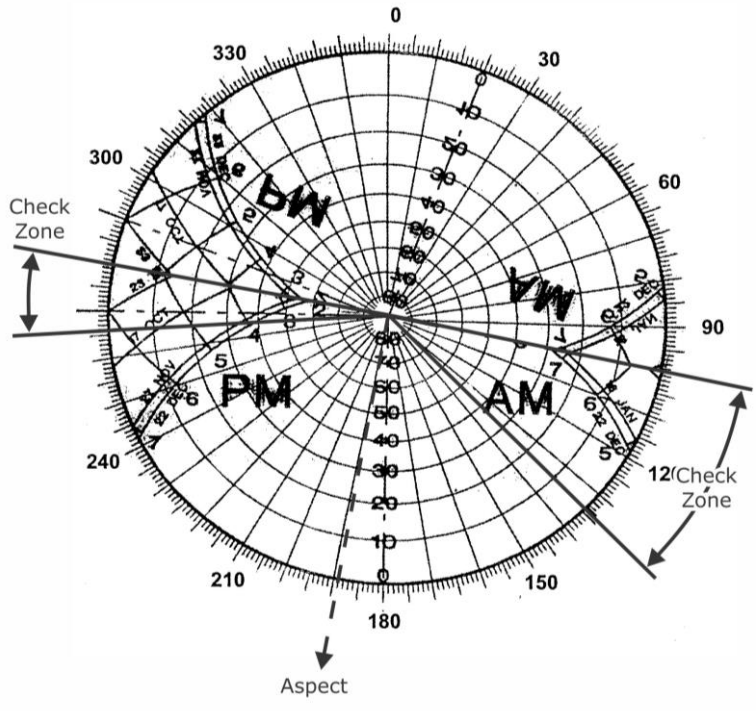

Figure B6: Sun Chart for Aspect 189º

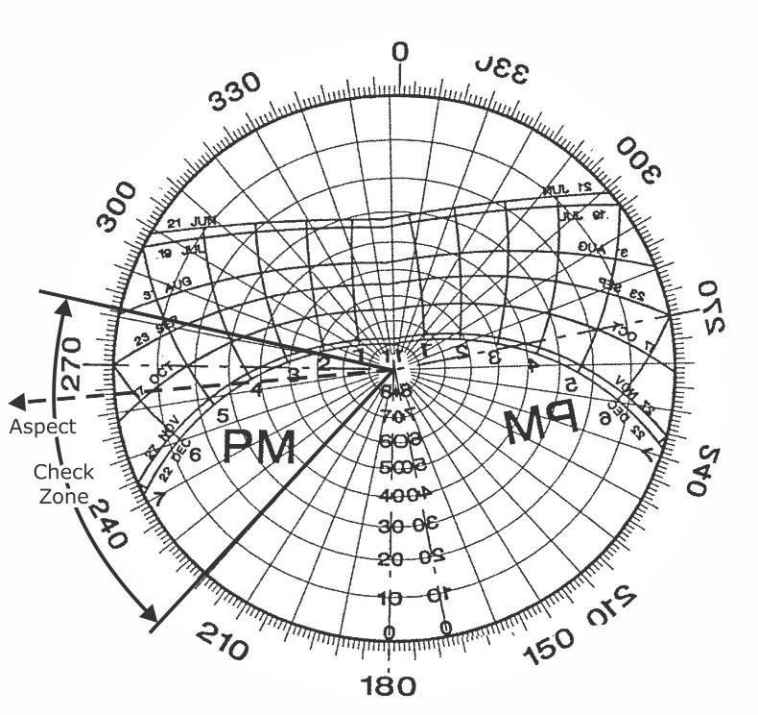

Figure B7: Sun Chart for Aspect 264º

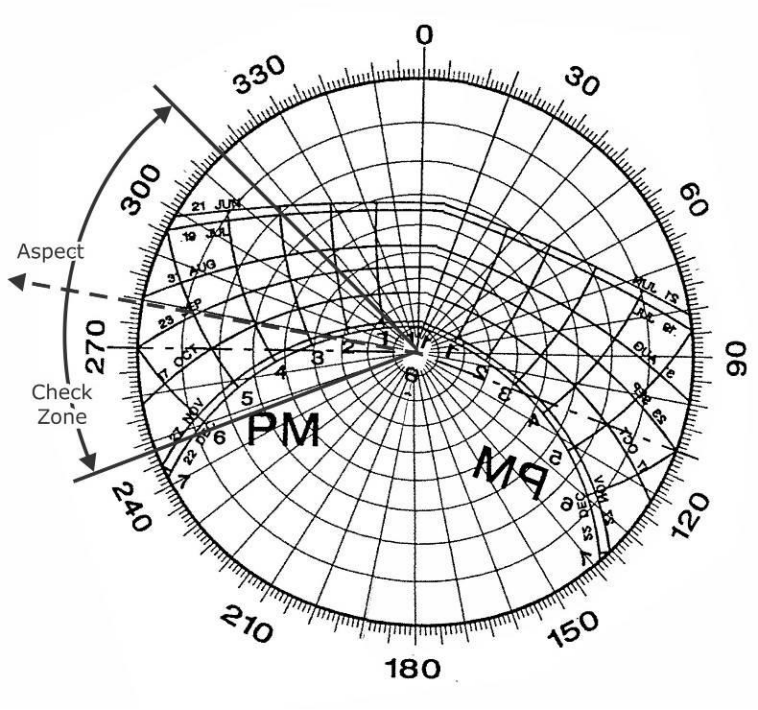

Figure B8: Sun Chart for Aspect 279º

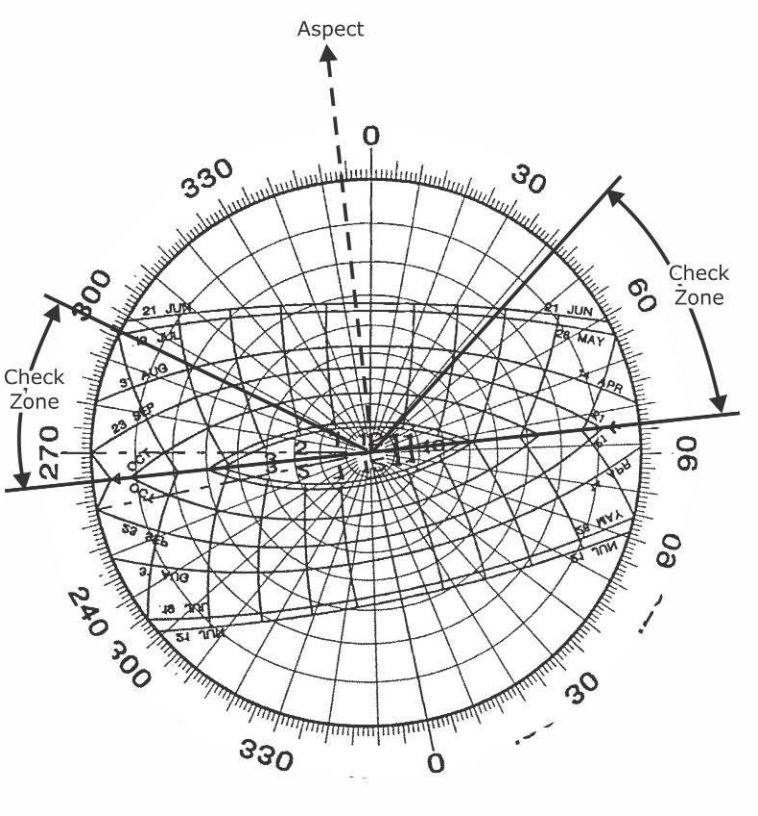

Figure B9: Sun Chart for Aspect 354º

APPENDIX C - STANDARD SUN CHART FOR THE SYDNEY REGION

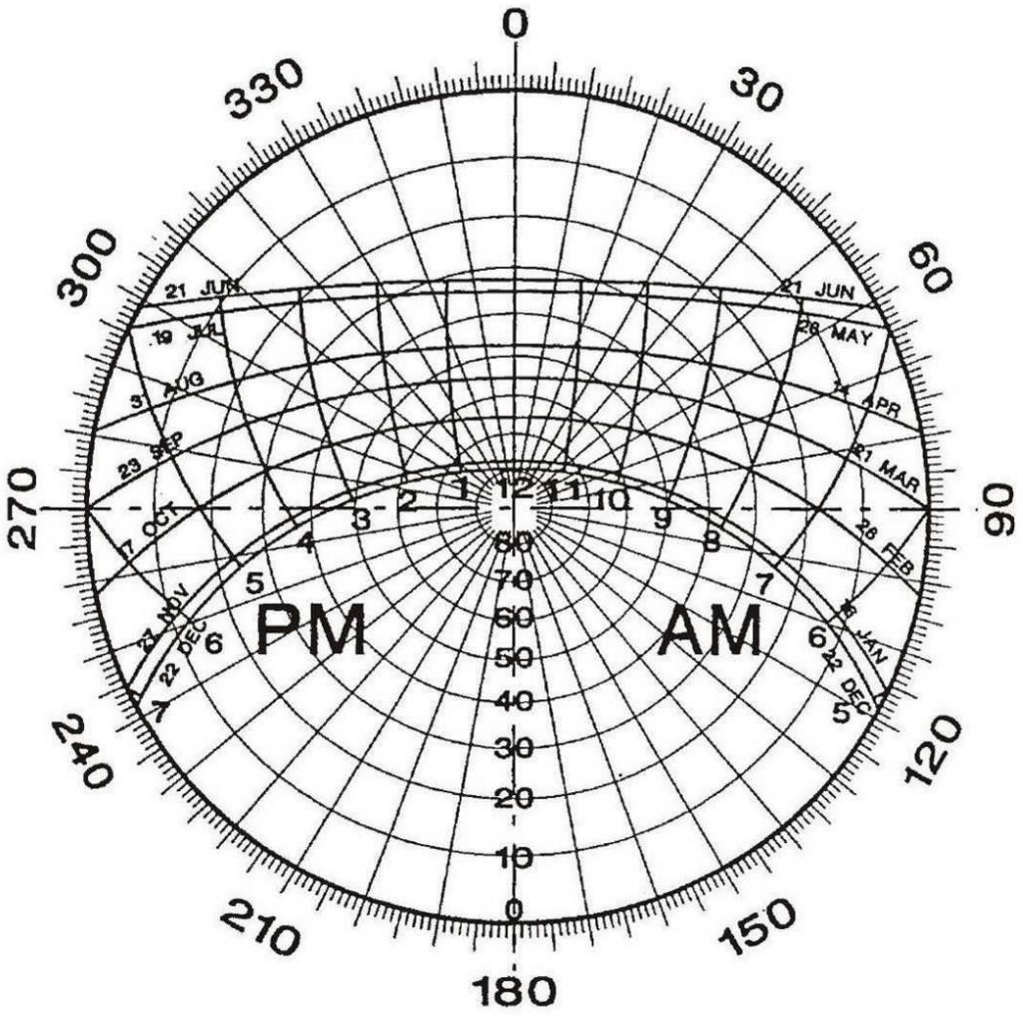

Figure C1: Standard Sun Chart for the Sydney Region