SOLAR LIGHT REFLECTIVITY ANALYSIS

PEMULWUY PRECINCT 3,
83-123 EVELEIGH STREET, REDFERN

WB028-04F03(REV0)- SR REPORT

JUNE 8, 2017

Prepared for:

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DOCUMENT CONTROL

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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 known as Pemulwuy Precinct 3, located at 83-123 Eveleigh Street, Redfern. This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians, train drivers, 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 City of Sydney 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, train drivers, and occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the glazing used on the external façade of the development should have a maximum normal specular reflectance of visible light of 20%. The orientation of the development, combined with the effect of recessing of many of the windows of the development, and the various blade walls and other protruding features across the façade of the development, assist in mitigating adverse glare being observed from the development from many of the surrounding locations.

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.

Hence, with the incorporation of the abovementioned recommendation, 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 the City of Sydney DCP 2012.

CONTENTS

1 METHODOLOGY

This study assesses compliance with the controls for solar glare from the City of Sydney 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 and train drivers, 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 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.

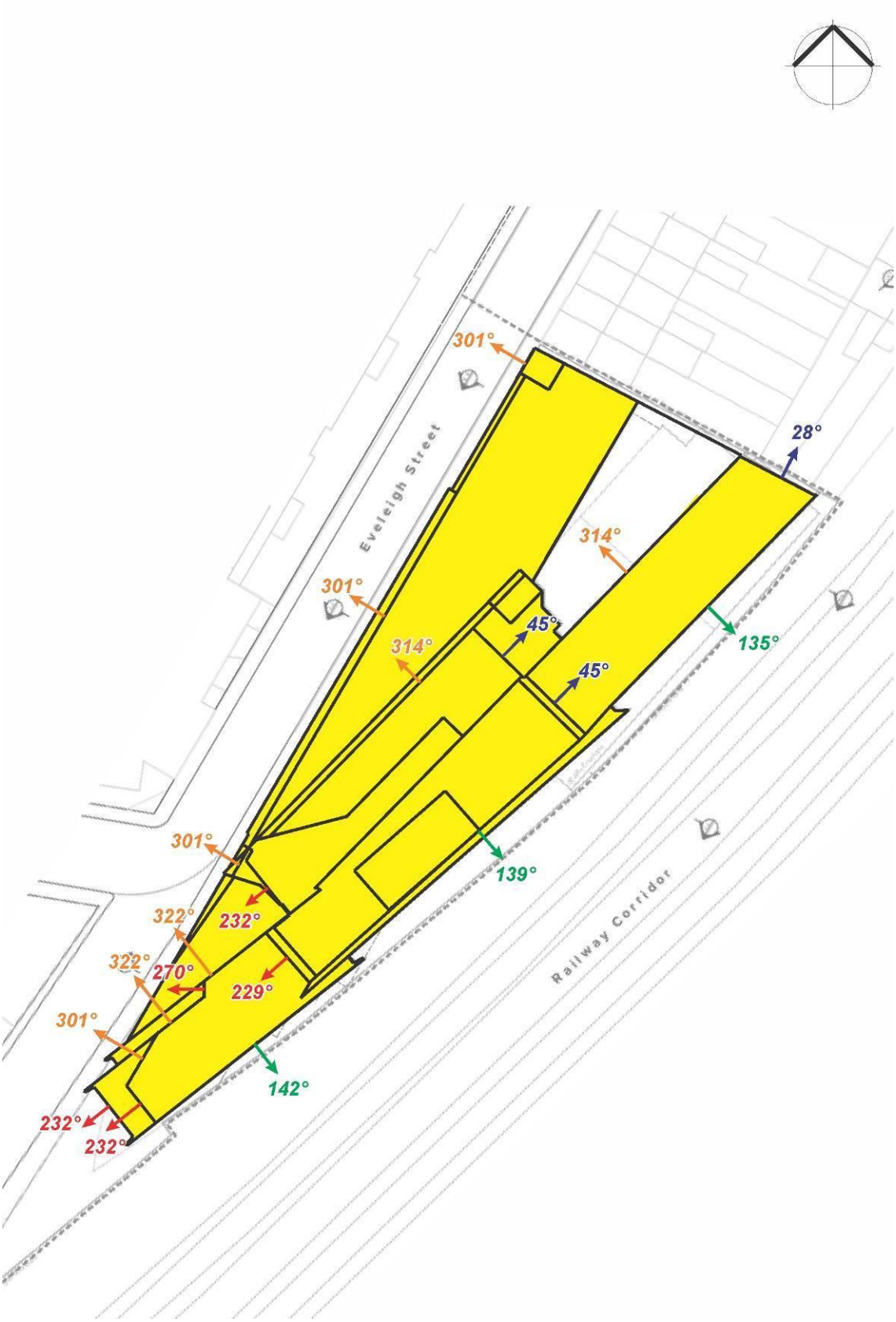

Figure 1: Critical Glazed Aspects of the Development

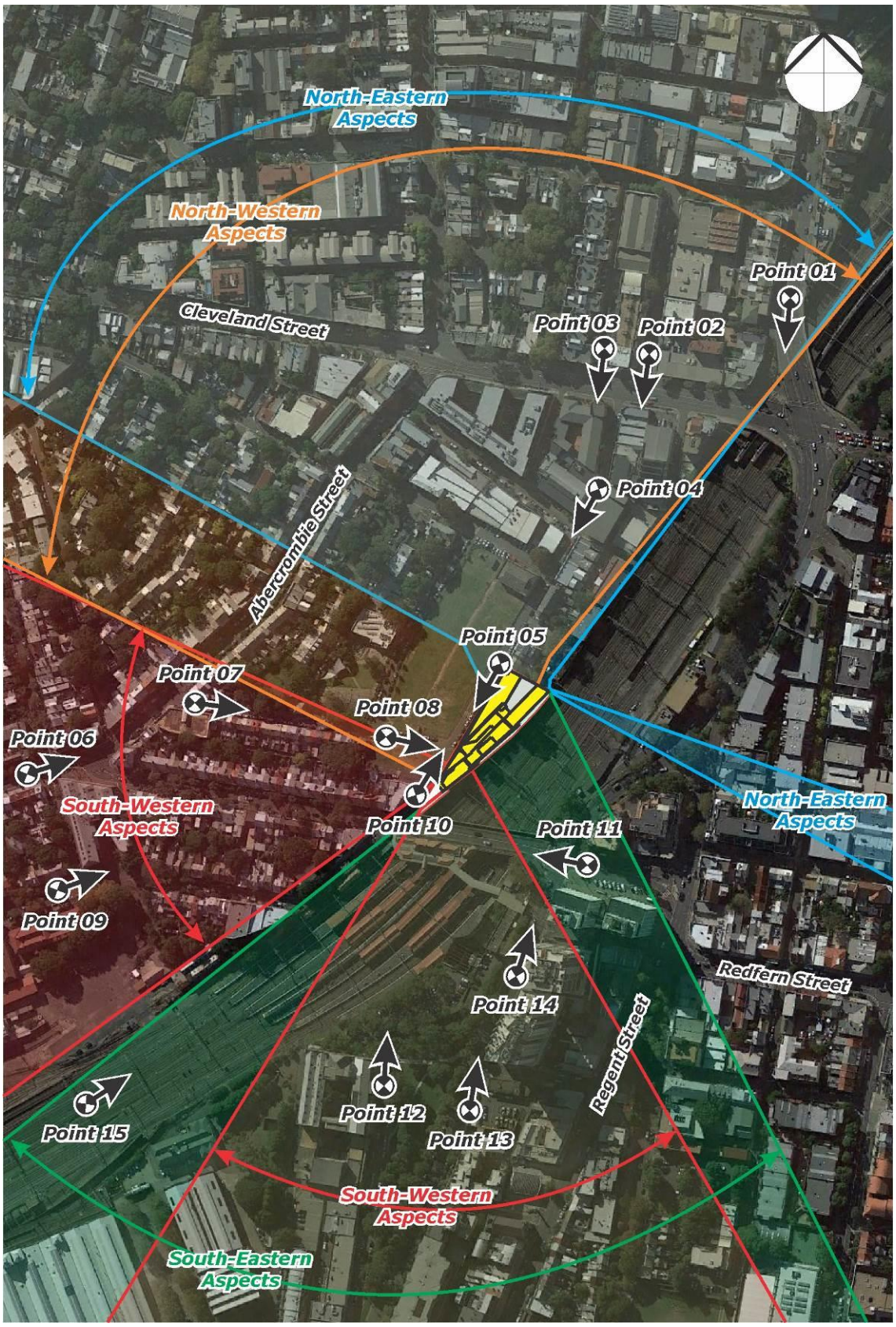

Figure 2: Check Zones and Study Point Locations
(the check zones are the areas where glare could potentially be observed)

2 ANALYSIS

2.1 Impact onto Motorists, Train Drivers, and Pedestrians

From the study of the check zones shown in Figure 2, a total of 15 locations have been identified for detailed analysis. A summary of the location of each study point and the vertical aspects of the subject 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, 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	Regent Street – Heading south	North-eastern and north-western aspects
2	Chippen Street – Heading south	North-eastern and north-western aspects
3	Dale Avenue – Heading south	North-eastern and north-western aspects
4	Eveleigh Street – Heading south	North-eastern and north-western aspects
5	Eveleigh Street – Heading south	North-eastern and north-western aspects
6	Abercrombie Street – Heading north-east	South-western aspects
7	Caroline Street – Heading east	South-western aspects
8	Caroline Street – Heading east	North-western and south-western aspects
9	Wilson Street – Heading north-east	South-western aspects
10	Eveleigh Street – Heading north	South-western aspects
11	Lawson Street – Heading west	South-eastern aspects
12	Rosehill Street – Heading north	South-eastern and south-western aspects
13	Gibbons Street – Heading north	South-eastern and south-western aspects
14	Gibbons Street – Heading north	South-eastern and south-western aspects
15	Rail corridor - Heading north-east	South-eastern aspects

2.1.1 Drivers heading south along Regent Street

Point 1 is located along Regent Street, to the north-east of the development site. This point represents the critical sightline of drivers heading south along Regent 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 A1 of Appendix A.

An analysis of the viewpoint at Point 1 indicates that the subject development will not be visible at this location. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading south along Regent Street at Point 1.

2.1.2 Drivers heading south along Chippen Street

Point 2 is located along Chippen Street, to the north of the development site. This point represents the critical sightline of drivers heading south along Chippen Street at this location. A site survey of this point has been undertaken, and photographs 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 A2 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 2 indicates that the proposed development will be not be visible 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 Chippen Street at Point 2.

2.1.3 Drivers heading south along Dale Street

Point 3 is located along Dale Street, to the north of the development site. This point represents the critical sightline of drivers heading south along Dale 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 A3 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 3 indicates that the proposed development will be not be visible 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 Dale Street at Point 3.

2.1.4 Drivers heading south along Eveleigh Street

Points 4 and 5 are located along Eveleigh Street, to the north of the development site. These points represent the critical sightline of drivers heading south along Eveleigh 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. The photographs have been scaled to enable the glare meter to be overlaid onto the images, as shown in Figures A4 and A5 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 4 indicates that the 314° aspect of the north-western façade will be visible and within the zone of sensitive vision of motorists at this location. However further analysis indicates that the glazed portions of this section of the north-western façade are recessed and will therefore be shaded. Furthermore, Point 4 is not located within the check zone for the portions of the north-western aspect which are visible within the zone of sensitive vision. The north-eastern aspect of the podium wing is

also visible and within the zone of sensitive vision at Point 4, however there is no glazing on this portion of the building façade. Hence there will be no adverse glare observed by motorists or pedestrians heading south along Eveleigh Street at Point 4.

An analysis of the glare meter overlaid onto the viewpoint at Point 5 indicates that the southern end of the 301° aspect of the north-western façade will be visible and within the zone of sensitive vision of motorists at this location. However further analysis indicates that the glazed areas on this façade are recessed and will therefore be shaded. Furthermore, Point 5 is not located within the check zone for the portions of the north-western aspect which are visible within the zone of sensitive vision. Hence there will be no adverse glare observed by motorists or pedestrians heading south along Eveleigh Street at Point 5.

2.1.5 Drivers heading north-east along Abercrombie Street

Point 6 is located along Dale Street, to the north of the development site. This point represents the critical sightline of drivers heading north-east along Abercrombie 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 A6 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 6 indicates that the proposed development will be not be visible 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 north-east along Abercrombie Street at Point 6.

2.1.6 Drivers heading east along Caroline Street

Points 7 and 8 are located along Caroline Street, to the west of the development site. These points represent the critical sightline of drivers heading east along Caroline 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. 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.

An analysis of the glare meter overlaid onto the viewpoint at Points 7 and 8 indicates that the 301° and 314° aspects of the north-western façade will be visible and within the zone of sensitive vision of motorists at these locations. However further analysis indicates that Points 7 and 8 lie outside the check zone for the portion of the 301° and 314° aspects of the development which are within the zone of sensitive vision of motorists at these locations. Hence there will be no adverse glare observed by motorists or pedestrians heading east along Caroline Street at Points 7 and 8.

2.1.7 Drivers heading north-east along Wilson Street

Point 9 is located along Wilson Street, to the south-west of the development site. This point represents the critical sightline of drivers heading north-east along Wilson 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 A9 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 9 indicates that the view of the proposed development is heavily obscured by trees. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading north-east along Wilson Street at Point 9.

2.1.8 Drivers heading north along Eveleigh Street

Point 10 is located along Eveleigh Street, to the south-west of the development site. This point represents the critical sightline of drivers heading north along Eveleigh 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 301° aspect of the north-western façade will be visible and within the zone of sensitive vision of motorists at this location. However further analysis indicates that Point 10 lies outside the check zone for the portion of the 301° aspect of the development which is within the zone of sensitive vision of motorists. Hence there will be no adverse glare observed by motorists or pedestrians heading north along Eveleigh Street at Point 10.

2.1.9 Drivers heading west along Lawson Street

Point 11 is located along Lawson Street, to the south-east of the development site. This point represents the critical sightline of drivers heading west along Lawson 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 A11 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 11 indicates that the proposed development will be not be visible 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 west along Lawson Street at Point 11.

2.1.10 Drivers heading north along Rosehill Street

Point 12 is located along Rosehill Street, to the south-west of the development site. This point represents the critical sightline of drivers heading north along Rosehill 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 A12 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 12 indicates that the proposed development will be not be visible 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 west along Lawson Street at Point 12.

2.1.11 Drivers heading north along Gibbons Street

Points 13 and 14 are located along Gibbons Street, to the south of the development site. These points represent the critical sightlines of drivers heading north along Gibbons Street at these locations. A site survey of these point has been undertaken, and photographs showing the viewpoints 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 A13 and A14 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Points 13 and 14 indicates that the proposed development will be not be visible within the zone of sensitive vision of motorists at these locations. Hence, there will be no adverse solar glare observed by motorists or pedestrians heading north along Gibbons Street at Points 13 and 14.

2.1.12 Train Drivers heading north-east along Rail Corridor

Point 15 is located along the rail corridor to the south-west of the development site. This point represents the critical sightline of train drivers heading north-east along the major rail corridor at this location.

Point 15 is located only within the check zone for the south-eastern aspects of the development. When viewed from Point 15, only a very narrow perspective of the south-eastern aspects of the development will be visible. Furthermore, the glazing on the south-eastern aspect of the development will be recessed, which will be effective in blocking glare that could have otherwise been observed at Point 15. Hence there will be no adverse solar glare observed by train drivers heading north-east along the rail corridor at Point 15.

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 Pemulwuy Precinct 3, located at 83-123 Eveleigh Street, Redfern. This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians, train drivers, 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 City of Sydney 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, train drivers, and occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the glazing used on the external façade of the development should have a maximum normal specular reflectance of visible light of 20%. The orientation of the development, combined with the effect of recessing of many of the windows of the development, and the various blade walls and other protruding features across the façade of the development, assist in mitigating adverse glare being observed from the development from many of the surrounding locations.

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.

Hence, with the incorporation of the abovementioned recommendation, 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 the City of Sydney DCP 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, "City of Sydney Development Control Plan 2012".

APPENDIX A - GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

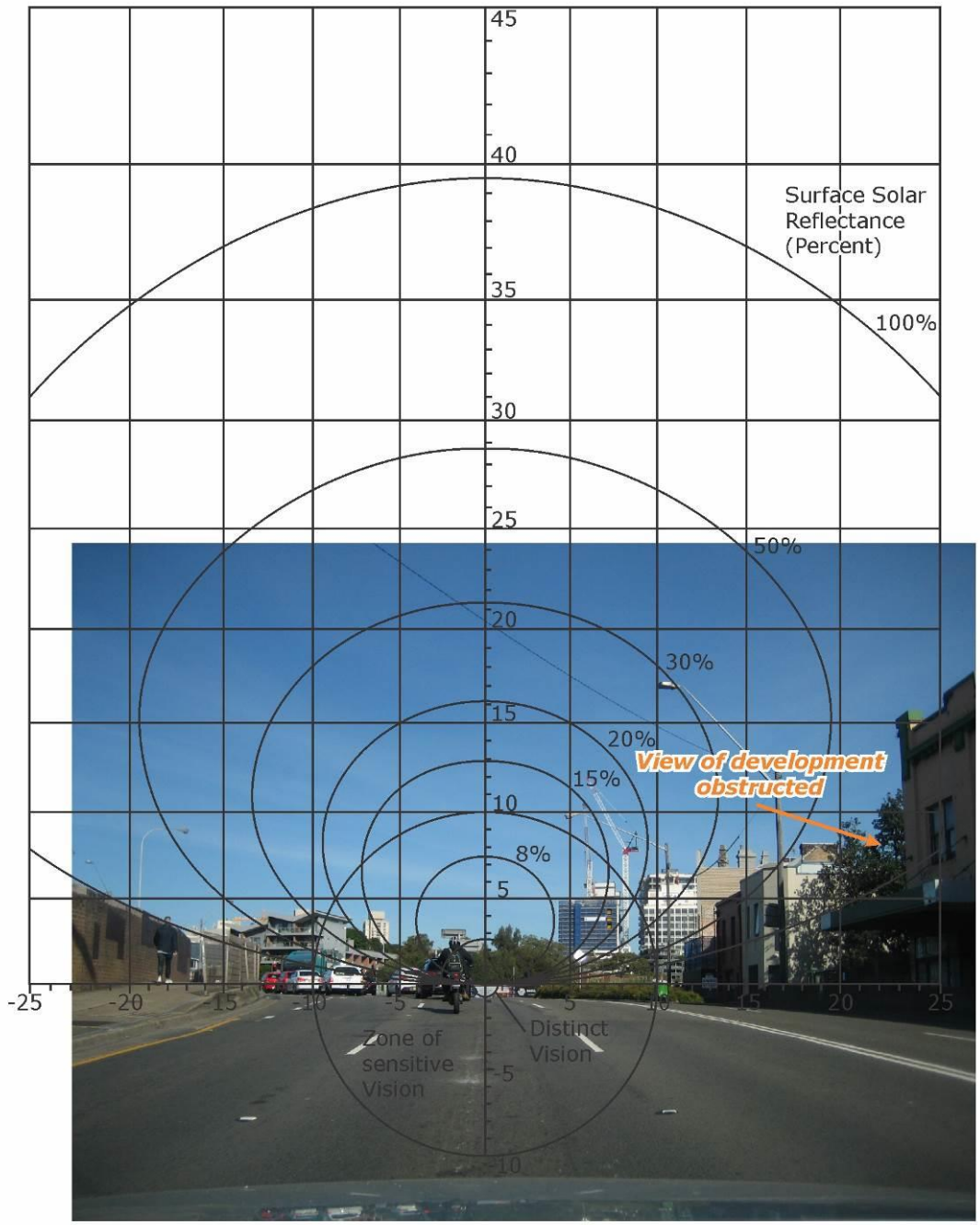

Figure A1: Glare Overlay for Point 1

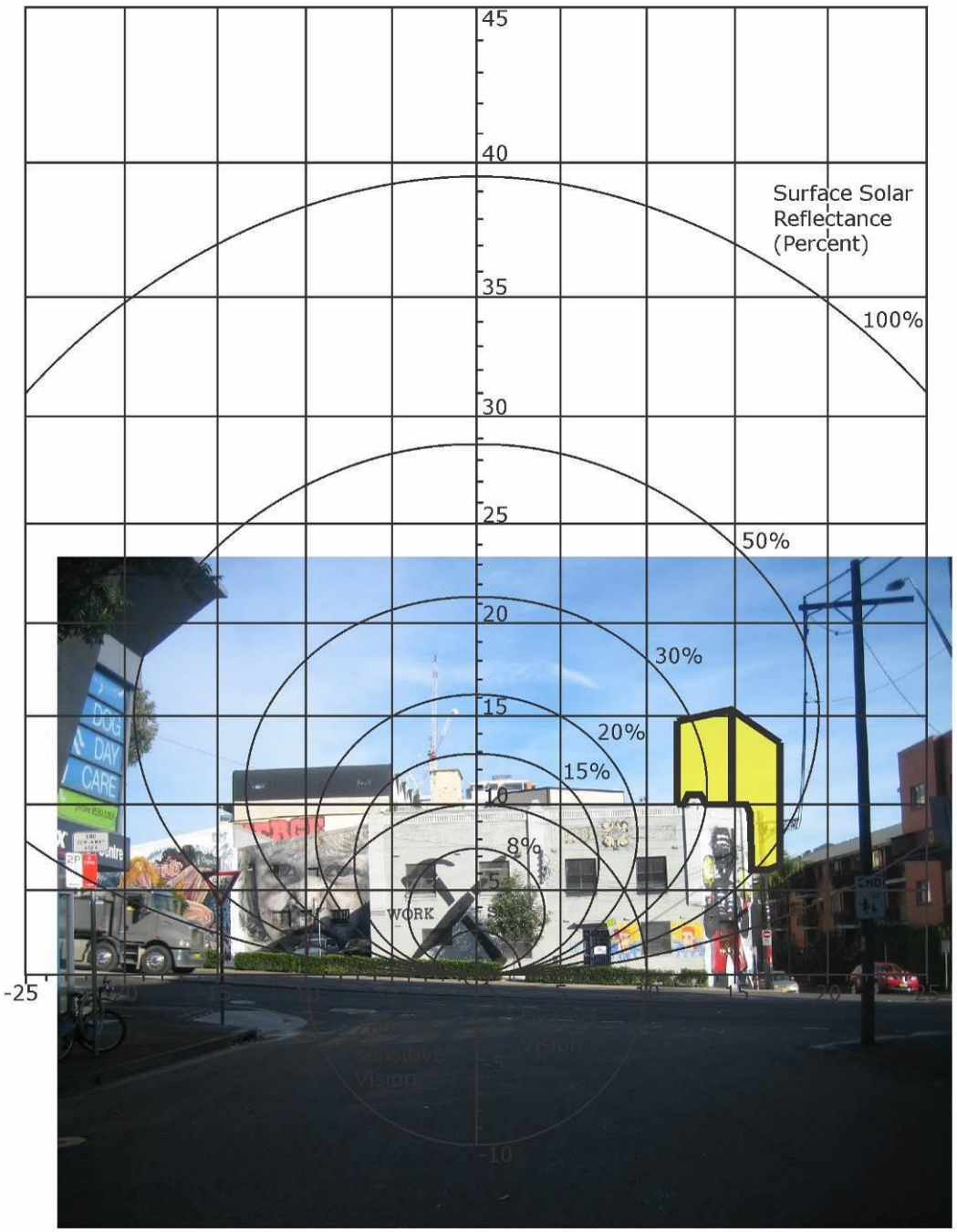

Figure A2: Glare Overlay for Point 2

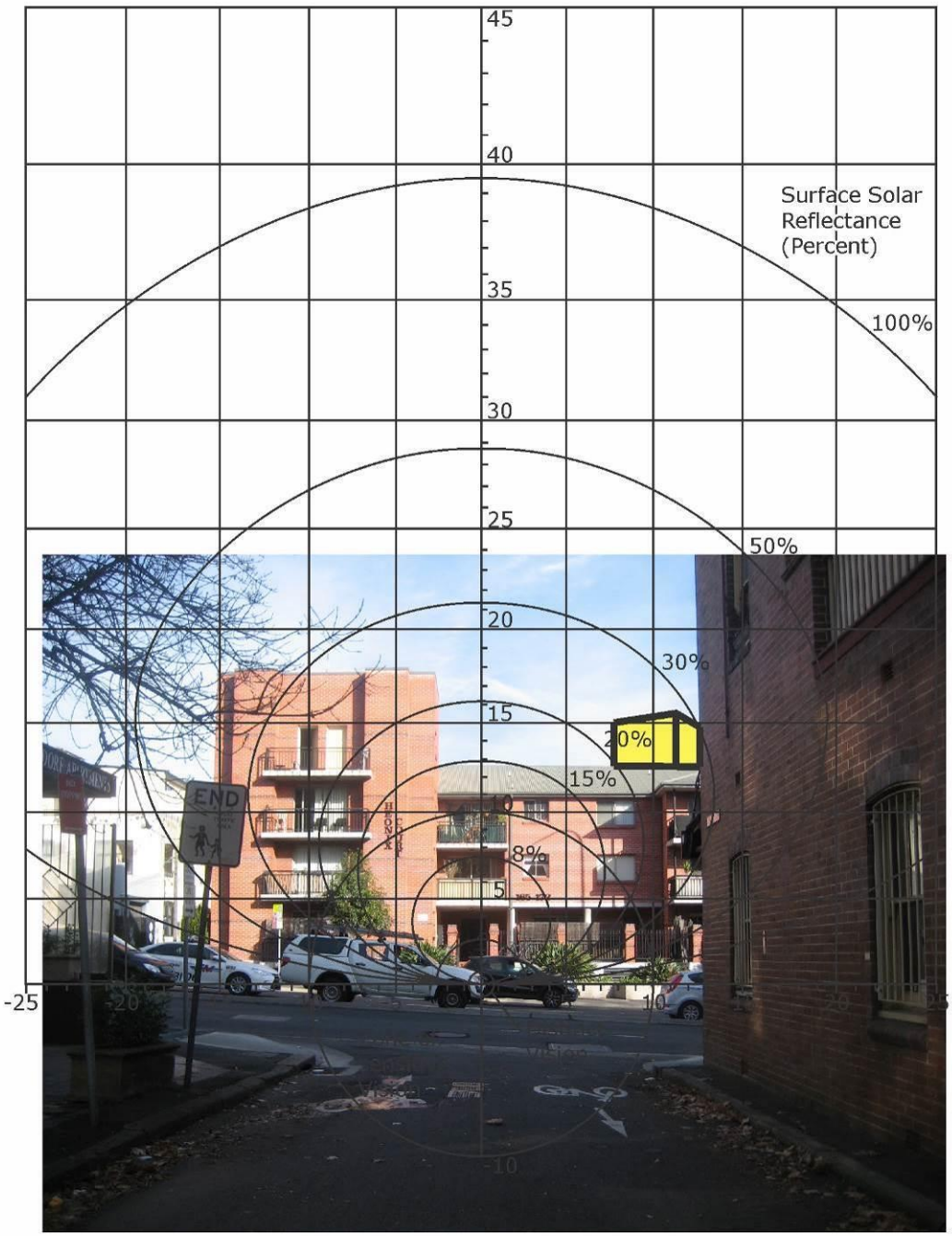

Figure A3: Glare Overlay for Point 3

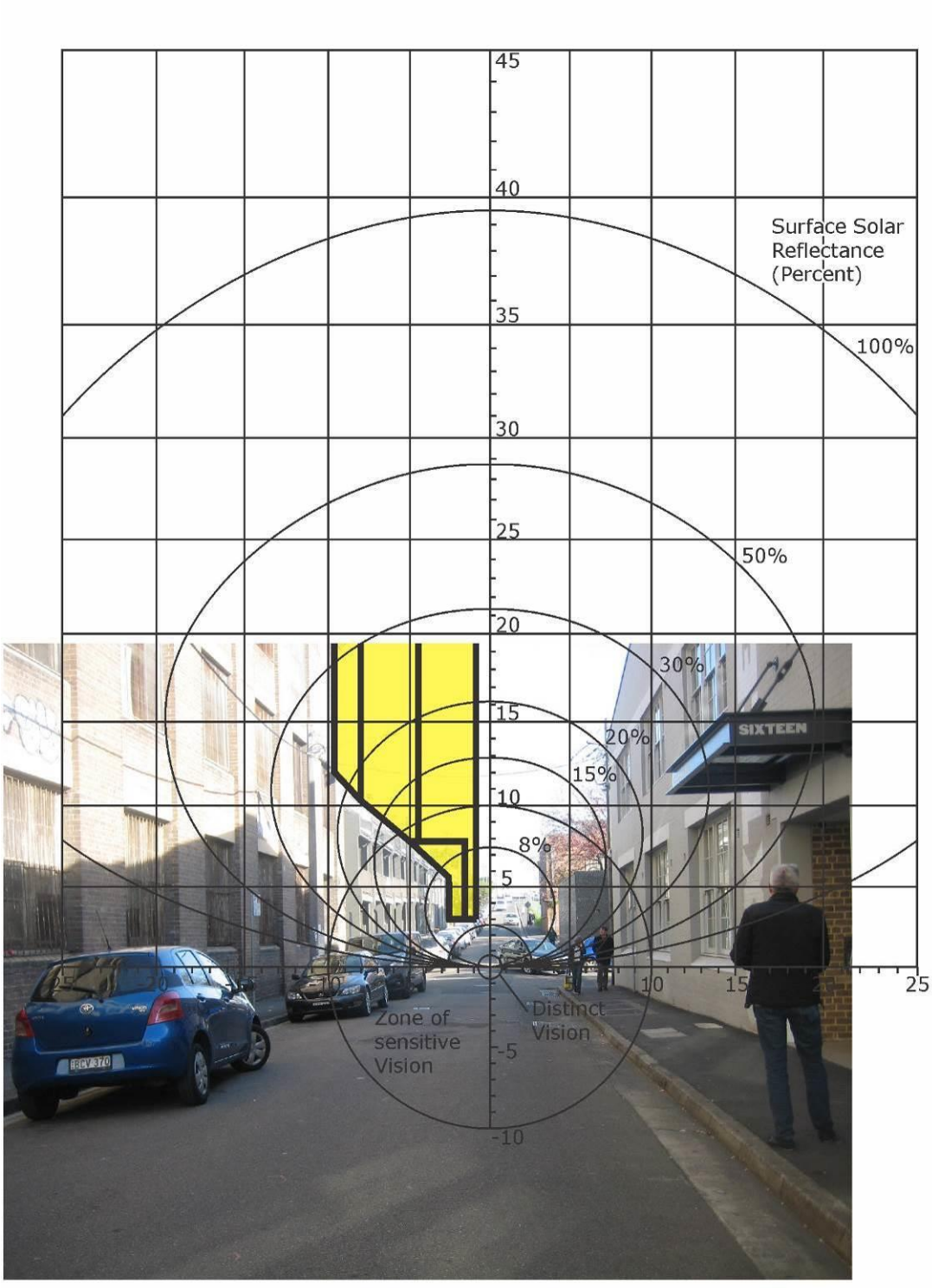

Figure A4: Glare Overlay for Point 4

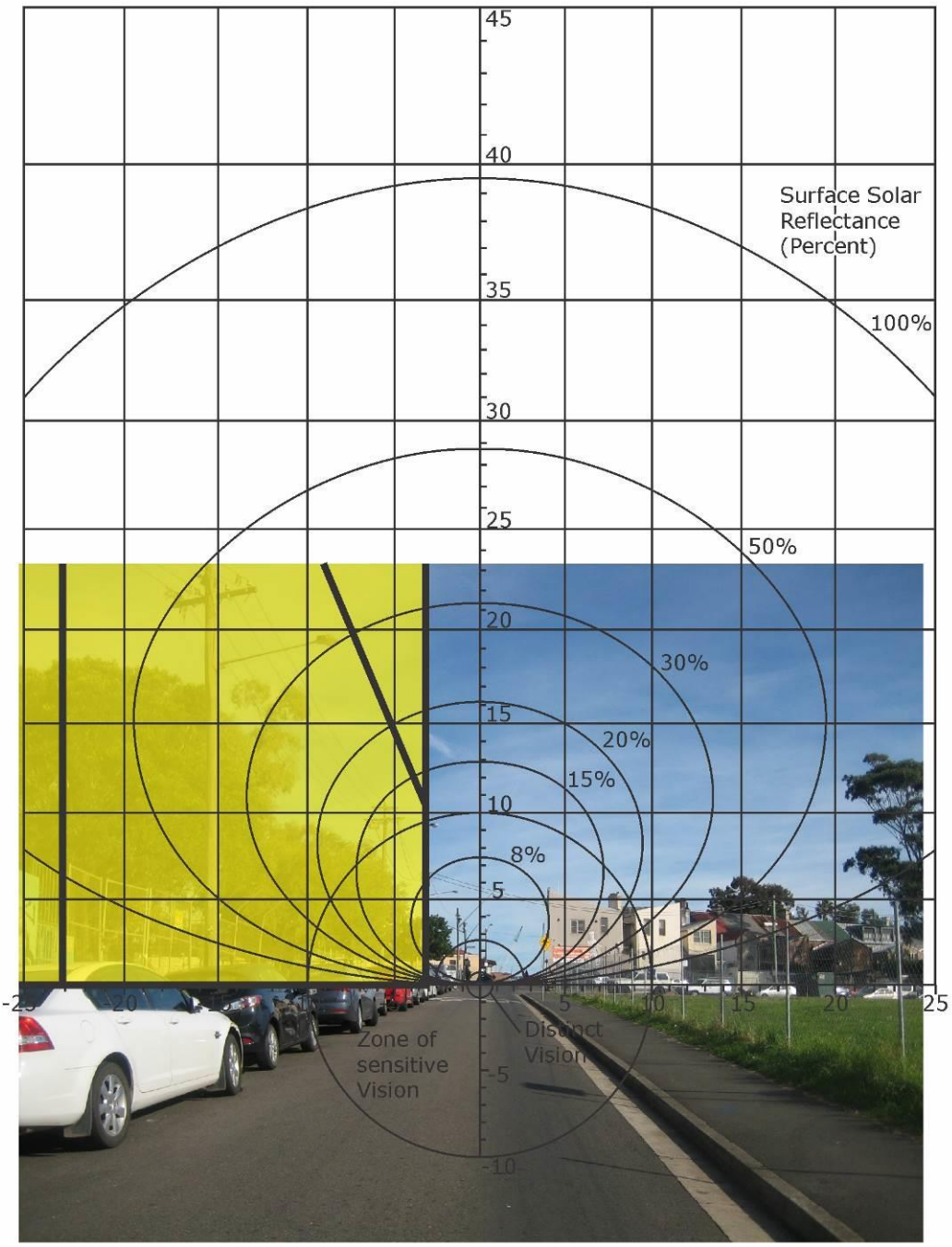

Figure A5: Glare Overlay for Point 5

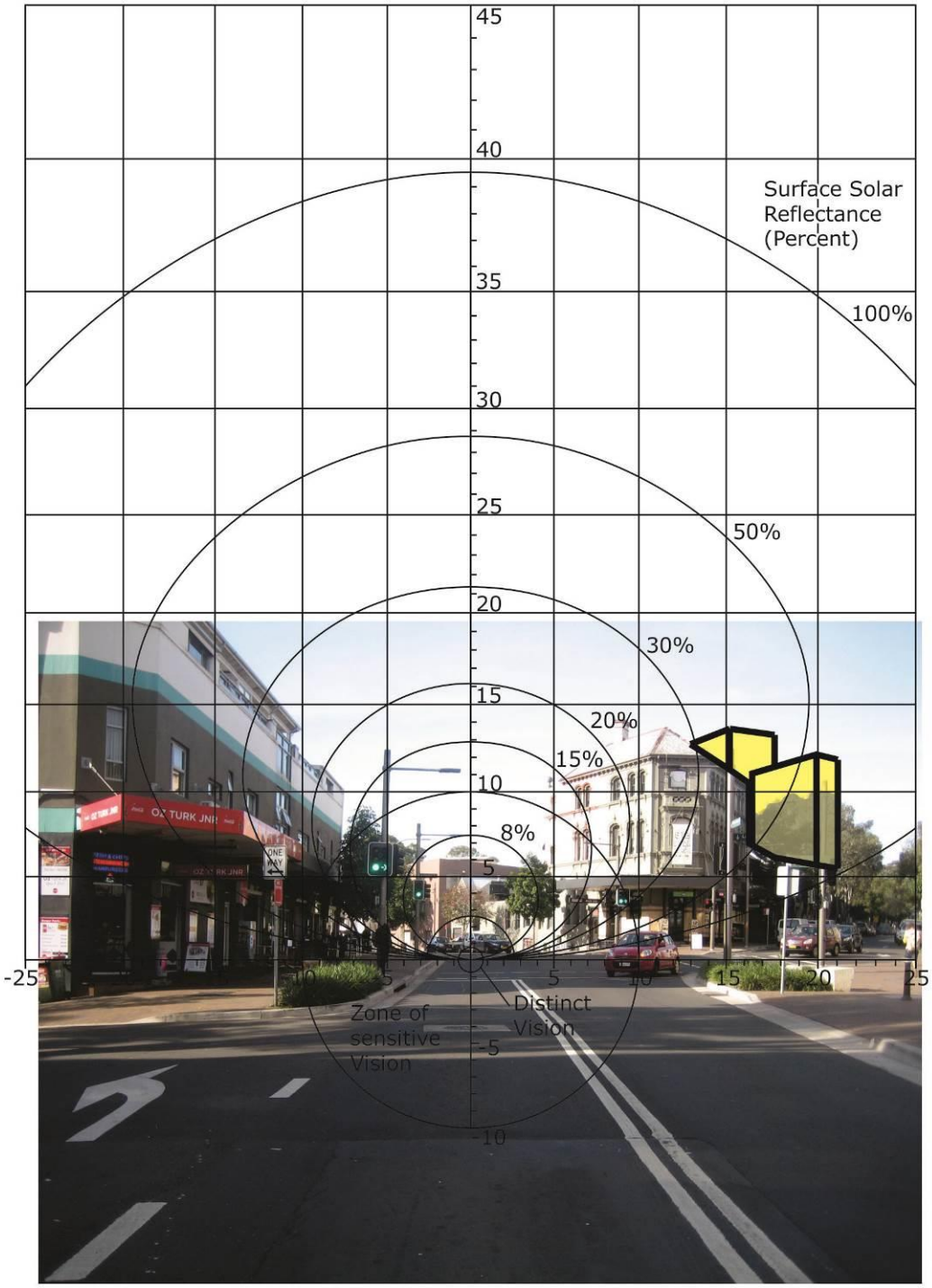

Figure A6: Glare Overlay for Point 6

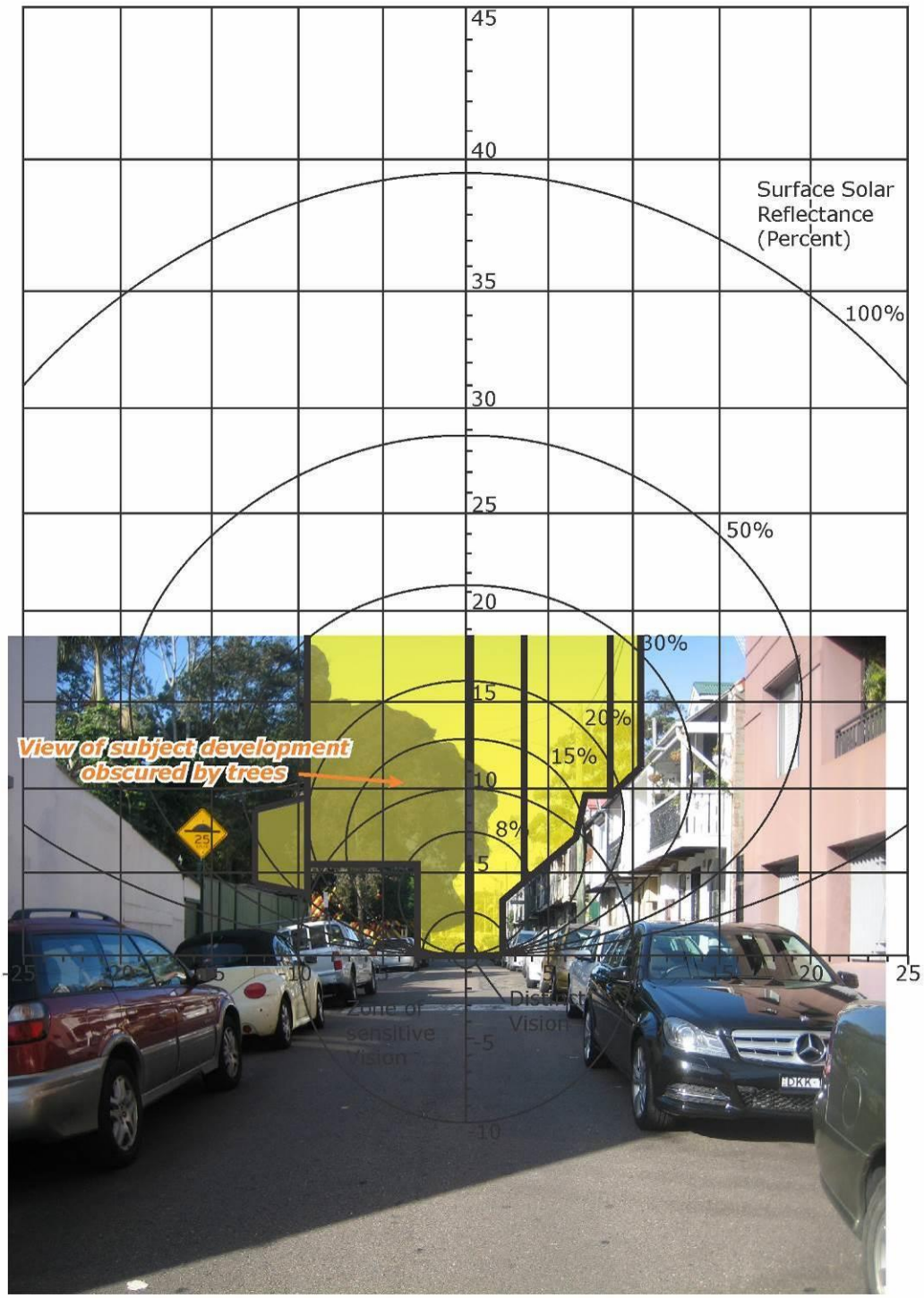

Figure A7: Glare Overlay for Point 7

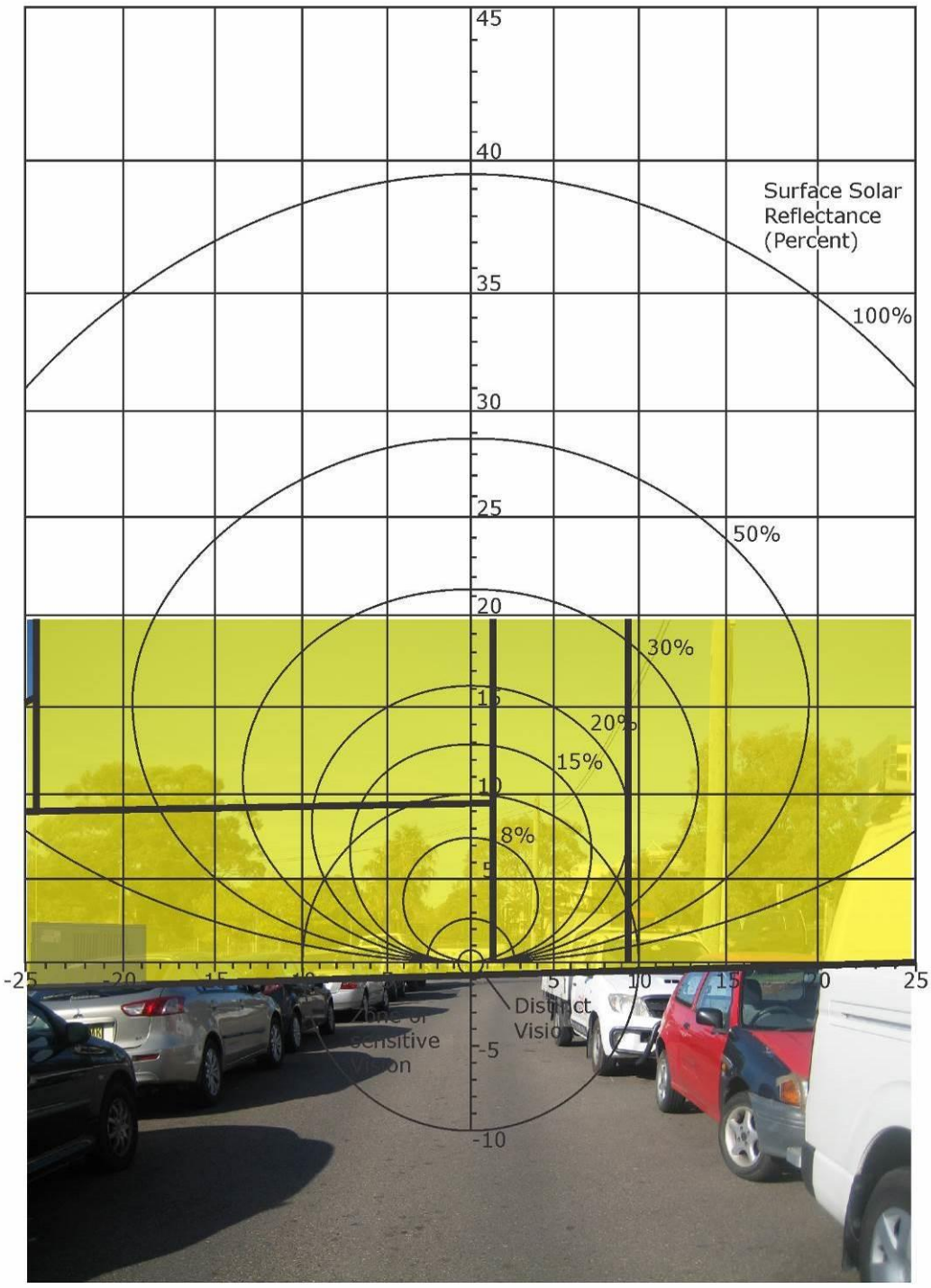

Figure A8: Glare Overlay for Point 8

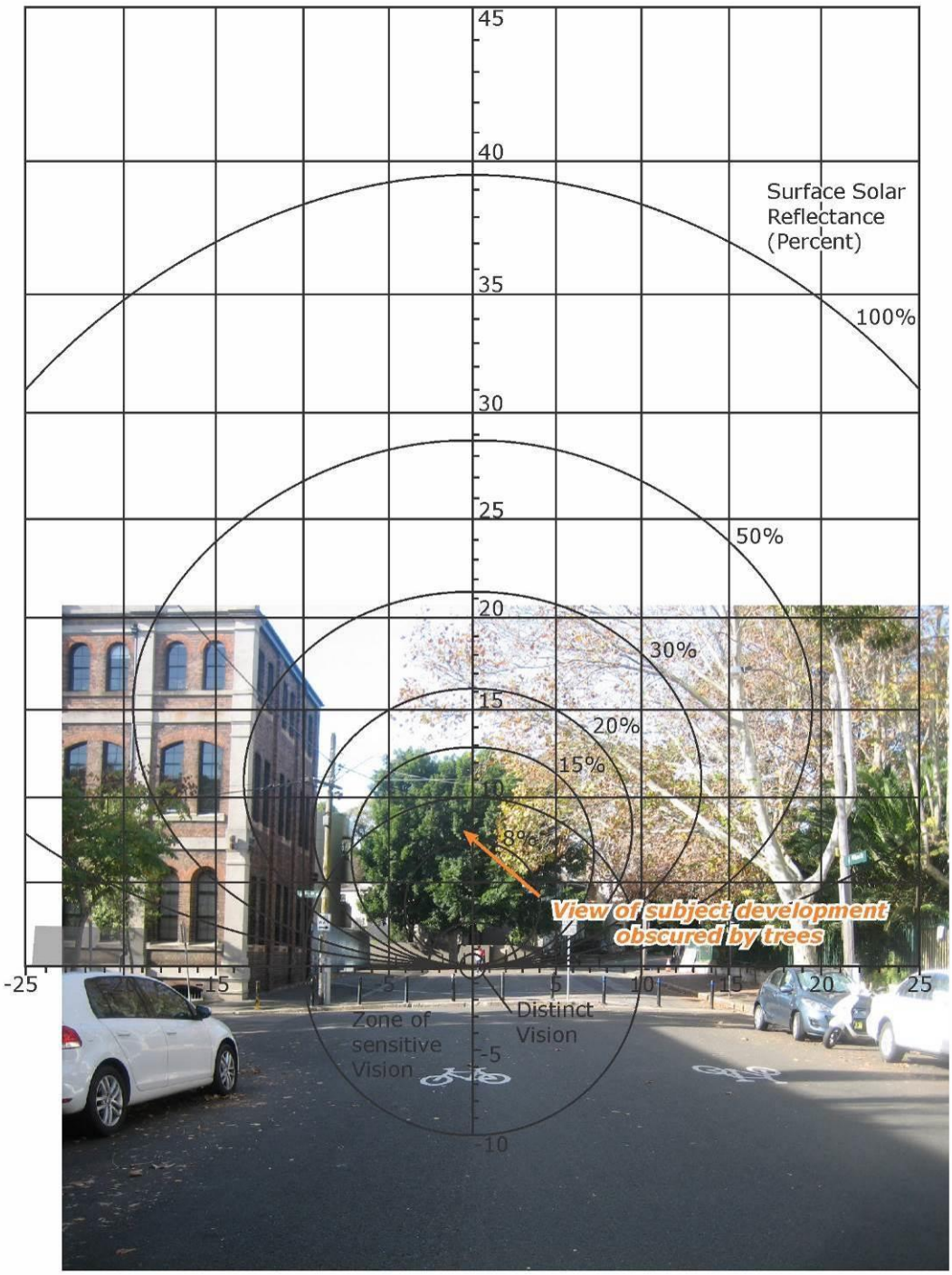

Figure A9: Glare Overlay for Point 9

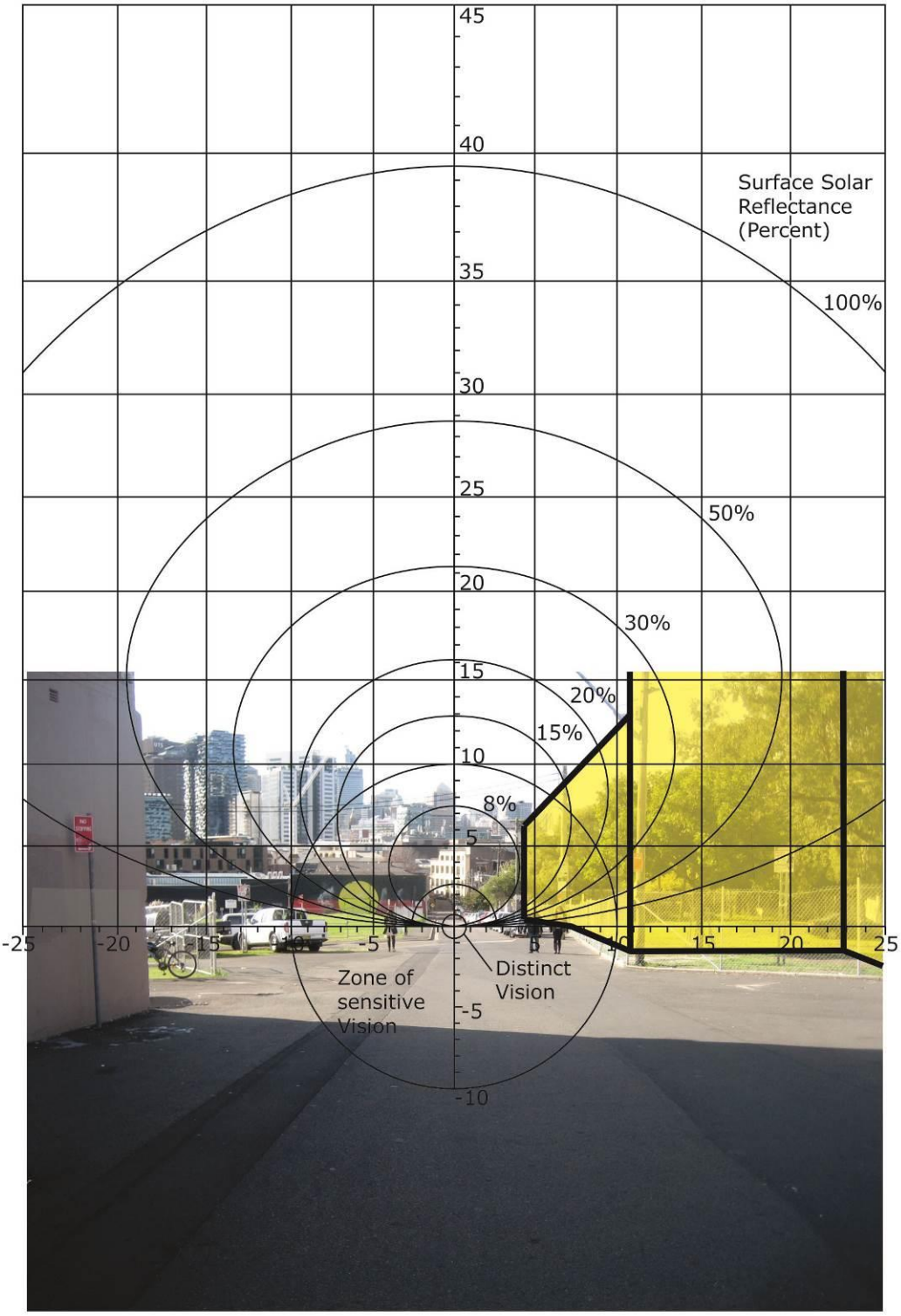

Figure A10: Glare Overlay for Point 10

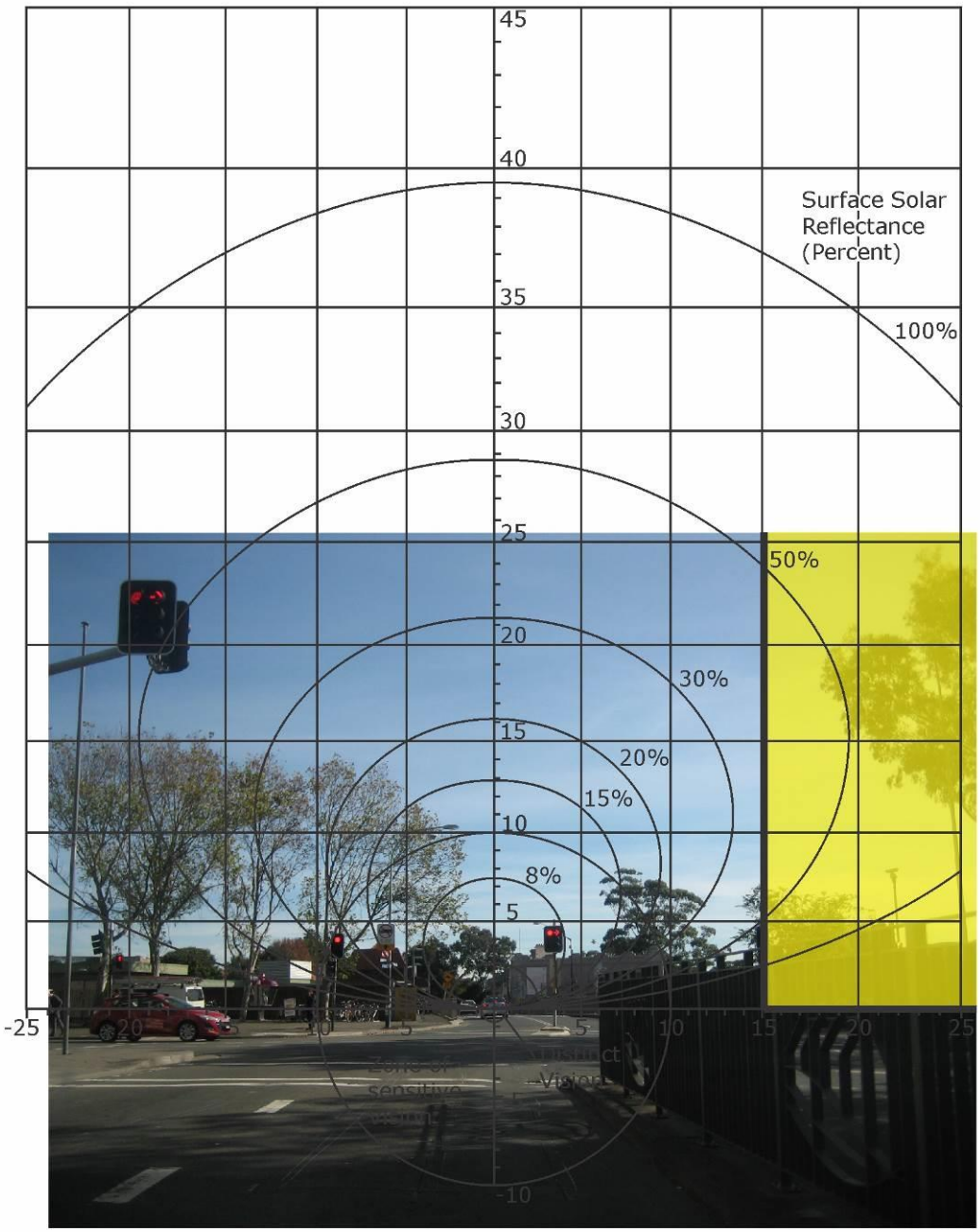

Figure A11: Glare Overlay for Point 11

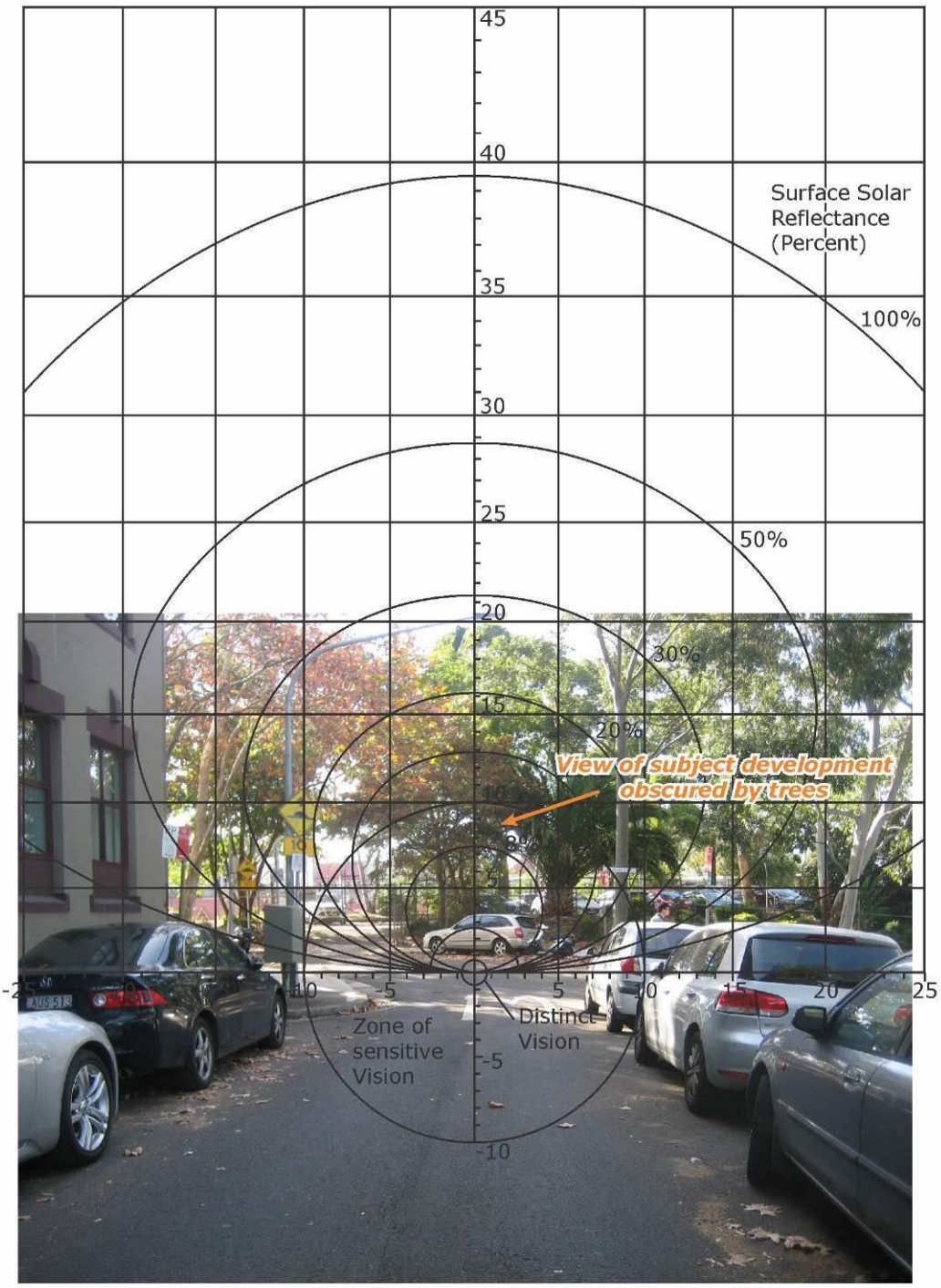

Figure A12: Glare Overlay for Point 12

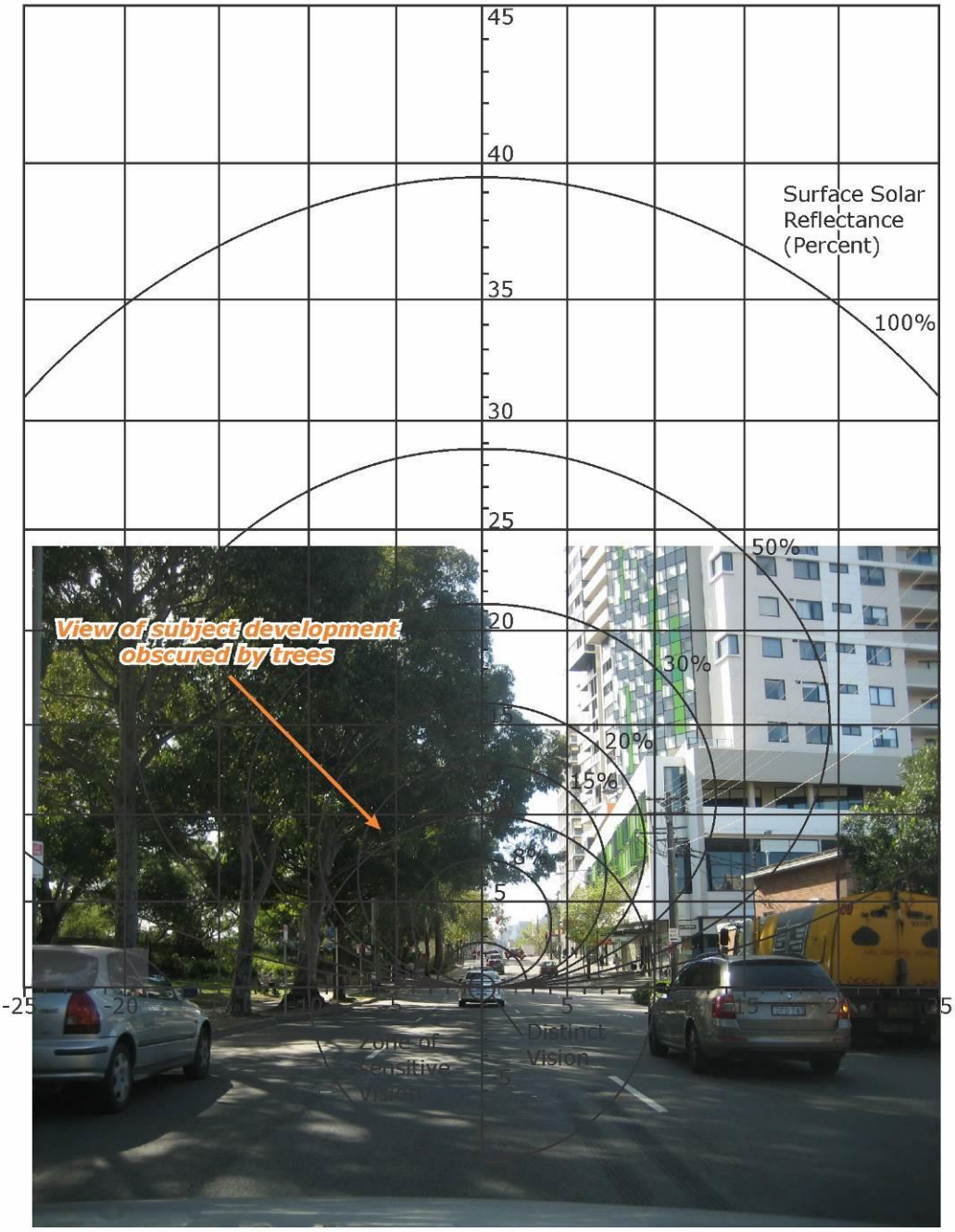

Figure A13: Glare Overlay for Point 13

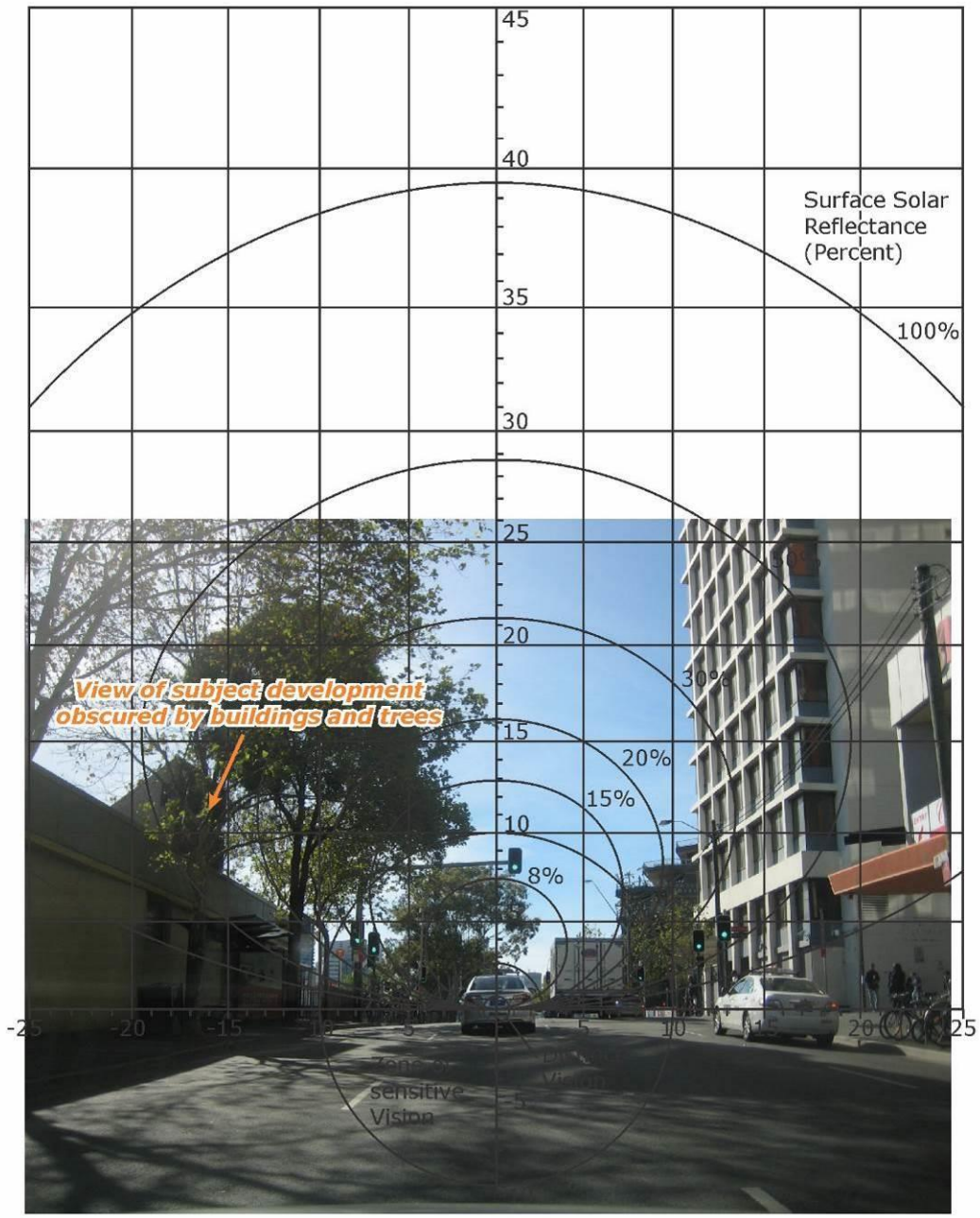

Figure A14: Glare Overlay for Point 14

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

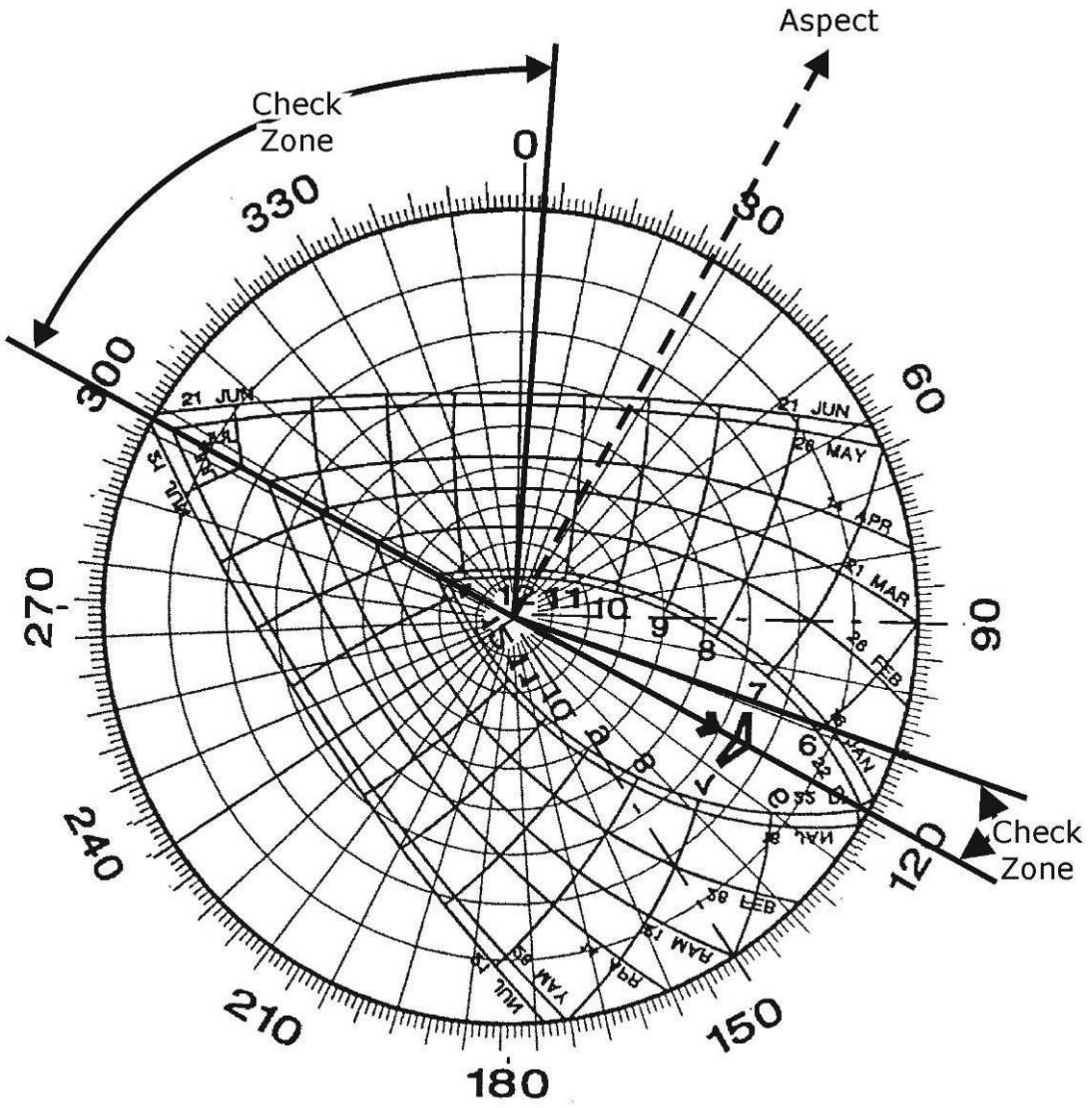

Figure B1: Sun Chart for Aspect 028^{O}

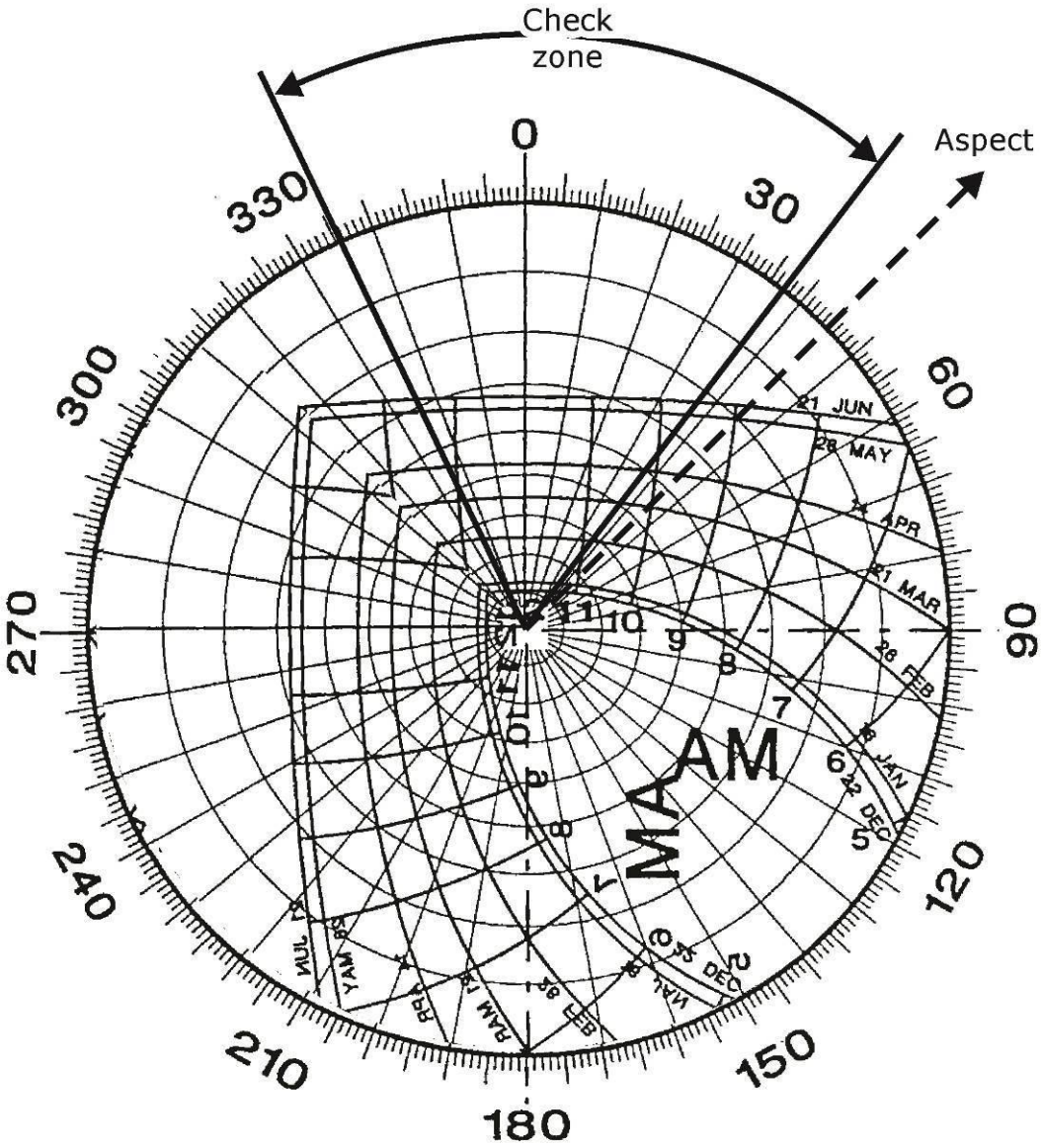

Figure B2: Sun Chart for Aspect 045^{o}

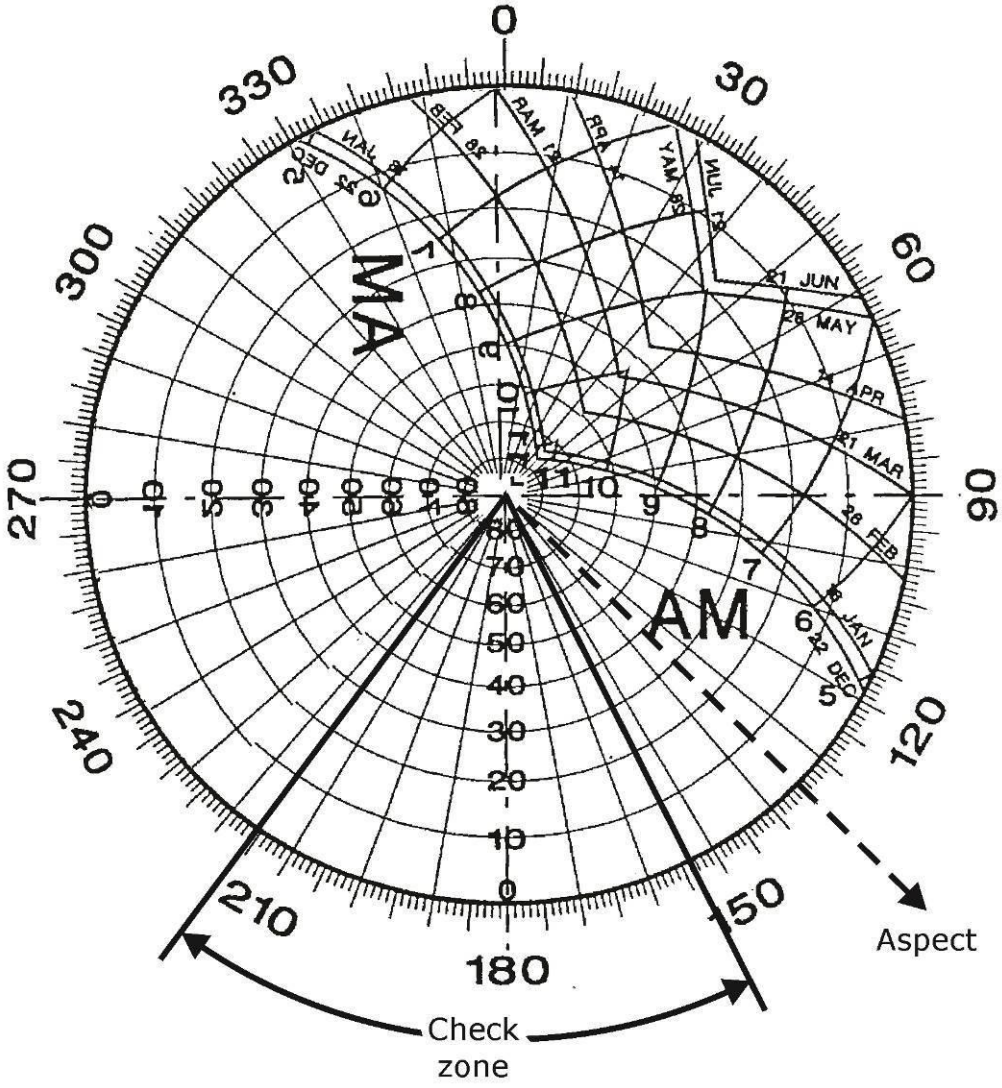

Figure B3: Sun Chart for Aspect 135^{O}

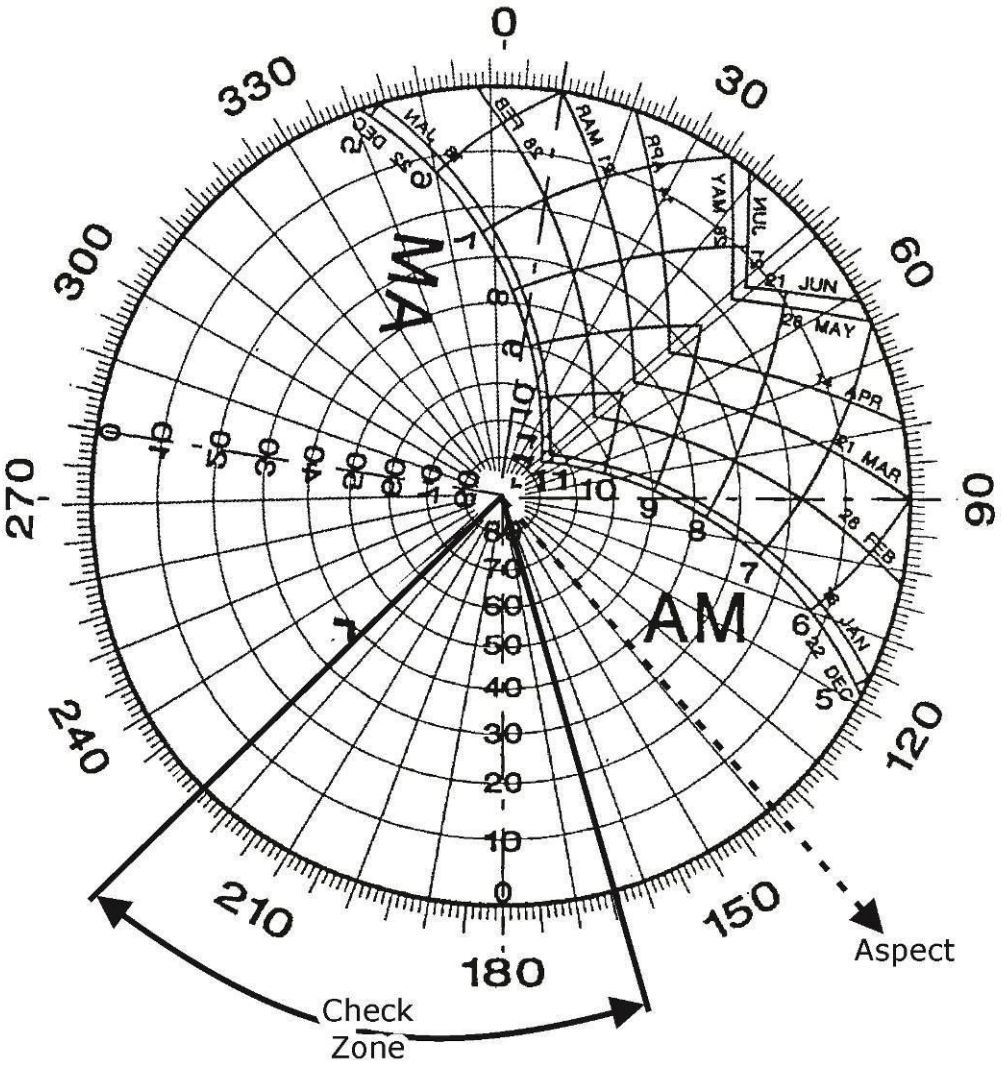

Figure B4: Sun Chart for Aspect 139^{o}

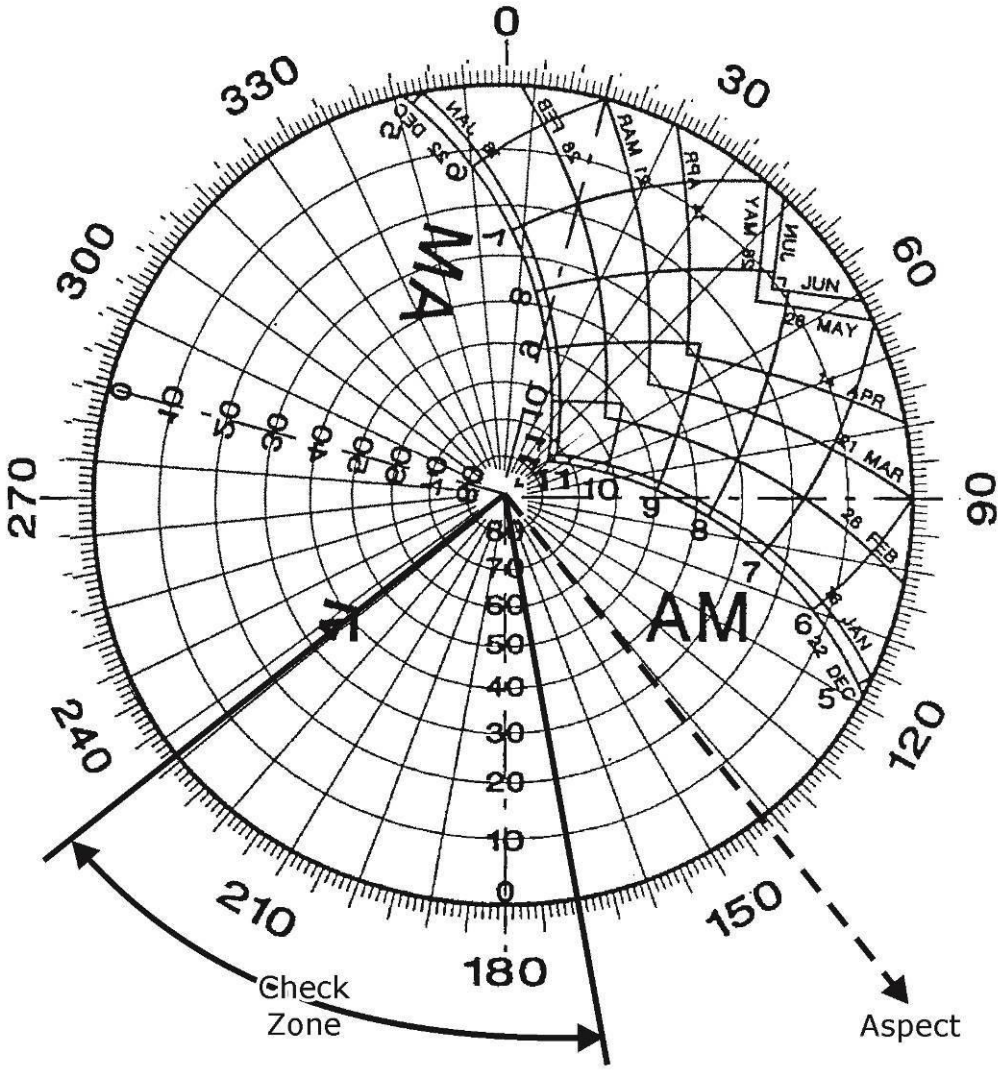

Figure B5: Sun Chart for Aspect 142^{o}

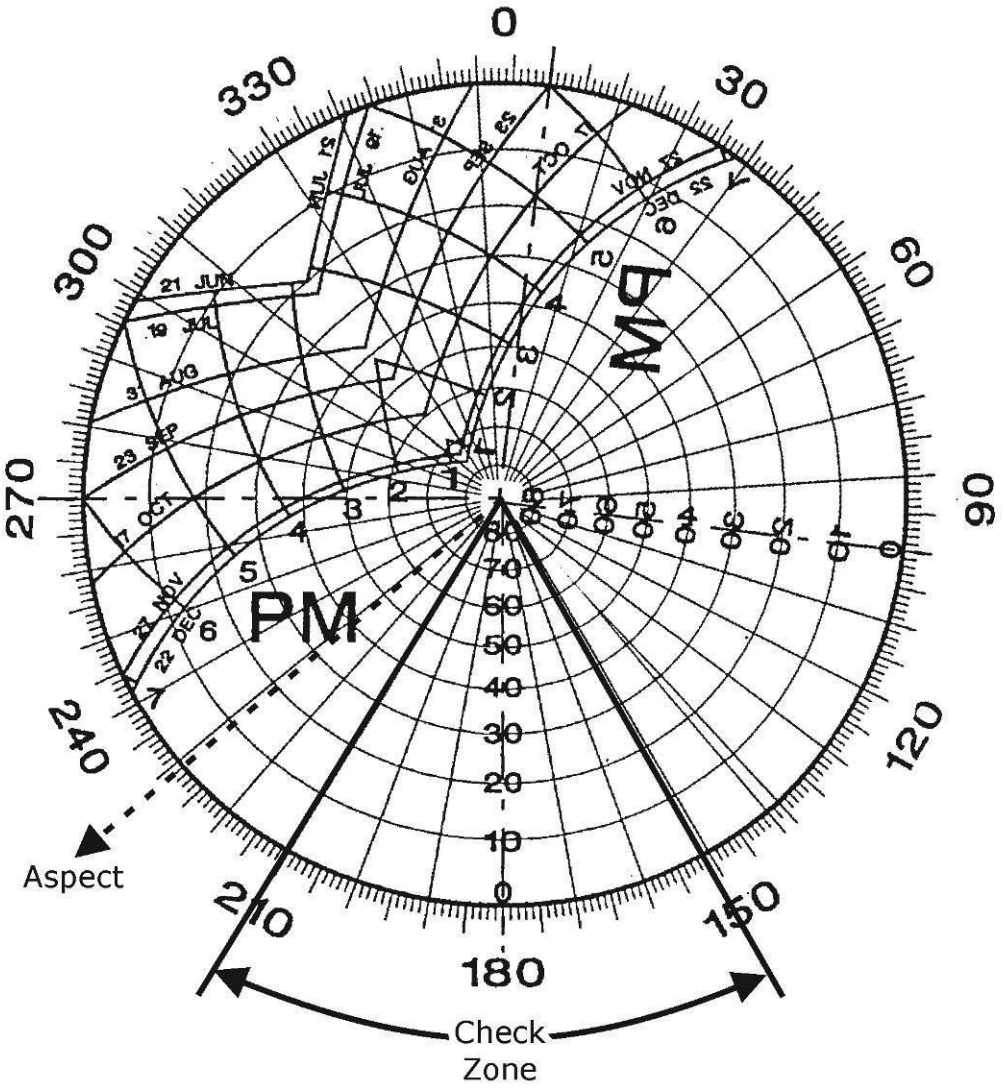

Figure B6: Sun Chart for Aspect 229^{o}

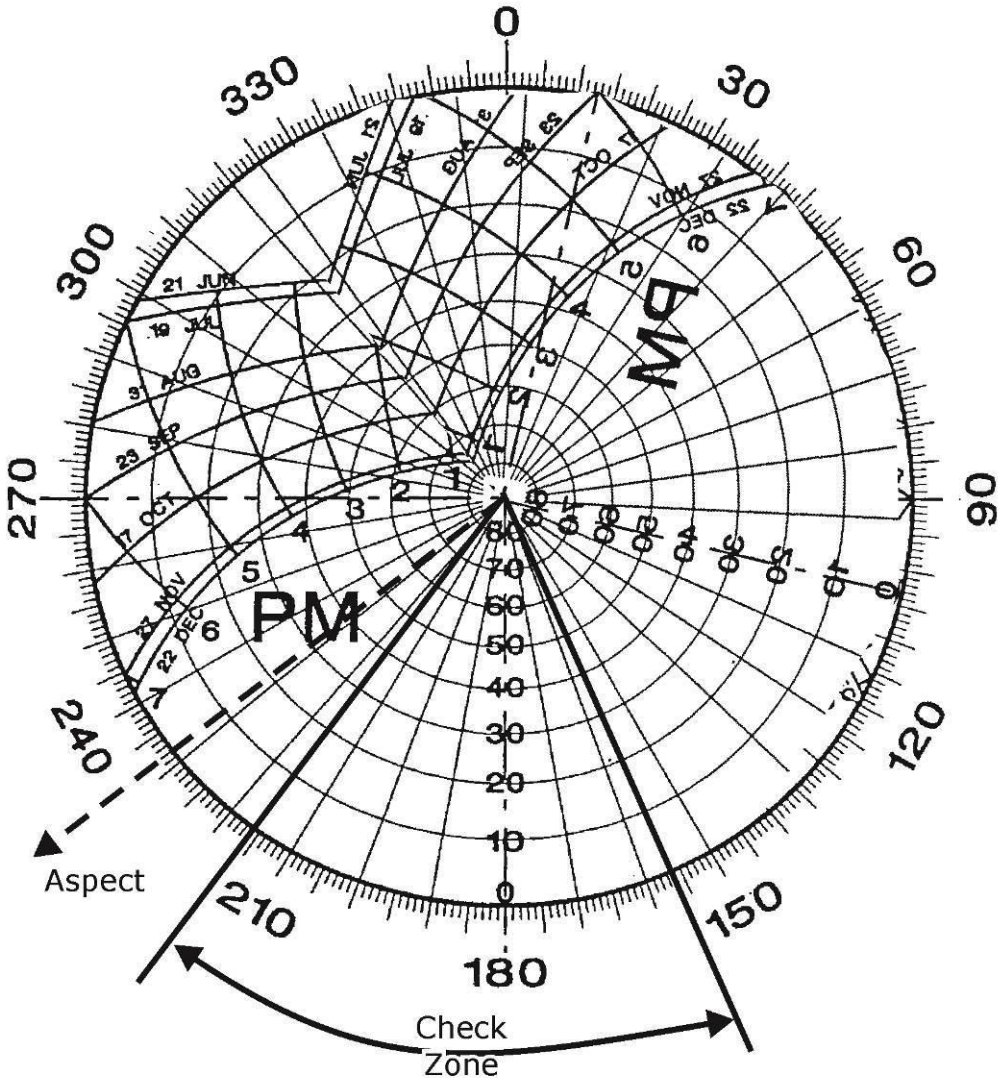

Figure B7: Sun Chart for Aspect 232^{o}

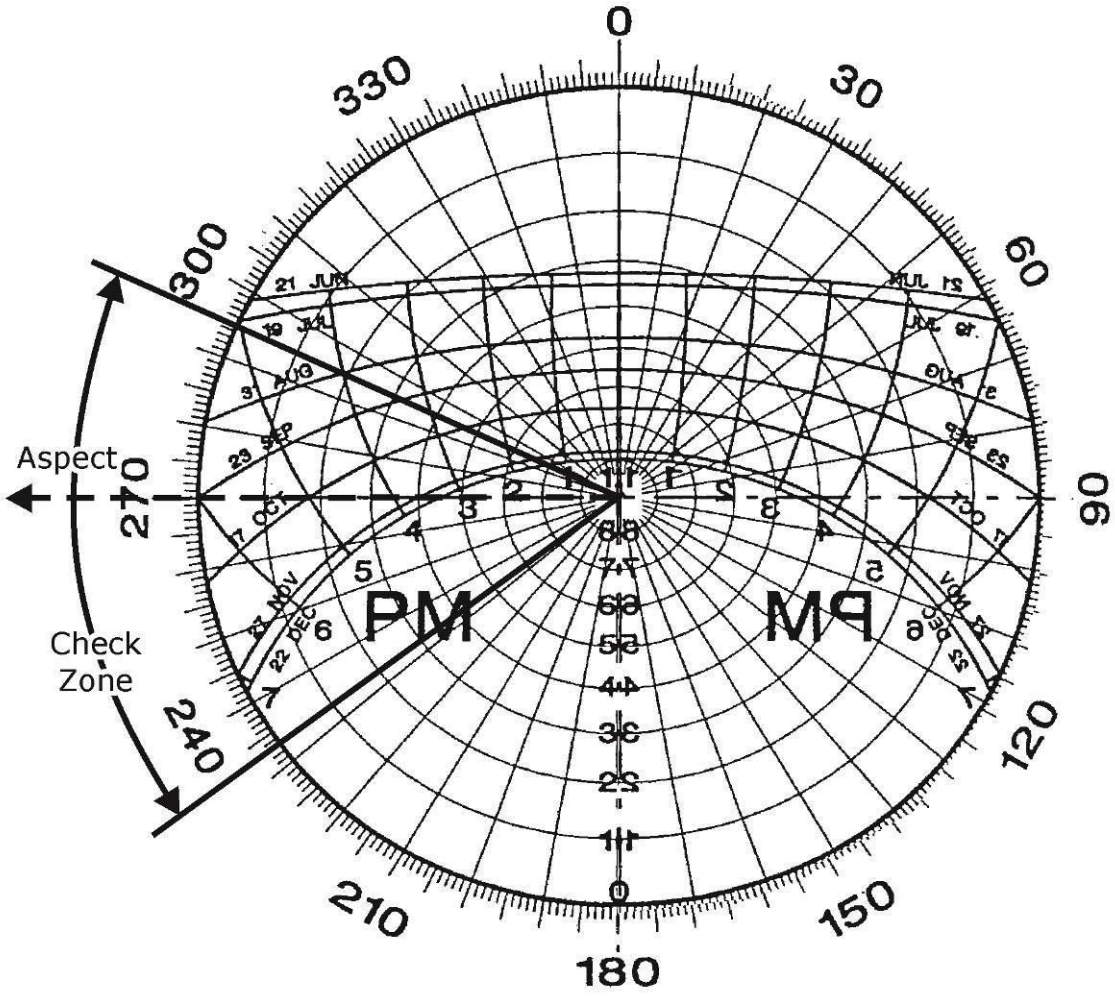

Figure B8: Sun Chart for Aspect 270^{O}

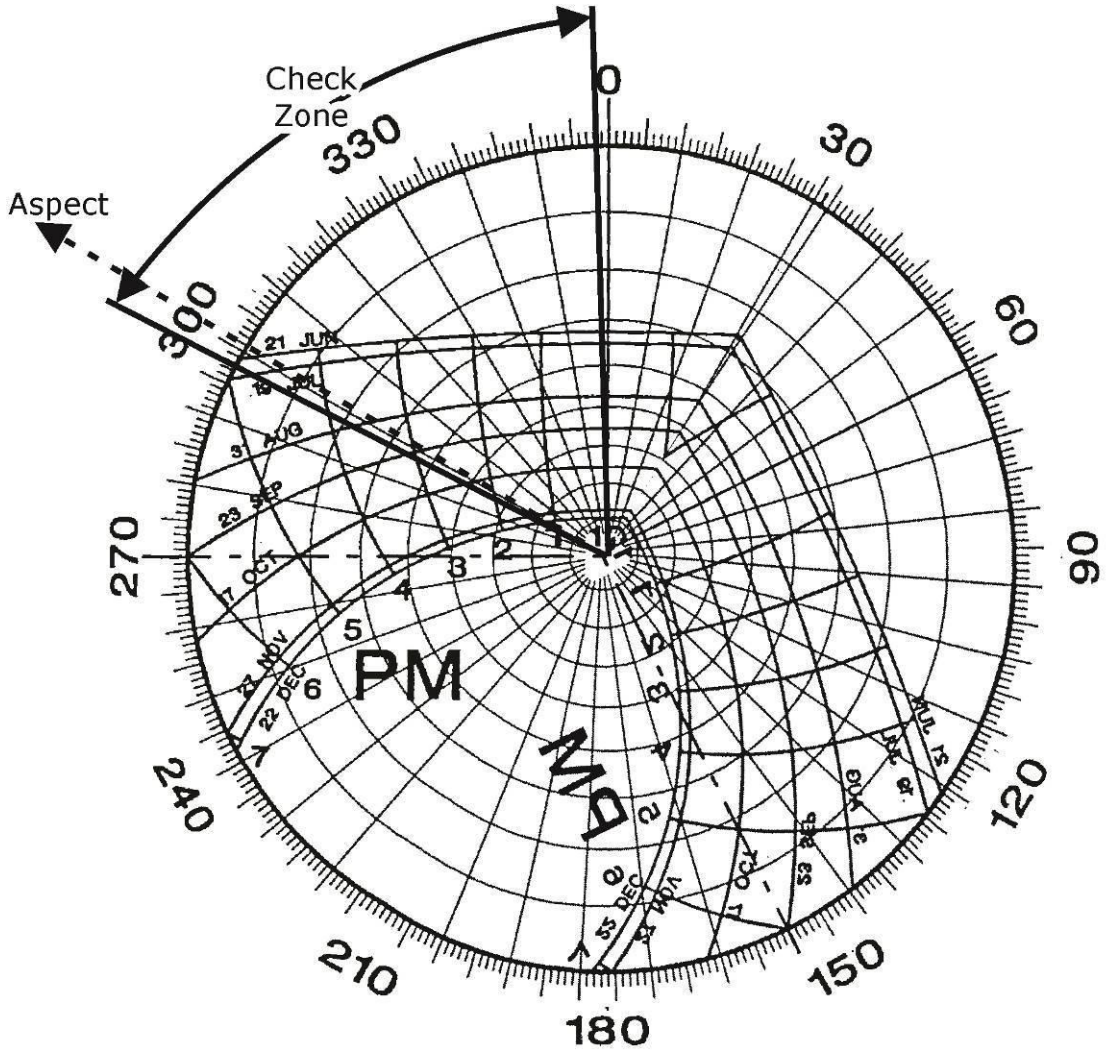

Figure B9: Sun Chart for Aspect 301^{o}

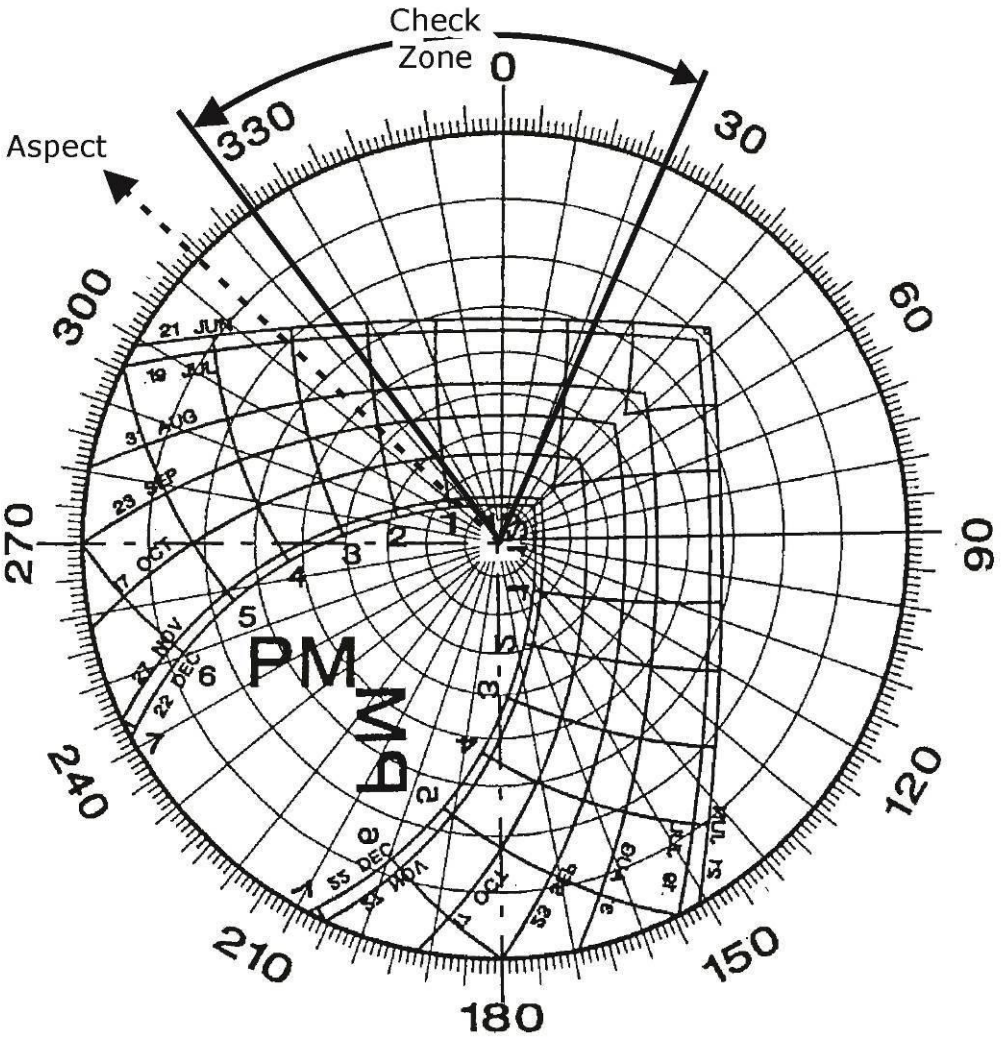

Figure B10: Sun Chart for Aspect 314^{o}

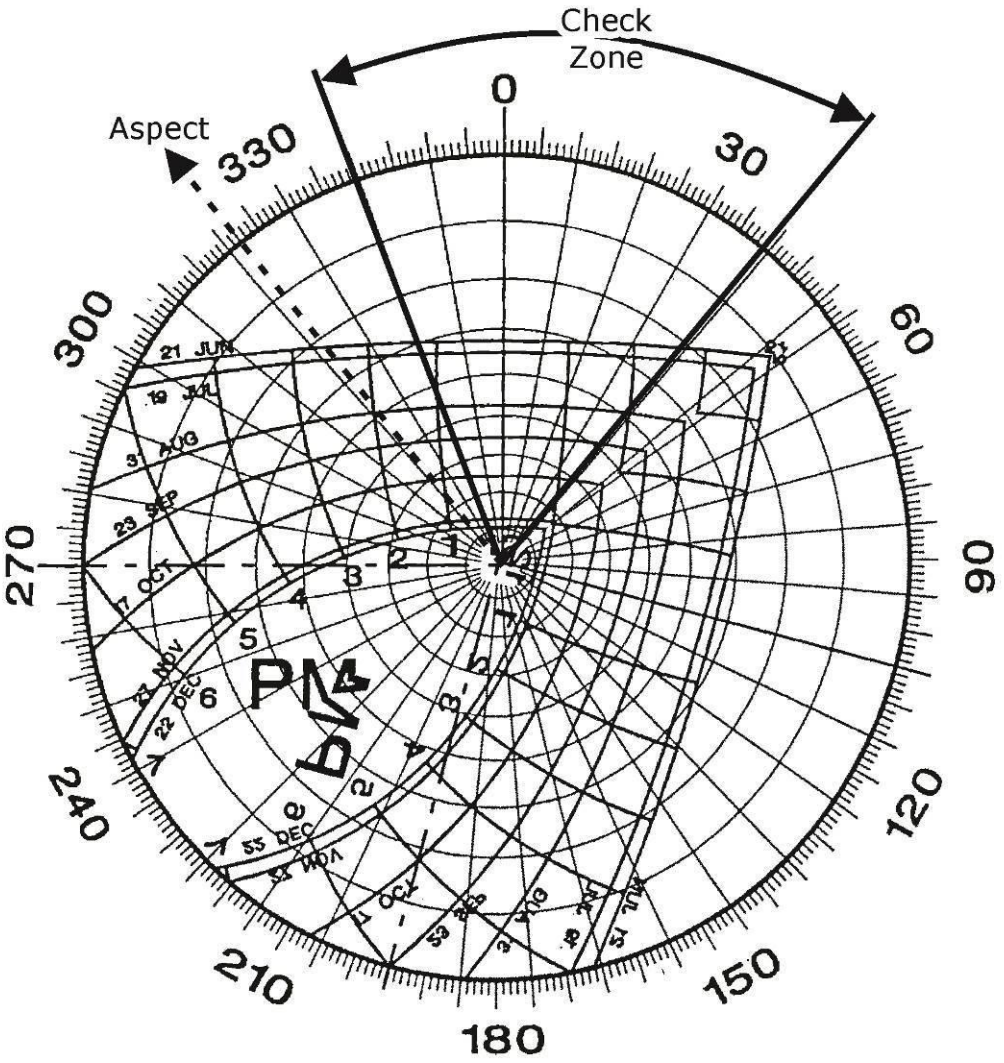

Figure B11: Sun Chart for Aspect 322^{o}

APPENDIX C - STANDARD SUN CHART FOR THE SYDNEY REGION

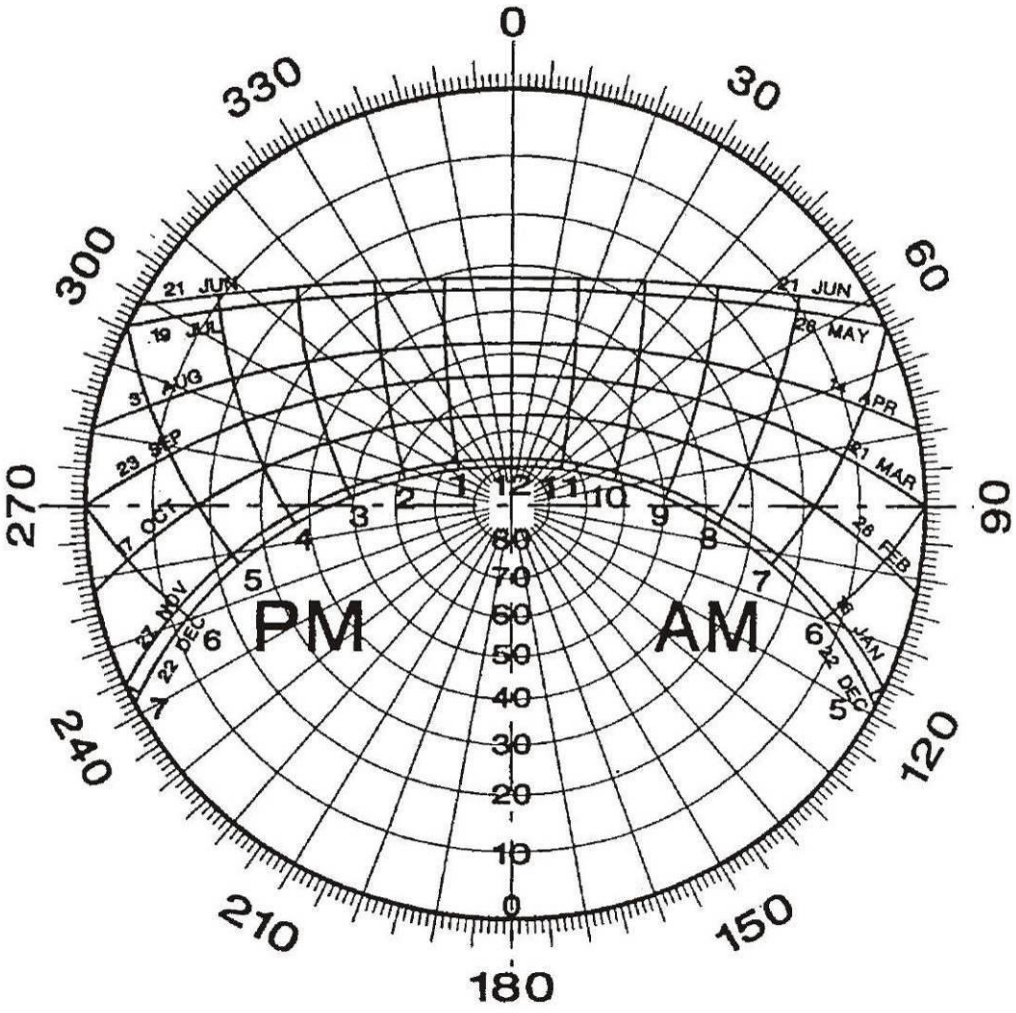

Figure C1: Standard Sun Chart for the Sydney Region